Project Specific Water Quality Management Plan

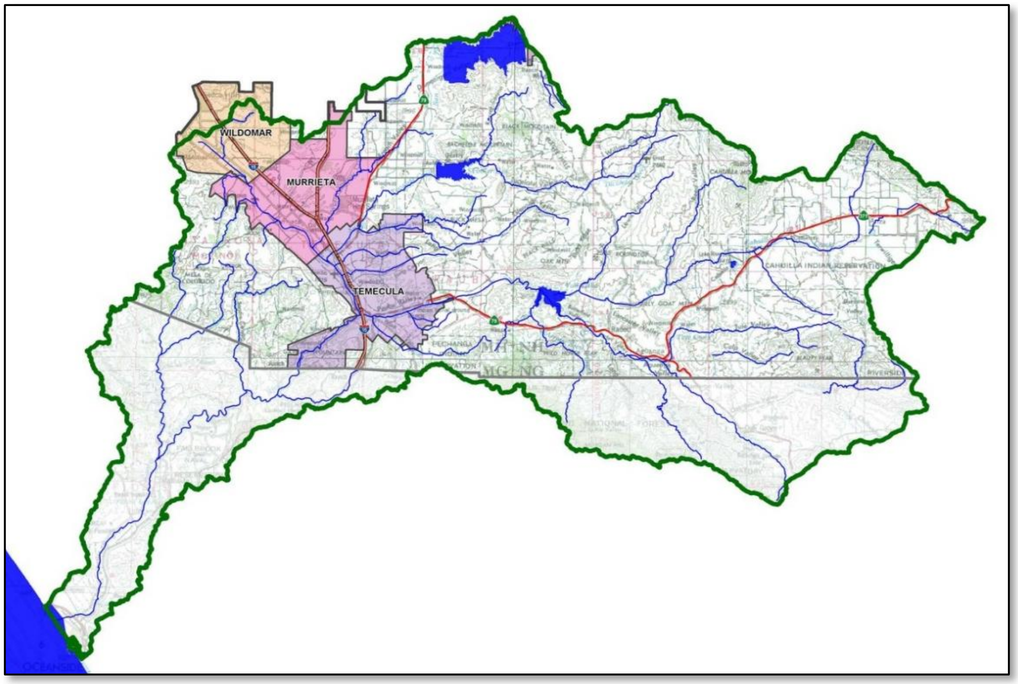
A Template for preparing Project Specific WQMPs for Priority Development Projects located within the Santa Margarita Region of Riverside County. This template does not apply to projects in other watersheds within Riverside County. It does not apply to projects in San Diego or Orange County.

Attention: This submittal package only applies to “Priority Development Projects” and does not apply to “Other Development Projects”. Proceed only if the Applicabilty Checklist completed for your project categorizes project activities as a “Priority Development Project.”

Project Title: The Terraces - Murrieta

Development No:

Design Review/Case No:



☒ Preliminary
☐ Final

Original Date Prepared: January 2022

Revision Date(s):

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Prepared for Compliance with Regional Board Order No. R9-2013-0001 *as amended by Order No.* R9-2015-0001 *and Order No.* R9-2015-0100

A Brief Introduction

The Regional Municipal Separate Stormwater Sewer System (MS4) Permit[1] requires that a Project-Specific WQMP be prepared for all development projects within the Santa Margarita Region (SMR) that meet the 'Priority Development Project' categories and thresholds listed in the SMR Water Quality Management Plan (WQPM). This Project-Specific WQMP Template for Development Projects in the Santa Margarita Region has been prepared to help document compliance and prepare a WQMP submittal. Below is a flowchart for the layout of this Template that will provide the steps required to document compliance.

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[1] Order No. R9-2013-0001 as amended by Order Nos. R9-2015-0001 and R9-2015-0100, NPDES No. CAS0109266, National Pollutant Discharge Elimination System (NPDES) Permit and Waste Discharge Requirements for Discharges from the MS4s Draining the Watersheds within the San Diego Region, California Regional Water Quality Control Board, May 8, 2013.

OWNER'S CERTIFICATION

This Project-Specific WQMP has been prepared for Universal Health Service, Inc. by Kimley-Horn and Associates, Inc. for the Rancho Springs Medical Center Expansion project.

This WQMP is intended to comply with the requirements of City of Murrieta Stormwater and Runoff Management and Discharge Controls Municipal Code Section 8.36.320, Water Quality Management Plan, 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 Best Management Practices until such time as this responsibility is formally transferred to a subsequent owner. This WQMP will be reviewed with the facility operator, facility supervisors, employees, tenants, maintenance and service contractors, or any other party (or parties) having responsibility for implementing portions of this WQMP. At least one copy of this WQMP will be maintained at the project site or project office in perpetuity. The undersigned is authorized to certify and to approve implementation of this WQMP. The undersigned is aware that implementation of this WQMP is enforceable under the City of Murrieta Stormwater and Runoff Management and Discharge Controls (Municipal Code Section 8.36).

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

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

PREPARER'S CERTIFICATION

"The selection, sizing and design of stormwater treatment and other stormwater quality and quantity control Best Management Practices in this plan meet the requirements of Regional Water Quality Control Board Order No. R9-2013-0001 as amended by Order Nos. R9-2015-0001 and R9-2015-0100."

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

Preparer's Licensure:

Table of Contents

List of Tables

List of Appendices

Section A: Project and Site Information

Use the table below to compile and summarize basic site information that will be important for completing subsequent steps. Subsections A.1 through A.4 provide additional detail on documentation of additional project and site information.

PROJECT INFORMATION		
Type of PDP:	New Development	
Type of Project:	Residential	
Planning Area:		
Community Name:		
Development Name:	The Terraces	
PROJECT LOCATION		
Latitude & Longitude (DMS):	33.556547, -117.189609	
Project Watershed and Sub-Watershed:	Santa Margarita River, Cole Canyon-Murrieta Creek	
24-Hour 85th Percentile Storm Depth (inches):	0.82 inches	
Is project subject to Hydromodification requirements?	☒ Y	☐ N (Select based on Section A.3)
APN(s):	910-310-001, 910-310-002, 910-310-003, 910-310-004, 910-310-005, 910-310-007, 910-310-008, 910-310-009, 910-310-010, 910-310-015, 910-310-017, 910-310-018, 910-310-021, 910-310-022, 910-310-023, 910-310-024, 910-310-025, 910-310-026, 949-190-011, 949-190-012, 949-190-013, 949-190-014, 949-190-015, 949-190-016, 949-190-017, 949-190-018, 949-190-019	
Map Book and Page No.:		
PROJECT CHARACTERISTICS		
Proposed or Potential Land Use(s)	Multifamily, residential	
Proposed or Potential SIC Code(s)	N/A	
Existing Impervious Area of Project Footprint (SF)	0 sf	
Total area of <u>proposed</u> Impervious Surfaces within the Project Limits (SF)/or Replacement	1,400,000 SF	
Total Project Area (ac)	+/- 37.8 acres	
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
Is the project exempt from Hydromodification Performance Standards?	☐ Y	☒ N
Does the project propose the use of Alternative Compliance to satisfy BMP requirements? (note, alternative compliance is not allowed for coarse sediment performance standards)	☐ Y	☒ N
Has preparation of Project-Specific WQMP included coordination with other site plans?	☐ Y	☒ N
EXISTING SITE CHARACTERISTICS		
Is the project located within any Multi-Species Habitat Conservation Plan area (MSHCP Criteria Cell?)	☐ Y If "Y" insert Cell Number	☒ N
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 Natural Resources Conservation Service (NRCS) soils type(s) present on the site (A, B, C and/or D)	N/A	

A.1 Maps and Site Plans

When completing your Project-Specific WQMP, include a map of the Project 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:

- Vicinity and location maps
- Parcel Boundary and Project Footprint
- Existing and Proposed Topography
- Drainage Management Areas (DMAs)
- Proposed Structural Best Management Practices (BMPs)
- Drainage Paths
- Drainage infrastructure, inlets, overflows
- Source Control BMPs
- Site Design BMPs
- Buildings, Roof Lines, Downspouts
- Impervious Surfaces
- Pervious Surfaces (i.e. Landscaping)
- 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 Copermittee plan reviewer must be able to easily analyze your Project utilizing this template and its associated site plans and maps. Complete the checklists in Appendix 1 to verify that all exhibits and components are included.

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. This map should identify the path of the stormwater discharged from the site all the way to the outlet of the Santa Margarita River to the Pacific Ocean. Use the most recent 303(d) list available from the State Water Resources Control Board Website.
(*http://www.waterboards.ca.gov/sandiego/water_issues/programs/basin_plan/*)

Table A-1 Identification of Receiving Waters

Receiving Waters	USEPA Approved 303(d) List Impairments	Designated Beneficial Uses	Proximity to RARE Beneficial Use
Warm Springs Creek	Indicator Bacteria; Chlorpyrifos; Metals (Iron, Manganese); Nutrients (Nitrogen, Phosphorus)	AGR, IND, MUN, PROC, REC1, REC2, WARM, WILD	Not a RARE water body
Murrieta Creek	Pesticides (Chlorpyrifos); Metals (Copper, Iron, Manganese); Nutrients (Nitrogen, Phosphorus); Toxicity (Toxicity)	MUN, AGR, IND, PROC, GWR, REC-2, WARM, WILD	Not a RARE water body
Santa Margarita River – Upper portion (HAS 2.22, 2.21)	Nutrients (Phosphorus), Pesticides (Toxicity)	MUN, AGR, IND, REC-1, REC-2, WARM, COLD, WILD, RARE	RARE WATERBODY 9.33 MILES
Santa Margarita River – Lower Portion (HSA 2.13, 2.12, 2.11)	Bacteria & Viruses (Enterococcus, Fecal Coliform), Nutrients (Phosphorus, Nitrogen	MUN, AGR, IND, PROC, REC-1, REC-2, WARM, COLD, WILD, RARE	RARE WATERBODY 19.36 MILES
Santa Margarita Lagoon	Nutrients (Eutrophic)	REC-1, REC-2, EST, WILD, RARE, MAR, MIGR, SPWN	RARE WATERBODY 28.81 MILES
Pacific Ocean	None	IND, NAV, REC-1, REC-2, COMM,	RARE WATERBODY

		BIOL, WILD, RARE, MAR, AQUA, MIGR, SPWN, SHELL	28.81 MILES

A.3 Drainage System Susceptibility to Hydromodification

Using Table A-2 below, list in order of the point of discharge at the project site down to the Santa Margarita River[2], each drainage system or receiving water that the project site is tributary to. Continue to fill each row with the material of the drainage system, and any exemption (if applicable). Based on the results, summarize the applicable hydromodification performance standards that will be documented in Section E. Exempted categories of receiving waters include:

- Existing storm drains that discharge directly to water storage reservoirs, lakes, or enclosed embayments, or
- Conveyance channels whose bed and bank are concrete lined all the way from the point of discharge to water storage reservoirs, lakes, enclosed embayments, or the Pacific Ocean.
- Other water bodies identified in an approved WMAA (See Exhibit G to the WQMP)

Include a map exhibiting each drainage system and the associated susceptibility in Appendix 1.

Table A-2 Identification of Susceptibility to Hydromodification

Drainage System	Drainage System Material	Hydromodification Exemption	Hydromodification Exempt
Murrieta Creek 4.6 miles	Native bottom	Exempt at the confluence and downstream of Warm Springs Creek	☐ Y ☒ N
Santa Margarita River 26 miles	Engineered bottom	Exempt.	☒ Y ☐ N
			☐ Y ☐ N
Summary of Performance Standards			
☐ Hydromodification Exempt – Select if "Y" is selected in the Hydromodification Exempt column above, project is exempt from hydromodification requirements. ☒ Not Exempt-Select if "N" is selected in any row of the Hydromodification Exempt column above. Project is subject to hydrologic control requirements and may be subject to sediment supply requirements.			

A.4 Additional Permits/Approvals required for the Project:

Table A-3 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 Section 401 Water Quality Certification	☒ Y	☐ N

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[2] Refer to Exhibit G of the WQMP for a map of exempt and potentially exempt areas. These maps are from the Draft SMR WMAA as of January 5, 2018 and will be replaced upon acceptance of the SMR WMAA.

US Army Corps of Engineers, Clean Water Act 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 Copermittee 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 LID 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 Low Impact Development (LID) design and explain your design decisions to others.

Apply the following LID Principles to the layout of the PDP to the extent they are applicable and feasible. Putting thought upfront about how best to organize the various elements of a site can help to significantly reduce the PDP's potential impact on the environment and reduce the number and size of Structural LID BMPs that must be implemented. Integrate opportunities to accommodate the following LID Principles within the preliminary PDP site layout to maximize implementation of LID Principles.

Site Optimization

Complete checklist below to determine applicable Site Design BMPs for your site.

Project- Specific WQMP Site Design BMP Checklist

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

SITE DESIGN REQUIREMENTS

Answer the following questions below by indicating "Yes," "No," or "N/A" (Not Applicable). Justify all "No" and "N/A" answers by inserting a narrative at the end of the section. The narrative should include identification and justification of any constraints that would prevent the use of those categories of LID BMPs. Upon identifying Site Design BMP opportunities, include these on your WQMP Site plan in Appendix 1.

☒ Yes ☐ No ☐ N/A

Did you identify and preserve existing drainage patterns?

Integrating existing drainage patterns into the site plan helps to maintain the time of concentration and infiltration rates of runoff, decreasing peak flows, and may also help preserve the contribution of Critical Coarse Sediment (i.e., Bed Sediment Supply) from the PDP to the Receiving Water. Preserve existing drainage patterns by:

- Minimizing unnecessary site grading that would eliminate small depressions, where appropriate add additional "micro" storage throughout the site landscaping.
- Where possible conform the PDP site layout along natural landforms, avoid excessive grading and disturbance of vegetation and soils, preserve or replicate the sites natural drainage features and patterns.
- Set back PDP improvements from creeks, wetlands, riparian habitats and any other natural water bodies.
- Use existing and proposed site drainage patterns as a natural design element, rather than using expensive impervious conveyance systems. Use depressed landscaped areas, vegetated buffers, and bioretention areas as amenities and focal points within the site and landscape design.

Discuss how this was included or provide a discussion/justification for "No" or "N/A" answer.

Yes, under existing conditions, stormwater runoff sheetflows towards existing storm drain inlets located offsite. Under proposed conditions, storm water will generally flow the same drainage patterns and be collected, treated, and stored in underground storage basins for residential use.

☒ Yes ☐ No ☐ N/A

Did you identify and protect existing vegetation?

Identify any areas containing dense native vegetation or well-established trees, and try to avoid disturbing these areas. Soils with thick, undisturbed vegetation have a much higher capacity to store and infiltrate runoff than do disturbed soils. Reestablishment of a mature vegetative community may take decades. Sensitive areas, such as streams and floodplains should also be avoided.

- Define the development envelope and protected areas, identifying areas that are most suitable for development and areas that should be left undisturbed.
- Establish setbacks and buffer zones surrounding sensitive areas.
- Preserve significant trees and other natural vegetation where possible.

Discuss how this was included or provide a discussion/justification for "No" or "N/A" answer. *Existing vegetation will be redeveloped as part of the project.*

<table>
<tr><th colspan="2">Project- Specific WQMP Site Design BMP Checklist</th></tr>
<tr><td>☒ Yes ☐ No ☐ N/A</td><td>Did you identify and preserve natural infiltration capacity?
A key component of LID is taking advantage of a site's natural infiltration and storage capacity. A site survey and geotechnical investigation can help define areas with high potential for infiltration and surface storage.
• Identify opportunities to locate LID Principles and Structural BMPs in highly pervious areas. Doing so will maximize infiltration and limit the amount of runoff generated.
• Concentrate development on portions of the site with less permeable soils, and preserve areas that can promote infiltration.</td></tr>
<tr><td colspan="2">Discuss how this was included or provide a discussion/justification for “No” or “N/A” answer. *The Geotechnical Investigation prepared for this project identified infiltration rates significant enough for use on the site. See proposed drainage plans for additional detail.*</td></tr>
<tr><td>☒ Yes ☐ No ☐ N/A</td><td>Did you minimize impervious area?
Look for opportunities to limit impervious cover through identification of the smallest possible land area that can be practically impacted or disturbed during site development.
• Limit overall coverage of paving and roofs. This can be accomplished by designing compact, taller structures, narrower and shorter streets and sidewalks, clustering buildings and sharing driveways, smaller parking lots (fewer stalls, smaller stalls, and more efficient lanes), and indoor or underground parking.
• Inventory planned impervious areas on your preliminary site plan. Identify where permeable pavements, or other permeable materials, such as crushed aggregate, turf block, permeable modular blocks, pervious concrete or pervious asphalt could be substituted for impervious concrete or asphalt paving. This will help reduce the amount of Runoff that may need to be addressed through Structural BMPs.
• Examine site layout and circulation patterns and identify areas where landscaping can be substituted for pavement, such as for overflow parking.
• Consider green roofs. Green roofs are roofing systems that provide a layer of soil/vegetative cover over a waterproofing membrane. A green roof mimics pre-development conditions by filtering, absorbing, and evapotranspiring precipitation to help manage the effects of an otherwise impervious rooftop.</td></tr>
<tr><td colspan="2">Discuss how this was included or provide a discussion/justification for “No” or “N/A” answer. *Impervious areas have been minimized to the maximum extent practicable. Impervious areas are included for parking, sidewalks, residential units, and street improvements. Parking lots, drive aisles, and sidewalks have all been designed to the minimum dimensions allowed.*</td></tr>
</table>

Project- Specific WQMP Site Design BMP Checklist	
☒ Yes ☐ No ☐ N/A	Did you identify and disperse runoff to adjacent pervious areas or small collection areas? Look for opportunities to direct runoff from impervious areas to adjacent landscaping, other pervious areas, or small collection areas where such runoff may be retained. This is sometimes referred to as reducing Directly Connected Impervious Areas. • Direct roof runoff into landscaped areas such as medians, parking islands, planter boxes, etc., and/or areas of pervious paving. Instead of having landscaped areas raised above the surrounding impervious areas, design them as depressed areas that can receive Runoff from adjacent impervious pavement. For example, a lawn or garden depressed 3"-4" below surrounding walkways or driveways provides a simple but quite functional landscape design element. • Detain and retain runoff throughout the site. On flatter sites, smaller Structural BMPs may be interspersed in landscaped areas among the buildings and paving. • On hillside sites, drainage from upper areas may be collected in conventional catch basins and piped to landscaped areas and LID BMPs and/or Hydrologic Control BMPs in lower areas. Low retaining walls may also be used to create terraces that can accommodate LID BMPs. Wherever possible, direct drainage from landscaped slopes offsite and not to impervious surfaces like parking lots. • Reduce curb maintenance and provide for allowances for curb cuts. • Design landscaped areas or other pervious areas to receive and infiltrate runoff from nearby impervious areas. • Use Tree Wells to intercept, infiltrate, and evapotranspire precipitation and runoff before it reaches structural BMPs. Tree wells can be used to limit the size of Drainage Management Areas that must be treated by structural BMPs. Guidelines for Tree Wells are included in the Tree Well Fact Sheet in the LID BMP Design Handbook.
Discuss how this was included or provide a discussion/justification for “No” or “N/A” answer. *Runoff from all areas will be diverted via a proposed storm drain system to a Bioclean Modular Wetland Systems.*	
☒ Yes ☐ No ☐ N/A	Did you utilize native or drought tolerant species in site landscaping? Wherever possible, use native or drought tolerant species within site landscaping instead of alternatives. These plants are uniquely suited to local soils and climate and can reduce the overall demands for potable water use associated with irrigation.
Discuss how this was included or provide a discussion/justification for “No” or “N/A” answer. *Native or drought tolerant species to be provided in final design.*	

Project- Specific WQMP Site Design BMP Checklist	
☐ Yes ☒ No ☐ N/A	Did implement harvest and use of runoff? Under the Regional MS4 Permit, Harvest and Use BMPs must be employed to reduce runoff on any site where they are applicable and feasible. However, Harvest and Use BMPs are effective for retention of stormwater runoff only when there is adequate demand for non-potable water during the wet season. If demand for non-potable water is not sufficiently large, the actual retention of stormwater runoff will be diminished during larger storms or during back-to-back storms. For the purposes of planning level Harvest and Use BMP feasibility screening, Harvest and Use is only considered to be a feasible if the total average wet season demand for non-potable water is sufficiently large to use the entire DCV within 72 hours. If the average wet season demand for non-potable water is not sufficiently large to use the entire DCV within 72 hours, then Harvest and Use is not considered to be feasible and need not be considered further. The general feasibility and applicability of Harvest and Use BMPs should consider: • Any downstream impacts related to water rights that could arise from capturing stormwater (not common). • Conflicts with recycled water used – where the project is conditioned to use recycled water for irrigation, this should be given priority over stormwater capture as it is a year-round supply of water. • Code Compliance - If a particular use of captured stormwater, and/or available methods for storage of captured stormwater would be contrary to building codes in effect at the time of approval of the preliminary Project-Specific WQMP, then an evaluation of harvesting and use for that use would not be required. • Wet season demand – the applicant shall demonstrate, to the acceptance of the [Insert Jurisdiction], that there is adequate demand for harvested water during the wet season to drain the system in a reasonable amount of time.
Discuss how this was included or provide a discussion/justification for "No" or "N/A" answer. *Project does not provide enough demand to meet harvest and use drawdown requirements.*	
☐ Yes ☒ No ☐ N/A	Did you keep the runoff from sediment producing pervious area hydrologically separate from developed areas that require treatment? Pervious area that qualify as self-treating areas or off-site open space should be kept separate from drainage to structural BMPs whenever possible. This helps limit the required size of structural BMPs, helps avoid impacts to sediment supply, and helps reduce clogging risk to BMPs.
Discuss how this was included or provide a discussion/justification for "No" or "N/A" answer. *Landscaped areas will be mostly in parking islands which will have a curb. Sedimentation will be reduced through the implementation of vegetation and through inspection and maintenance of landscaped areas.*	

Section C: Delineate Drainage Management Areas (DMAs)

This section provides streamlined guidance and documentation of the DMA delineation and categorization process, for additional information refer to the procedure in Section 3.3 of the SMR WQMP which discusses the methods of delineating and mapping your project site into individual DMAs. Complete Steps 1 to 4 to successfully delineate and categorize DMAs.

Step 1: Identify Surface Types and Drainage Pathways

Carefully delineate pervious areas and impervious areas (including roofs) throughout site and identify overland flow paths and above ground and below ground conveyances. Also identify common points (such as BMPs) that these areas drain to.

Step 2: DMA Delineation

Use the information in Step 1 to divide the entire PDP site into individual, discrete DMAs. Typically, lines delineating DMAs follow grade breaks and roof ridge lines. Where possible, establish separate DMAs for each surface type (e.g., landscaping, pervious paving, or roofs). Assign each DMA a unique code and determine its size in square feet. The total area of your site should total the sum of all of your DMAs (unless water from outside the project limits comingles with water from inside the project limits, i.e. run-on). Complete Table C-1

Table C-1 DMA Identification

DMA Name or Identification	Surface Type(s)[1]	Area (Sq. Ft.)	DMA Type
B1	Landscape, pavement	248,728	Type D
B2	Landscape, pavement	178,596	Type D
B3	Landscape, pavement	170,320	Type D
B4	Landscape, pavement	126,760	Type D
B5	Landscape, pavement	181,210	Type D
C1	Landscape, pavement	133,729	Type D
D1	Landscape, pavement	140,263	Type D
D2	Landscape, pavement	145,490	Type D

Add Columns as Needed

Step 3: DMA Classification

Determine how drainage from each DMA will be handled by using information from Steps 1 and 2 and by completing Steps 3.A to 3.C. Each DMA will be classified as one of the following four types:

- Type ‘A’: Self-Treating Areas:
- Type ‘B’: Self-Retaining Areas
- Type ‘C’: Areas Draining to Self-Retaining Areas
- Type ‘D’: Areas Draining to BMPs

Step 3.A – Identify Type ‘A’ Self-Treating Area

Indicate if the DMAs meet the following criteria by answering “Yes” or “No”.

☐ Yes ☐ No Area is undisturbed from their natural condition OR restored with Native and/or California Friendly vegetative covers.

☐ Yes ☐ No Area is irrigated, if at all, with appropriate low water use irrigation systems to prevent irrigation runoff.

☐ Yes ☐ No Runoff from the area will not comingle with runoff from the developed portion of the site, or across other landscaped areas that do not meet the above criteria.

If all answers indicate "Yes," complete Table C-2 to document the DMAs that are classified as Self-Treating Areas.

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

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

Step 3.B – Identify Type 'B' Self-Retaining Area and Type 'C' Areas Draining to Self-Retaining Areas

Type 'B' Self-Retaining Area: A Self-Retaining Area is shallowly depressed 'micro infiltration' areas designed to retain the Design Storm rainfall that reaches the area, without producing any Runoff.

Indicate if the DMAs meet the following criteria by answering "Yes," "No," or "N/A".

☐ Yes ☐ No ☐ N/A Slopes will be graded toward the center of the pervious area.

☐ Yes ☐ No ☐ N/A Soils will be freely draining to not create vector or nuisance conditions.

☐ Yes ☐ No ☐ N/A Inlet elevations of area/overflow drains, if any, should be clearly specified to be three inches or more above the low point to promote ponding.

☐ Yes ☐ No ☐ N/A Pervious pavements (e.g., crushed stone, porous asphalt, pervious concrete, or permeable pavers) can be self-retaining when constructed with a gravel base course four or more inches deep below any underdrain discharge elevation.

If all answers indicate "Yes," DMAs may be categorized as Type 'B', proceed to identify Type 'C' Areas Draining to Self-Retaining Areas.

Type 'C' Areas Draining to Self-Retaining Areas: Runoff from impervious or partially pervious areas can be managed by routing it to Self-Retaining Areas consistent with the LID Principle discussed in SMR WQMP Section 3.2.5 for 'Dispersing Runoff to Adjacent Pervious Areas'.
Indicate if the DMAs meet the following criteria by answering "Yes" or "No".

☐ Yes ☐ No The drainage from the tributary area must be directed to and dispersed within the Self-Retaining Area.

☐ Yes ☐ No Area must be designed to retain the entire Design Storm runoff without flowing offsite.

If all answers indicate “Yes,” DMAs may be categorized as Type ‘C’.

Complete Table C-3 and Table C-4 to identify Type ‘B’ Self-Retaining Areas and Type ‘C’ Areas Draining to Self-Retaining Areas.

Table C-3 Type ‘B’, Self-Retaining Areas

Self-Retaining Area				Type ‘C’ DMAs that are draining to the Self-Retaining Area		
DMA Name/ ID	Post-project surface type	Area (square feet)	Storm Depth (inches)	DMA Name / ID	[C] from Table C-4=	Required Retention Depth (inches)
		[A]	[B]		[C]	$[D] = [B] + \frac{[B]\cdot[C]}{[A]}$

Table C-4 Type ‘C’, Areas that Drain to Self-Retaining Areas

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

Note: (See Section 3.3 of SMR WQMP) Ensure that partially pervious areas draining to a Self-Retaining area do not exceed the following ratio:

$$\left(\frac{\mathbf{2}}{\boldsymbol{Impervious\ Fraction}}\right)\mathbf{:1}$$

(Tributary Area: Self-Retaining Area)

Step 3.C – Identify Type 'D' Areas Draining to BMPs

Areas draining to BMPs are those that could not be fully managed through LID Principles (DMA Types A through C) and will instead drain to an LID BMP and/or a Conventional Treatment BMP designed to manage water quality impacts from that area, and Hydromodification where necessary.

Complete Table C-5 to document which DMAs are classified as Areas Draining to BMPs

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

DMA Name or ID	BMP Name or ID Receiving Runoff from DMA
B1	Bioretention B1
B3	Bioretention B3
B4	Bioretention B4
B5	Bioretention B3
D1	Bioretention D1
D2	Bioretention D2

Note: More than one DMA may drain to a single LID BMP; however, one DMA may not drain to more than one BMP.

Section D: Implement LID BMPs

The Regional MS4 Permit requires the use of LID BMPs to provide retention or treatment of the DCV and includes a BMP hierarchy which requires Full Retention BMPs (Priority 1) to be considered before Biofiltration BMPs (Priority 2) and Flow-Through Treatment BMPs and Alternative Compliance BMPs (Priority 3). LID BMP selection must be based on technical feasibility and should be considered early in the site planning and design process. Use this section to document the selection of LID BMPs for each DMA. Note that feasibility is based on the DMA scale and may vary between DMAs based on site conditions.

D.1 Full Infiltration Applicability

An assessment of the feasibility of utilizing full infiltration BMPs is required for all projects, *except where it can be shown that site design LID principals fully retain the DCV (i.e., all DMAs are Type A, B, or C), or where Harvest and Use BMPs fully retain the DCV. Check the following box if applicable:*

☐ Site design LID principals fully retain the DCV (i.e., all DMAs are Type A, B, or C), (Proceed to Section E).

If the above box remains unchecked, perform a site-specific evaluation of the feasibility of Infiltration BMPs using each of the applicable criteria identified in Chapter 2.3.3 of the SMR WQMP and complete the remainder of Section D.1.

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 Copermittee, at their discretion, may not require a geotechnical report for small projects as described in Chapter 2 of the SMR WQMP. 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.

A Geotechnical Investigation Report prepared by Geocon West, Inc. dated April 26, 2016. An updated Geotechnical Investigation Report, dated October 25, 2021 was prepared for the site by Alta California Geotechnical Inc. A total of seven borings were performed onsite. Site geologic materials encountered consist of undocumented artificial fill, alluvium, and Pauba Formation. At 20 feet below ground surface, infiltration rates varied from 0.74 in/hr – 10.03 in/hr. At 30 feet below ground surface, the infiltration rate is 0.11 in/hour.

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 SMR WQMP in Chapter 2.3.3. 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

Downstream Impacts (SMR WQMP Section 2.3.3.a)		
Does the project site…	YES	NO
…have any DMAs where infiltration would negatively impact downstream water rights or other Beneficial Uses[3]?		X
If Yes, list affected DMAs:		
Groundwater Protection (SMR WQMP Section 2.3.3.b)		
Does the project site…	YES	NO
…have any DMAs with industrial, and other land uses that pose a high threat to water quality, which cannot be treated by Bioretention BMPs? Or have DMAs with active industrial process areas?		X
If Yes, list affected DMAs:		
…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 horizontally of a water supply well?		X
If Yes, list affected DMAs:		
…have any DMAs that would restrict BMP locations to within a 2:1 (horizontal: vertical) influence line extending from any septic leach line?		
If Yes, list affected DMAs:		
…have any DMAs been evaluated by a licensed Geotechnical Engineer, Hydrogeologist, or Environmental Engineer, who has concluded that the soils do not have adequate physical and chemical characteristics for the protection of groundwater, and has treatment provided by amended media layers in Bioretention BMPs been considered in evaluating this factor?		X
If Yes, list affected DMAs:		
Public Safety and Offsite Improvements (SMR WQMP Section 2.3.3.c)		
Does the project site…	YES	NO
…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:		
Infiltration Characteristics For LID BMPs (SMR WQMP Section 2.3.3.d)		
Does the project site…	YES	NO
…have factored infiltration rates of less than 0.8 inches / hour? (Note: on a case-by-case basis, the Local Jurisdiction may allow a factor of safety as low as 1.0 to support selection of full infiltration BMPs. Therefore, measured infiltration rates could be as low as 0.8 in/hr to support full infiltration. A higher factor of safety would be required for design in accordance with the LID BMP Deign Handbook).		X
If Yes, list affected DMAs:		
Cut/Fill Conditions (SMR WQMP Section 2.3.3.e)		
Does the project site…	YES	NO
…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:		
Other Site-Specific Factors (SMR WQMP Section 2.3.3.f)		
Does the project site…	YES	NO
…have DMAs where the geotechnical investigation discovered other site-specific factors that would preclude effective and/or safe infiltration?		X
Describe here:		

If you answered "Yes" to any of the questions above for any DMA, Infiltration BMPs that rely solely on infiltration should not be used for those DMAs and you should proceed to the assessment for Biofiltration BMPs below. Biofiltration BMPs that provide partial infiltration may still be feasible and should be

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[3] Such a condition must be substantiated by sufficient modeling to demonstrate an impact and would be subject to [Insert Jurisdiction] discretion. There is not a standardized method for assessing this criterion. Water rights evaluations should be site-specific.

assessed in Section D.2. Summarize concerns identified in the Geotechnical Report, if any, that resulted in a “YES” response above in the table below.

Table D-2 Geotechnical Concerns for Onsite Infiltration

Type of Geotechnical Concern	DMAs Feasible (By Name or ID)	DMAs Infeasible (By Name or ID)
Collapsible Soil		
Expansive Soil		
Slopes		
Liquefaction		
Other (infiltration rate)		

D.2 Biofiltration Applicability

This section should document the applicability of biofiltration BMPs for Type D DMAs that are not feasible for full infiltration BMPs. The key decisions to be documented in this section include:

1. Are biofiltration BMPs with partial infiltration feasible?
    a. Biofiltration BMPs must be designed to maximize incidental infiltration via a partial infiltration design unless it is demonstrated that this design is not feasible.
    b. These designs can be used at sites with low infiltration rates where other feasibility factors do not preclude incidental infiltration.

   Document summary in Table D-3.

2. If not, what are the factors that require the use of biofiltration with no infiltration? This may include:
    a. Geotechnical hazards
    b. Water rights issues
    c. Water balance issues
    d. Soil contamination or groundwater quality issues
    e. Very low infiltration rates (factored rates < 0.1 in/hr)
    f. Other factors, demonstrated to the acceptance of the local jurisdiction

   If this applies to any DMAs, then rationale must be documented in Table D-3.

3. Are biofiltration BMPs infeasible?
    a. If yes, then provide 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 with jurisdiction over the Project site to discuss this option. Proceed to Section F to document your alternative compliance measures.

Table D-3 Evaluation of Biofiltration BMP Feasibility

DMA ID	Is Partial/ Incidental Infiltration Allowable? (Y/N)	Basis for Infeasibility of Partial Infiltration (provide summary and include supporting basis if partial infiltration not feasible)
B1	Y	
B3	Y	
B4	Y	
B5	Y	
D1	Y	
D2	Y	

Proprietary Biofiltration BMP Approval Criteria

If the project will use proprietary BMPs as biofiltration BMPs, then this section is completed to document that the proprietary BMPs are selected in accordance with Section 2.3.7 of the SMR WQMP. Proprietary Biofiltration BMPs must meet both of the following approval criteria:

1. Approval Criteria for All Proprietary BMPs, and
2. Acceptance Criteria for Proprietary Biofiltration BMPs.

When the use of proprietary biofiltration BMPs is proposed to meet the Pollutant Control performance standards, use Table D-4 to document that appropriate approval criteria have been met for the proposed BMPs. Add additional rows to document approval criteria are met for each type of BMP proposed.

Table D-4 Proprietary BMP Approval Requirement Summary

Proposed Proprietary Biofiltration BMP	Approval Criteria	Notes/Comments
Bioclean Modular Wetland System	☒ Proposed BMP has an active TAPE GULD Certification for the project pollutants of concern[4] or equivalent 3rd party demonstrated performance.	
	☒ The BMP is used in a manner consistent with manufacturer guidelines and conditions of its third-party certification.	
	☒ The BMP includes biological features including vegetation supported by engineered or other growing media.	
	☐ The BMP is designed to maximize infiltration, or supplemental infiltration is provided to achieve retention equivalent to Biofiltration with Partial Infiltration BMPs if factored infiltration rate is between 0.1 and 0.8 inches/hour.	Bioclean Modular Wetland system is proprietary and is fully enclosed in concrete vault thus not allowing for partial infiltration. However, the proposed underground detention

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[4] Use Table F-1 and F-2 to identify and document the pollutants of concern and include these tables in Appendix 5.

		system will have open windows at its base to allow for minimal infiltration.
	☒ The BMP is sized using one of two Biofiltration LID sizing options in Section 2.3.2 of the SRM WQMP.	

Runoff entering the Bioclean Modular Wetland system will be controlled in a flow control structure immediately upstream of BMP #1. The treated runoff from the system will discharge to the proposed underground detention vault system.

D.3 Feasibility Assessment Summaries

From the Infiltration, Biofiltration with Partial Infiltration and Biofiltration with No Infiltration Sections above, complete Table D-5 below to summarize which LID BMPs are technically feasible, and which are not, based upon the established hierarchy.

Table D-5 LID Prioritization Summary Matrix

DMA Name/ID	LID BMP Hierarchy			No LID (Alternative Compliance)
	1. Infiltration	2. Biofiltration with Partial Infiltration	3. Biofiltration with No Infiltration	
B1	☒	☐	☐	☐
B3	☒	☐	☐	☐
B4	☒	☐	☐	☐
B5	☒	☐	☐	☐
D1	☒	☐	☐	☐
D2	☒	☐	☐	☐

For those DMAs where LID BMPs are not feasible, provide a narrative in Table D-6 below summarizing why they are not feasible, include your technical infeasibility criteria in Appendix 5, and proceed to Section F below to document Alternative Compliance measures for those DMAs. Recall that each proposed DMA must pass through the LID BMP hierarchy before alternative compliance measures may be considered.

This is based on the clarification letter titled "San Diego Water Board's Expectations of Documentation to Support a Determination of Priority Development Project Infiltration Infeasibility" (April 28, 2017, Via email from San Diego Regional Water Quality Control Board to San Diego County Municipal Storm Water Copermittees[5]).

Table D-6 Summary of Infeasibility Documentation

Question	Narrative Summary (include reference to applicable appendix/attachment/report, as applicable)
a) When in the entitlement process did a geotechnical engineer	Yes. ALTA's findings during subsurface investigation, laboratory results and staff experience with the area, show that the site is feasible. (ALTA CALIFORNIA GEOTHECHNICAL INC. 10/25/21)

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[5] http://www.projectcleanwater.org/download/pdp-infiltration-infeasibility/

analyze the site for infiltration feasibility?	
b) When in the entitlement process were other investigations conducted (e.g., groundwater quality, water rights) to evaluate infiltration feasibility?	No- investigations not completed.
c) What was the scope and results of testing, if conducted, or rationale for why testing was not needed to reach findings?	
d) What public health and safety requirements affected infiltration locations?	
e) What were the conclusions and recommendations of the geotechnical engineer and/or other professional responsible for other investigations?	Remedial grading, site preparation, unsuitable soil removal, undocumented artificial fill, alluvium, pauba formation, over-excavation of building pads, cut pads, general earthwork, expansive soils, fill placement, moisture content, mixing, import soils, fill slope construction, backfill, backcut stability. Please see attached Geotechnical report by ALTA CALIFORNIA GEOTECHNICAL INC. dated 10/25/2021 for further details
f) What was the history of design discussions between the permittee and applicant for the proposed project, resulting in the final design determination related locations feasible for infiltration?	
g) What site design alternatives were considered to achieve infiltration or partial infiltration on site?	
h) What physical impairments (i.e., fire road egress, public safety considerations, utilities) and public safety concerns influenced site	

	layout and infiltration feasibility?	
i)	What LID Principles (site design BMPs) were included in the project site design?	Existing drainage patterns were preserved in proposed conditions to the maximum extent possible. Impervious areas were minimized by designing the parking lots to the minimum dimensions required for impervious areas (parking stalls, drive aisles, and walkways) and maximizing landscaped areas.

D.4 LID BMP Sizing

Each LID BMP must be designed to ensure that the DCV will be captured by the selected BMPs with no discharge to the storm drain or surface waters during the DCV size storm. Infiltration BMPs must at minimum be sized to capture the DCV to achieve pollutant control requirements.

Biofiltration BMPs must at a minimum be sized to:

- Treat 1.5 times the DCV not reliably retained on site using a volume-base or flow-based sizing method, or
- Include static storage volume, including pore spaces and pre-filter detention volume, at least 0.75 times the portion of the DCV not reliably retained on site.

First, calculate the DCV 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 the methods included in Section 3 of the LID BMP Design Handbook. Utilize the worksheets found in the LID BMP Design Handbook or consult with the Copermittee to assist you in correctly sizing your LID BMPs. Use Table D-7 below to document the DCV each LID BMP. Provide the completed design procedure sheets for each LID BMP in Appendix 6. You may add additional rows to the table below as needed.

Table D-7 DCV Calculations for LID BMPs

DMA Type/ID	DMA (square feet)	Post-Project Surface Type	Effective Impervious Fraction, I_f	**DMA Runoff Factor**	DMA Areas x Runoff Factor	*Enter BMP Name / Identifier Here*		
	[A]		[B]	[C]	[A] x [C]			
						Design Storm Depth (in)	*DCV, V_{BMP} (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
B1	*248,728*	*Mixed*	*0.82*	*0.62*	*154,211*			
B3	*170,320*	*Mixed*	*0.82*	*0.62*	*105,598*			
B4	*126,760*	*Mixed*	*0.82*	*0.62*	*78,591*			
B5	*181,210*	*Mixed*	*0.82*	*0.62*	*112,350*			
D1	*140,263*	*Mixed*	*0.82*	*0.62*	*86,963*			
D2	*145,490*	*Mixed*	*0.82*	*0.62*	*90,204*			
Total	1,012,771				627,917	0.81	41,961	*41,961*

[B], [C] is obtained as described in Section 2.6.1.b of the SMR WQMP
[E] is obtained from Exhibit A in the SMR WQMP
[G] is obtained from a design procedure sheet, such as in LID BMP Design Handbook and placed in Appendix 6.

Complete Table D-8 below to document the Design Capture Volume and the Proposed Volume for each LID BMP. You can add rows to the table as needed. Alternatively, the Santa Margarita Hydrology Model (SMRHM) can be used to size LID BMPs to address the DCV and, if applicable, to size Hydrologic Control BMPs to meet the Hydrologic Performance Standard described in the SMR WQMP, as identified in Section E.

Table D-8 LID BMP Sizing

BMP Name / ID	DMA No.	BMP Type / Description	Design Capture Flow (cfs)	Proposed Flow (cfs)
B2	B2	Bioclean Modular Wetland	0.50	0.58
B5	B5	Bioclean Modular Wetland	0.50	0.58
C1	C1	Bioclean Modular Wetland	0.40	0.46

If bioretention will include a capped underdrain, then include sizing calculations demonstrating that the BMP will meet infiltration sizing requirements with the underdrain capped and also meet biofiltration sizing requirements if the underdrain is uncapped.

Section E: Implement Hydrologic Control BMPs and Sediment Supply BMPs

If a completed Table 1.2 demonstrates that the project is exempt from Hydromodification Performance Standards, specify N/A and proceed to Section G.

☐ N/A Project is Exempt from Hydromodification Performance Standards.

If a PDP is not exempt from hydromodification requirements than the PDP must satisfy the requirements of the performance standards for hydrologic control BMPs and Sediment Supply BMPs. The PDP may choose to satisfy hydrologic control requirements using onsite or offsite BMPs (i.e. Alternative Compliance). Sediment supply requirements cannot be met via alternative compliance. If N/A is not selected above, select one of the two options below and complete the applicable sections.

☒ Project is Not Hydromodification Exempt and chooses to implement Hydrologic Control and Sediment Supply BMPs Onsite (complete Section E).

☐ Project is Not Hydromodification Exempt and chooses to implement Hydrologic Control Requirements using Alternative Compliance (complete Section F). Selection of this option must be approved by the Copermittee.

E.1 Hydrologic Control BMP Selection

Capture of the DCV and achievement of the Hydrologic Performance Standard may be met by combined and/or separate structural BMPs. The user should consider the full suite of Hydrologic Control BMPs to manage runoff from the post-development condition and meet the Hydrologic Performance Standard identified in this section.

The Hydrologic Performance Standard consists of matching or reducing the flow duration curve of post-development conditions to that of pre-existing, naturally occurring conditions, for the range of geomorphically significant flows (10% of the 2-year runoff event up to the 10-year runoff event). Select each of the hydrologic control BMP types that are applied to meet the above performance standard on the site.

☐ LID principles as defined in Section 3.2 of the SMR WQMP.

☐ Structural LID BMPs that may be modified or enlarged, if necessary, beyond the DCV.

☒ Structural Hydrologic Control BMPs that are distinct from the LID BMPs above. The LID BMP Design Handbook provides information not only on Hydrologic Control BMP design, but also on BMP design to meet the combined LID requirement and Hydrologic Performance Standard. The Handbook specifies the type of BMPs that can be used to meet the Hydrologic Performance Standard.

E.2 Hydrologic Control BMP Sizing

Hydrologic Control BMPs must be designed to ensure that the flow duration curve of the post-development DMA will not exceed that of the pre-existing, naturally occurring, DMA for the range of geomorphically significant flows. Using SMRHM, (or another acceptable continuous simulation model if approved by the Copermittee) the applicant shall demonstrate that the performance of the Hydrologic Control BMPs complies with the Hydrologic Performance Standard. Complete Table E-1 below and identify, for each DMA, the type of Hydrologic Control BMP, if the SMRHM model confirmed the management (Identified as "passed" in SMRHM), the total volume capacity of the Hydrologic Control BMP, the Hydrologic Control BMP footprint at top floor elevation, and the drawdown time of the Hydrologic Control BMP. SMRHM summary reports should be documented in Appendix 7. Refer to the SMRHM Guidance Document for additional information on SMRHM. You can add rows to the table as needed.

Table E-1 Hydrologic Control BMP Sizing

BMP Name / ID	DMA No.	BMP Type / Description	SMRHM Passed	BMP Volume (ac-ft)	BMP Footprint (ac)	Drawdown time (hr)
B1	B1, B2	Infiltration Vault	☒	1.77	0.28	
B3	B3-B5	Infiltration Vault	☒	2.53	0.40	
C1	C1	Infiltration Vault	☒	0.82	0.11	
D1	D1,D2	Infiltration Vault	☒	1.31	0.14	

If a bioretention BMP with capped underdrain is used and hydromodification requirements apply, then sizing calculations must demonstrate that the BMP meets flow duration control criteria with the underdrain capped and uncapped. Both calculations must be included.

E.3 Implement Sediment Supply BMPs

The sediment supply performance standard applies to PDPs for which hydromodification applied that have the potential to impact Potential Critical Coarse Sediment Yield Areas. Refer to Exhibit G of the WQMP to determine if there are onsite Potential Critical Coarse Sediment Yield Areas or Potential Sediment Source Areas. Select one of the two options below and include the Potential Critical Coarse Sediment Yield Area Exhibit showing your project location in Appendix 7.

☒ There are no mapped Potential Critical Coarse Sediment Yield Areas or Potential Sediment Source Areas on the site. The Sediment Supply Performance Standard is met with no further action.

☐ There are mapped Potential Critical Coarse Sediment Yield Areas or Potential Sediment Source Areas on the site, the Sediment Supply Performance Standard will be met through Option 1 or Option 2 below.

The applicant may refer to Section 3.6.4 of the SMR WQMP for a description of the methodology to meet the Sediment Supply Performance Standard. Select the applicable compliance pathway and complete the appropriate sections to demonstrate compliance with the Sediment Supply Performance Standard if the second box is selected above:

☐ Avoid impacts related to any PDP activities to Potential Critical Coarse Sediment Yield Areas. Proceed to Section E.3.1.

☐ Complete a Site-Specific Critical Coarse Sediment Analysis. Proceed to Section E.3.2.

E.3.1 Option 1: Avoid Potential Critical Coarse Sediment Yield Areas and Potential Sediment Source Areas

The simplest approach for complying with the Sediment Supply Performance Standard is to avoid impacts to areas identified as Potential Critical Coarse Sediment Yield Areas or Potential Sediment Supply Areas. If a portion of PDP is identified as a Potential Critical Coarse Sediment Yield Area or a Potential Sediment Source Area, that PDP may still achieve compliance with the Sediment Supply Performance Standards if Potential Critical Coarse Sediment Yield Areas and Potential Sediment Supply Areas are avoided, i.e. areas are not developed and thereby delivery of Critical Coarse Sediment to the receiving waters is not impeded by site developments.

Provide a narrative describing how the PDP has avoided impacts to Potential Critical Coarse Sediment Yield Areas and/or Potential Sediment Source Areas below.

Insert narrative description here

If it is not feasible to avoid these areas, proceed to Option 2 to complete a Site-Specific Critical Coarse Sediment Analysis.

E.3.2 Option 2: Site-Specific Critical Coarse Sediment Analysis

Perform a stepwise assessment to ensure the maintenance of the pre-project source(s) of Critical Coarse Sediment (i.e., Bed Sediment Supply):

1. Determine whether the site or a portion of the site is a Significant Source of Bed Sediment Supply to the Receiving Channel (i.e., an actual verified Critical Coarse Sediment Yield Area);
2. Avoid areas identified as actual verified Critical Coarse Sediment Yield Areas in the PDP design and maintain pathways for discharge of Bed Sediment Supply from these areas to receiving waters.

Step 1: Identify if the site is an actual verified Critical Coarse Sediment Yield Area supplying Bed Sediment Supply to the receiving channel

☐ Step 1.A – Is the Bed Sediment of onsite streams similar to that of receiving streams?

Rate the similarity: ☐ High
☐ Medium
☐ Low

Results from the geotechnical and sieve analysis to be performed both onsite and in the receiving channel should be documented in Appendix 7. Of particular interest, the results of the sieve analysis, the soil erodibility factor, a description of the topographic relief of the project area, and the lithology of onsite soils should be reported in Appendix 7.

☐ Step 1.B – Are onsite streams capable of delivering Bed Sediment Supply from the site, if any, to the receiving channel?

Rate the potential:
☐ High
☐ Medium
☐ Low

Results from the analyses of the sediment delivery potential to the receiving channel should be documented in Appendix 7 and identify, at a minimum, the Sediment Source, the distance to the receiving channel, the onsite channel density, the project watershed area, the slope, length, land use, and rainfall intensity.

☐ Step 1.C – Will the receiving channel adversely respond to a change in Bed Sediment Load?

Rate the need for bed sediment supply:
☐ High
☐ Medium
☐ Low

Results from the in-stream analysis to be performed both onsite should be documented in Appendix 7. The analysis should, at a minimum, quantify the bank stability and the degree of incision, provide a gradation of the Bed Sediment within the receiving channel, and identify if the channel is sediment supply-limited.

☐ Step 1.D – Summary of Step 1

Summarize in Table E.3 the findings of Step 1 and associate a score (in parenthesis) to each step. The sum of the three individual scores determines if a stream is a significant contributor to the receiving stream.

- Sum is equal to or greater than eight - Site is a significant source of sediment bed material – all on-site streams must be preserved or by-passed within the site plan. The applicant shall proceed to Step 2 for all onsite streams.
- Sum is greater than five but lower than eight. Site is a source of sediment bed material – some of the on-site streams must be preserved (with identified streams noted). The applicant shall proceed to Step 2 for the identified streams only.
- Sum is equal to or lower than five. Site is not a significant source of sediment bed material. The applicant may advance to Section F.

Table E-2 Triad Assessment Summary

Step	Rating			Total Score
1.A	☐ High (3)	☐ Medium (2)	☐ Low (1)	
1.B	☐ High (3)	☐ Medium (2)	☐ Low (1)	

1.C	☐ High (3)	☐ Medium (2)	☐ Low (1)	
Significant Source Rating of Bed Sediment to the receiving channel(s)				

Step 2: Avoid Development of Critical Coarse Sediment Yield Areas, Potential Sediment Sources Areas, and Preserve Pathways for Transport of Bed Sediment Supply to Receiving Waters

Onsite streams identified as a actual verified Critical Coarse Sediment Yield Areas should be avoided in the site design and transport pathways for Critical Coarse Sediment should be preserved

Check those that apply:

☐ The site design does avoid all onsite channels identified as actual verified Critical Coarse Sediment Yield Areas

AND

☐ The drainage design bypasses flow and sediment from onsite upstream drainages identified as actual verified Critical Coarse Sediment Yield Areas to maintain Critical Coarse Sediment supply to receiving waters

(If both are yes, the applicant may disregard subsequent steps of Section E.3 and directly advance directly to Section G).

- *Or* -

☐ The site design does NOT avoid all onsite channels identified as actual verified Critical Coarse Sediment Yield Areas

OR

☐ The project impacts transport pathways of Critical Coarse Sediment from onsite upstream drainages.

(If either of these are the case, the applicant may proceed with the subsequent steps of Section E.3).

Provide in Appendix 7 a site map that identifies all onsite channels and highlights those onsite channels that were identified as a Significant Source of Bed Sediment. The site map shall demonstrate, if feasible, that the site design avoids those onsite channels identified as a Significant Source of Bed Sediment. In addition, the applicant shall describe the characteristics of each onsite channel identified as a Significant Source of Bed Sediment. If the design plan cannot avoid the onsite channels, please provide a rationale for each channel individually.

The site map shall demonstrate that the drainage design bypasses those onsite channels that supply Critical Coarse Sediment to the receiving channel(s). In addition, the applicant shall describe the characteristics of each onsite channel identified as an actual verified Critical Coarse Sediment Yield Area.

Identified Channel #1 - Insert narrative description here

Identified Channel #2 - Insert narrative description here

Identified Channel #3 - Insert narrative description here

E.3.3 Sediment Supply BMPs to Result in No Net Impact to Downstream Receiving Waters

If impacts to Critical Coarse Sediment Yield Areas cannot be avoided, sediment supply BMPs must be implemented such there is no net impact to receiving waters. Sediment supply BMPs may consist of approaches that permit flux of bed sediment supply from Critical Coarse Sediment Yield Areas within the project boundary. This approach is subject to acceptance by the [Insert Jurisdiction]. It may require extensive documentation and analysis by qualified professionals to support this demonstration.

Appendix H of the San Diego Model BMP Design Manual provides additional information on site-specific investigation of Critical Coarse Sediment Supply areas.

http://www.projectcleanwater.org/download/2018-model-bmp-design-manual/

If applicable, insert narrative description here

Documentation of sediment supply BMPs should be detailed in Appendix 7.

Section F: Alternative Compliance

Alternative Compliance may be used to achieve compliance with pollutant control and/or hydromodification requirements for a given PDP. Alternative Compliance may be used under two scenarios, check the applicable box if the PDP is proposing to use Alternative Compliance to satisfy all or a portion of the Pollutant Control and/or Hydrologic Control requirements (but not sediment supply requirements)

☐ If it is not feasible to fully implement Infiltration or Biofiltration BMPs at a PDP site, Flow-Through Treatment Control BMPs may be used to treat pollutants contained in the portion of DCV not reliably retained on site and Alternative Compliance measures must also be implemented to mitigate for those pollutants in the DCV that are not retained or removed on site prior to discharging to a receiving water.

☐ Alternative Compliance is selected to comply with either pollutant control or hydromodification flow control requirements even if complying with these requirements is potentially feasible on-site. If such voluntary Alternative Compliance is implemented, Flow-Through Treatment Control BMPs must still be used to treat those pollutants in the portion of the DCV not reliably retained on site prior to discharging to a receiving water.

Refer to Section 2.7 of the SMR WQMP and consult the Local Jurisdiction for currently available Alternative Compliance pathways. Coordinate with the Copermittee if electing to participate in Alternative Compliance and complete the sections below to document implementation of the Flow-Through BMP component of the program.

F.1 Identify Pollutants of Concern

The purpose of this section is to help you appropriately plan for mitigating your Pollutants of Concern in lieu of implementing LID BMPs and to document compliance and.

Utilize Table A-1 **Identification of Receiving Waters**

Receiving Waters	USEPA Approved 303(d) List Impairments	Designated Beneficial Uses	Proximity to RARE Beneficial Use
Warm Springs Creek	Indicator Bacteria; Chlorpyrifos; Metals (Iron, Manganese); Nutrients (Nitrogen, Phosphorus)	AGR, IND, MUN, PROC, REC1, REC2, WARM, WILD	Not a RARE water body
Murrieta Creek	Pesticides (Chlorpyrifos); Metals (Copper, Iron, Manganese); Nutrients (Nitrogen, Phosphorus); Toxicity (Toxicity)	MUN, AGR, IND, PROC, GWR, REC-2, WARM, WILD	Not a RARE water body
Santa Margarita River – Upper portion (HAS 2.22, 2.21)	Nutrients (Phosphorus), Pesticides (Toxicity)	MUN, AGR, IND, REC-1, REC-2, WARM, COLD, WILD, RARE	RARE WATERBODY 9.33 MILES
Santa Margarita River – Lower Portion (HSA 2.13, 2.12, 2.11)	Bacteria & Viruses (Enterococcus, Fecal Coliform), Nutrients (Phosphorus, Nitrogen	MUN, AGR, IND, PROC, REC-1, REC-2, WARM, COLD, WILD, RARE	RARE WATERBODY 19.36 MILES
Santa Margarita Lagoon	Nutrients (Eutrophic)	REC-1, REC-2, EST, WILD, RARE, MAR, MIGR, SPWN	RARE WATERBODY 28.81 MILES
Pacific Ocean	None	IND, NAV, REC-1, REC-2, COMM, BIOL, WILD, RARE, MAR, AQUA,	RARE WATERBODY 28.81 MILES

		MIGR, SPWN, SHELL	

from Section A, which noted your project's Receiving Waters, to identify impairments for Receiving Waters (including downstream receiving waters) by completing Table F-1. Table F-1 includes the watersheds identified as impaired in the Approved 2010 303(d) list; check box corresponding with the PDP's receiving water. The most recent 303(d) lists are available from the State Water Resources Control Board website:
https://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml).https://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml.

Table F-1 Summary of Approved 2010 303(d) listed waterbodies and associated pollutants of concern for the Riverside County SMR Region and downstream waterbodies.

Water Body		**Nutrients[1]**	**Metals[2]**	**Toxicity**	**Bacteria and Pathogens**	**Pesticides and Herbicides**	**Sulfate**	**Total Dissolved Solids**
☐	De Luz Creek	X	X				X	
☐	Long Canyon Creek		X		X	X		
☒	Murrieta Creek	X	X	X		X		
☐	Redhawk Channel	X	X		X	X		X
☐	Santa Gertudis Creek	X	X		X	X		
☐	Santa Margarita Estuary	X						
☒	Santa Margarita River (Lower)	X			X			
☒	Santa Margarita River (Upper)	X		X				
☐	Temecula Creek	X	X	X		X		X
☐	Warm Springs Creek	X	X		X	X		

[1] Nutrients include nitrogen, phosphorus and eutrophic conditions caused by excess nutrients.

[2] Metals includes copper, iron, and manganese.

Use Table F-2 to identify the pollutants identified with the project site. Indicate the applicable PDP Categories and/or Project Features by checking the boxes that apply. If the identified General Pollutant Categories are the same as those listed for your Receiving Waters, then these will be your Pollutants of Concern; check the appropriate box or boxes in the last row.

Table F-2 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	Total Dissolved Solids	Sulfate
☐	Detached Residential Development	P	N	P	P	N	P	P	P	N	N
☐	Attached Residential Development	P	N	P	P	N	P	P	P[2]	N	N
☒	Commercial/Industrial Development	P[3]	P[7]	P[1]	P[1]	P	P[1]	P	P	N	N
☐	Automotive Repair Shops	N	P	N	N	P[4, 5]	N	P	P	N	N
☐	Restaurants (>5,000 ft²)	P	N	N	P[1]	N	N	P	P	N	N
☐	Hillside Development (>5,000 ft²)	P	N	P	P	N	P	P	P	N	N
☐	Parking Lots (>5,000 ft²)	P[6]	P[7]	P[1]	P[1]	P[4]	P	P	P	N	N
☐	Streets, Highways, and Freeways	P[6]	P[7]	P[1]	P[1]	P[4]	P	P	P	N	N
☐	Retail Gasoline Outlets	N	P[7]	N	N	P[4]	N	P	P	N	N
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 products; otherwise not expected*

[4] *Including petroleum hydrocarbons*

[5] *Including solvents*

[6] *Bacterial indicators are routinely detected in pavement runoff*

[7] *A potential source of metals, primarily copper and zinc. Iron, magnesium, and aluminum are commonly found in the environment and are commonly associated with soils, but are not primarily of anthropogenic stormwater origin in the municipal environment.*

F.2 Treatment Control BMP Selection

Treatment Control BMPs typically provide proprietary treatment mechanisms to treat potential Pollutants in runoff, but do not sustain significant biological processes. Treatment Control BMPs must be selected to address the Project Priority Pollutants of Concern (identified above) and meet the acceptance criteria described in Section 2.3.7 of the SMR WQMP. Documentation of acceptance criteria 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 F-3 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 Copermittee Approved Study and provided in Appendix 6.

F.3 Sizing Criteria

Utilize Table F-4 below to appropriately size flow-through BMPs to the DCV, or Design Flow Rate, as applicable. Please reference Chapter 3.5.1 of the SMR WQMP for further information.

Table F-4 Treatment Control BMP Sizing

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Impervious Fraction, I_f	**DMA Runoff Factor**	DMA Areas x Runoff Factor	*Enter BMP Name / Identifier Here*	
	[A]		[B]	[C]	[A] x [C]		
						Design Storm (in)	*Design Flow Rate (cfs)*
	$A_T = \Sigma[A]$				$\Sigma = [D]$	[E]	$[F] = \frac{[D]x[E]}{[G]}$

[B], [C] is obtained as described in Section 2.6.1.b from the SMR WQMP

[E] either 0.2 inches or 2 times the 85th percentile hourly rainfall intensity

[G] = 43,560,.

F.4 Hydrologic Performance Standard – Alternative Compliance Approach

Alternative compliance options are only available if the governing Copermittee has acknowledged the infeasibility of onsite Hydrologic Control BMPs and approved an alternative compliance approach. See Section 3.5 and 3.6 of the SMR WQMP.

Select the pursued alternative and describe the specifics of the alternative:

☐ Offsite Hydrologic Control Management within the same channel system

Insert narrative description here

☐ In-Stream Restoration Project

Insert narrative description here

For Offsite Hydrologic Control BMP Option

Each Hydrologic Control BMP must be designed to ensure that the flow duration curve of the post-development DMA will not exceed that of the pre-existing, naturally occurring, DMA by more than ten percent over a one-year period. Using SMRHM, the applicant shall demonstrate that the performance of each designed Hydrologic Control BMP is equivalent with the Hydrologic Performance Standard for onsite conditions. Complete Table F-5 below and identify, for each Hydrologic Control BMP, the equivalent DMA the Hydrologic Control BMP mitigates, that the SMRHM model passed, the total volume capacity of the BMP, the BMP footprint at top floor elevation, and the drawdown time of the BMP. SMRHM summary reports for the alternative approach should be documented in Appendix 7. Refer to the SMRHM Guidance Document for additional information on SMRHM. You can add rows to the table as needed.

Table F-5 Offsite Hydrologic Control BMP Sizing

BMP Name / Type	Equivalent DMA (ac)	SMRHM Passed	BMP Volume (ac-ft)	BMP Footprint (ac)	Drawdown time (hr)
		☐			
		☐			
		☐			
		☐			

For Instream Restoration Option

Attach to Appendix 7 the technical report detailing the condition of the receiving channel subject to the proposed hydrologic and sediment regimes. Provide the full design plans for the in-stream restoration project that have been approved by the Copermittee. Utilize the San Diego Regional Water Quality Equivalency Guidance Document.

Section G: Implement Trash Capture BMPs

The Local Jurisdiction may require full trash capture BMPs to be installed as part of the project. Consult with the Local Jurisdiction to determine applicability.

Trash Capture BMPs may be applicable to Type 'D' DMAs, as defined in Section 2.3.4 of the SMR WQMP. Trash Capture BMPs are designed to treat Q_{TRASH}, the runoff flow rate generated during the 1-year 1-hour precipitation depth. Utilize Table G-1 to size Trash Capture BMP. Refer to Table G-2 to determine the Trash Capture Design Storm Intensity (E).

Table G-1 Sizing Trash Capture BMPs

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Impervious Fraction, I_f	**DMA Runoff Factor**	DMA Areas x Runoff Factor	*Enter BMP Name / Identifier Here*	
	[A]		[B]	[C]	[A] x [C]		
						Trash Capture Design Storm Intensity (in) [E]	*Trash Capture Design Flow Rate (cubic feet or cfs) [D]*[E]/[G]*

[B], [C] is obtained as described in Section 2.6.1.b from the SMR WQMP
[G] = 43,560

Each Drainage Management Area has multiple sub-drainage areas which will have a grate or curb inlet. A FloGard Catch Basin Insert Filter has been proposed for each catch basin and will be sized per the manufacturer's sizing guide to meet design flow rates for each sub area.

Table G-2 Approximate precipitation depth/intensity values for calculation of the Trash Capture Design Storm

City	1-year 1-hour Precipitation Depth/Intensity (inches/hr)
Murrieta	0.47
Temecula	0.50
Wildomar	0.37

Use Table G-3 to summarize and document the selection and sizing of Trash Capture BMPs.

Table G-3 Trash Capture BMPs

BMP Name / ID	DMA No(s)	BMP Type / Description	Required Trash Capture Flowrate (cfs)	Provided Trash Capture Flowrate (cfs)

Section H: 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 Maximum Extent Practicable (MEP) standard typically requires both types of BMPs. In general, Operational Source Control BMPs cannot be substituted for a feasible and effective Structural Source Control BMP. Complete checklist below to determine applicable Source Control BMPs for your site.

Project-Specific WQMP Source Control BMP Checklist

All development projects must implement Source Control BMPs. Source Control BMPs are used to minimize pollutants that may discharge to the MS4. Refer to Chapter 3 (Section 3.8) of the SMR WQMP for additional information. Complete Steps 1 and 2 below to identify Source Control BMPs for the project site.

STEP 1: IDENTIFY POLLUTANT SOURCES

Review project site plans and identify the applicable pollutant sources. "Yes" indicates that the pollutant source is applicable to project site. "No" indicates that the pollutant source is not applicable to project site.

☒ Yes ☐ No Storm Drain Inlets
☐ Yes ☒ No Floor Drains
☐ Yes ☒ No Sump Pumps
☐ Yes ☒ No Pets Control/Herbicide Application
☐ Yes ☒ No Food Service Areas
☒ Yes ☐ No Trash Storage Areas
☐ Yes ☒ No Industrial Processes
☐ Yes ☒ No Vehicle and Equipment Cleaning and Maintenance/Repair Areas
☐ Yes ☒ No Outdoor storage areas
☐ Yes ☒ No Material storage areas
☐ Yes ☒ No Fueling areas
☐ Yes ☒ No Loading Docks
☒ Yes ☐ No Fire Sprinkler Test/Maintenance water
☒ Yes ☐ No Plazas, Sidewalks and Parking Lots
☒ Yes ☐ No Pools, Spas, Fountains and other water features

STEP 2: REQUIRED SOURCE CONTROL BMPS

List each Pollutant source identified above in column 1 and fill in the corresponding Structural Source Control BMPs and Operational Control BMPs by referring to the Stormwater Pollutant Sources/Source Control Checklist included in Appendix 8. The resulting list of structural and operational source control BMPs must be implemented as long as the associated sources are present on the project site. Add additional rows as needed.

Pollutant Source	Structural Source Control BMP	Operational Source Control BMP
Storm Drain Inlets	Mark inlets with "Only Rain Down the Storm Drain"	Maintain and Periodically repaint of replace inlet markings. See CASQA Fact Sheet SC-44.
Trash Storage Areas	Refuse areas to be covered and marked with "Do Not Dump Hazardous Materials Here".	Provide adequate number of receptacles. Inspect receptacles regularly; repair or replace leaky receptacles. Pick liter up litter daily and clean up spills immediately. See CAQA Fact Sheet SC-34.

Fire Sprinkler Test/Maintenance Water	Provide means to drain fire sprinkler test water to the sanitary sewer.	Prevent and reduce the discharge of pollutants to stormwater from building. See CASQA Fact Sheet SC-22.
Plazas, Sidewalks, and Parking Lots		Sweep sidewalks and parking lots regularly to prevent accumulation of litter and debris.
Pools, Spas, Fountains and other water features		

Section I: Coordinate Submittal with Other Site Plans

Populate Table I-1 Construction Plan Cross-reference below to assist the plan checker in an expeditious review of your project. During construction and at completion, City of Murrieta inspectors will verify the installation of BMPs against the approved plans. 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.

BMP No. or ID	BMP Identifier and Description	Corresponding Plan Sheet(s)
Insert text here	Insert text here	Insert text here
Insert text here	Insert text here	Insert text here
Insert text here	Insert text here	Insert text here
Insert text here	Insert text here	Insert text here
Insert text here	Insert text here	Insert text here

Table I-1 Construction Plan Cross-reference

BMP No. or ID	BMP Identifier and Description	Corresponding Plan Sheet(s)
Insert text here	Insert text here	Insert text here
Insert text here	Insert text here	Insert text here
Insert text here	Insert text here	Insert text here
Insert text here	Insert text here	Insert text here
Insert text here	Insert text here	Insert text here

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. The Copermittee with jurisdiction over the Project site can advise you regarding the process required to propose changes to the approved Project-Specific WQMP.

Use

Table I-2 to identify other applicable permits that may impact design of the site. If yes is answered to any of the items below, the Copermittee may require proof of approval/coverage from those agencies as applicable including documentation of any associated requirements that may affect this Project-Specific WQMP.

Table I-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 Section 401 Water Quality Certification	☒ Y	☐ N
US Army Corps of Engineers, Clean Water Act 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

Section J: Operation, Maintenance and Funding

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

1. A means to finance and implement maintenance of BMPs 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 Operations and Maintenance or inspections but will require typical landscape maintenance as noted in Chapter 5, in the SMR WQMP. Include a brief description of typical landscape maintenance for these areas.

The Copermittee with jurisdiction over the Project site will also require that you prepare and submit a detailed BMP Operation and Maintenance Plan that sets forth a maintenance schedule for each of the 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 BMP Operation and Maintenance Plan are in Chapter 5 of the SMR WQMP.

Maintenance Mechanism: Maintenance agreement recorded against the property.

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

☐ Y ☒ N

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

Section K: Acronyms, Abbreviations and Definitions

Regional MS4 Permit	Order No. R9-2013-0001 as amended by Order No. R9-2015-0001 and Order No. R9-2015-0100 an NPDES Permit issued by the San Diego Regional Water Quality Control Board.
Applicant	Public or private entity seeking the discretionary approval of new or replaced improvements from the Copermittee with jurisdiction over the project site. The Applicant has overall responsibility for the implementation and the approval of a Priority Development Project. The WQMP uses consistently the term "user" to refer to the applicant such as developer or project proponent. The WQMP employs also the designation "user" to identify the Registered Professional Civil Engineer responsible for submitting the Project-Specific WQMP, and designing the required BMPs.
Best Management Practice (BMP)	Defined in 40 CFR 122.2 as schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of waters of the United States. BMPs also include treatment requirements, operating procedures and practices to control plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage. In the case of municipal storm water permits, BMPs are typically used in place of numeric effluent limits.
BMP Fact Sheets	BMP Fact Sheets are available in the LID BMP Design Handbook. Individual BMP Fact Sheets include sitting considerations, and design and sizing guidelines for seven types of structural BMPs (infiltration basin, infiltration trench, permeable pavement, harvest-and-use, bioretention, extended detention basin, and sand filter).
California Stormwater Quality Association (CASQA)	Publisher of the California Stormwater Best Management Practices Handbooks, available at www.cabmphandbooks.com.
Conventional Treatment Control BMP	A type of BMP that provides treatment of stormwater runoff. Conventional treatment control BMPs, while designed to treat particular Pollutants, typically do not provide the same level of volume reduction as LID BMPs, and commonly require more specialized maintenance than LID BMPs. As such, the Regional MS4 Permit and this WQMP require the use of LID BMPs wherever feasible, before Conventional Treatment BMPs can be considered or implemented.
Copermittees	The Regional MS4 Permit identifies the Cities of Murrieta, Temecula, and Wildomar, the County, and the District, as Copermittees for the SMR.

County	The abbreviation refers to the County of Riverside in this document.
CEQA	California Environmental Quality Act - a statute that requires state and local agencies to identify the significant environmental impacts of their actions and to avoid or mitigate those impacts, if feasible.
CIMIS	California Irrigation Management Information System - an integrated network of 118 automated active weather stations all over California managed by the California Department of Water Resources.
CWA	Clean Water Act - is the primary federal law governing water pollution. Passed in 1972, the CWA established the goals of eliminating releases of high amounts of toxic substances into water, eliminating additional water pollution by 1985, and ensuring that surface waters would meet standards necessary for human sports and recreation by 1983. CWA Section 402(p) is the federal statute requiring NPDES permits for discharges from MS4s.
CWA Section 303(d) Waterbody	Impaired water in which water quality does not meet applicable water quality standards and / or is not expected to meet water quality standards, even after the application of technology based pollution controls required by the CWA. The discharge of urban runoff to these water bodies by the Copermittees is significant because these discharges can cause or contribute to violations of applicable water quality standards.
Design Storm	The Regional MS4 Permit has established the 85th percentile, 24-hour storm event as the "Design Storm". The applicant may refer to Exhibit A to identify the applicable Design Storm Depth (D85) to the project.
DCV	Design Capture Volume (DCV) is the volume of runoff produced from the Design Storm to be mitigated through LID Retention BMPs, Other LID BMPs and Volume Based Conventional Treatment BMPs, as appropriate.
Design Flow Rate	The design flow rate represents the minimum flow rate capacity that flow-based conventional treatment control BMPs should treat to the MEP, when considered.
DCIA	Directly Connected Impervious Areas - those impervious areas that are hydraulically connected to the MS4 (i.e. street curbs, catch basins, storm drains, etc.) and thence to the structural BMP without flowing over pervious areas.
Discretionary Approval	A decision in which a Copermittee uses its judgment in deciding whether and how to carry out or approve a project.
District	Riverside County Flood Control and Water Conservation District.

DMA	A Drainage Management Area - a delineated portion of a project site that is hydraulically connected to a common structural BMP or conveyance point. The Applicant may refer to Section 3.3 for further guidelines on how to delineate DMAs.
Drawdown Time	Refers to the amount of time the design volume takes to pass through the BMP. The specified or incorporated drawdown times are to ensure that adequate contact or detention time has occurred for treatment, while not creating vector or other nuisance issues. It is important to abide by the drawdown time requirements stated in the fact sheet for each specific BMP.
Effective Area	Area which 1) is suitable for a BMP (for example, if infiltration is potentially feasible for the site based on infeasibility criteria, infiltration must be allowed over this area) and 2) receives runoff from impervious areas.
ESA	An Environmental Sensitive Area (ESA) designates an area "in which plants or animals life or their habitats are either rare or especially valuable because of their special nature or role in an ecosystem and which would be easily disturbed or degraded by human activities and developments". (Reference: California Public Resources Code § 30107.5).
ET	Evapotranspiration (ET) is the loss of water to the atmosphere by the combined processes of evaporation (from soil and plant surfaces) and transpiration (from plant tissues). It is also an indicator of how much water crops, lawn, garden, and trees need for healthy growth and productivity
FAR	The Floor Area Ratio (FAR) is the total square feet of a building divided by the total square feet of the lot the building is located on.
Flow-Based BMP	Flow-based BMPs are conventional treatment control BMPs that are sized to treat the design flow rate.
FPPP	Facility Pollution Prevention Plan
HCOC	Hydrologic Condition of Concern - Exists when the alteration of a site's hydrologic regime caused by development would cause significant impacts on downstream channels and aquatic habitats, alone or in conjunction with impacts of other projects.
HMP	Hydromodification Management Plan – Plan defining Performance Standards for PDPs to manage increases in runoff discharge rates and durations.
Hydrologic Control BMP	BMP to mitigate the increases in runoff discharge rates and durations and meet the Performance Standards set forth in the HMP.
HSG	Hydrologic Soil Groups – soil classification to indicate the minimum rate of infiltration obtained for bare soil after prolonged wetting. The HSGs are A (very low runoff potential/high infiltration rate), B, C, and D (high runoff potential/very low infiltration rate)

Hydromodification	The Regional MS4 Permit identifies that increased volume, velocity, frequency and discharge duration of storm water runoff from developed areas has the potential to greatly accelerate downstream erosion, impair stream habitat in natural drainages, and negatively impact beneficial uses.
JRMP	A separate Jurisdictional Runoff Management Plan (JRMP) has been developed by each Copermittee and identifies the local programs and activities that the Copermittee is implementing to meet the Regional MS4 Permit requirements.
LID	Low Impact Development (LID) is a site design strategy with a goal of maintaining or replicating the pre-development hydrologic regime through the use of design techniques. LID site design BMPs help preserve and restore the natural hydrologic cycle of the site, allowing for filtration and infiltration which can greatly reduce the volume, peak flow rate, velocity, and pollutant loads of storm water runoff.
LID BMP	A type of stormwater BMP that is based upon Low Impact Development concepts. LID BMPs not only provide highly effective treatment of stormwater runoff, but also yield potentially significant reductions in runoff volume – helping to mimic the pre-project hydrologic regime, and also require less ongoing maintenance than Treatment Control BMPs. The applicant may refer to Chapter 2.
LID BMP Design Handbook	The LID BMP Design Handbook was developed by the Copermittees to provide guidance for the planning, design and maintenance of LID BMPs which may be used to mitigate the water quality impacts of PDPs within the County.
LID Bioretention BMP	LID Bioretention BMPs are bioretention areas are vegetated (i.e., landscaped) shallow depressions that provide storage, infiltration, and evapotranspiration, and provide for pollutant removal (e.g., filtration, adsorption, nutrient uptake) by filtering stormwater through the vegetation and soils. In bioretention areas, pore spaces and organic material in the soils help to retain water in the form of soil moisture and to promote the adsorption of pollutants (e.g., dissolved metals and petroleum hydrocarbons) into the soil matrix. Plants use soil moisture and promote the drying of the soil through transpiration. The Regional MS4 Permit defines “retain” as to keep or hold in a particular place, condition, or position without discharge to surface waters.
LID Biofiltration BMP	BMPs that reduce stormwater pollutant discharges by intercepting rainfall on vegetative canopy, and through incidental infiltration and / or evapotranspiration, and filtration, and other biological and chemical processes. As stormwater passes down through the planting soil, pollutants are filtered, adsorbed, biodegraded, and sequestered by the soil and plants, and collected through an underdrain.

LID Harvest and Reuse BMP	BMPs used to facilitate capturing Stormwater Runoff for later use without negatively impacting downstream water rights or other Beneficial Uses.
LID Infiltration BMP	BMPs to reduce stormwater runoff by capturing and infiltrating the runoff into in-situ soils or amended onsite soils. Typical LID Infiltration BMPs include infiltration basins, infiltration trenches and pervious pavements.
LID Retention BMP	BMPs to ensure full onsite retention without runoff of the DCV such as infiltration basins, bioretention, chambers, trenches, permeable pavement and pavers, harvest and reuse.
LID Principles	Site design concepts that prevent or minimize the causes (or drivers) of post-construction impacts, and help mimic the pre-development hydrologic regime.
MEP	Maximum Extent Practicable - standard established by the 1987 amendments to the CWA for the reduction of Pollutant discharges from MS4s. Refer to Attachment C of the Regional MS4 Permit for a complete definition of MEP.
MF	Multi-family – zoning classification for parcels having 2 or more living residential units.
MS4	Municipal Separate Storm Sewer System (MS4) is a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains): (i) Owned or operated by a State, city, town, borough, county, parish, district, association, or other public body (created by or pursuant to State law) having jurisdiction over disposal of sewage, industrial wastes, storm water, or other wastes, including special districts under State law such as a sewer district, flood control district or drainage district, or similar entity, or an Indian tribe or an authorized Indian tribal organization, or designated and approved management agency under section 208 of the CWA that discharges to waters of the United States; (ii) Designated or used for collecting or conveying storm water; (iii) Which is not a combined sewer; (iv) Which is not part of the Publicly Owned Treatment Works (POTW) as defined at 40 CFR 122.26.
New Development Project	Defined by the Regional MS4 Permit as 'Priority Development Projects' if the project, or a component of the project meets the categories and thresholds described in Section 1.1.1.
NPDES	National Pollution Discharge Elimination System - Federal program for issuing, modifying, revoking and reissuing, terminating, monitoring and enforcing permits, and imposing and enforcing pretreatment requirements, under Sections 307, 318, 402, and 405 of the CWA.
NRCS	Natural Resources Conservation Service

PDP	Priority Development Project - Includes New Development and Redevelopment project categories listed in Provision E.3.b of the Regional MS4 Permit.
Priority Pollutants of Concern	Pollutants expected to be present on the project site and for which a downstream water body is also listed as Impaired under the CWA Section 303(d) list or by a TMDL.
Project-Specific WQMP	A plan specifying and documenting permanent LID Principles and Stormwater BMPs to control post-construction Pollutants and stormwater runoff for the life of the PDP, and the plans for operation and maintenance of those BMPs for the life of the project.
Receiving Waters	Waters of the United States.
Redevelopment Project	The creation, addition, and or replacement of impervious surface on an already developed site. Examples include the expansion of a building footprint, road widening, the addition to or replacement of a structure, and creation or addition of impervious surfaces. Replacement of impervious surfaces includes any activity that is not part of a routine maintenance activity where impervious material(s) are removed, exposing underlying soil during construction. Redevelopment does not include trenching and resurfacing associated with utility work; resurfacing existing roadways; new sidewalk construction, pedestrian ramps, or bike lane on existing roads; and routine replacement of damaged pavement, such as pothole repair. Project that meets the criteria described in Section 1.
Runoff Fund	Runoff Funds have not been established by the Copermittees and are not available to the Applicant. If established, a Runoff Fund will develop regional mitigation projects where PDPs will be able to buy mitigation credits if it is determined that implementing onsite controls is infeasible.
San Diego Regional Board	San Diego Regional Water Quality Control Board - The term "Regional Board", as defined in Water Code section 13050(b), is intended to refer to the California Regional Water Quality Control Board for the San Diego Region as specified in Water Code Section 13200. State agency responsible for managing and regulating water quality in the SMR.
SCCWRP	Southern California Coastal Water Research Project
Site Design BMP	Site design BMPs prevent or minimize the causes (or drivers) of post-construction impacts, and help mimic the pre-development hydrologic regime.
SF	Parcels with a zoning classification for a single residential unit.
SMC	Southern California Stormwater Monitoring Coalition
SMR	The Santa Margarita Region (SMR) represents the portion of the Santa Margarita Watershed that is included within the County of Riverside.

Source Control BMP	Source Control BMPs land use or site planning practices, or structural or nonstructural measures that aim to prevent runoff pollution by reducing the potential for contamination at the source of pollution. Source control BMPs minimize the contact between Pollutants and runoff.
Structural BMP	Structures designed to remove pollutants from stormwater runoff and mitigate hydromodification impacts.
SWPPP	Storm Water Pollution Prevention Plan
Tentative Tract Map	Tentative Tract Maps are required for all subdivision creating five (5) or more parcels, five (5) or more condominiums as defined in Section 783 of the California Civil Code, a community apartment project containing five (5) or more parcels, or for the conversion of a dwelling to a stock cooperative containing five (5) or more dwelling units.
TMDL	Total Maximum Daily Load - the maximum amount of a Pollutant that can be discharged into a waterbody from all sources (point and non-point) and still maintain Water Quality Standards. Under CWA Section 303(d), TMDLs must be developed for all waterbodies that do not meet Water Quality Standards after application of technology-based controls.
USEPA	United States Environmental Protection Agency
Volume-Based BMP	Volume-Based BMPs applies to BMPs where the primary mode of pollutant removal depends upon the volumetric capacity such as detention, retention, and infiltration systems.
WQMP	Water Quality Management Plan
Wet Season	The Regional MS4 Permit defines the wet season from October 1 through April 30.

Appendix 1: Maps and Site Plans

Location Map, WQMP Site Plan and Receiving Waters Map

Complete the checklist below to verify all exhibits and components are included in the Project-Specific WQMP. Refer Section 4 of the SMR WQMP and Section D of this Template.

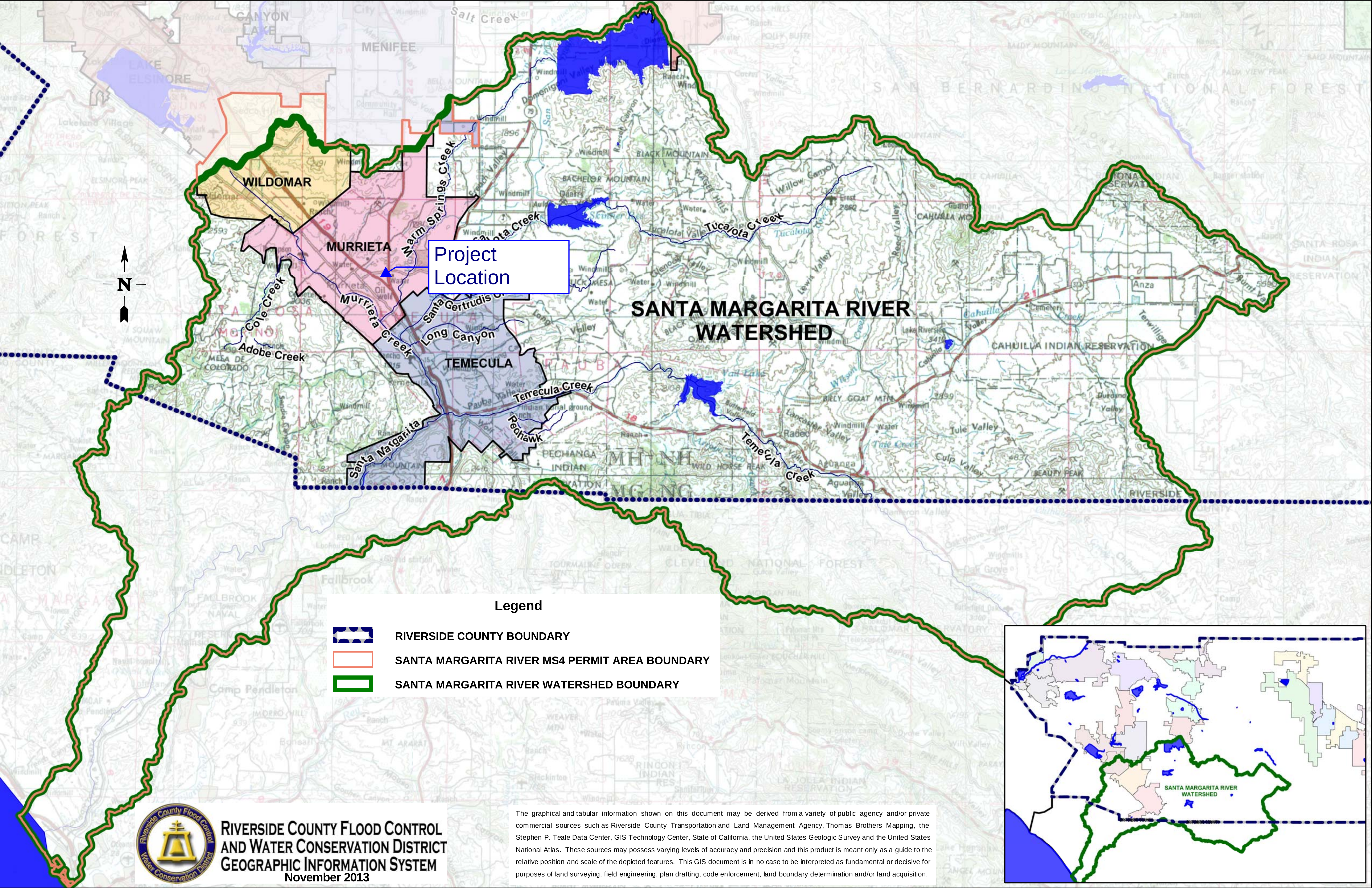
Map and Site Plan Checklist

Indicate all Maps and Site Plans are included in your Project-Specific WQMP by checking the boxes below.

- ☒ Vicinity and Location Map
- ☒ Existing Site Map (unless exiting conditions are included in WQMP Site Plan): *Refer to Demolition Plan in Appendix 2.*
- ☒ WQMP Site Plan
  - ☒ Parcel Boundary and Project Footprint
  - ☒ Existing and Proposed Topography
  - ☒ Drainage Management Areas (DMAs)
  - ☒ Proposed Structural Best Management Practices (BMPs)
  - ☒ Drainage Paths
  - ☒ Drainage infrastructure, inlets, overflows
  - ☒ Source Control BMPs
  - ☒ Site Design BMPs
  - ☒ Buildings, Roof Lines, Downspouts
  - ☒ Impervious Surfaces
  - ☒ Pervious Surfaces (i.e. Landscaping)
  - ☒ Standard Labeling

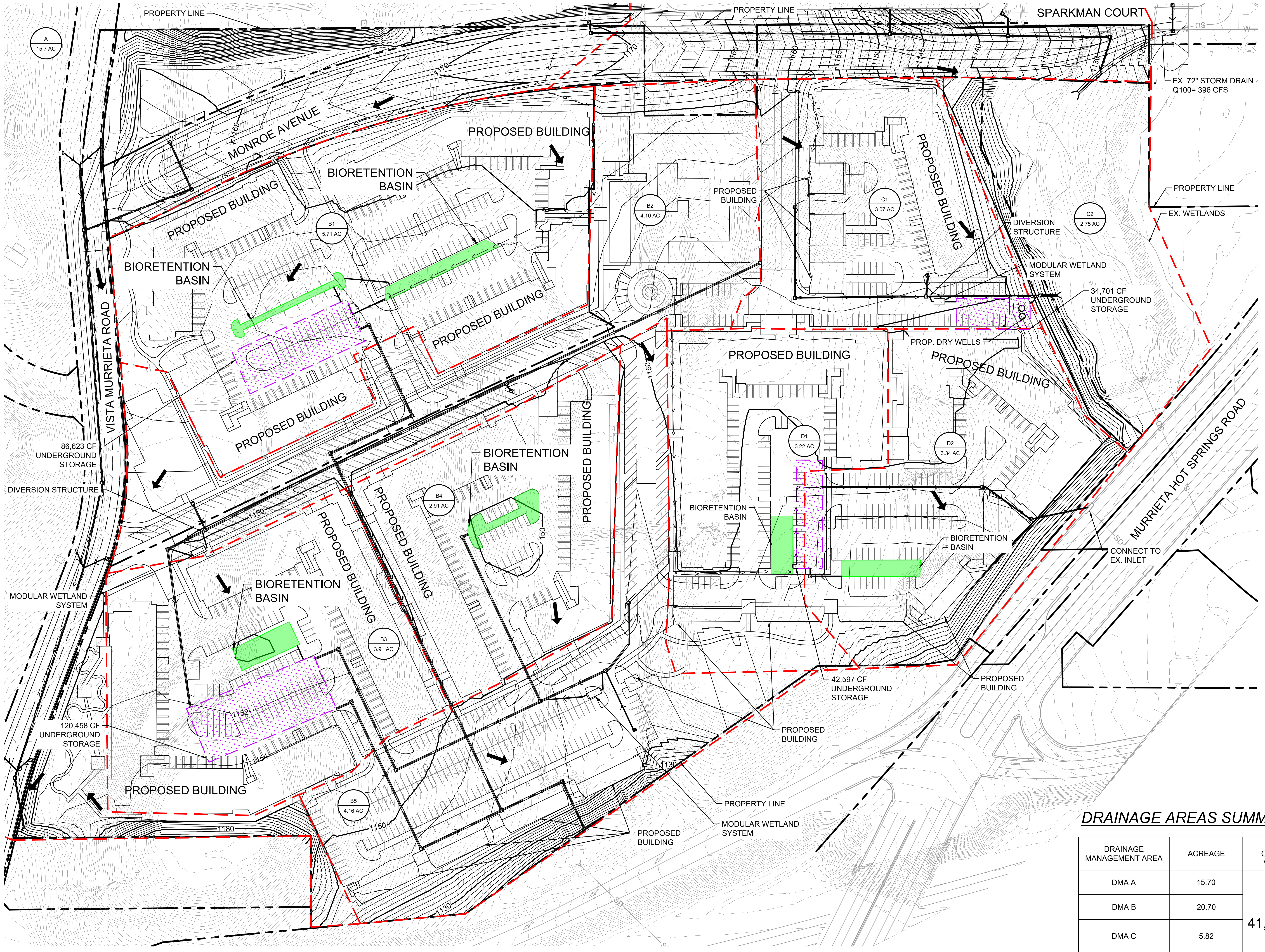
Kimley»Horn

401 B STREET, SUITE 600, SAN DIEGO, CA 92101
PHONE: 619-234-9411
WWW.KIMLEY-HORN.COM



RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT GEOGRAPHIC INFORMATION SYSTEM

November 2013



LEGEND

🟥	DMA BOUNDARY
←	OVERLAND FLOW DIRECTION
— · —	PROPERTY LINE/RIGHT-OF-WAY
━	PROPOSED STORM DRAIN
—SD—	EXISTING STORM DRAIN
▨	PROPOSED STORAGE VAULT
🟩	PROPOSED BIORETENTION BASIN

DRAINAGE AREAS SUMMARY

DRAINAGE MANAGEMENT AREA	ACREAGE	DESIGN CAPTURE VOLUME	WATER QUALITY FLOW RATE (CFS)	TREATMENT METHOD	HYDROMODIFICATION BMP	HYDROMODIFICATION VOLUME (AC-FT)
DMA A	15.70	41,961 CF	32.35	DE MINIMIS (LANDSCAPED AREAS SELF TREATING)	UNDERGROUND VAULT DETENTION SYSTEM	6.51
DMA B	20.70		81.49	BIOCLEAN MODULAR WETLAND SYSTEM & BIORETENTION BASINS		
DMA C	5.82		20.89	BIOCLEAN MODULAR WETLAND SYSTEM		
DMA D	6.56		23.45	BIOCLEAN MODULAR WETLAND SYSTEM & BIORETENTION BASINS		

NORTH

GRAPHIC SCALE IN FEET
0 40 80 160

No.	REVISIONS	DATE	BY

Kimley»Horn

401 B STREET, SUITE 600; SAN DIEGO, CA 92101
PHONE: 619-234-9411
WWW.KIMLEY-HORN.COM

KHA PROJECT
195120004
DATE
1/28/2022
SCALE AS SHOWN
DESIGNED BY ___
DRAWN BY ___
CHECKED BY ___

WQMP EXHIBIT
FOR
THE TERRACES MURRIETA

CITY OF MURRIETA CA

SHEET NUMBER
1 OF 1

Plotted By:Gappy, Marta Sheet Set:Kha Layout:WQMP EXHIBIT January 28, 2022 10:38:40am K:\SND_LDEV\195120004 - The Terraces Murrieta\Drainage\WQMP\WQMP Resources\EXHIBIT A\CAD\WQMP EXHIBIT.dwg

Appendix 2: Construction Plans

The latest set of Grading, Drainage and Street Improvement Plans <u>shall be included.</u>

For Bioretention and Biofiltration facilities, the following construction notes shall be shown on the Grading and/or Drainage plans.

1) BSM and Aggregates should not be delivered or placed in frozen, wet or muddy conditions. The Contractor should protect materials from absorbing excess water and from erosion at all times. The Contractor shall not store materials unprotected during large rainfall events (>.25 inches). If water is introduced into material while it is stockpiled, the Contractor shall allow the material to drain to an acceptable level before it is placed.
2) The Engineer shall furnish to the City 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 the material is imported or if the material is mixed onsite prior to installation. Onsite mixing may only occur if sand or topsoil components are sourced from the Project site. Onsite mixing may be conducted by using loaders.
3) BSM shall be lightly compacted and placed in loose lifts of 12 inches thick. Compaction should not exceed 75% standard procter. Machinery should not be used in the BSM area to place BSM. 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.
4) The Engineer conducting the Quality Control testing shall furnish to the City a copy of the QA testing and a certification that the BSM for the project meets all of the following requirements.
    a. BSM shall consist of 60-80% clean sand, up to 20% clean 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/100 g; 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 for pollutant concentrations in saturated extract: Phosphorous: < 1 mg/L; Nitrate < 3 mg/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 CalRecyle, preferably through USCC STA program. Compost shall conform to the following requirements: Physical contaminants <1% by dry weight; Carbon:Nitrogen ratio: 12:1 to 40:1, Maturity/Stability shall conform to either: Solvita Maturity Index: ≥ 5.5, CO2 Evolution: < 2.5 mg CO2-C per g compost organic matter per day, or < 5 mg CO2 – shall be more than 6 months old and representative of current stockpiles.

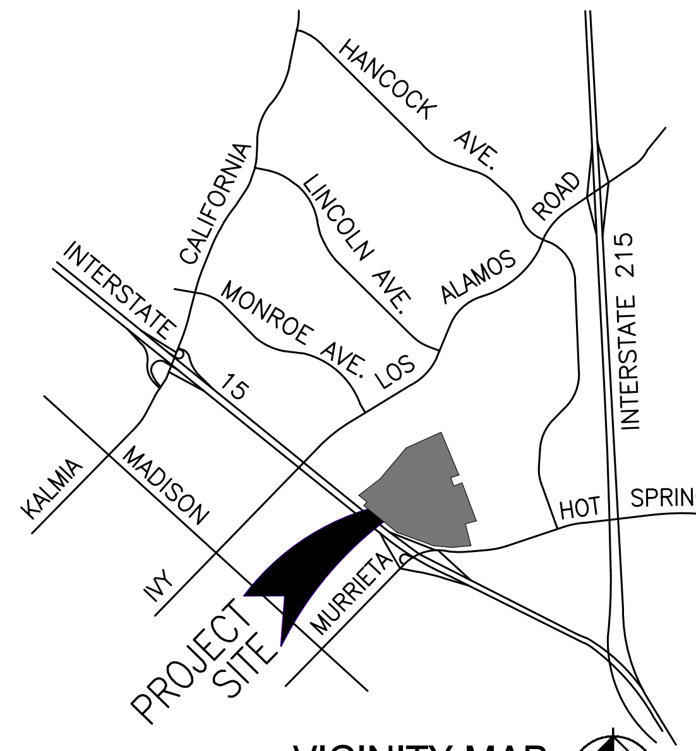
e. Coconut coir pith used in BSM shall be thoroughly rinsed with freshwater and screened to remove coarse fibers as part of production and aged > 6 months. Peat used in BSM shall be sphagnum peat.

Potential BSM sources may include (not part of construction note): Gail Materials (Temescal Valley), Agriservice (Oceanside), Greatsoils (Escondido), and Earthworks (Riverside).

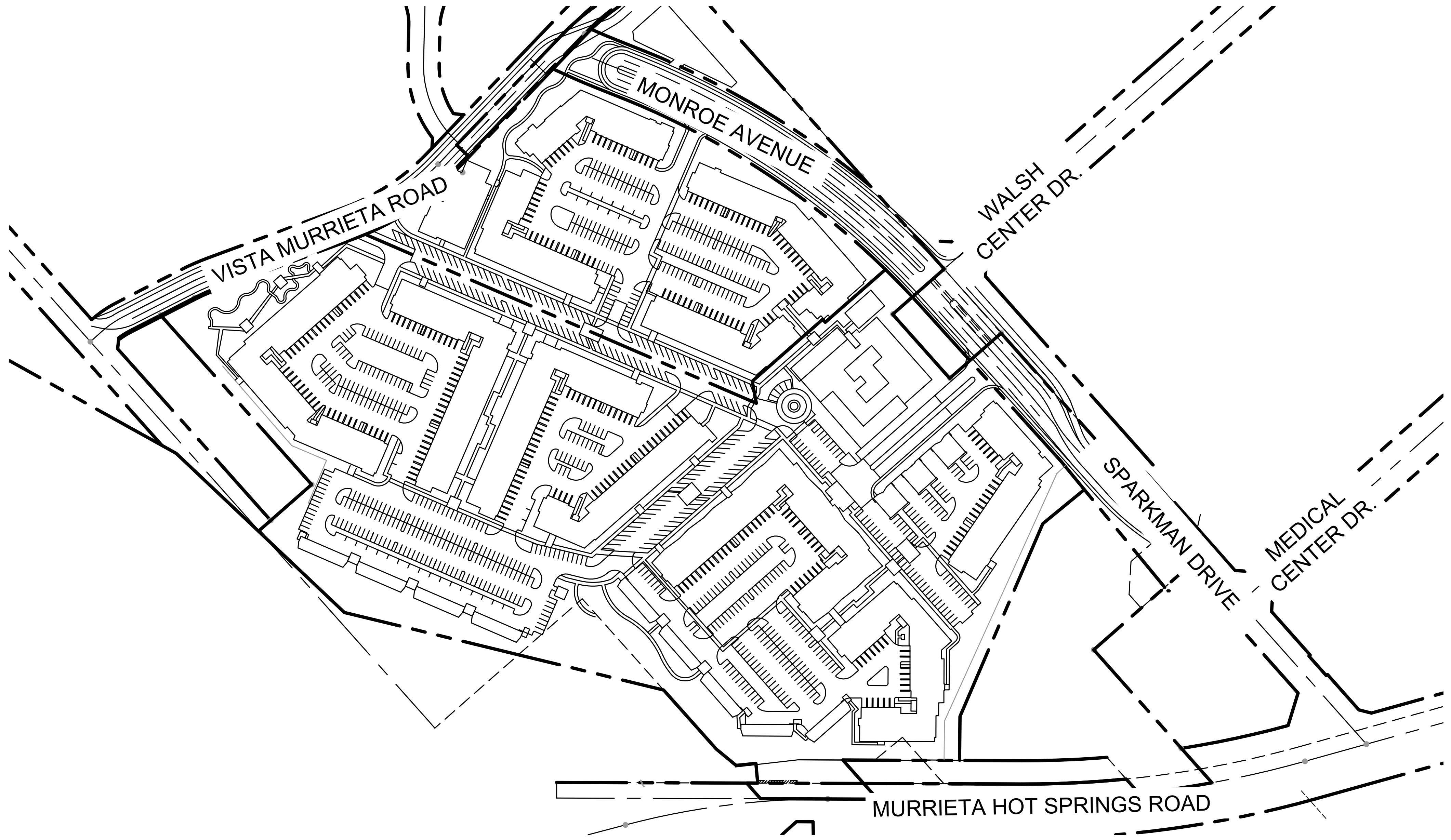
Potential Laboratories may include (not part of construction note): Fruit Growers Laboratory, Inc. (Santa Paula, http://www.fglinc.com/), Wallace Laboratories (El Segundo, http://us.wlabs.com/), Control Labs (Watsonville, http://controllabs.com) and A&L Western Laboratories (Modesto, http://www.al-labs-west.com/)

THE TERRACES

CONCEPTUAL SITE, GRADING, AND DRAINAGE PLANS
IN THE CITY OF MURRIETA, CALIFORNIA



VICINITY MAP
NOT TO SCALE
NORTH



PROJECT MAP
SCALE: 1" = 200'

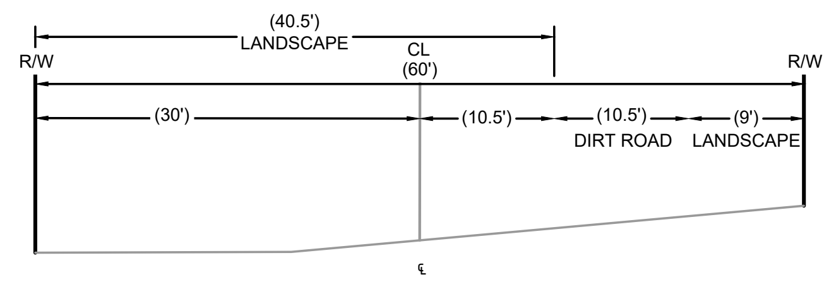
ZONING
EXISTING: REGIONAL COMMERCIAL (RC)
PROPOSED: REGIONAL COMMERCIAL (RC)

SURROUNDING
SOUTH - REGIONAL OCMMERCIAL (RC)
SOUTHWEST- COMMUNITY COMMERCIAL (CC)
SOUTHEAT- COMMUNITY COMMERCIAL (CC)
NORTH - OFFICE (O)
NORTHWEST- REGIONAL COMMERCIAL (RC)
NORTHEAST- OFFICE (O)

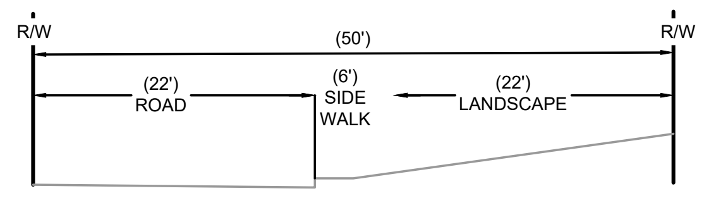
LAND AREA
± 37.7 ACRES

ABBREVIATIONS

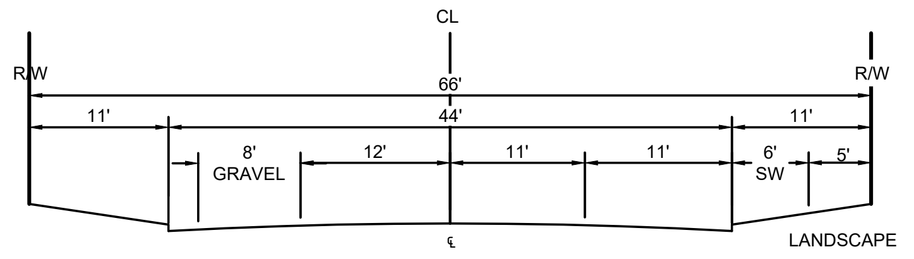
CURB AND GUTTER	C&G	TOP OF CURB	TC
SIDEWALK	S/W	FINISH GRADE	FG
EXISTING	EX.	FINISH SURFACE	FS
PROPOSED	PROP.	FLOW LINE	FL
RIGHT OF WAY	R/W	HIGH POINT	HP
STORM DRAIN	SD	LOW POINT	LP
FIRE HYDRANT	FH	GRADE BRAKE	GB
ASPHALT CONCRETE	AC	PAD ELEVATION	PE
AGGREGATE BASE	AB	FINISH FLOOR	FF
RIDGELINE	R	DOUBLE CHECK DETECTOR	DCDA



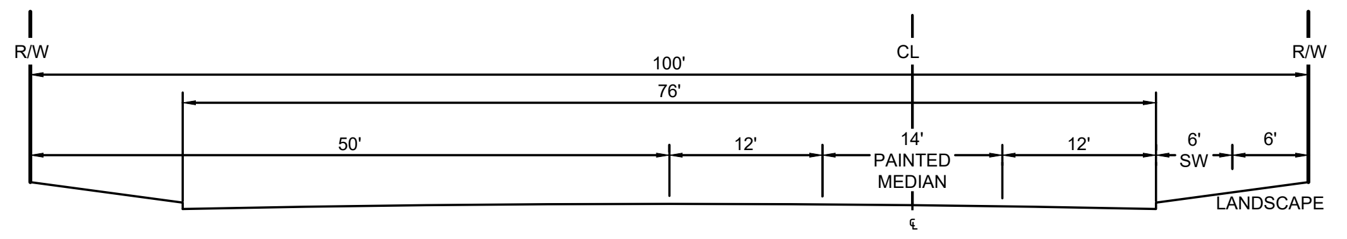
VISTA MURRIETA EXISTING
NOT TO SCALE



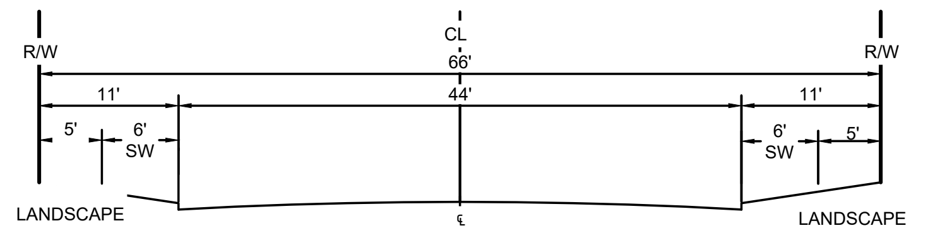
MONROE AVE EXISTING
NOT TO SCALE



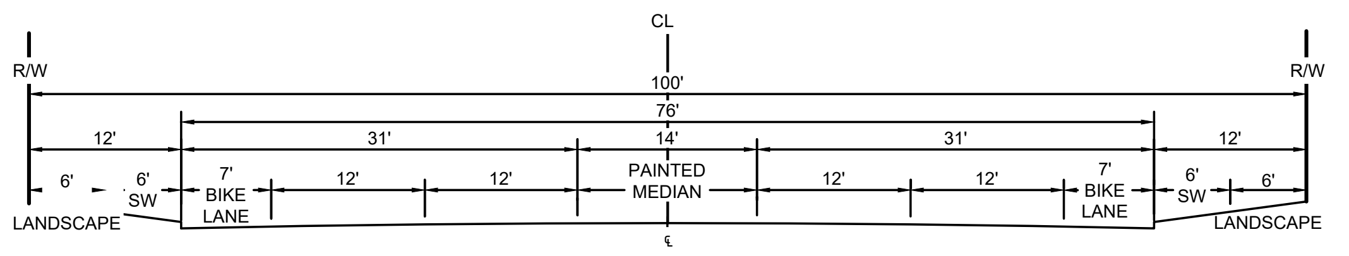
VISTA MURRIETA INTERIM
NOT TO SCALE



MONROE AVE INTERIM
NOT TO SCALE



VISTA MURRIETA ULTIMATE
SCALE: 1" = 200'



MONROE AVE ULTIMATE
NOT TO SCALE

BASIS OF BEARINGS NOTE
THE BEARINGS SHOWN HEREON ARE BASED ON THE LINE BETWEEN STATIONS "BILL" AND "DVLS" (POSITIONS PER NATIONAL GEODETIC SURVEY, NAD83, EPOCH 2007.0) BEING NORTH 05°05'38.82" EAST.

UNADJUSTED EARTHWORK QUANTITIES
CUT: 324,227 CUYD
FILL: 330,968 CUYD

NET: 6,741 CUYD (IMPORT)

SHEET INDEX

LEGEND:

RIGHT OF WAY/PROPERTY LINE	— — — —
EXISTING WATER	———W———
PROPOSED WATER	———W———
EXISTING SEWER	———S———
PROPOSED SEWER	———S———
PROPOSED FIRE	———FW———
EXISTING STORM DRAIN	———SD———
EASEMENT	– – – – – – – –
LOT LINE	— — — —
FLOW ARROWS	⇨
EXISTING CONTOURS	— (XXX) —
PROPOSED CONTOURS	——— (XXX) ———
ADA PATH	— — — —
JURISDICTIONAL AREA	▨
UNDERGROUND DETENTION	▩

UTILITY PURVEYORS

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

ELECTRICITY
SOUTHERN CALIFORNIA EDISON (SCE)
14005 S. BENSON AVE,
CHINO, CA 91710
(909) 548-7249

GAS
SOUTHERN CALIFORNIA GAS COMPANY
9400 OAKDALE AVE
CHATSWORTH, CA 91311
(818) 701-3245

VERIZON
24520 VILLAGE WALK PL STE A
MURRIETA, CA 92562
(800) 880-1077

SANITATION
EASTERN MUNICIPAL WATER DISTRICT
2270 TRUMBLE ROAD
PERRIS, CA 92570
(310) 928-3777

GENERAL DESCRIPTION

1. THIS A.L.T.A. SURVEY WAS PREPARED FOR THE EXCLUSIVE USE OF THE PERSONS OR ENTITIES NAMED HEREON. SAID SURVEYOR'S STATEMENT DOES NOT EXTEND TO UNNAMED PERSONS OR ENTITIES WITHOUT THE EXPRESSED CONSENT OF THE SURVEYOR NAMING SAID PERSONS OR ENTITIES.
2. THE PROJECT SITE LIES WITHIN FLOOD ZONE "X" (AREAS DETERMINED TO BE OUTSIDE THE 0.2% ANNUAL CHANCE FLOODPLAIN) ON FIRM PANELS 06065C2715G, WITH AN EFFECTIVE DATE OF AUGUST 28, 2008.
3. THE BASIS OF THIS SURVEY IS A PRELIMINARY TITLE REPORT PREPARED BY CHICAGO TITLE COMPANY, ORDER NUMBER 00156783-993-SD2-CFU, DATED SEPTEMBER 24, 2021. GEOGRAPHICALLY LOCATABLE ITEMS FROM THE REPORT WHICH AFFECT THE PROPERTIES ARE SHOWN ON THIS MAP WITH A HEXAGON AND ARE NUMERICALLY KEYED TO SAID REPORT.
4. THERE IS NO VISIBLE EVIDENCE OF RECENT EARTH MOVING WORK, BUILDING CONSTRUCTION, OR BUILDING ADDITIONS OBSERVED IN THE PROCESS OF CONDUCTING THE FIELD WORK.
5. THERE IS NO EVIDENCE OF MOBILE HOMES ON THE PROPERTY IN THE PROCESS OF CONDUCTING THE FIELD WORK.
6. THE LAND SHOWN IN THE SURVEY IS THE SAME AS THAT DESCRIBED IN THE PRELIMINARY TITLE REPORT PREPARED BY CHICAGO TITLE COMPANY, ORDER NUMBER 00156783-993-SD2-CFU, DATED SEPTEMBER 24, 2021.
7. THE SURVEYOR DID NOT OBSERVE ANY MARKERS DELINEATING WETLANDS ON THE PROPERTY.
8. THE RECORD DESCRIPTIONS OF THE SUBJECT PARCELS FORM A MATHEMATICAL CLOSED FIGURE.
9. THERE ARE NO GAPS OR OVERLAPS BETWEEN THE RECORD LEGAL DESCRIPTIONS SHOWN IN THE TITLE REPORT.
10. THERE IS NO OBSERVED EVIDENCE THE SITE IS BEING USED AS A SOLID WASTE DUMP, SUMP OR SANITARY LANDFILL.
11. THE SUBJECT PROPERTY HAS VEHICULAR ACCESS TO AND FROM MURRIETA HOT SPRINGS ROAD, SPARKMAN DRIVE, AND VISTA MURRIETA ROAD.
12. UNDERGROUND UTILITIES ARE PLOTTED BASED UPON RECORD MAPS FROM UTILITY COMPANIES RECEIVED PRIOR TO 11/17/2021. HOWEVER, LACKING EXCAVATION, THE EXACT LOCATION OF UNDERGROUND FEATURES CANNOT BE ACCURATELY, COMPLETELY, AND RELIABLY DEPICTED.

ASSESSOR'S PARCEL NO.
APN: 910-310-001, 910-310-002, 910-310-003, 910-310-004, 910-310-005, 910-310-007, 910-310-008, 910-310-009, 910-310-010, 910-310-015, 910-310-017, 910-310-018, 910-310-021, 910-310-022, 910-310-023, 910-310-024, 910-310-025, 910-310-026, 949-190-011, 949-190-012, 949-190-013, 949-190-014, 949-190-015, 949-190-016, 949-190-017, 949-190-018, 949-190-019

SOILS ENGINEER
ALTA CALIFORNIA GEOTECHNICAL INC.
170 NORTH MAPLE STREET, SUITE 108
CORONA, CA 92880

ENGINEER
TAMMIE MORENO
KIMLEY-HORN AND ASSOCIATES, INC.
401 B. STREET, SUITE 600
SAN DIEGO, CA 92101
619.929.2958

TOPOGRAPHY
AEROTECH MAPPING
200 SPECTRUM CENTER DR SUITE 300
IRVINE, CA 92618
619.606.5020

OWNER/APPLICANT
GS PARKS AT MURRIETA, LLC
380 STEVENS AVENUE, SUITE 305
SOLONA BEACH, CA 92075

ARCHITECT
SERAFIN MARANAN
ARCHITECTS ORANGE
144 NORTH ORANGE STREET
ORANGE, CA 92866
714.308.0092

No.	REVISIONS	DATE	BY

Kimley»Horn

401 B STREET, SUITE 600; SAN DIEGO, CA 92101
PHONE: 619-234-9411
WWW.KIMLEY-HORN.COM

KHA PROJECT
195120004

DATE
1/28/2022

SCALE AS SHOWN
DESIGNED BY ___
DRAWN BY ___
CHECKED BY ___

COVER SHEET
FOR
THE TERRACES MURRIETA

CITY OF MURRIETA CA

SHEET NUMBER
1
OF
9

LEGAL DESCRIPTION

THE LAND REFERRED TO HEREIN BELOW IS SITUATED IN THE CITY OF MURRIETA, IN THE COUNTY OF RIVERSIDE, STATE OF CALIFORNIA, AND IS DESCRIBED AS FOLLOWS:

PARCEL 1:

THOSE PORTIONS OF HAWTHORNE STREET AND LOT 128 AS SHOWN BY MAP ENTITLED TEMECULA LAND AND WATER COMPANY ON FILE IN BOOK 8, PAGE 359, RECORDS OF SAN DIEGO COUNTY, CALIFORNIA, DESCRIBED AS FOLLOWS:

COMMENCING AT THE INTERSECTION OF THE CENTER LINES OF HAWTHORNE STREET AND MONROE AVENUE;
THENCE NORTHEASTERLY ON THE CENTER LINES OF HAWTHORNE STREET, 660 FEET TO THE TRUE POINT OF BEGINNING;
THENCE SOUTHEASTERLY PARALLEL WITH THE CENTER LINE OF MONROE AVENUE 330 FEET;
THENCE NORTHEASTERLY PARALLEL WITH THE CENTER LINE OF HAWTHORNE STREET 66 FEET;
THENCE NORTHWESTERLY PARALLEL WITH THE CENTER LINE OF MONROE AVENUE 330 FEET TO THE CENTER LINE OF HAWTHORNE STREET;
THENCE SOUTHWESTERLY ON THE CENTER LINE OF HAWTHORNE STREET 66 FEET TO THE TRUE POINT OF BEGINNING.

PARCEL 2:

ALL THAT PORTION OF HAWTHORNE STREET AND LOT 128 AS SHOWN BY MAP ENTITLED "MAP OF TEMECULA LAND AND WATER COMPANY" ON FILE IN BOOK 8, PAGE 359 OF MAPS, RECORDS OF SAN DIEGO COUNTY, CALIFORNIA, DESCRIBED AS FOLLOWS:

COMMENCING AT THE INTERSECTION OF THE CENTER LINES OF HAWTHORNE STREET AND MONROE AVENUE; THENCE NORTHEASTERLY ON THE CENTER LINE OF HAWTHORNE STREET, 726 FEET TO THE TRUE POINT OF BEGINNING; THENCE SOUTHEASTERLY, PARALLEL WITH THE CENTER LINE OF MONROE AVENUE, 330 FEET; THENCE NORTHEASTERLY, PARALLEL WITH THE CENTER LINE OF HAWTHORNE STREET, 66 FEET; THENCE NORTHWESTERLY, PARALLEL WITH THE CENTER LINE OF MONROE AVENUE, 330 FEET TO THE CENTER OF HAWTHORNE STREET; THENCE SOUTHWESTERLY ON THE CENTER LINE OF HAWTHORNE STREET, 66 FEET TO THE TRUE POINT OF BEGINNING.

PARCEL 3:

THAT PORTION OF LOT 128 OF MAP OF TEMECULA LAND AND WATER COMPANY, IN THE COUNTY OF RIVERSIDE, STATE OF CALIFORNIA, AS SHOWN BY MAP ON FILE IN BOOK 8, PAGE 359 OF MAPS, RECORDS OF SAN DIEGO COUNTY, CALIFORNIA, DESCRIBED AS FOLLOWS:

BEGINNING AT THE INTERSECTIONS OF THE CENTERLINES OF HAWTHORNE STREET AND MONROE AVENUE; THENCE NORTHEAST 792.00 FEET ON SAID CENTERLINE OF HAWTHORNE STREET TO THE TRUE POINT OF BEGINNING. THENCE SOUTHEAST 330.00 FEET, PARALLEL WITH SAID CENTERLINE OF MONROE AVENUE; THENCE NORTHEAST 132.00 FEET, PARALLEL WITH SAID CENTERLINE OF HAWTHORNE STREET; THENCE NORTHWEST 330.00 FEET, PARALLEL WITH SAID CENTERLINE OF MONROE AVENUE TO SAID CENTERLINE OF HAWTHORNE STREET; THENCE SOUTHWEST 132.00 FEET ON LAST SAID CENTERLINE TO THE TRUE POINT OF BEGINNING.

PARCEL 4:

THAT PORTION OF LOT 128 OF MAPS OF TEMECULA LAND AND WATER COMPANY, IN THE COUNTY OF RIVERSIDE, STATE OF CALIFORNIA, AS SHOWN BY MAP ON FILE IN BOOK 8, PAGE 359 OF MAPS, RECORDS OF SAN DIEGO COUNTY, CALIFORNIA, DESCRIBED AS FOLLOWS:

BEGINNING AT THE INTERSECTION OF THE CENTERLINE OF HAWTHORNE STREET AND MONROE AVENUE; THENCE NORTHEAST 1,056.00 FEET ON SAID CENTERLINE OF HAWTHORNE STREET TO THE TRUE POINT OF BEGINNING; THENCE SOUTHEAST 330.00 FEET, PARALLEL WITH SAID CENTERLINE OF MONROE AVENUE; THENCE NORTHEAST 132.00 FEET, PARALLEL WITH SAID CENTERLINE OF HAWTHORNE STREET; THENCE NORTHWEST 330.00 FEET, PARALLEL WITH SAID CENTERLINE OF MONROE AVENUE TO SAID CENTERLINE OF HAWTHORNE STREET; THENCE SOUTHWEST 132.00 FEET ON LAST SAID CENTERLINE TO THE TRUE POINT OF BEGINNING.

PARCEL 5:

THAT PORTION OF LOT 128 OF TEMECULA LAND AND WATER CO., AS SHOWN BY MAP ON FILE IN BOOK 8, PAGE 359 OF MAPS, RECORDS OF SAN DIEGO COUNTY, CALIFORNIA, DESCRIBED AS FOLLOWS:

COMMENCING AT THE INTERSECTION OF THE CENTERLINE OF HAWTHORNE STREET AND MONROE AVENUE; THENCE NORTHEASTERLY ON THE CENTER LINE OF HAWTHORNE STREET, 1,188 FEET; THENCE SOUTHEASTERLY PARALLEL WITH THE CENTER LINE OF MONROE AVENUE 165 FEET TO THE TRUE POINT OF BEGINNING; THENCE SOUTHEASTERLY PARALLEL WITH THE CENTER LINE OF MONROE AVENUE 165 FEET; THENCE NORTHEASTERLY PARALLEL WITH THE CENTER LINE OF HAWTHORNE STREET, 132 FEET TO THE CENTER LINE OF JACKSON AVENUE; THENCE NORTHWESTERLY ON THE CENTER LINE OF
JACKSON AVENUE 165 FEET; THENCE SOUTHWESTERLY PARALLEL WITH THE CENTER LINE OF HAWTHORNE STREET 132 FEET TO THE TRUE POINT OF BEGINNING.

PARCEL 6:

THOSE PORTIONS OF JACKSON AVENUE AND LOT 128, AS SHOWN BY MAP ENTITLED "MAP OF TEMECULA LAND AND WATER COMPANY" ON FILE IN BOOK 8, PAGE 359 OF MAPS, RECORDS OF SAN DIEGO COUNTY, CALIFORNIA, DESCRIBED AS FOLLOWS

COMMENCING AT THE INTERSECTION OF THE CENTER LINES OF HAWTHORNE STREET AND JACKSON AVENUE; THENCE SOUTHEASTERLY ALONG THE CENTER LINE OF JACKSON AVENUE, 330 FEET TO A POINT, WHICH IS THE TRUE POINT OF BEGINNING; THENCE SOUTHEASTERLY ALONG THE CENTER LINE OF JACKSON AVENUE 110 FEET TO A POINT; THENCE SOUTHWESTERLY ALONG A LINE THAT IS PARALLEL WITH THE CENTER LINE OF HAWTHORNE STREET, 396 FEET TO A POINT; THENCE NORTHWESTERLY ALONG A LINE THAT IS PARALLEL TO THE CENTER LINE OF JACKSON AVENUE, 110 FEET TO A POINT; THENCE NORTHEASTERLY ALONG A LINE PARALLEL WITH THE CENTER LINE OF HAWTHORNE STREET, 396 FEET TO THE TRUE POINT OF BEGINNING.

PARCEL 7:

THOSE PORTIONS OF JACKSON AVENUE AND LOT 128, AS SHOWN BY MAP ENTITLED "TEMECULA LAND AND WATER COMPANY", ON FILE IN BOOK 8, PAGE 359 OF MAPS, RECORDS OF SAN DIEGO COUNTY, CALIFORNIA, DESCRIBED AS FOLLOWS:

COMMENCING AT THE INTERSECTION OF THE CENTER LINES OF HAWTHORNE STREET AND JACKSON AVENUE; THENCE SOUTHEASTERLY ALONG THE CENTERLINE OF JACKSON AVENUE 440 FEET TO A POINT WHICH IS THE TRUE POINT OF BEGINNING; THENCE SOUTHEASTERLY ALONG THE CENTER LINE OF JACKSON AVENUE, 220 FEET TO A POINT; THENCE SOUTHWESTERLY ALONG A LINE PARALLELING THE CENTER LINE OF HAWTHORNE STREET, 396 FEET TO A POINT; THENCE NORTHWESTERLY ALONG A LINE PARALLELING THE CENTER LINE OF JACKSON AVENUE, 220 FEET TO A POINT; THENCE NORTHEASTERLY ALONG A LINE PARALLELING THE CENTER LINE OF HAWTHORNE STREET, 396 FEET TO THE TRUE POINT OF BEGINNING.

LEGAL DESCRIPTION CONTINUED

PARCEL 8:

THAT PORTION OF LOT 128 OF MAP OF TEMECULA LAND AND WATER COMPANY, IN THE COUNTY OF RIVERSIDE, STATE OF CALIFORNIA, AS SHOWN BY MAP ON FILE IN BOOK 8, PAGE 359 OF MAPS, RECORDS OF SAN DIEGO COUNTY, CALIFORNIA, DESCRIBED AS FOLLOWS:

BEGINNING AT THE INTERSECTION OF THE CENTERLINES OF HAWTHORNE STREET AND MONROE AVENUE; THENCE NORTHEAST 660.00 FEET ON SAID CENTERLINE OF HAWTHORNE STREET; THENCE SOUTHEAST 495.00 FEET, PARALLEL WITH SAID CENTERLINE OF MONROE AVENUE TO THE TRUE POINT OF BEGINNING; THENCE CONTINUING SOUTHEAST 165.00 FEET, PARALLEL WITH SAID CENTERLINE OF MONROE AVENUE; THENCE NORTHEAST 264.00 FEET, PARALLEL WITH SAID CENTERLINE OF HAWTHORNE AVENUE TO THE MOST SOUTHERLY CORNER OF THE LAND DESCRIBED IN DEED TO ISABELLA MARGARET BARTLET RECORDED APRIL 6, 1939 IN BOOK 412 PAGE 444 OFFICIAL RECORDS OF RIVERSIDE COUNTY, CALIFORNIA; THENCE NORTHWEST 165.00 FEET ON THE SOUTHWEST LINE OF LAST SAID LAND TO A LINE PARALLEL WITH SAID CENTERLINE OF HAWTHORNE STREET AND WHICH PASSES THROUGH THE TRUE POINT OF BEGINNING; THENCE SOUTHWEST 264.00 FEET ON SAID PARALLEL LINE TO THE TRUE POINT OF

THAT PORTION OF LOT 128, AS SHOWN BY MAP ENTITLED "MAP OF TEMECULA LAND AND WATER COMPANY" SAID MAP BEING ON FILE IN THE OFFICE OF THE COUNTY RECORDER OF SAN DIEGO COUNTY, CALIFORNIA, IN BOOK 8 PAGE 359, THEREOF, BOUNDED AND DESCRIBED AS FOLLOWS:

COMMENCING AT THE INTERSECTION OF THE CENTERLINE OF HAWTHORNE STREET AND MONROE AVENUE; THENCE NORTHEASTERLY ALONG THE CENTER LINE OF HAWTHORNE STREET, 660 FEET TO A POINT; THENCE SOUTHEASTERLY ALONG A LINE PARALLELING THE CENTER OF MONROE AVENUE, 330 FEET TO A POINT WHICH IS THE TRUE POINT OF BEGINNING; THENCE NORTHEASTERLY ALONG A LINE PARALLELING THE CENTER LINE OF HAWTHORNE STREET, 264 FEET, MORE OR LESS, TO A POINT DISTANT SOUTHWESTERLY 396 FEET FROM THE CENTER LINE OF JACKSON AVENUE; THENCE SOUTHEASTERLY ALONG A LINE PARALLELING THE CENTER LINE OF MONROE AVENUE, 165 FEET TO A POINT; THENCE SOUTHWESTERLY ALONG A LINE PARALLELING THE CENTER LINE OF HAWTHORNE STREET, 264 FEET, MORE OR LESS, TO A POINT DISTANT NORTHEASTERLY FROM THE CENTERLINE OF MONROE AVENUE, 660 FEET; THENCE NORTHWESTERLY ALONG A LINE PARALLELING THE CENTER LINE OF MONROE AVENUE, 165 FEET TO THE TRUE POINT OF BEGINNING.

PARCEL 10:

THOSE PORTIONS OF HAWTHORNE STREET AND LOT 128 AS SHOWN BY MAP ENTITLED "MAP OF TEMECULA LAND AND WATER COMPANY" AS SHOWN BY MAP ON FILE IN BOOK 8, PAGE 359 OF MAPS, RECORDS OF SAN DIEGO COUNTY, CALIFORNIA, DESCRIBED AS FOLLOWS:

BEGINNING ON THE CENTER LINE OF SAID HAWTHORNE STREET DISTANT THEREON NORTH 48° 42' 37" EAST 377.40 FEET FROM THE INTERSECTION OF THE CENTERLINES OF MONROE AVENUE AND HAWTHORNE STREET; THENCE COURSE "A", ALONG A LINE PARALLELING THE CENTER LINE OF MONROE AVENUE SOUTH 41° 42' 12" EAST 235.50 FEET; THENCE NORTH 76° 18' 56" WEST 287.58 FEET TO SAID CENTERLINE OF HAWTHORNE STREET; THENCE ALONG SAID CENTERLINE NORTH 48° 42' 37" EAST 163.35 FEET TO THE TRUE POINT OF BEGINNING.

PARCEL 11:

THOSE PORTIONS OF HAWTHORNE STREET AND LOT 128 AS SHOWN BY MAP ENTITLED "MAP OF TEMECULA LAND AND WATER COMPANY" ON FILE IN BOOK 8, PAGE 359 OF MAPS, RECORDS OF SAN DIEGO COUNTY, CALIFORNIA, DESCRIBED AS FOLLOWS:

COMMENCING AT THE INTERSECTION OF THE CENTER LINES OF HAWTHORNE STREET AND MONROE AVENUE; THENCE NORTHEASTERLY ON THE CENTER LINE OF HAWTHORNE STREET, 518.7 FEET TO THE TRUE POINT OF BEGINNING; THENCE NORTHEASTERLY ON THE CENTER LINE OF HAWTHORNE STREET, 141.3 FEET; THENCE SOUTHEASTERLY, PARALLEL WITH THE CENTER LINE OF MONROE AVENUE, 308.3 FEET; THENCE SOUTHWESTERLY, PARALLEL WITH THE CENTER LINE OF HAWTHORNE STREET, 141.3 FEET; THENCE NORTHWESTERLY, PARALLEL WITH THE CENTER LINE OF MONROE AVENUE, 308.3 FEET MORE OR LESS TO THE TRUE POINT OF BEGINNING.

EXCEPTING THEREFROM ALL OIL AND MINERAL RIGHTS THEREOF AS RESERVED IN DEED FROM ERNEST SALMON AND MURIEL SALMON, HIS WIFE, TO CHARLES HOILAND AND PEARL HOILAND, HUSBAND AND WIFE, AND CARLINGTON L. CAIN AND EUNICE CAIN, HUSBAND AND WIFE, BY DEED RECORDED DECEMBER 19, 1963 AS INSTRUMENT NO. 134009 OFFICIAL RECORDS.

PARCEL 12:

THOSE PORTIONS OF HAWTHORNE STREET AND LOT 128 AS SHOWN BY MAP ENTITLED "MAP OF TEMECULA LAND AND WATER COMPANY" ON FILE IN BOOK 8 PAGE 359 OF MAPS, RECORDS OF SAN DIEGO COUNTY, CALIFORNIA, DESCRIBED AS FOLLOWS:

COMMENCING AT THE INTERSECTION OF THE CENTER LINES OF HAWTHORNE STREET AND MONROE AVENUE; THENCE NORTHEASTERLY ON THE CENTER LINE OF HAWTHORNE STREET 377.4 FEET TO THE TRUE POINT OF BEGINNING; THENCE NORTHEASTERLY ON THE CENTER LINE OF HAWTHORNE STREET 141.3 FEET; THENCE SOUTHEASTERLY PARALLEL WITH THE CENTER LINE OF MONROE AVENUE 308.3 FEET; THENCE SOUTHWESTERLY, PARALLEL WITH THE CENTER LINE OF HAWTHORNE STREET, 141.3 FEET; THENCE NORTHWESTERLY, PARALLEL WITH THE CENTER LINE OF MONROE AVENUE 308.3 FEET, MORE OR LESS, TO THE TRUE POINT OF BEGINNING.

EXCEPTING THEREFROM ALL OIL AND MINERAL RIGHTS THEREOF AS RESERVED IN DEED FROM ERNEST SALMON AND MURIEL SALMON, HIS WIFE, TO CHARLES HOILAND AND PEARL HOILAND, HUSBAND AND WIFE, AND CARLINGTON L. CAIN AND EUNICE CAIN, HUSBAND AND WIFE, BY DEED RECORDED DECEMBER 19, 1963 AS INSTRUMENT NO. 134009 OFFICIAL RECORDS.

PARCEL 13:

THOSE PORTIONS OF HAWTHORNE STREET AND LOT 128 AS SHOWN BY MAP ENTITLED "MAP OF TEMECULA LAND AND WATER COMPANY" ON FILE IN BOOK 8, PAGE 359 OF MAPS, RECORDS OF SAN DIEGO COUNTY, CALIFORNIA, DESCRIBED AS FOLLOWS:

COMMENCING AT THE INTERSECTION OF THE CENTER LINES OF HAWTHORNE STREET AND MONROE AVENUE; THENCE NORTHEASTERLY ON THE CENTER LINE OF HAWTHORNE STREET, 545 FEET TO A POINT; THENCE SOUTHEASTERLY PARALLEL WITH THE CENTER LINE OF MONROE AVENUE, 308.3 FEET TO THE TRUE POINT OF BEGINNING; THENCE SOUTHEASTERLY PARALLEL WITH THE CENTER LINE OF MONROE AVENUE TO ITS INTERSECTION WITH THE CENTER LINE OF RIVERSIDE COUNTY HIGHWAY THROUGH SAID LOT 128 AS DESCRIBED IN THAT HIGHWAY DEED DATED JULY 6, 1937, RECORDED AUGUST 17, 1937 IN BOOK 336, PAGE 351 OFFICIAL RECORDS OF RIVERSIDE COUNTY, CALIFORNIA; THENCE EASTERLY ON THE CENTER LINE OF SAID HIGHWAY TO A POINT DISTANT FROM THE CENTER LINE OF MONROE AVENUE, AND DIRECTLY AT RIGHT ANGLES TO MONROE AVENUE, 660 FEET; THENCE NORTHWESTERLY, PARALLEL WITH THE CENTER LINE OF MONROE AVENUE TO A POINT DISTANT SOUTHEASTERLY FROM THE CENTER LINE OF HAWTHORNE STREET, 308.3 FEET; THENCE SOUTHWESTERLY 115 FEET TO THE TRUE POINT OF BEGINNING;

EXCEPTING THEREFROM THAT PORTION CONVEYED TO THE COUNTY OF RIVERSIDE BY DEED RECORDED AUGUST 17, 1937 IN BOOK 336 PAGE 351 OFFICIAL RECORDS OF RIVERSIDE COUNTY, CALIFORNIA.

EXCEPTING THEREFROM ALL OIL AND MINERAL RIGHTS THEREOF AS RESERVED IN DEED FROM ERNEST SALMON AND MURIEL SALMON, HIS WIFE, TO CHARLES HOILAND AND PEARL HOILAND, HUSBAND AND WIFE, AND CARLINGTON L. CAIN AND EUNICE CAIN, HUSBAND AND WIFE, BY DEED RECORDED DECEMBER 19, 1963 AS INSTRUMENT NO. 134009 OFFICIAL RECORDS.

LEGAL DESCRIPTION CONTINUED

PARCEL 14:

THAT PORTION OF LOT 128, AS SHOWN BY MAP ENTITLED "MAP OF TEMECULA LAND AND WATER COMPANY" ON FILE IN BOOK 8, PAGE 359 OF MAPS, RECORDS OF SAN DIEGO COUNTY, CALIFORNIA, DESCRIBED AS FOLLOWS:

COMMENCING AT THE INTERSECTION OF THE CENTER LINES OF HAWTHORNE STREET AND MONROE AVENUE; THENCE NORTHEASTERLY ALONG THE CENTER LINE OF HAWTHORNE STREET, 377.4 FEET TO A POINT; THENCE SOUTHEASTERLY ALONG A LINE PARALLELING THE CENTER LINE OF MONROE AVENUE, 308.3 FEET TO A POINT WHICH IS THE TRUE POINT OF BEGINNING; THENCE SOUTHEASTERLY ALONG A LINE PARALLELING THE CENTER LINE OF MONROE AVENUE TO ITS INTERSECTION WITH THE CENTER LINE OF RIVERSIDE COUNTY HIGHWAY THROUGH SAID LOT 128, AS DESCRIBED IN THAT HIGHWAY DEED DATED JULY 6, 1937, RECORDED AUGUST 17, 1937 IN BOOK 336 PAGE 351 OFFICIAL RECORDS OF RIVERSIDE COUNTY, CALIFORNIA; THENCE EASTERLY ALONG THE CENTER LINE OF SAID HIGHWAY TO A POINT DISTANT NORTHEAST FROM THE CENTER LINE OF MONROE AVENUE, AND DIRECTLY AT RIGHT ANGLES TO MONROE AVENUE, 545 FEET; THENCE NORTHWESTERLY ALONG A LINE PARALLELING THE CENTER LINE OF MONROE AVENUE TO A POINT DISTANT SOUTHEASTERLY FROM THE CENTERLINE OF HAWTHORNE STREET, 308.3 FEET; THENCE SOUTHWESTERLY 167.6 FEET TO THE TRUE POINT OF BEGINNING.

EXCEPTING THEREFROM THAT PORTION CONVEYED TO THE STATE OF CALIFORNIA BY DEED RECORDED OCTOBER 2, 1974 AS INSTRUMENT NO. 126969 AND MAY 10, 1996 AS INSTRUMENT NO. 173831, RESPECTIVELY BOTH OF OFFICIAL RECORDS OF RIVERSIDE COUNTY, CALIFORNIA.

PARCEL 15:

THOSE PORTIONS OF HAWTHORNE STREET AND LOT 128, AS SHOWN BY MAP ENTITLED "MAP OF TEMECULA LAND AND WATER COMPANY" ON FILE IN BOOK 8 PAGE 359 OF MAPS, RECORDS OF SAN DIEGO COUNTY, CALIFORNIA, BOUNDED AND DESCRIBED AS FOLLOWS:

COMMENCING AT THE INTERSECTION OF THE CENTER LINE OF HAWTHORNE STREET AND MONROE AVENUE; THENCE NORTHEASTERLY ALONG THE CENTER LINE OF HAWTHORNE STREET 924 FEET TO A POINT WHICH IS THE TRUE POINT OF BEGINNING; THENCE SOUTHEASTERLY ALONG A LINE PARALLELING THE CENTER LINE OF MONROE AVENUE 330 FEET TO A POINT; THENCE NORTHEASTERLY ALONG A LINE PARALLELING THE CENTER LINE OF HAWTHORNE STREET 132 FEET TO A POINT; THENCE NORTHWESTERLY ALONG A LINE PARALLELING THE CENTER LINE OF MONROE AVENUE 330 FEET TO A POINT IN THE CENTER LINE OF HAWTHORNE STREET; THENCE SOUTHWESTERLY ALONG THE CENTER LINE OF HAWTHORNE STREET 132 FEET TO THE TRUE POINT OF BEGINNING.

PARCEL 16:

THAT PORTION OF JACKSON AVENUE AND LOT 128 AS SHOWN BY A MAP ENTITLED "MAP OF TEMECULA LAND AND WATER COMPANY", IN THE CITY OF MURRIETA, COUNTY OF RIVERSIDE, STATE OF CALIFORNIA, SAID MAP BEING ON FILE IN BOOK 8, PAGE 359 OF MAPS, SAN DIEGO COUNTY RECORDS, DESCRIBED AS FOLLOWS:

COMMENCING AT THE INTERSECTION OF THE CENTER LINE OF HAWTHORNE STREET AND JACKSON AVENUE; THENCE SOUTHEASTERLY ALONG THE CENTER LINE OF JACKSON AVENUE 660 FEET TO A POINT, WHICH IS THE TRUE POINT OF BEGINNING; THENCE SOUTHWESTERLY ALONG A LINE PARALLELING THE CENTERLINE OF HAWTHORNE STREET 271.5 FEET TO A POINT; THENCE SOUTHEASTERLY ALONG A LINE PARALLELING THE CENTER LINE OF JACKSON AVENUE 80.22 FEET; THENCE NORTHEASTERLY ALONG A LINE PARALLELING THE CENTER LINE OF HAWTHORNE STREET 271.5 FEET TO A POINT; THENCE NORTHWESTERLY ALONG THE CENTER LINE OF JACKSON AVENUE 80.22 FEET TO THE TRUE POINT OF BEGINNING.

PARCEL 17:

THAT PORTION OF LOT 128 OF THE MURRIETA PORTION OF TEMECULA RANCHO, AS SHOWN BY MAP ENTITLED "MAP OF TEMECULA LAND AND WATER COMPANY" ON FILE IN BOOK 8 PAGE 359 OF MAPS, RECORDS OF SAN DIEGO COUNTY, CALIFORNIA, DESCRIBED AS FOLLOWS:

COMMENCING AT A POINT IN THE CENTER LINE OF JACKSON AVENUE DISTANT SOUTHEASTERLY 660 FEET FROM THE INTERSECTION OF THE CENTER LINE OF JACKSON AVENUE WITH THE CENTER LINE OF HAWTHORNE STREET; THENCE SOUTHWESTERLY, PARALLEL WITH THE CENTER LINE OF HAWTHORNE STREET, 271.5 FEET TO TRUE POINT OF BEGINNING; THENCE SOUTHEASTERLY, PARALLEL WITH THE CENTER LINE OF JACKSON AVENUE, 406.5 FEET MORE OR LESS, TO THE CENTER LINE OF THAT CERTAIN RIGHT OF WAY CONVEYED TO THE COUNTY OF RIVERSIDE BY DEED RECORDED AUGUST 17, 1937 IN BOOK 336 PAGE 351 OF OFFICIAL RECORDS OF RIVERSIDE COUNTY, CALIFORNIA; THENCE SOUTHWESTERLY ON THE CENTER LINE OF SAID RIGHT OF WAY TO A POINT 390 FEET DISTANT SOUTHWESTERLY AT RIGHT ANGLES FROM THE CENTER LINE OF JACKSON AVENUE; THENCE NORTHWESTERLY, PARALLEL WITH THE CENTER LINE OF JACKSON AVENUE, 330 FEET MORE OR LESS TO A POINT DISTANT SOUTHEASTERLY 660 FEET FROM THE CENTER LINE OF HAWTHORNE STREET; THENCE NORTHEASTERLY, PARALLEL WITH THE CENTER LINE OF HAWTHORNE STREET, 118.5 FEET TO THE TRUE POINT OF BEGINNING.

PARCEL 18:

THAT PORTION OF LOT 128 OF THE MURRIETA PORTION OF TEMECULA RANCHO, AS SHOWN BY MAP ENTITLED "MAP OF TEMECULA LAND AND WATER COMPANY" ON FILE IN BOOK 8 PAGE 359 OF MAPS, RECORDS OF SAN DIEGO COUNTY, CALIFORNIA, DESCRIBED AS FOLLOWS:

COMMENCING AT A POINT ON THE CENTER LINE OF JACKSON AVENUE, 660 FEET SOUTHEASTERLY FROM ITS INTERSECTION WITH THE CENTER LINE OF HAWTHORNE STREET; THENCE SOUTHWESTERLY, PARALLEL WITH THE CENTER LINE OF HAWTHORNE STREET, 390 FEET, FOR THE TRUE POINT OF BEGINNING; THENCE CONTINUING SOUTHWESTERLY, PARALLEL WITH THE CENTER LINE OF HAWTHORNE STREET, 270 FEET; THENCE SOUTHEASTERLY, PARALLEL WITH THE CENTER LINE OF JACKSON AVENUE, TO THE CENTER LINE OF THE RIVERSIDE COUNTY HIGHWAY THROUGH SAID LOT 128; THENCE NORTHEASTERLY ON THE CENTER LINE OF SAID HIGHWAY, TO A POINT DISTANT 390 FEET SOUTHWESTERLY AT RIGHT ANGLES FROM THE CENTER LINE OF JACKSON AVENUE; THENCE NORTHWESTERLY, PARALLEL WITH THE CENTER LINE OF JACKSON AVENUE, 330 FEET TO THE TRUE POINT OF BEGINNING.

EXCEPTING THEREFROM THAT PORTION IN THE RIVERSIDE COUNTY HIGHWAY.

PARCEL 19:

PARCEL 1 OF PARCEL MAP NO. 8049, IN THE CITY OF MURRIETA, COUNTY OF RIVERSIDE, STATE OF CALIFORNIA, AS SHOWN BY MAP ON FILE IN BOOK 38, PAGES 4 AND 5 OF PARCEL MAPS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY.

PARCEL 20:

PARCEL 2 OF PARCEL MAP 8049, IN THE CITY OF MURRIETA, COUNTY OF RIVERSIDE, STATE OF CALIFORNIA, AS PER MAP RECORDED IN BOOK 38, PAGES 4 AND 5 OF PARCEL MAPS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY.

PARCEL 21:

PARCEL 3 OF PARCEL MAP 8049, IN THE CITY OF MURRIETA, COUNTY OF RIVERSIDE, STATE OF CALIFORNIA, AS PER MAP FILED IN BOOK 38 PAGES 4 AND 5 OF PARCEL MAPS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY.EXCEPTING THEREFROM ANY MOBILE HOME LOCATED THEREON.

LEGAL DESCRIPTION CONTINUED

PARCEL 22:

PARCEL 1 OF PARCEL MAP NO. 7759, IN THE CITY OF MURRIETA, COUNTY OF RIVERSIDE, STATE OF CALIFORNIA, AS SHOWN BY MAP ON FILE IN BOOK 43, PAGES 68 AND 69 OF PARCEL MAPS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY.

EXCEPTING THEREFROM THE MOBILE HOME LOCATED THEREON.

PARCEL 23:

PARCEL 2 OF PARCEL MAP NO. 7759, IN THE CITY OF MURRIETA, COUNTY OF RIVERSIDE, STATE OF CALIFORNIA, AS SHOWN BY MAP ON FILE IN BOOK 43, PAGES 68 AND 69 OF PARCEL MAPS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY.

PARCEL 24:

THAT PORTION OF LOT 4 IN BLOCK "B" OF MURRIETA EUCALYPTUS COMPANY'S TRACT IN THE TEMECULA RANCHO, AS SHOWN BY MAP ON FILE IN BOOK 6 PAGE 73 OF MAPS, RECORDS OF RIVERSIDE COUNTY, CALIFORNIA, AND THOSE PORTIONS OF MONROE AVENUE AND HAWTHORNE STREET AS SHOWN ON SAID MAP AND THAT PORTION OF JACKSON AVENUE VACATED BY ORDER OF THE BOARD OF SUPERVISORS OF THE COUNTY OF RIVERSIDE, RECORDED MARCH 9, 1967 AS INSTRUMENT NO. 19905, RECORDS OF RIVERSIDE COUNTY, CALIFORNIA, DESCRIBED AS A WHOLE AS FOLLOWS:

BEGINNING AT THE INTERSECTION OF THE CENTER LINE OF HAWTHORNE STREET, 60 FEET WIDE WITH THE CENTER LINE OF SAID JACKSON AVENUE, VACATED;

THENCE ALONG SAID CENTER LINE OF JACKSON AVENUE, VACATED, NORTH 42° 11' 08" WEST 125.72 FEET TO THE MOST EASTERLY CORNER OF PARCEL MAP NO. 7759, AS SHOWN BY MAP ON FILE IN BOOK 43, PAGES 68 AND 69 OF PARCEL MAPS, RECORDS OF RIVERSIDE COUNTY, CALIFORNIA; THENCE ALONG THE SOUTHERLY BOUNDARY LINE OF SAID PARCEL MAP NO. 7759, WESTERLY ALONG A TANGENT CURVE CONCAVE SOUTHERLY HAVING A RADIUS OF 200.00 FEET THROUGH A CENTRAL ANGLE OF 69° 06' 36" AN ARC DISTANCE OF 241.24 FEET AND TANGENT TO SAID CURVE SOUTH 68° 42' 16" WEST 222.48 FEET TO THE BEGINNING OF A TANGENT CURVE THEREIN CONCAVE NORTHERLY HAVING A RADIUS OF 300.00 FEET, AND WESTERLY ALONG SAID CURVE THROUGH A CENTRAL ANGLE 16° 04' 03" AN ARC DISTANCE OF 84.13 FEET TO THE NORTHEAST CORNER OF LOT "C" OF SAID PARCEL MAP NO. 7759; THENCE ALONG THE EASTERLY LINE OF LOT "C" AND PARCEL 2 OF SAID PARCEL MAP NO. 7759, SOUTH 04° 23' 48" EAST 173.61 FEET TO THE MOST EASTERLY CORNER OF SAID PARCEL 2;
THENCE ALONG THE SOUTHEASTERLY AND SOUTHWESTERLY LINES OF SAID PARCEL 2, SOUTH 48° 11' 51" WEST 579.00 FEET AND NORTH 42° 11' 50" WEST, 200.00 FEET TO THE SOUTHEASTERLY LINE OF PARCEL MAP NO. 8049, AS SHOWN BY MAP ON FILE IN BOOK 38 PAGE 4 AND 5 OF SAID PARCEL MAPS;
THENCE ALONG THE LAST MENTIONED SOUTHEASTERLY LINE, SOUTH 48° 11' 51" WEST 223 FEET, MORE OR LESS, TO THE CENTER LINE OF MONROE AVENUE, 60 FEET WIDE;
THENCE ALONG THE LAST MENTIONED CENTER LINE, SOUTH 42° 11' 50" EAST TO THE MOST NORTHERLY CORNER OF THE LAND DESCRIBED IN THE DEED TO THE STATE OF CALIFORNIA, RECORDED NOVEMBER 7, 1975 AS INSTRUMENT NO. 138775 OFFICIAL RECORDS OF RIVERSIDE COUNTY, CALIFORNIA;
THENCE EASTERLY ALONG THE NORTHERLY BOUNDARY LINE OF SAID LAND OF THE STATE OF CALIFORNIA TO SAID CENTER LINE OF HAWTHORNE STREET;
THENCE ALONG THE LAST MENTIONED CENTER LINE, NORTH 48° 11' 51" EAST TO THE POINT OF BEGINNING.

PARCEL 25:

PARCEL 3 ALONG WITH LETTERED LOTS "E" AND "F" OF PARCEL MAP 7759 AS SHOWN BY MAP ON FILE IN BOOK 43, PAGES 68 AND 69 OF PARCEL MAPS, RIVERSIDE COUNTY RECORDS.

PARCEL 26:
PARCEL 4 AND LETTERED LOTS D AND G OF PARCEL MAP NO. 7759, IN THE CITY OF MURRIETA, COUNTY OF RIVERSIDE, STATE OF CALIFORNIA, AS SHOWN BY MAP ON FILE IN BOOK 43, PAGES 68 AND 69 OF PARCEL MAPS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY.

EXCEPTING THEREFROM ANY MOBILEHOME LOCATED THEREON.

BEGINNING.

PARCEL 9:

No.	REVISIONS	DATE	BY

Kimley»Horn

401 B STREET, SUITE 600; SAN DIEGO, CA 92101
PHONE: 619-234-9411
WWW.KIMLEY-HORN.COM

KHA PROJECT
195120004

DATE
1/28/2022

SCALE AS SHOWN

DESIGNED BY ___

DRAWN BY ___

CHECKED BY ___

GENERAL NOTES
FOR
THE TERRACES MURRIETA

CITY OF MURRIETA CA

SHEET NUMBER
2
OF
9

UTILITY NOTES

1	CONNECT FIRE SERVICE TO PUBLIC WATER MAIN.
2	CONNECT WATER SERVICE TO PUBLIC WATER MAIN.
3	PROPOSED 10" WATER LINE.
4	PROPOSED 6" WATER LINE.
5	PROPOSED 12" FIRE WATER LINE.
6	PROPOSED 6" FIRE WATER LINE.
7	PROPOSED 8" SEWER LINE.
8	CONNECT TO EXISTING SEWER MAIN.
9	8" REDUCED PRESSURE BACKFLOW PREVENTER AND WATER METER.
10	12" DOUBLE CHECK DETECTOR BACKFLOW PREVENTOR.
11	6" FIRE HYDRANT LATERAL CONNECTED TO PROPOSED PUBLIC WATER LINE.
12	PROPOSED 12" WATER MAIN.
13	EX. PUBLIC HIGHWAY AND PUBLIC UTILITIES EASEMENT PER CITY OF MURRIETA BOOK 336, PAGE 351 OFFICIAL RECORDS.
14	EX. PUBLIC UTILITIES EASEMENT PER INSTRUMENT NO. 1972-121672 OFFICIAL RECORDS.
15	EX. PUBLIC UTILITIES EASEMENT PER INSTRUMENT NO. 1972-129403 OFFICIAL RECORDS.
16	EX. PUBLIC UTILITIES EASEMENT PER INSTRUMENT NO. 1973-69193 OFFICIAL RECORDS.
17	EX. PUBLIC UTILITIES EASEMENT PER INSTRUMENT NO. 1973-86474 OFFICIAL RECORDS.
18	EX. STREET & PUBLIC UTILITIES EASEMENT PER COUNTY OF RIVERSIDE BY RESOLUTION NO. 82-198, RECORDED PER INSTRUMENT NO. 1982-107810 OFFICIAL RECORDS.
19	EX. STORM DRAIN AND ALL APPURTENANT WORKS, INCLUDING INGRESS AND EGRESS. EASEMENT PER INSTRUMENT NO. 1989-446018 OFFICIAL RECORDS.
20	EX. PUBLIC STREET EASEMENT PER CITY OF MURRIETA, INSTRUMENT NO. 1998-500238 OFFICIAL RECORDS.
21	EX. DRAINAGE EASEMENT PER CITY OF MURRIETA, INSTRUMENT NO. 1998-117946 OFFICIAL RECORDS.
23	EX. PUBLIC STREET EASEMENT PER CITY OF MURRIETA, INSTRUMENT NO. 1998-117948 OFFICIAL RECORDS.
24	EX. INGRESS AND EGRESS EASEMENT PER INSTRUMENT NO. 1998-045972 OFFICIAL RECORDS.
26	ANY EASEMENT OR OTHER RIGHTS WHICH MAY EXIST OVER SAID LAND, AS DISCLOSED ON A COPY OF PARCEL MAP 7759, FILED IN THE OFFICE OF THE COUNTY ROAD COMMISSIONER AND REFERRED TO IN THE DEDICATION CLAUSE OF SAID MAP.
27	A WAIVER IN FAVOR OF THE STATE OF CALIFORNIA OF ANY CLAIMS FOR DAMAGE TO SAID LAND BY REASON OF THE LOCATION OF A HIGHWAY CONTIGUOUS THERETO AS CONTAINED IN GRANT DEED, PER INSTRUMENT NO. 1996-173831 OFFICIAL RECORDS.

PROPOSED PUBLIC WATER LINE CONTINUATION

No.	REVISIONS	DATE	BY

401 B STREET, SUITE 600; SAN DIEGO, CA 92101
PHONE: 619-234-9411
WWW.KIMLEY-HORN.COM

KHA PROJECT
195120004

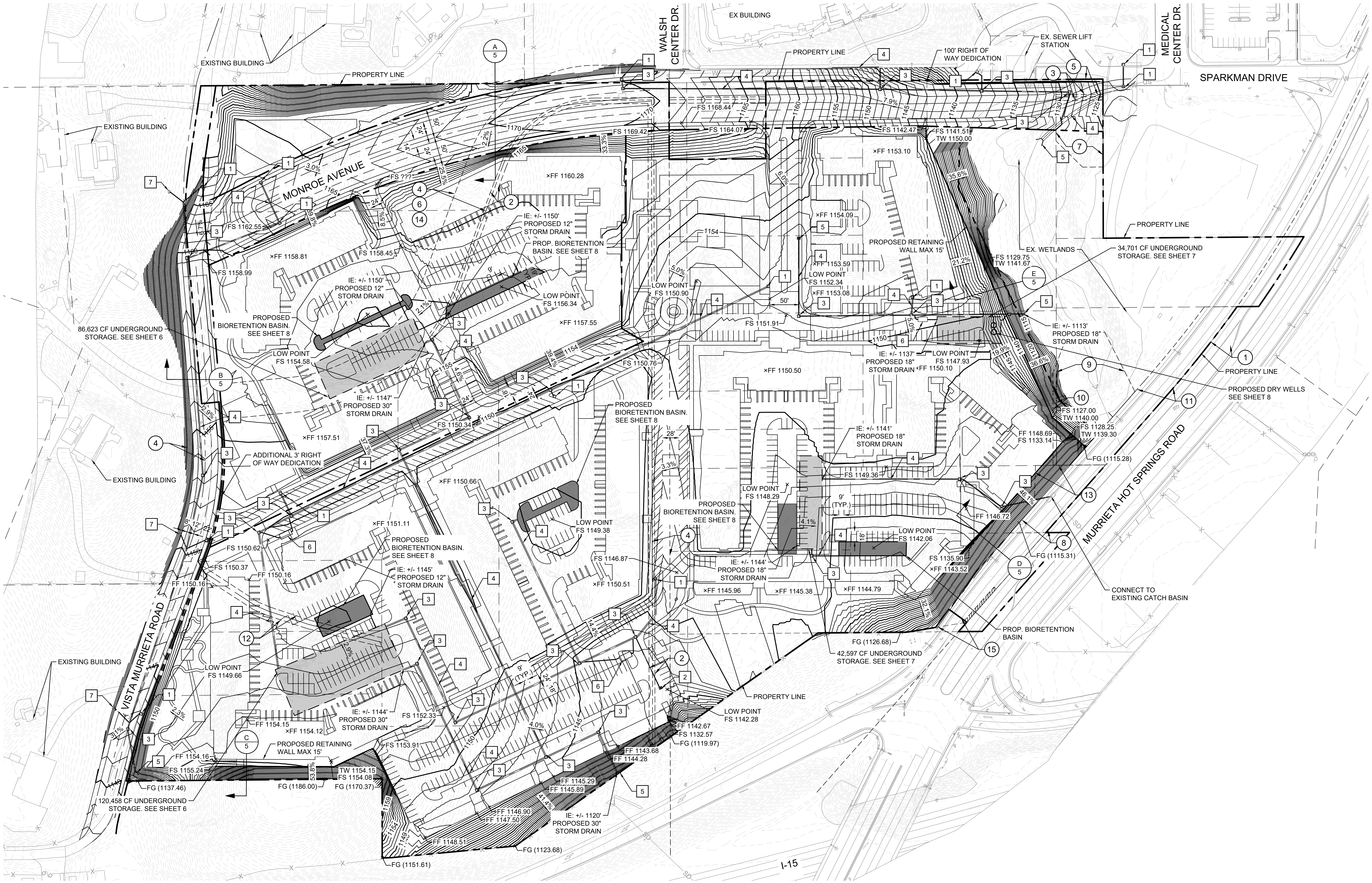
DATE
1/28/2022

SCALE AS SHOWN
DESIGNED BY ___
DRAWN BY ___
CHECKED BY ___

CONCEPTUAL UTILITY PLAN
FOR
THE TERRACES MURRIETA

CITY OF MURRIETA CA

SHEET NUMBER
3
OF
9



EXISTING EASEMENT NOTES

1. EX. PUBLIC HIGHWAY AND PUBLIC UTILITIES EASEMENT PER CITY OF MURRIETA BOOK 336, PAGE 351 OFFICIAL RECORDS.
2. EX. PUBLIC UTILITIES EASEMENT PER INSTRUMENT NO. 1972-121672 OFFICIAL RECORDS.
3. EX. PUBLIC UTILITIES EASEMENT PER INSTRUMENT NO. 1972-129403 OFFICIAL RECORDS.
4. EX. PUBLIC UTILITIES EASEMENT PER INTRUMENT NO. 1973-69193 OFFICIAL RECORDS.
5. EX. PUBLIC UTILITIES EASEMENT PER INTRUMENT NO. 1973-86474 OFFICIAL RECORDS.
6. EX. STREET & PUBLIC UTILITIES EASEMENT PER COUNTY OF RIVERSIDE BY RESOLUTION NO. 82-198, RECORDED PER INSTRUMENT NO. 1982-107810 OFFICIAL RECORDS
7. EX. STORM DRAIN AND ALL APPURTENANT WORKS, INCLUDING INGRESS AND EGRESS, EASEMENT PER INSTRUMENT NO. 1989-446018 OFFICIAL RECORDS
8. EX. PUBLIC STREET EASEMENT PER CITY OF MURRIETA, INSTRUMENT NO. 1998-500238 OFFICIAL RECORDS
9. EX. DRAINAGE EASEMENT PER CITY OF MURRIETA, INSTRUMENT NO. 1998-117946 OFFICIAL RECORDS
10. EX. DRAINAGE EASEMENT PER CITY OF MURRIETA, INSTRUMENT NO. 1998-117947 OFFICIAL RECORDS
11. EX. PUBLIC STREET EASEMENT PER CITY OF MURRIETA, INSTRUMENT NO. 1998-117948 OFFICIAL RECORDS
12. EX. INGRESS AND EGRESS EASEMENT PER INSTRUMENT NO. 1998-045972 OFFICIAL RECORD
13. EX. DRAINAGE EASEMENT PER CITY OF MURRIETA, INSTRUMENT NO. 1998-500239 OFFICIAL RECORDS
14. ANY EASEMENT OR OTHER RIGHTS WHICH MAY EXIST OVER SAID LAND, AS DISCLOSED ON A COPY OF PARCEL MAP 7759, FILED IN THE OFFICE OF THE COUNTY ROAD COMMISSIONER AND REFERRED TO IN THE DEDICATION CLAUSE OF SAID MAP
15. A WAIVER IN FAVOR OF THE STATE OF CALIFORNIA OF ANY CLAIMS FOR DAMAGE TO SAID LAND BY REASON OF THE LOCATION OF A HIGHWAY CONTIGUOUS THERETO AS CONTAINED IN GRANT DEED,PER INSTRUMENT NO. 1996-173831 OFFICIAL RECORDS

STORM DRAIN NOTES

1. PROPOSED CURB INLET
2. PROPOSED GRATE INLET
3. PROPOSED CLEAN OUT
4. PROPOSED STORM DRAIN
5. PROPOSED HEADWALL
6. PROPOSED MODULAR WETLAND PER BIOCLEAN. SEE SHEET 9
7. PROPOSED CATCH BASIN

NORTH

GRAPHIC SCALE IN FEET
0 40 80 160

No.	REVISIONS	DATE	BY

Kimley»Horn

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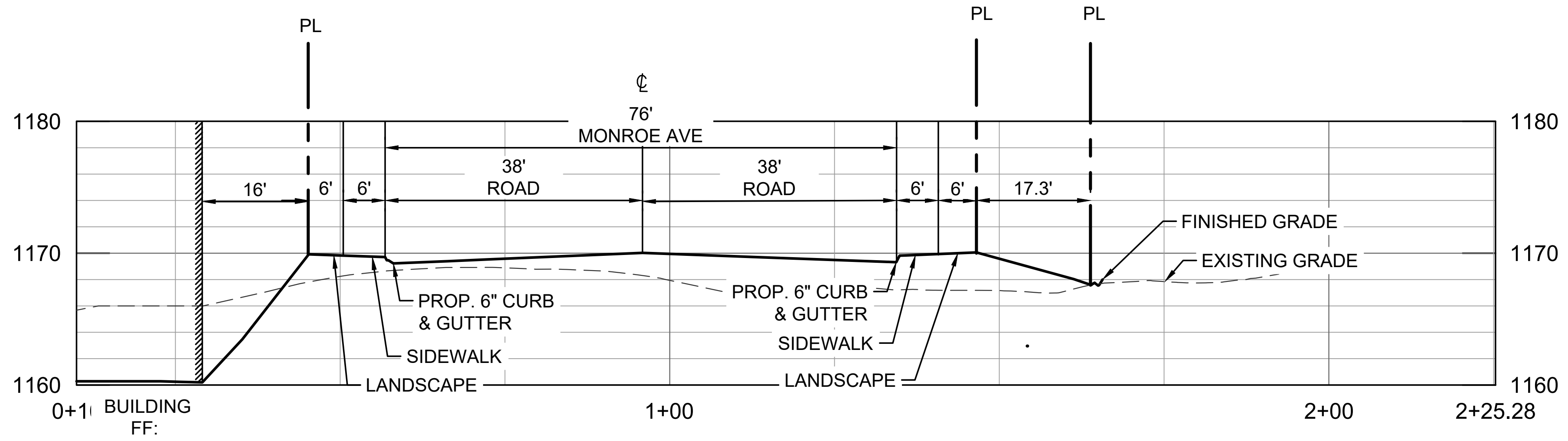
401 B STREET, SUITE 600; SAN DIEGO, CA 92101
PHONE: 619-234-9411
WWW.KIMLEY-HORN.COM

KHA PROJECT 195120004
DATE 1/28/2022
SCALE AS SHOWN
DESIGNED BY ___
DRAWN BY ___
CHECKED BY ___

CONCEPTUAL GRADING PLAN
FOR
THE TERRACES MURRIETA

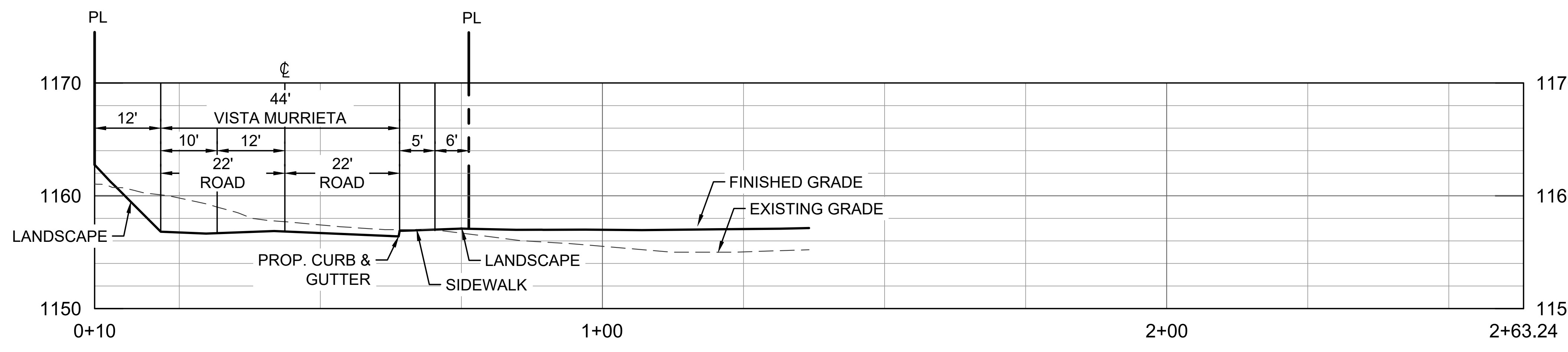
CITY OF MURRIETA CA

SHEET NUMBER
4
OF
9



SECTION A

HORZ: 1" = 20'
VERT: 1" = 10'



SECTION B

HORZ: 1" = 20'
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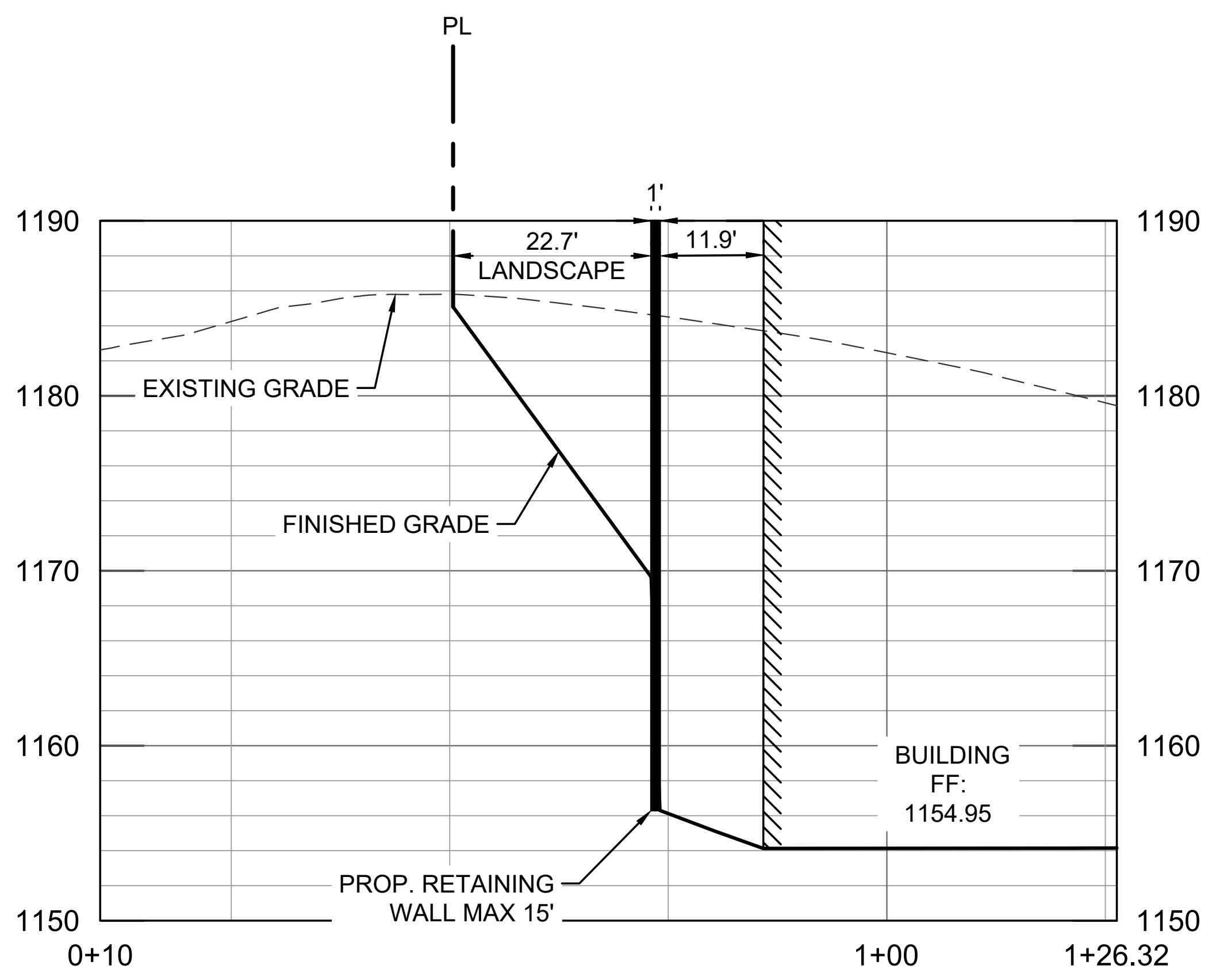

SECTION C

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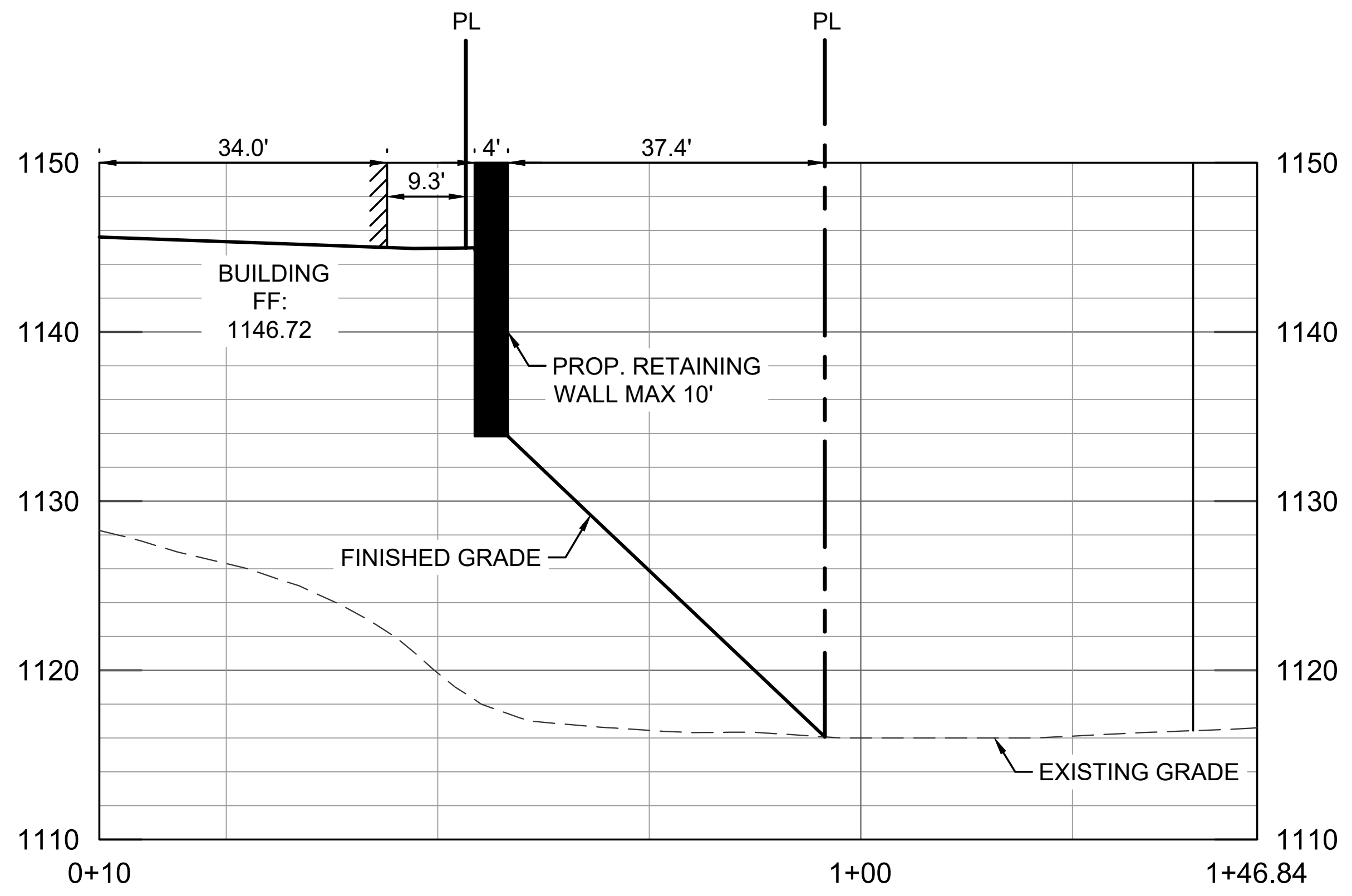

SECTION D

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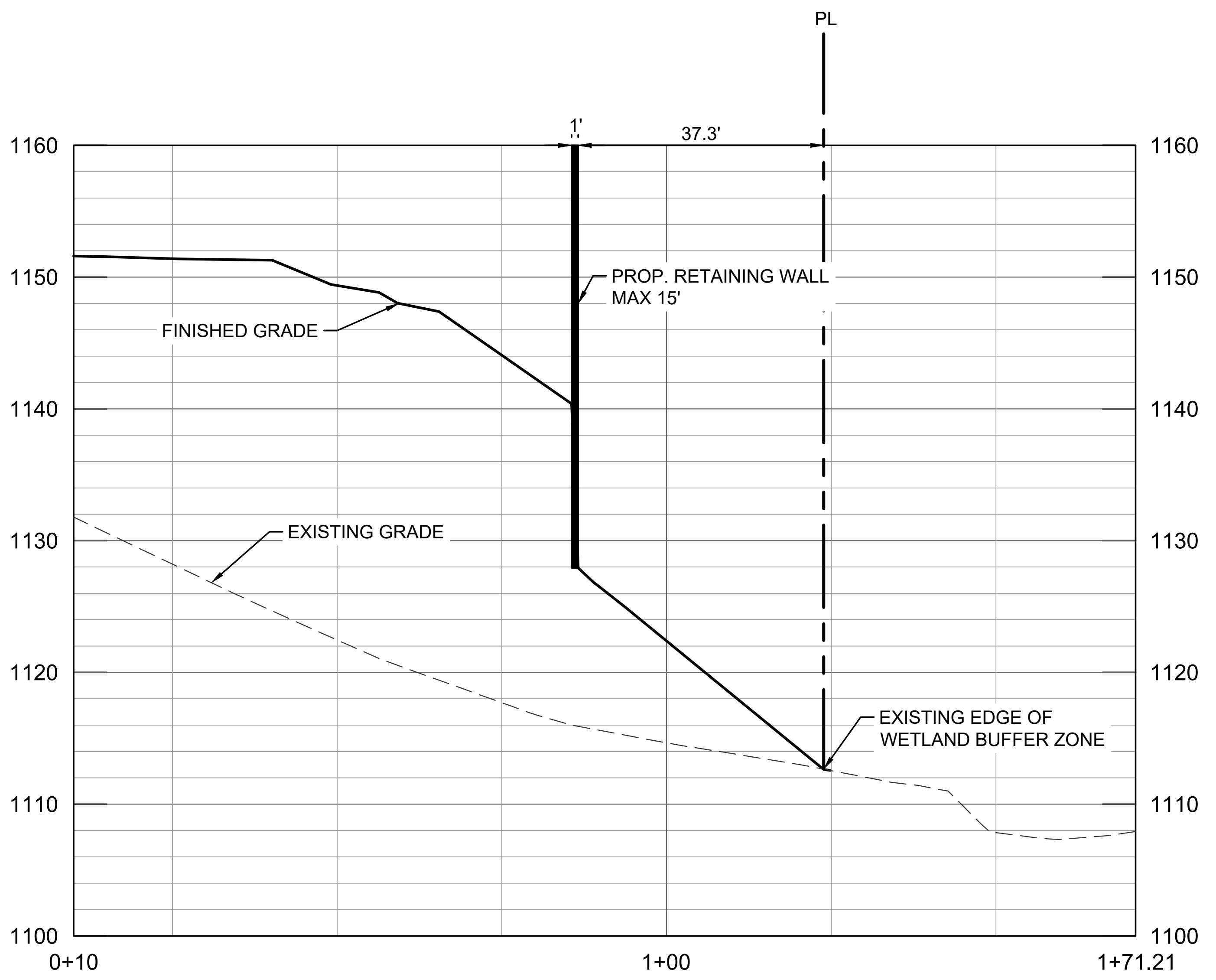
VERT: 1" = 10'



SECTION E

HORZ: 1" = 20'
VERT: 1" = 10'

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KHA PROJECT
195120004
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DETAILS
FOR
THE TERRACES MURRIETA

CITY OF MURRIETA CA

SHEET NUMBER
5
OF
9

PRINSCO
ENGINEERED WITH INTEGRITY

KIMLEY-HORN
MURRIETA, CA
HYDROSTOR HS290 STORMWATER CHAMBER SYSTEM

STORMWATER CHAMBER SPECIFICATIONS

1. CHAMBERS SHALL BE HYDROSTOR HS290 OR APPROVED EQUIVALENT.
2. CHAMBERS SHALL BE MADE FROM VIRGIN, IMPACT-MODIFIED POLYPROPYLENE COPOLYMERS.
3. CHAMBER ROWS SHALL PROVIDE CONTINUOUS, UNOBSTRUCTED INTERNAL SPACE WITH NO INTERNAL SUPPORT PANELS THAT WOULD IMPEDE FLOW OR LIMIT ACCESS FOR INSPECTION.
4. THE STRUCTURAL DESIGN OF THE CHAMBERS, THE STRUCTURAL BACKFILL, AND THE INSTALLATION REQUIREMENTS SHALL ENSURE THAT THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, SECTION 12.12, ARE MET FOR: 1) LONG-DURATION DEAD LOADS AND 2) SHORT-DURATION LIVE LOADS, BASED ON THE AASHTO DESIGN TRUCK WITH CONSIDERATION FOR IMPACT AND MULTIPLE VEHICLE PRESENCES.
5. CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F2418-12, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS."
6. ONLY CHAMBERS THAT ARE APPROVED BY THE SITE DESIGN ENGINEER WILL BE ALLOWED. THE CHAMBER MANUFACTURER SHALL SUBMIT THE FOLLOWING UPON REQUEST TO THE SITE DESIGN ENGINEER FOR APPROVAL BEFORE DELIVERING CHAMBERS TO THE PROJECT SITE:
   A. A STRUCTURAL EVALUATION SEALED BY A REGISTERED PROFESSIONAL ENGINEER THAT DEMONSTRATES THAT THE SAFETY FACTORS ARE GREATER THAN OR EQUAL TO 1.95 FOR DEAD LOAD AND 1.75 FOR LIVE LOAD, THE MINIMUM REQUIRED BY ASTM F2787 AND BY AASHTO FOR THERMOPLASTIC PIPE.
   B. A STRUCTURAL EVALUATION SEAL BY A REGISTERED PROFESSIONAL ENGINEER THAT DEMONSTRATES THAT THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, SECTION 12.12, ARE MET. THE 50 YEAR CREEP MODULUS DATA SPECIFIED IN ASTM F2418 MUST BE USED AS PART OF THE AASHTO STRUCTURAL EVALUATION TO CERTIFY LONG-TERM PERFORMANCE.
   C. STRUCTURAL CROSS SECTION DETAIL ON WHICH THE STRUCTURAL EVALUATION IS BASED.
7. CHAMBERS SHALL BE PRODUCED AT AN ISO 9001 CERTIFIED MANUFACTURING FACILITY.

NOTES:

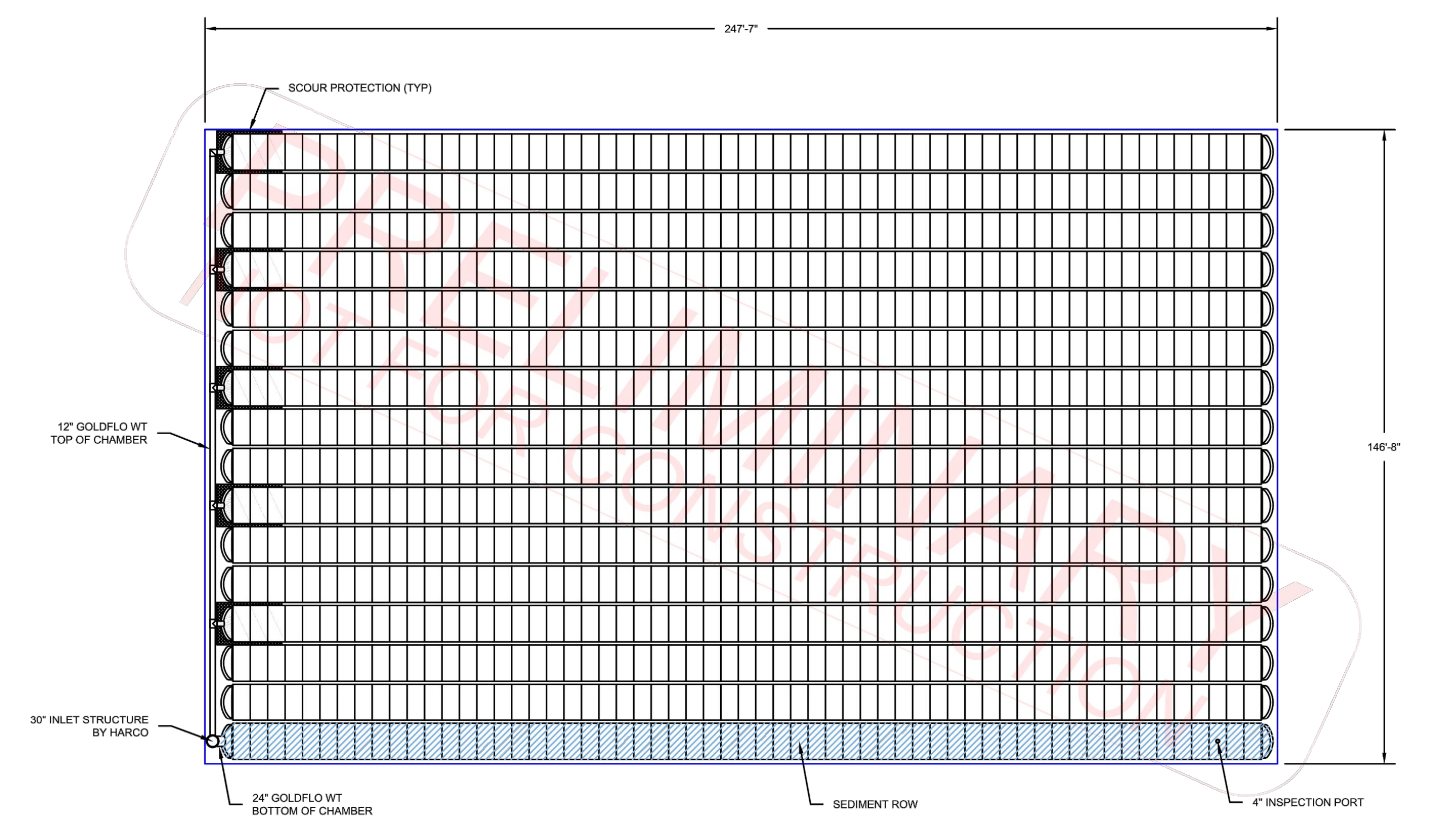
1. PRIOR TO BEGINNING INSTALLATION OF HYDROSTOR STORMWATER CHAMBERS, A PRECONSTRUCTION MEETING SHALL BE HELD WITH A PRINSCO REPRESENTATIVE AND THE INSTALLERS.
2. HYDROSTOR STORMWATER CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE PRINSCO "HYDROSTOR CONSTRUCTION GUIDE."
3. HYDROSTOR STORMWATER CHAMBERS SHALL NOT BE INSTALLED ON WET OR UNSTABLE FOUNDATION OR SUBGRADE. FOUNDATION STONE MUST BE LEVEL AND COMPACTED.
4. PRINSCO RECOMMENDS PRETREATMENT OF STORMWATER RUNOFF USING A PRINSCO STORMWATER QUALITY UNIT AND/OR A SEDIMENT ROW.
5. MAINTAIN MINIMUM SPACING OF 8.5" (SPECIFICALLY HS290) BETWEEN CHAMBERS.
6. CONSTRUCTION EQUIPMENT SHALL NOT BE SITUATED ATOP THE CHAMBERS UNTIL SUFFICIENT COVER HAS BEEN ACHIEVED. DUMP TRUCKS, RUBBER TIRE LOADERS, EXCAVATORS, WHEEL OR ROLLER LOADS ARE NOT ALLOWED UNTIL PROPER FILL HEIGHTS HAVE BEEN ACHIEVED. REFER TO PRINSCO "HYDROSTOR CONSTRUCTION GUIDE" FOR SPECIFIC LOADING CRITERIA.
7. EMBEDMENT BACKFILL MUST BE PLACED USING THE FOLLOWING METHODS ONLY:
   - BACKFILL WITH AN EXCAVATOR LOCATED OUTSIDE THE EXCAVATION
   - BACKFILL WITH A STONE SHOOTER LOCATED OUTSIDE THE EXCAVATION
   - BACKFILL AS ROWS ARE BUILT WITH AN EXCAVATOR ON THE SUBGRADE OR FOUNDATION STONE
8. EMBEDMENT BACKFILL SHALL NOT BE PLACED USING THE "DUMP AND PUSH" METHOD. THIS MAY CAUSE DAMAGE TO THE CHAMBERS, WILL RESULT IN IMPROPER INSTALLATION AND WILL VOID THE PRINSCO STANDARD WARRANTY.
9. ONCE SUFFICIENT COVER IS ACHIEVED (12" FOR HS290), GRADING MAY COMMENCE WITH A SMALL DOZER OR SKID LOADER (LESS THAN 4.5 PSI GROUND PRESSURE). EQUIPMENT SHALL ALWAYS TRAVEL PARALLEL TO CHAMBER ROWS. SEE PRINSCO "HYDROSTOR CONSTRUCTION GUIDE" FOR SPECIFIC LOADING CRITERIA.

PROJECT INFORMATION:

- PROJECT NUMBER: 22-020
- PRINSCO SALES CONTACT: Doug Berg: 323-680-8459
- ENGINEER: ----
- CONTRACTOR: ----
- DISTRIBUTOR: ----

THE UNDERSIGNED HEREBY APPROVES THE ATTACHED (14) PAGES

CUSTOMER ______________ DATE ______



BILL OF MATERIALS - SYSTEM A

PART	DESCRIPTION	QTY.	PART	DESCRIPTION	QTY.
A1	HYDROSTOR HS290 CHAMBER (HS290C)	944	A2	HYDROSTOR HS290 END CAP (HS290E)	26
A3	HYDROSTOR HS290 END CAP w/ 24" CORED HOLE BOTTOM (HS290E-24HB)	1	A4	24GF20NP (FIELD CUT PIPE FOR MANIFOLD)	20'
A5	HYDROSTOR HS290 END CAP w/ 12" CORED HOLE TOP (HS290E-12HT)	5	A6	12" GOLDFLO 90° ELBOW (GFE12902)	1
A7	12GF20NP (FIELD CUT PIPE FOR MANIFOLD)	160'	A8	12" GOLDFLO TEE (GFT1212)	4
A9	12" SPLIT COUPLER (SC12)	14			

TYPICAL ELEVATIONS - HS290 BEDS (ft)

MAXIMUM ALLOWABLE GRADE (TOP OF PAVEMENT/UNPAVED):	1152.21
MINIMUM ALLOWABLE GRADE (UNPAVED WITH TRAFFIC):	1146.71
MINIMUM ALLOWABLE GRADE (UNPAVED WITH NO TRAFFIC):	1146.21
MINIMUM ALLOWABLE GRADE (BASE OF FLEXIBLE PAVEMENT):	1146.21
MINIMUM ALLOWABLE GRADE (TOP OF RIGID CONCRETE PAVEMENT):	1146.21
TOP OF STONE (MIN):	1145.21
TOP OF CHAMBER:	1144.21
12" TOP OF CHAMBER (INVERT):	1142.55
24" BOTTOM OF CHAMBER (INVERT):	1139.50
BOTTOM OF CHAMBER (MIN):	1139.25
BOTTOM OF FOUNDATION STONE:	1138.50

PROPOSED SYSTEM LAYOUT HS290

INSTALLED SYSTEM VOLUME (ft^3):	163,107
INSTALLED SYSTEM FOOTPRINT (ft^2):	37,345
SYSTEM PERIMETER (ft):	788
TOTAL CHAMBERS:	944
TOTAL END CAPS:	32
STONE REQUIRED (yd^3):	5,394
NON-WOVEN GEOTEXTILE (yd^2):	10,664
WOVEN GEOTEXTILE (yd^2):	345

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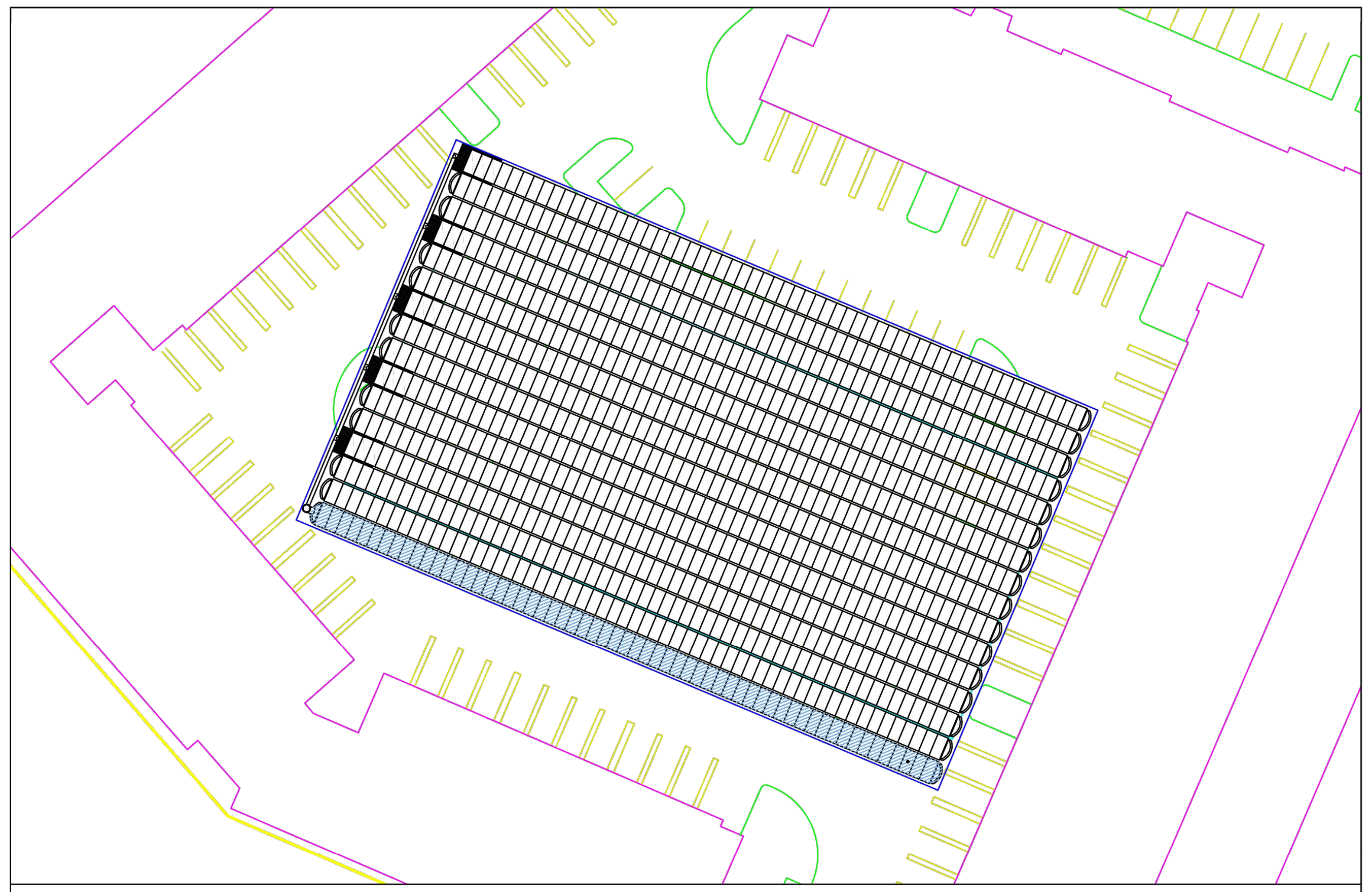
REV: A
CHECKED BY: JTC
PRINSCO SALES CONTACT: Doug Berg: 323-680-8459
DRAWN BY: TJW
DATE: 13-Jan-22
DRAWING NUMBER: 22-020
SCALE: NTS
SHEET: 1 OF 8

PRINSCO SYSTEM A

NTS



OVERLAY - SYSTEM A

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OVERLAY SYSTEM A

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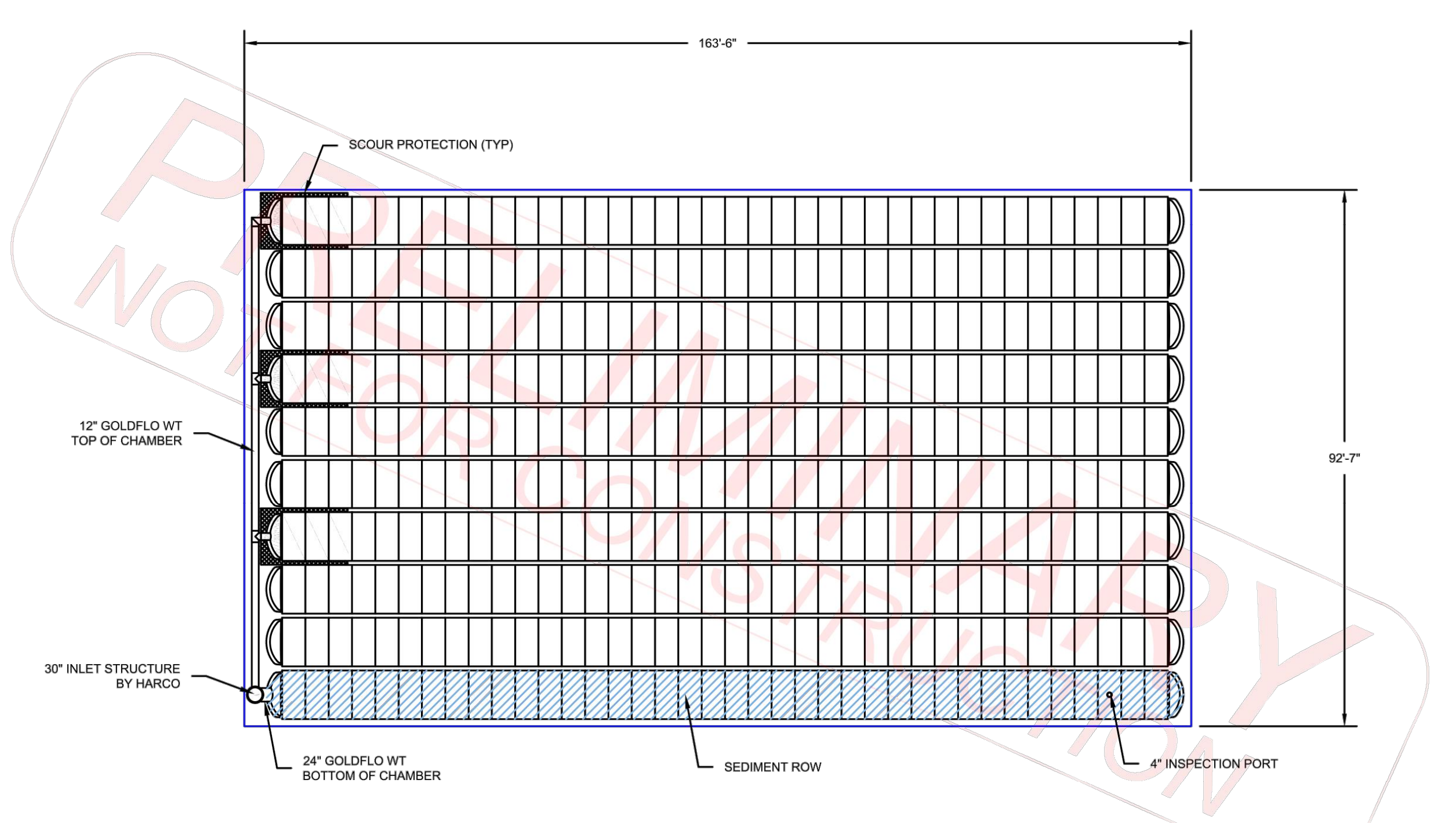

BILL OF MATERIALS - SYSTEM B

PART	DESCRIPTION	QTY.	PART	DESCRIPTION	QTY.
B1	HYDROSTOR HS290 CHAMBER (HS290C)	380	B2	HYDROSTOR HS290 END CAP (HS290E)	16
B3	HYDROSTOR HS290 END CAP w/ 24" CORED HOLE BOTTOM (HS290E-24HB)	1	B4	24GF20NP (FIELD CUT PIPE FOR MANIFOLD)	20'
B5	HYDROSTOR HS290 END CAP w/ 12" CORED HOLE TOP (HS290E-12HT)	3	B6	12" GOLDFLO 90° ELBOW (GFE12902)	1
B7	12GF20NP (FIELD CUT PIPE FOR MANIFOLD)	100'	B8	12" GOLDFLO TEE (GFT1212)	2
B9	12" SPLIT COUPLER (SC12)	8			

TYPICAL ELEVATIONS - HS290 BEDS (ft)

MAXIMUM ALLOWABLE GRADE (TOP OF PAVEMENT/UNPAVED):	1159.71
MINIMUM ALLOWABLE GRADE (UNPAVED WITH TRAFFIC):	1154.21
MINIMUM ALLOWABLE GRADE (UNPAVED WITH NO TRAFFIC):	1153.71
MINIMUM ALLOWABLE GRADE (BASE OF FLEXIBLE PAVEMENT):	1153.71
MINIMUM ALLOWABLE GRADE (TOP OF RIGID CONCRETE PAVEMENT):	1153.71
TOP OF STONE (MIN):	1152.71
TOP OF CHAMBER:	1151.71
12" TOP OF CHAMBER (INVERT):	1150.05
24" BOTTOM OF CHAMBER (INVERT):	1147.00
BOTTOM OF CHAMBER (MIN):	1146.75
BOTTOM OF FOUNDATION STONE:	1146.00

PROPOSED SYSTEM LAYOUT HS290

INSTALLED SYSTEM VOLUME (ft^3):	67,268
INSTALLED SYSTEM FOOTPRINT (ft^2):	15,566
SYSTEM PERIMETER (ft):	512
TOTAL CHAMBERS:	380
TOTAL END CAPS:	20
STONE REQUIRED (yd^3):	2,292
NON-WOVEN GEOTEXTILE (yd^2):	4,609
WOVEN GEOTEXTILE (yd^2):	220

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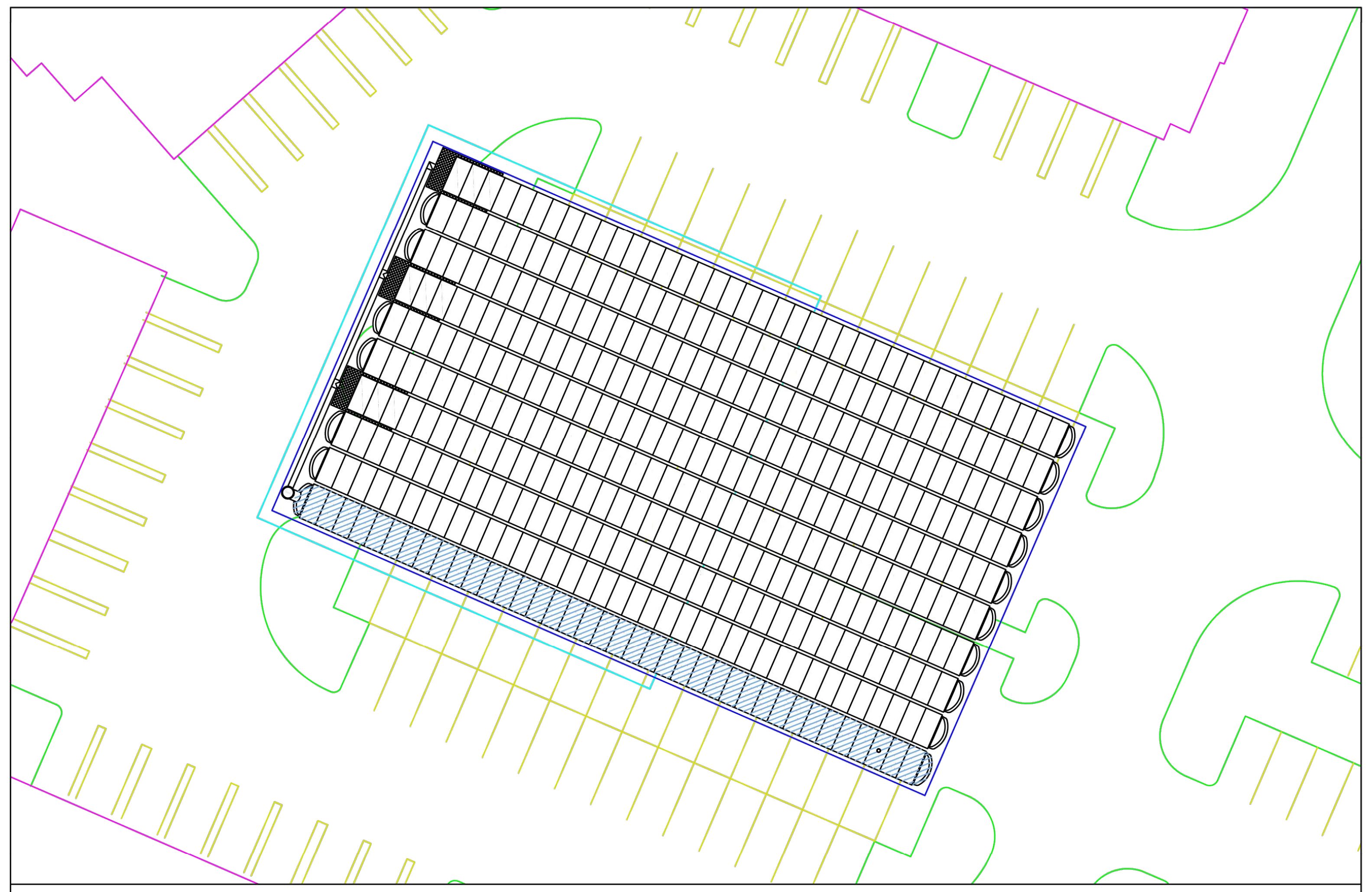
PRINSCO SYSTEM B

NTS



OVERLAY - SYSTEM B

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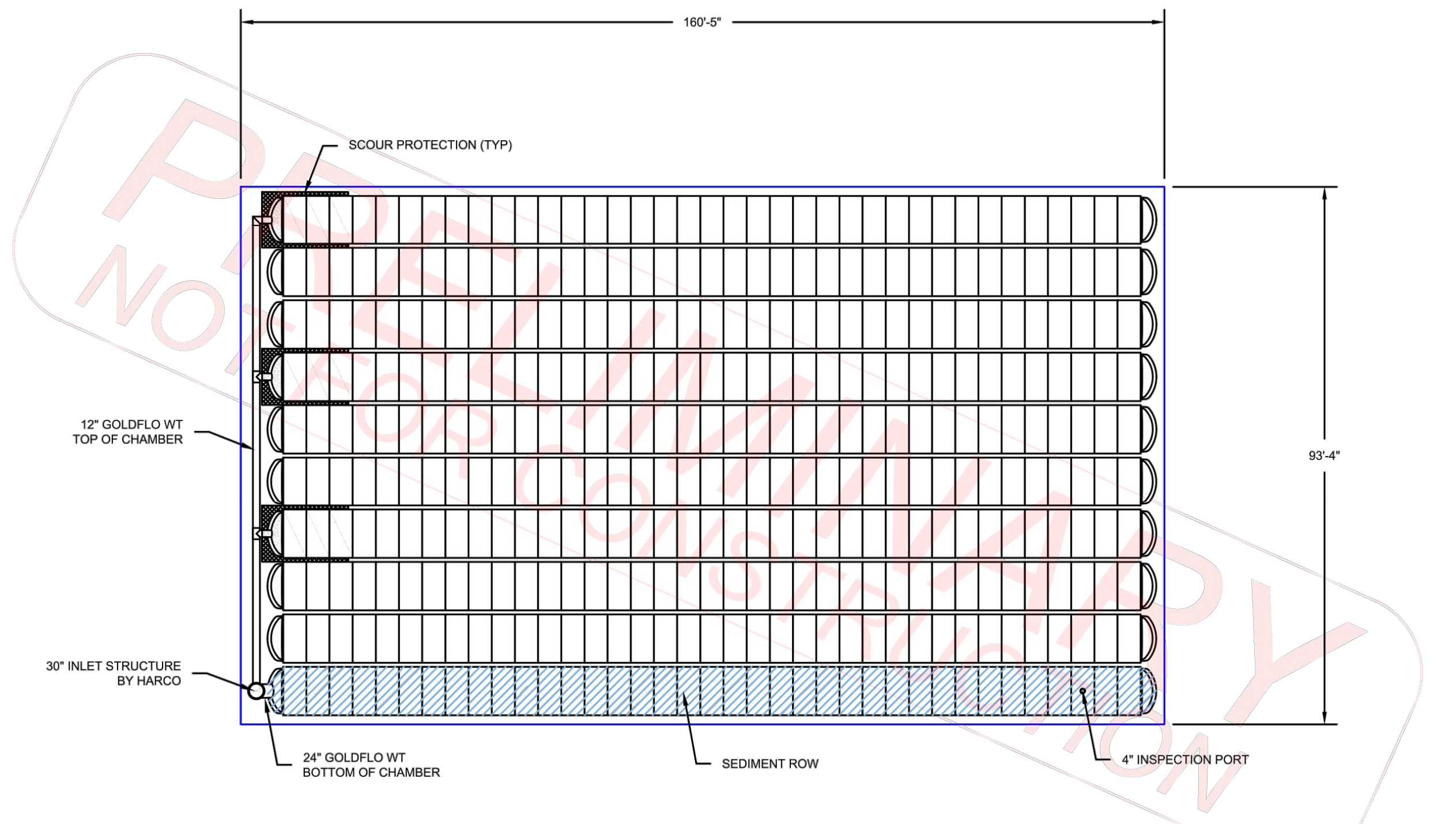
OVERLAY SYSTEM B

NTS



BILL OF MATERIALS - SYSTEM C

PART	DESCRIPTION	QTY.	PART	DESCRIPTION	QTY.
C1	HYDROSTOR HS290 CHAMBER (HS290C)	370	C2	HYDROSTOR HS290 END CAP (HS290E)	16
C3	HYDROSTOR HS290 END CAP w/ 24" CORED HOLE BOTTOM (HS290E-24HB)	1	C4	24GF20NP (FIELD CUT PIPE FOR MANIFOLD)	20'
C5	HYDROSTOR HS290 END CAP w/ 12" CORED HOLE TOP (HS290E-12HT)	3	C6	12" GOLDFLO 90° ELBOW (GFE12902)	1
C7	12GF20NP (FIELD CUT PIPE FOR MANIFOLD)	100'	C8	12" GOLDFLO TEE (GFT1212)	2
C9	12" SPLIT COUPLER (SC12)	8			

TYPICAL ELEVATIONS - HS290 BEDS (ft)

MAXIMUM ALLOWABLE GRADE (TOP OF PAVEMENT/UNPAVED):	1151.71
MINIMUM ALLOWABLE GRADE (UNPAVED WITH TRAFFIC):	1146.21
MINIMUM ALLOWABLE GRADE (UNPAVED WITH NO TRAFFIC):	1145.71
MINIMUM ALLOWABLE GRADE (BASE OF FLEXIBLE PAVEMENT):	1145.71
MINIMUM ALLOWABLE GRADE (TOP OF RIGID CONCRETE PAVEMENT):	1145.71
TOP OF STONE (MIN):	1144.71
TOP OF CHAMBER:	1143.71
12" TOP OF CHAMBER (INVERT):	1142.05
24" BOTTOM OF CHAMBER (INVERT):	1139.00
BOTTOM OF CHAMBER (MIN):	1139.75
BOTTOM OF FOUNDATION STONE:	1138.00

PROPOSED SYSTEM LAYOUT HS290

INSTALLED SYSTEM VOLUME (ft^3):	66,149
INSTALLED SYSTEM FOOTPRINT (ft^2):	15,393
SYSTEM PERIMETER (ft):	507
TOTAL CHAMBERS:	370
TOTAL END CAPS:	20
STONE REQUIRED (yd^3):	2,290
NON-WOVEN GEOTEXTILE (yd^2):	4,559
WOVEN GEOTEXTILE (yd^2):	216

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DRAWING NUMBER: 22-020
SCALE: NTS
SHEET: 5 OF 8

PRINSCO SYSTEM B

NTS

No.	REVISIONS	DATE	BY

Kimley»Horn

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PHONE: 619-234-9411
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KHA PROJECT 195120004
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DRAWN BY ___
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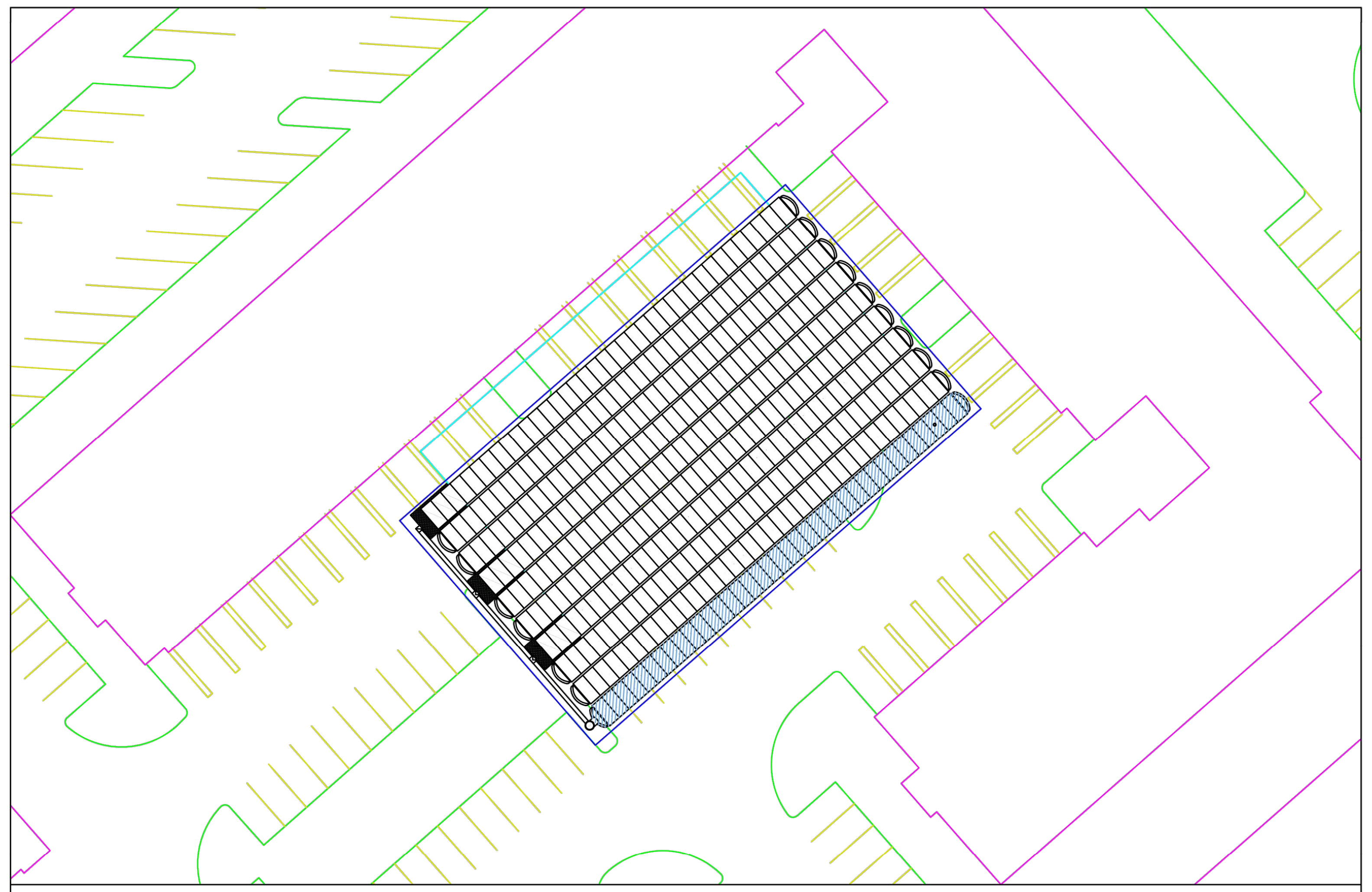
STORM DRAIN DETAILS
FOR
THE TERRACES MURRIETA

CITY OF MURRIETA CA

SHEET NUMBER
6
OF
9



OVERLAY - SYSTEM C

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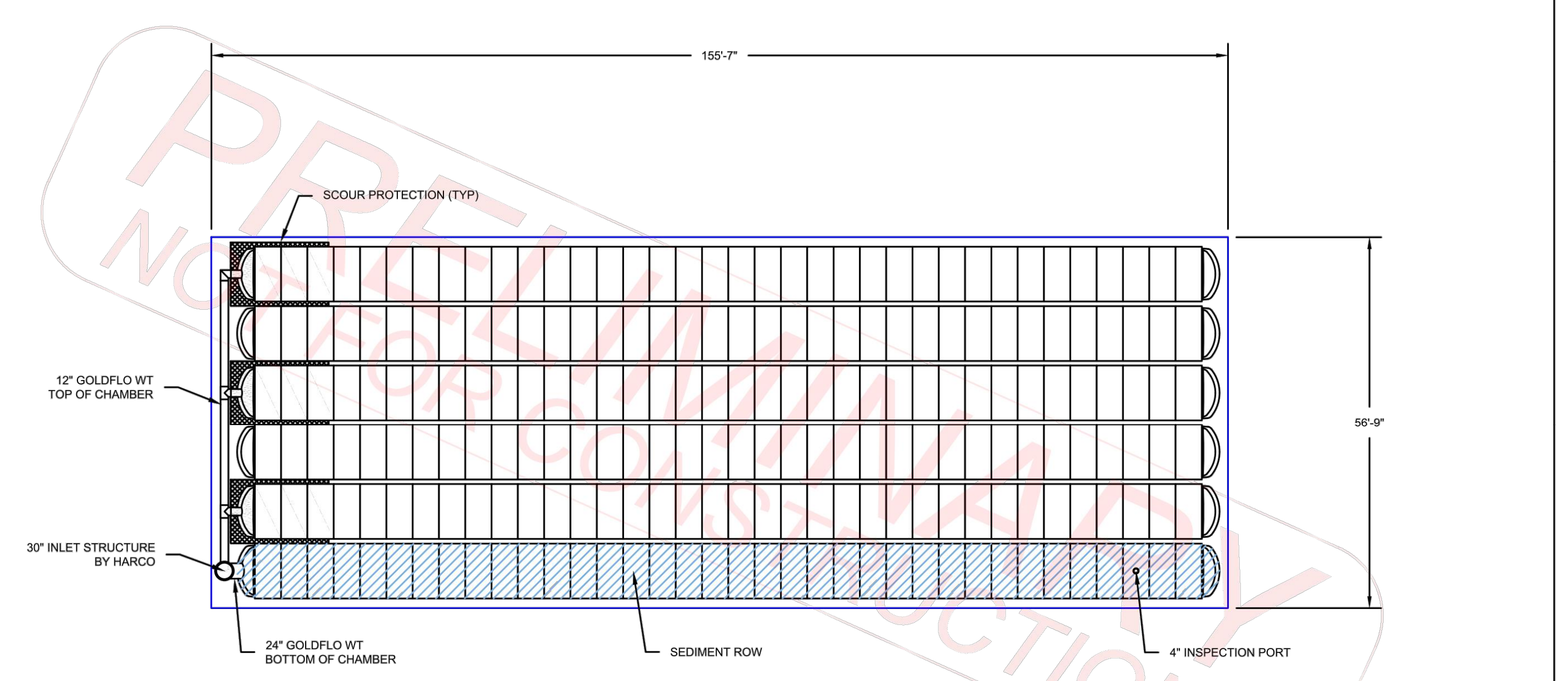
OVERLAY SYSTEM C

NTS



BILL OF MATERIALS - SYSTEM D					
PART	DESCRIPTION	QTY.	PART	DESCRIPTION	QTY.
D1	HYDROSTOR HS290 CHAMBER (HS290C)	216	D2	HYDROSTOR HS290 END CAP (HS290E)	8
D3	HYDROSTOR HS290 END CAP w/ 24" CORED HOLE BOTTOM (HS290E-24HB)	1	D4	24GF20NP (FIELD CUT PIPE FOR MANIFOLD)	20'
D5	HYDROSTOR HS290 END CAP w/ 12" CORED HOLE TOP (HS290E-12HT)	3	D6	12" GOLDFLO 90° ELBOW (GFE12902)	1
D7	12GF20NP (FIELD CUT PIPE FOR MANIFOLD)	60'	D8	12" GOLDFLO TEE (GFT1212)	2
D9	12" SPLIT COUPLER (SC12)	8			

TYPICAL ELEVATIONS - HS290 BEDS (ft)

MAXIMUM ALLOWABLE GRADE (TOP OF PAVEMENT/UNPAVED):	1150.21
MINIMUM ALLOWABLE GRADE (UNPAVED WITH TRAFFIC):	1144.71
MINIMUM ALLOWABLE GRADE (UNPAVED WITH NO TRAFFIC):	1144.21
MINIMUM ALLOWABLE GRADE (BASE OF FLEXIBLE PAVEMENT):	1144.21
MINIMUM ALLOWABLE GRADE (TOP OF RIGID CONCRETE PAVEMENT):	1144.21
TOP OF STONE (MIN):	1143.21
TOP OF CHAMBER:	1142.21
12" TOP OF CHAMBER (INVERT):	1140.55
24" BOTTOM OF CHAMBER (INVERT):	1137.50
BOTTOM OF CHAMBER (MIN):	1137.25
BOTTOM OF FOUNDATION STONE:	1136.50

PROPOSED SYSTEM LAYOUT HS290

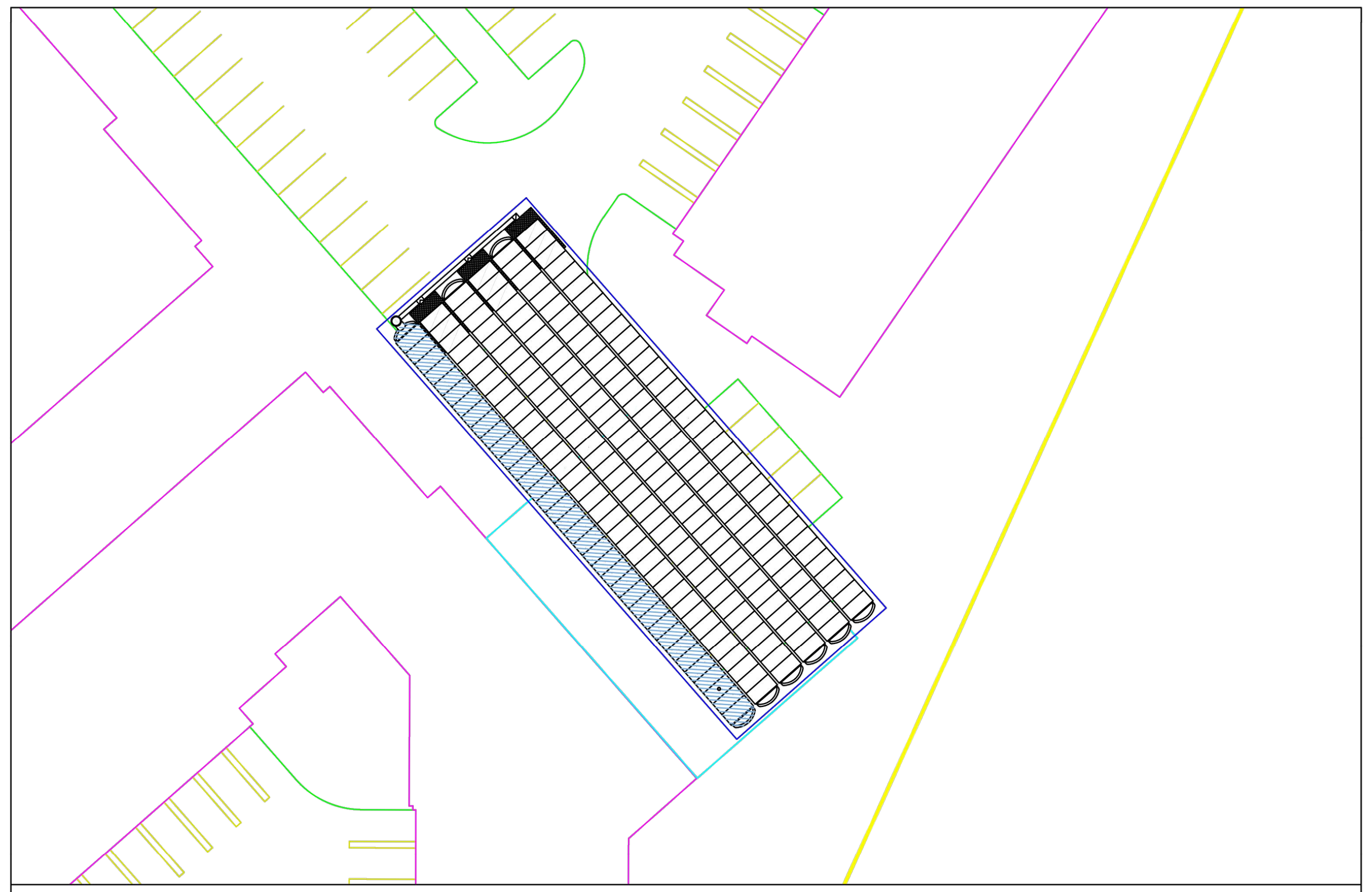
INSTALLED SYSTEM VOLUME (ft^3):	38,860
INSTALLED SYSTEM FOOTPRINT (ft^2):	9,074
SYSTEM PERIMETER (ft):	425
TOTAL CHAMBERS:	216
TOTAL END CAPS:	12
STONE REQUIRED (yd^3):	1,358
NON-WOVEN GEOTEXTILE (yd^2):	2,799
WOVEN GEOTEXTILE (yd^2):	212

PRINSCO ENGINEERED WITH INTEGRITY
1717 16TH ST. NE
WILLMAR, MN 56201
www.prinsco.com

TITLE: KIMLEY-HORN
MURRIETA, CA
REV: A
CHECKED BY: JTC
PRINSCO SALES CONTACT: Doug Berg: 323-680-8459
DRAWN BY: TJW
DATE: 13-Jan-22
DRAWING NUMBER: 22-020
SCALE: NTS
SHEET: 7 OF 8

PRINSCO SYSTEM D

NTS



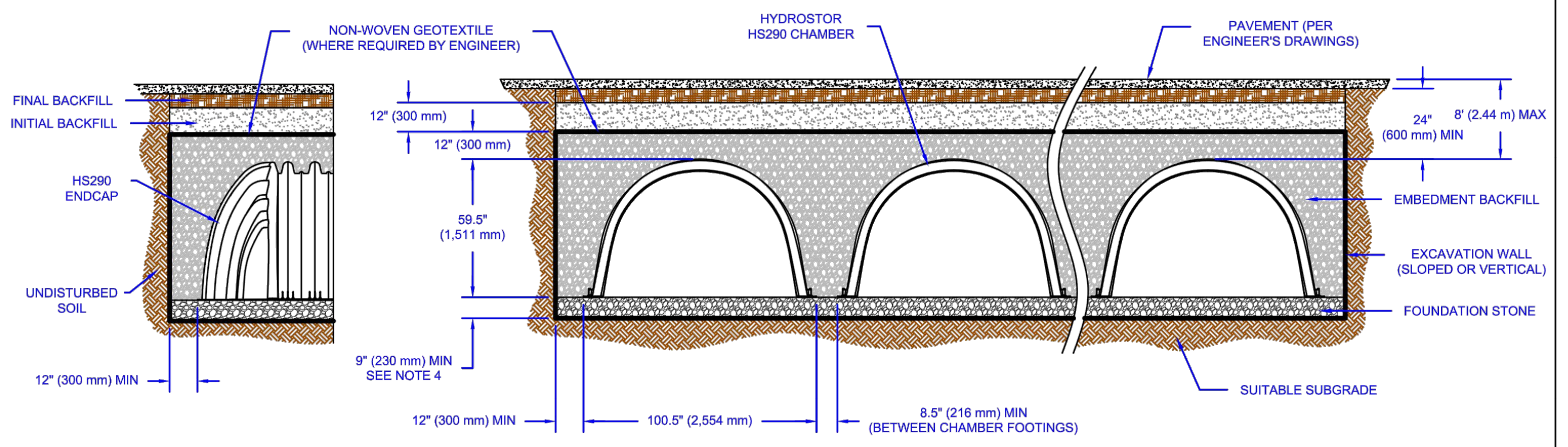
OVERLAY - SYSTEM D

PRINSCO ENGINEERED WITH INTEGRITY
1717 16TH ST. NE
WILLMAR, MN 56201
www.prinsco.com

TITLE: KIMLEY-HORN
MURRIETA, CA
REV: A
CHECKED BY: JTC
PRINSCO SALES CONTACT: Doug Berg: 323-680-8459
DRAWN BY: TJW
DATE: 13-Jan-22
DRAWING NUMBER: 22-020
SCALE: NTS
SHEET: 8 OF 8

OVERLAY SYSTEM D

NTS



NOTES:

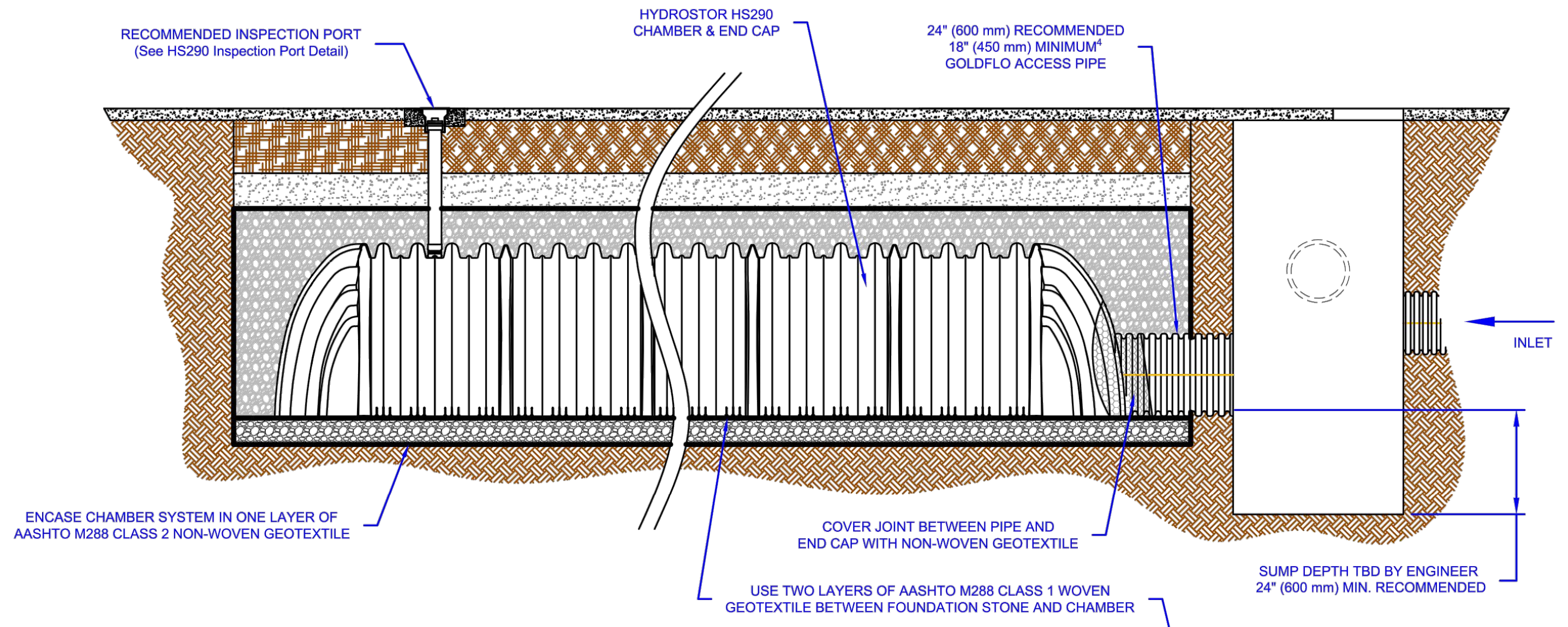
1. HYDROSTOR HS290 CHAMBERS SHALL BE DESIGNED IN ACCORDANCE WITH ASTM F2787 AND SHALL CONFORM TO THE REQUIREMENTS OF ASTM F2418. HS180 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURER'S LATEST INSTALLATION GUIDELINES.
2. **SUBGRADE:** TRENCH BOTTOMS WITH UNSTABLE OR UNYIELDING MATERIAL SHALL BE EXCAVATED TO A DEPTH DIRECTED BY THE ENGINEER AND REPLACED WITH SUITABLE MATERIAL. FOR UNSTABLE MATERIALS, GEOTEXTILE MAY BE USED TO STABILIZE THE TRENCH BOTTOM, IF DIRECTED BY THE ENGINEER. THE DESIGN ENGINEER IS RESPONSIBLE FOR VERIFYING SUBGRADE SUITABILITY.
3. **GEOTEXTILE:** A 4 oz/yd^2 (136 g/m^2) OR HEAVIER NON-WOVEN GEOTEXTILE FILTER FABRIC SHOULD BE USED FOR EMBEDMENT BACKFILL MATERIAL SIZED 3/4 - 1 1/2 INCH (19 - 38 mm). A 6 oz/yd^2 (203 g/m^2) NON-WOVEN GEOTEXTILE FILTER FABRIC SHOULD BE USED FOR EMBEDMENT BACKFILL MATERIAL SIZED 1 1/2 - 2 INCH (38 - 51 mm). GEOTEXTILE FILTER FABRIC IS PLACED AROUND THE SYSTEM TO PREVENT NATIVE SOIL FROM MIGRATING INTO THE EMBEDMENT BACKFILL MATERIAL. TO ENSURE FABRIC IS SUITABLE WITH IN SITU SOILS, A GEOTECHNICAL ENGINEER SHOULD BE CONSULTED.
4. **FOUNDATION STONE:** SUITABLE MATERIAL SHALL BE A 3/4 - 2 INCH (19 - 51 mm), WASHED, CRUSHED ANGULAR STONE, OR AASHTO M43 SIZES (3, 357, 4, 467, 5, 56, 57) WITH WASHED, CRUSHED, ANGULAR STONE ADDED TO THE GRADATION, e.g., WASHED, CRUSHED, ANGULAR #3 (AASHTO M43) STONE. MINIMUM FOUNDATION STONE THICKNESS TO BE DETERMINED BY DESIGN ENGINEER. MINIMUM OF 9" (230 mm) RECOMMENDED. REFER TO PRINSCO DESIGN MANUAL FOR ADDITIONAL GUIDANCE. COMPACTION SHOULD BE DONE IN LIFTS OF NO MORE THAN 9 INCHES (230 mm).
5. **EMBEDMENT BACKFILL:** SUITABLE MATERIAL SHALL BE A 3/4 - 2 INCH (19 - 51 mm), WASHED, CRUSHED ANGULAR STONE, OR AASHTO M43 SIZES (3, 357, 4, 467, 5, 56, 57) WITH WASHED, CRUSHED, ANGULAR STONE ADDED TO THE GRADATION, e.g., WASHED, CRUSHED, ANGULAR #3 (AASHTO M43) STONE. EMBEDMENT BACKFILL SHALL EXTEND FROM TOP OF BEDDING TO NOT LESS THAN 12 INCHES (300 mm) ABOVE THE TOP OF THE CHAMBER. NO COMPACTION IS REQUIRED BUT AN EFFORT SHOULD BE MADE TO HAND KNIFE STONE IN BETWEEN ALL CORRUGATIONS.
6. **INITIAL BACKFILL:** SUITABLE MATERIAL SHALL BE A GRANULAR, WELL GRADED SOIL WITH LESS THAN 35% FINES OR AASHTO M43 SIZES (3, 357, 4, 467, 5, 56, 57, 6, 67, 68, 7, 78, 8, 89, 9, 10). MOST PAVEMENT SUBBASE MATERIALS FALL WITHIN THIS GRADING CRITERIA. INITIAL BACKFILL SHALL EXTEND FROM TOP OF EMBEDMENT BACKFILL TO NOT LESS THAN 24 INCHES (600 mm) ABOVE THE TOP OF THE CHAMBER. COMPACT TO A MINIMUM OF 95% STANDARD PROCTOR DENSITY.
7. **FINAL BACKFILL:** SUITABLE MATERIALS SHALL BE ANY SOIL DIRECTED BY THE ENGINEER. FINAL BACKFILL SHALL EXTEND FROM TOP OF INITIAL BACKFILL TO NO MORE THAN 8 FEET (2.44 m) ABOVE THE TOP OF THE CHAMBER. COMPACTION LEVELS SHOULD FOLLOW ENGINEERS RECOMMENDATIONS.
8. **MINIMUM COVER:** FOR TRAFFIC APPLICATIONS A MINIMUM COVER OF 24 INCHES (600 mm) IS REQUIRED, MEASURED FROM THE TOP OF THE CHAMBER TO THE BOTTOM OF FLEXIBLE PAVEMENT OR TO THE TOP OF RIGID PAVEMENT. FOR UNPAVED INSTALLATIONS WHERE RUTTING MAY OCCUR, INCREASE COVER TO 30 INCHES (750 mm) FOR H-20 LOADING. ADDITIONAL COVER MAY BE REQUIRED FOR CONSTRUCTION LOADS.
9. **MAXIMUM COVER:** A COVER HEIGHT OF OVER 8 FEET (2.44 m) IS NOT RECOMMENDED. COVER HEIGHT IS MEASURED FROM THE TOP OF THE CHAMBER TO THE TOP OF THE PAVEMENT.
10. **LOAD RATING:** HS290 CHAMBERS ARE TRAFFIC RATED FOR H-20 VEHICLES WITH ADDITIONAL CONSIDERATION FOR LANE LOADING, COMMONLY REFERRED TO AS HL-93 LOAD RATING (AASHTO DESIGN TRUCK).

PRINSCO WATER MANAGEMENT SOLUTIONS
1717 16TH ST. NE
WILLMAR, MN 56201
www.prinsco.com

TITLE: HYDROSTOR HS290 - CROSS SECTION
DRAWN BY: TJW
DATE: 21-Dec-20
DRAWING NUMBER: D-7-500A
SCALE: NTS
SHEET: 1 OF 1

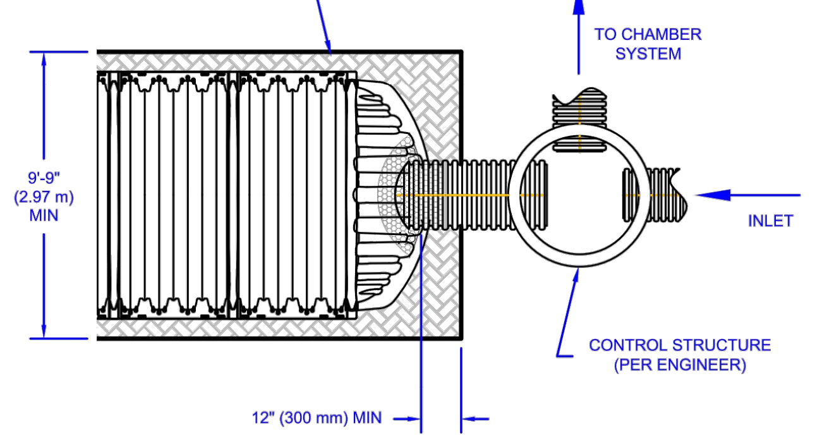
HYDROSTOR HS290: CROSS-SECTION

NTS



NOTES:

1. HYDROSTOR HS290 CHAMBERS SHALL BE DESIGNED IN ACCORDANCE WITH ASTM F2787 AND SHALL CONFORM TO THE REQUIREMENTS OF ASTM F2418. HS290 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURER'S LATEST INSTALLATION GUIDELINES.
2. **GEOTEXTILE:** TWO DIFFERENT GEOTEXTILES WILL BE USED IN CREATING A FUNCTIONING SEDIMENT ROW. TO ENSURE FABRIC IS SUITABLE WITH IN SITU SOILS, A GEOTECHNICAL ENGINEER SHOULD BE CONSULTED.
   - A NON-WOVEN GEOTEXTILE FILTER FABRIC 4 oz/yd^2 (136 g/m^2) OR HEAVIER SHOULD BE USED AROUND THE PERIMETER OF THE CHAMBER SYSTEM FOR EMBEDMENT BACKFILL MATERIAL SIZED 3/4 - 1 1/2 INCH (19-38 mm). A 6 oz/yd^2 (203 g/m^2) NON-WOVEN GEOTEXTILE FILTER FABRIC SHOULD BE USED FOR EMBEDMENT BACKFILL MATERIAL SIZED 1 1/2 - 2 INCH (38-51 mm). GEOTEXTILE FILTER FABRIC IS PLACED AROUND THE SYSTEM TO PREVENT NATIVE SOIL FROM MIGRATING INTO THE EMBEDMENT BACKFILL MATERIAL.
   - TWO LAYERS OF 6 oz/yd^2 (203 g/m^2) WOVEN FABRIC IS PLACED BETWEEN THE FOUNDATION AND THE CHAMBER FOR THE CREATION OF THE SEDIMENT ROW. THE TWO LAYERS PROVIDE A PROTECTIVE BARRIER FOR THE EMBEDMENT BACKFILL BUT STILL ALLOW WATER TO INFILTRATE INTO THE SYSTEM. THE WOVEN GEOTEXTILE IS DURABLE ENOUGH TO ALLOW JETTING TO CLEAN THE SEDIMENT ROW.
3. **INSPECTION AND MAINTENANCE**: INSPECTION OF THE SYSTEM SHOULD OCCUR BIANNUALLY TO ENSURE LARGE AMOUNTS OF SEDIMENT OR DEBRIS HAVE NOT BEEN DEPOSITED IN THE SEDIMENT ROW. DURING THE FIRST YEAR INSPECTION SHOULD OCCUR MORE FREQUENTLY DUE TO CONSTRUCTION SEDIMENT LOADING. TO CLEAN THE SYSTEM, A JET/VAC PROCESS CAN BE USED TO REMOVE SEDIMENT AND DEBRIS FROM THE SEDIMENT ROW. FOR MORE INFORMATION, REFER TO PRINSCO'S "RETENTION/DETENTION CLEANING AND MAINTENANCE" TECHNICAL NOTE.
4. **ACCESS PIPE**: PRINSCO RECOMMENDS A 24 INCH (600 mm) DIAMETER ACCESS PIPE TO THE SEDIMENT ROW. CONTACT YOUR LOCAL SALES REPRESENTATIVE WITH ANY QUESTIONS.

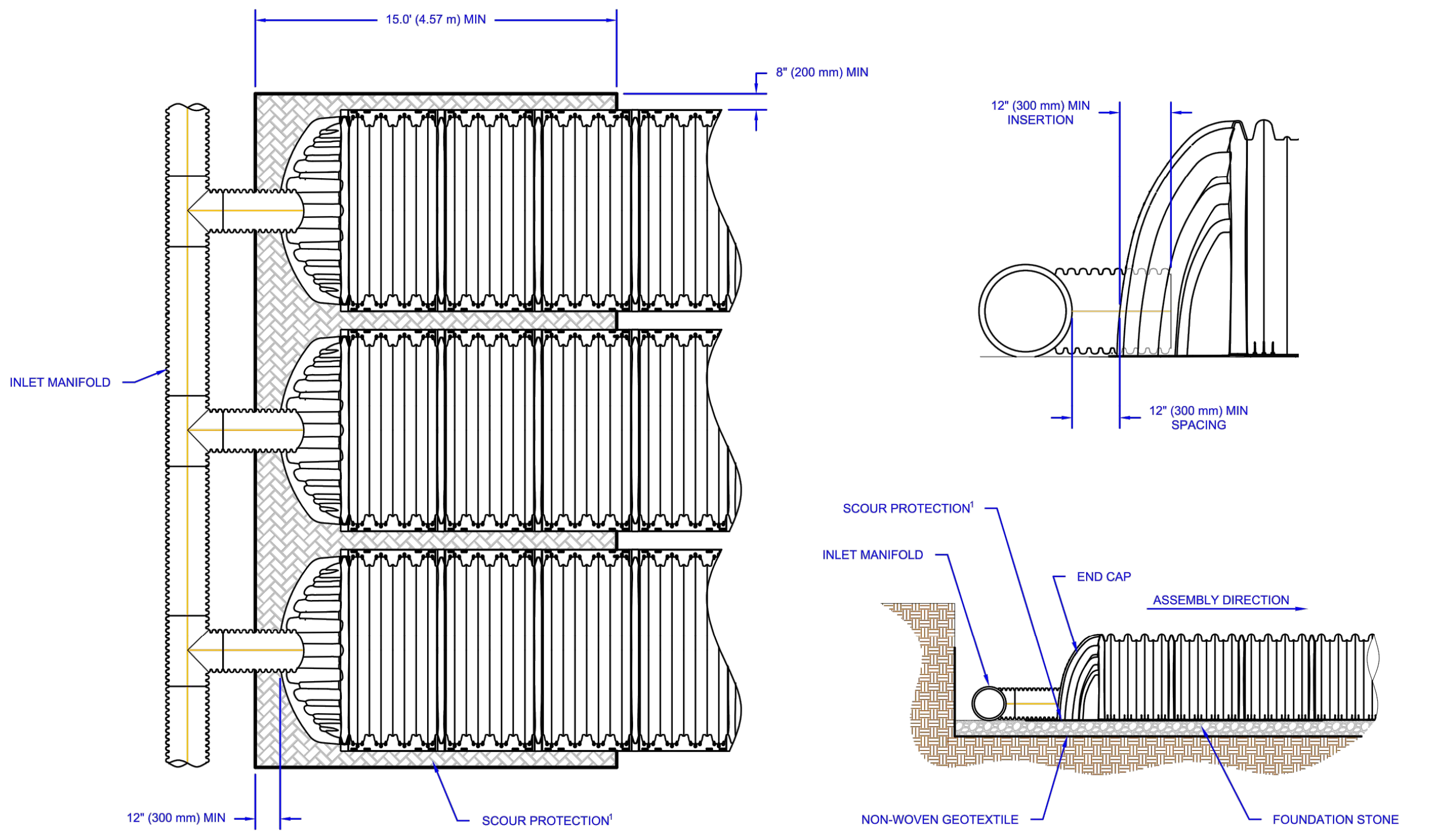


PRINSCO WATER MANAGEMENT SOLUTIONS
1717 16TH ST. NE
WILLMAR, MN 56201
www.prinsco.com

TITLE: HYDROSTOR HS290 - SEDIMENT ROW
DRAWN BY: TJW
DATE: 13-Apr-21
DRAWING NUMBER: D-7-502
SCALE: NTS
SHEET: 1 OF 1

HYDROSTOR HS290: SEDIMENT ROW

NTS



NOTES:

1. SCOUR PROTECTION SHOULD USE A MIN 6 oz/yd^2 (203 g/m^2) WOVEN GEOTEXTILE. GEOTEXTILE SHOULD MEET AASHTO M288 CLASS 1 SPECIFICATION.
2. SCOUR PROTECTION IS ONLY NEEDED WITH CHAMBER ROWS CONNECTED TO THE INLET MANIFOLD.

PRINSCO WATER MANAGEMENT SOLUTIONS
1717 16TH ST. NE
WILLMAR, MN 56201
www.prinsco.com

TITLE: HYDROSTOR HS290 - SCOUR PROTECTION
DRAWN BY: TJW
DATE: 28-Aug-20
DRAWING NUMBER: D-7-507
SCALE: NTS
SHEET: 1 OF 1

HYDROSTOR HS290: SCOUR PROTECTION

NTS

No.	REVISIONS	DATE	BY

Kimley»Horn

401 B STREET, SUITE 600; SAN DIEGO, CA 92101
PHONE: 619-234-9411
WWW.KIMLEY-HORN.COM

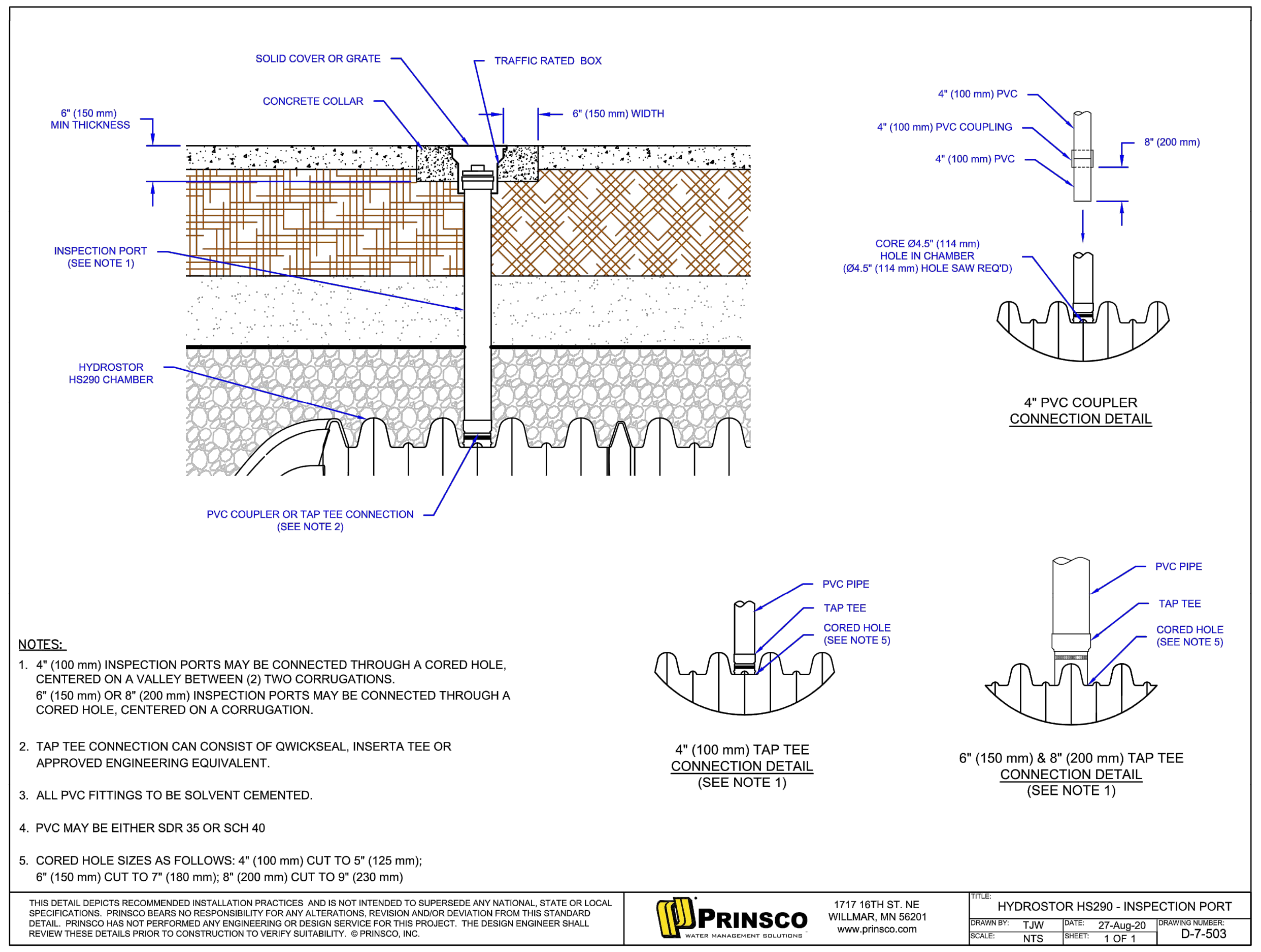
KHA PROJECT 195120004
DATE 1/28/2022
SCALE AS SHOWN
DESIGNED BY ___
DRAWN BY ___
CHECKED BY ___

STORM DRAIN DETAILS
FOR
THE TERRACES MURRIETA

CITY OF MURRIETA CA

SHEET NUMBER
7
OF
9

Plotted By:Gappy, Marta Sheet Set:Kha Layout:SD DETAILS 3 January 28, 2022 11:44:31am \\SNDFP01\CA_SND1\SND_LDEV\195120004 - The Terraces Murrieta\Design\PlanSheets - Entitlements\STORM DETAILS .dwg



NOTES:

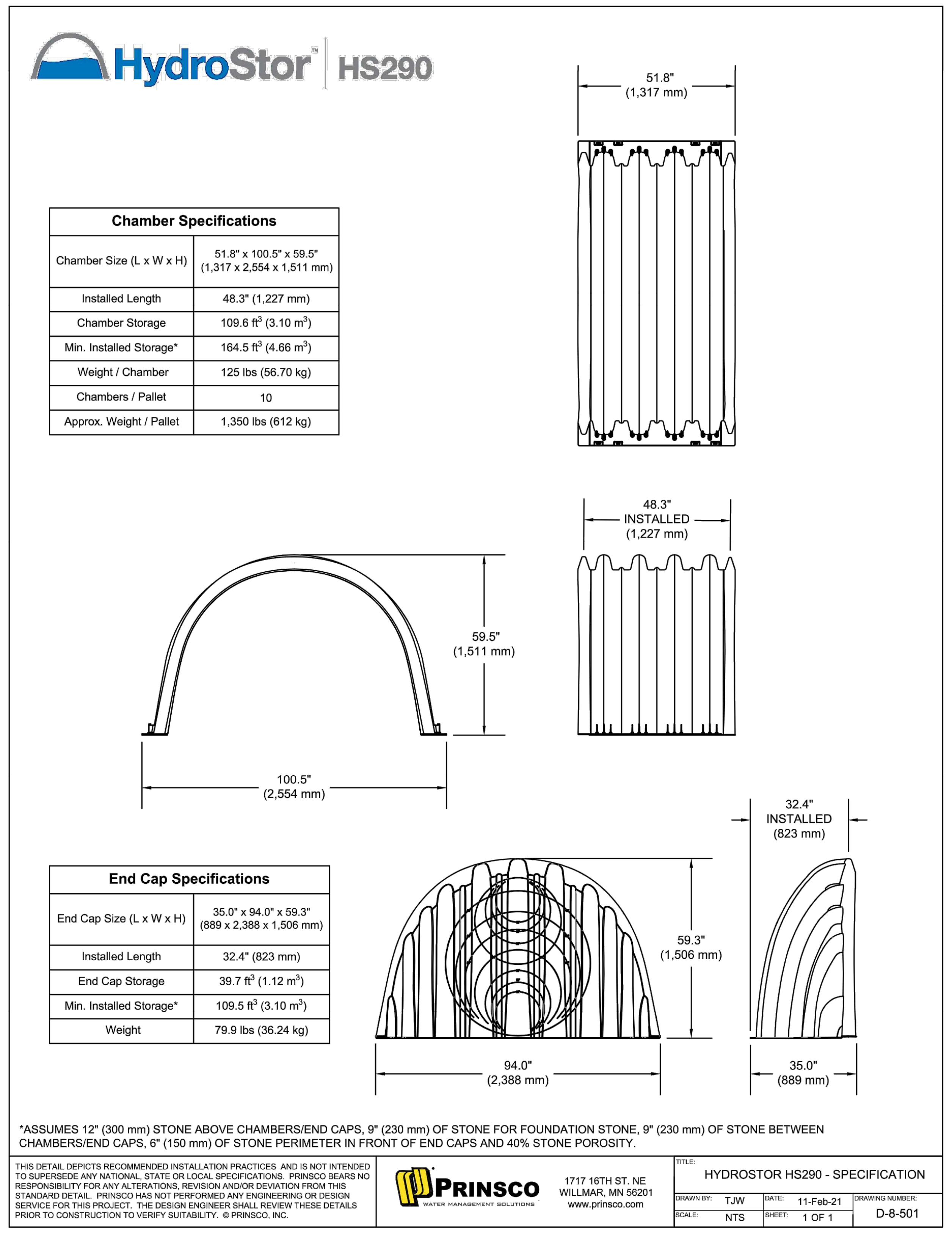
1. 4" (100 mm) INSPECTION PORTS MAY BE CONNECTED THROUGH A CORED HOLE, CENTERED ON A VALLEY BETWEEN (2) TWO CORRUGATIONS.
   6" (150 mm) OR 8" (200 mm) INSPECTION PORTS MAY BE CONNECTED THROUGH A CORED HOLE, CENTERED ON A CORRUGATION.
2. TAP TEE CONNECTION CAN CONSIST OF QWICKSEAL, INSERTA TEE OR APPROVED ENGINEERING EQUIVALENT.
3. ALL PVC FITTINGS TO BE SOLVENT CEMENTED.
4. PVC MAY BE EITHER SDR 35 OR SCH 40
5. CORED HOLE SIZES AS FOLLOWS: 4" (100 mm) CUT TO 5" (125 mm); 6" (150 mm) CUT TO 7" (180 mm); 8" (200 mm) CUT TO 9" (230 mm)

PRINSCO WATER MANAGEMENT SOLUTIONS
1717 16TH ST. NE
WILLMAR, MN 56201
www.prinsco.com

TITLE: HYDROSTOR HS290 - INSPECTION PORT
DRAWN BY: TJW
DATE: 27-Aug-20
DRAWING NUMBER: D-7-503
SCALE: NTS
SHEET: 1 OF 1

HYDROSTOR HS290: INSPECTION PORT

NTS



Chamber Specifications	
Chamber Size (L x W x H)	51.8" x 100.5" x 59.5" (1,317 x 2,554 x 1,511 mm)
Installed Length	48.3" (1,227 mm)
Chamber Storage	109.6 ft^3 (3.10 m^3)
Min. Installed Storage*	164.5 ft^3 (4.66 m^3)
Weight / Chamber	125 lbs (56.70 kg)
Chambers / Pallet	10
Approx. Weight / Pallet	1,350 lbs (612 kg)

End Cap Specifications	
End Cap Size (L x W x H)	35.0" x 94.0" x 59.3" (889 x 2,388 x 1,506 mm)
Installed Length	32.4" (823 mm)
End Cap Storage	39.7 ft^3 (1.12 m^3)
Min. Installed Storage*	109.5 ft^3 (3.10 m^3)
Weight	79.9 lbs (36.24 kg)

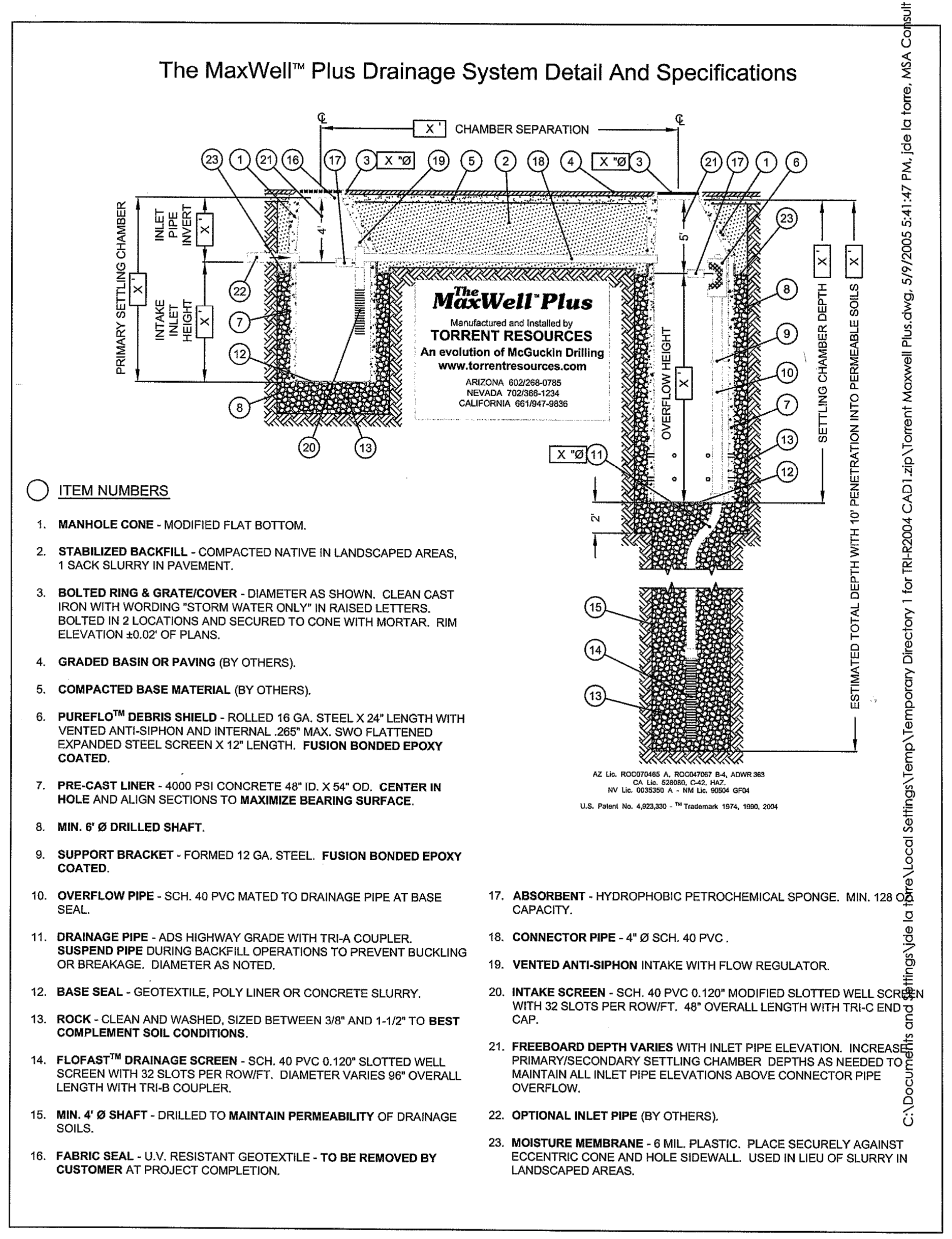
*ASSUMES 12" (300 mm) STONE ABOVE CHAMBERS/END CAPS, 9" (230 mm) OF STONE FOR FOUNDATION STONE, 9" (230 mm) OF STONE BETWEEN CHAMBERS/END CAPS, 6" (150 mm) OF STONE PERIMETER IN FRONT OF END CAPS AND 40% STONE POROSITY.

PRINSCO WATER MANAGEMENT SOLUTIONS
1717 16TH ST. NE
WILLMAR, MN 56201
www.prinsco.com

TITLE: HYDROSTOR HS290 - SPECIFICATION
DRAWN BY: TJW
DATE: 11-Feb-21
DRAWING NUMBER: D-8-501
SCALE: NTS
SHEET: 1 OF 1

HYDROSTOR HS290: SPECIFICATION

NTS



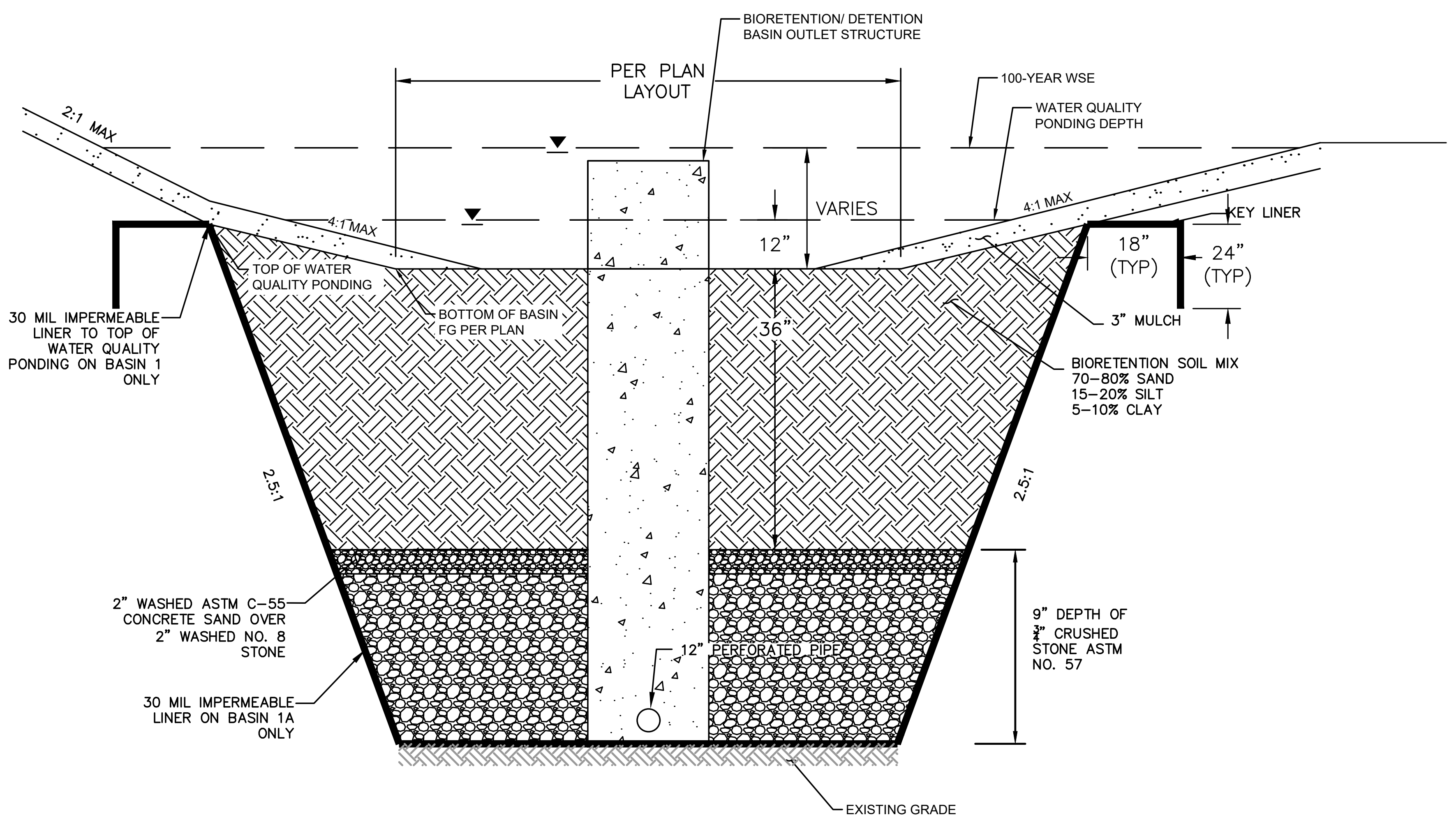
The MaxWell™ Plus Drainage System Detail And Specifications

○ ITEM NUMBERS

1. **MANHOLE CONE** - MODIFIED FLAT BOTTOM.
2. **STABILIZED BACKFILL** - COMPACTED NATIVE IN LANDSCAPED AREAS, 1 SACK SLURRY IN PAVEMENT.
3. **BOLTED RING & GRATE/COVER** - DIAMETER AS SHOWN. CLEAN CAST IRON WITH WORDING "STORM WATER ONLY" IN RAISED LETTERS. BOLTED IN 2 LOCATIONS AND SECURED TO CONE WITH MORTAR. RIM ELEVATION ±0.02' OF PLANS.
4. **GRADED BASIN OR PAVING** (BY OTHERS).
5. **COMPACTED BASE MATERIAL** (BY OTHERS).
6. **PUREFLO^{TM} DEBRIS SHIELD** - ROLLED 16 GA. STEEL X 24" LENGTH WITH VENTED ANTI-SIPHON AND INTERNAL .265" MAX. SWO FLATTENED EXPANDED STEEL SCREEN X 12" LENGTH. **FUSION BONDED EPOXY COATED.**
7. **PRE-CAST LINER** - 4000 PSI CONCRETE 48" ID. X 54" OD. **CENTER IN HOLE** AND ALIGN SECTIONS TO **MAXIMIZE BEARING SURFACE**.
8. **MIN. 6' Ø DRILLED SHAFT**.
9. **SUPPORT BRACKET** - FORMED 12 GA. STEEL. **FUSION BONDED EPOXY COATED**.
10. **OVERFLOW PIPE** - SCH. 40 PVC MATED TO DRAINAGE PIPE AT BASE SEAL.
11. **DRAINAGE PIPE** - ADS HIGHWAY GRADE WITH TRI-A COUPLER. **SUSPEND PIPE** DURING BACKFILL OPERATIONS TO PREVENT BUCKLING OR BREAKAGE. DIAMETER AS NOTED.
12. **BASE SEAL** - GEOTEXTILE, POLY LINER OR CONCRETE SLURRY.
13. **ROCK** - CLEAN AND WASHED, SIZED BETWEEN 3/8" AND 1-1/2" TO **BEST COMPLEMENT SOIL CONDITIONS**.
14. **FLOFAST^{TM} DRAINAGE SCREEN** - SCH. 40 PVC 0.120" SLOTTED WELL SCREEN WITH 32 SLOTS PER ROW/FT. DIAMETER VARIES 96" OVERALL LENGTH WITH TRI-B COUPLER.
15. **MIN. 4' Ø SHAFT** - DRILLED TO **MAINTAIN PERMEABILITY** OF DRAINAGE SOILS.
16. **FABRIC SEAL** - U.V. RESISTANT GEOTEXTILE - **TO BE REMOVED BY CUSTOMER** AT PROJECT COMPLETION.
17. **ABSORBENT** - HYDROPHOBIC PETROCHEMICAL SPONGE. MIN. 128 OZ CAPACITY.
18. **CONNECTOR PIPE** - 4" Ø SCH. 40 PVC .
19. **VENTED ANTI-SIPHON** INTAKE WITH FLOW REGULATOR.
20. **INTAKE SCREEN** - SCH. 40 PVC 0.120" MODIFIED SLOTTED WELL SCREEN WITH 32 SLOTS PER ROW/FT. 48" OVERALL LENGTH WITH TRI-C END CAP.
21. **FREEBOARD DEPTH VARIES** WITH INLET PIPE ELEVATION. INCREASE PRIMARY/SECONDARY SETTLING CHAMBER DEPTHS AS NEEDED TO MAINTAIN ALL INLET PIPE ELEVATIONS ABOVE CONNECTOR PIPE OVERFLOW.
22. **OPTIONAL INLET PIPE** (BY OTHERS).
23. **MOISTURE MEMBRANE** - 6 MIL. PLASTIC. PLACE SECURELY AGAINST ECCENTRIC CONE AND HOLE SIDEWALL. USED IN LIEU OF SLURRY IN LANDSCAPED AREAS.

TORRENT RESOURCES DRY WELL DETAIL

NTS



TYPICAL BIORETENTION/ DETENTION BASIN

NTS

No.	REVISIONS	DATE	BY

Kimley»Horn

401 B STREET, SUITE 600; SAN DIEGO, CA 92101
PHONE: 619-234-9411
WWW.KIMLEY-HORN.COM

KHA PROJECT 195120004
DATE 1/28/2022
SCALE AS SHOWN
DESIGNED BY ___
DRAWN BY ___
CHECKED BY ___

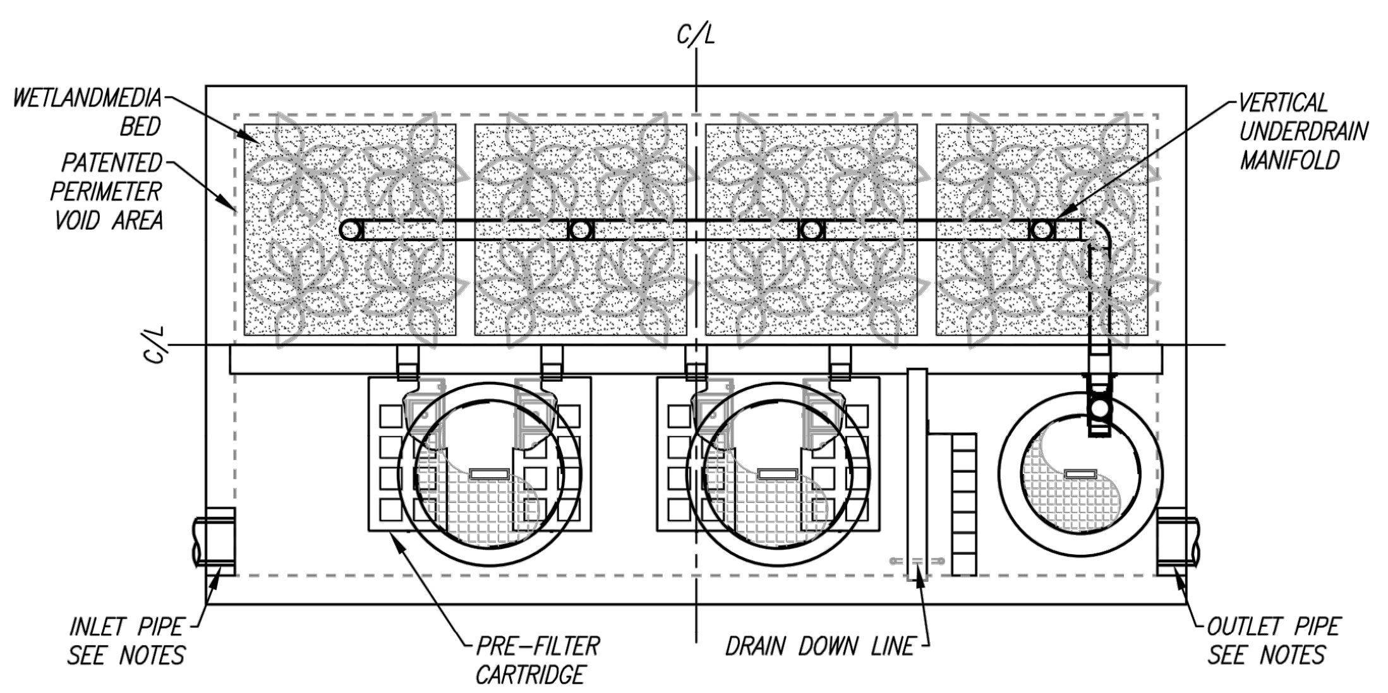
STORM DRAIN DETAILS
FOR
THE TERRACES MURRIETA

CITY OF MURRIETA CA

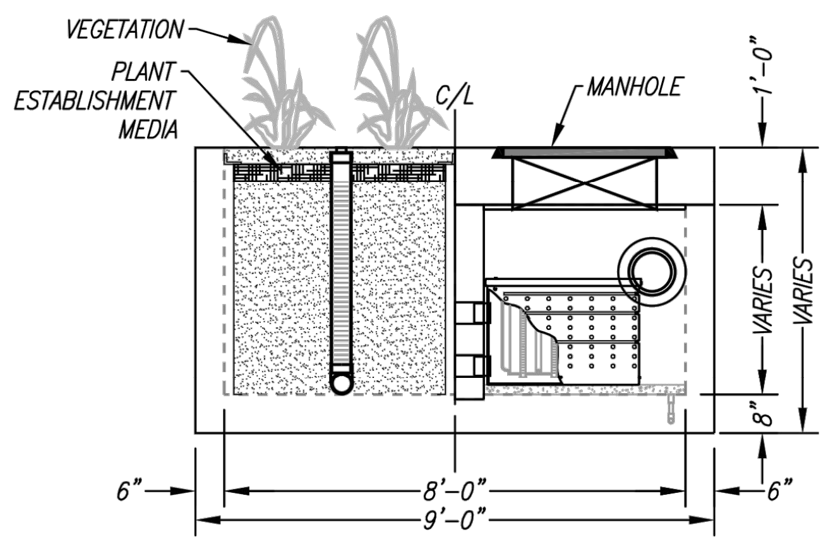
SHEET NUMBER 8 OF 9

SITE SPECIFIC DATA			
PROJECT NUMBER			
PROJECT NAME			
PROJECT LOCATION			
STRUCTURE ID			
TREATMENT REQUIRED			
VOLUME BASED (CF)		FLOW BASED (CFS)	
N/A		0.462	
PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE			OFFLINE
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE 1			
INLET PIPE 2	N/A	N/A	N/A
OUTLET PIPE			
	PRETREATMENT	BIOFILTRATION	DISCHARGE
RIM ELEVATION			
SURFACE LOAD	PEDESTRIAN		
FRAME & COVER	2EA ø30"	OPEN PLANTER	ø24"
NOTES:			

* PRELIMINARY NOT FOR CONSTRUCTION



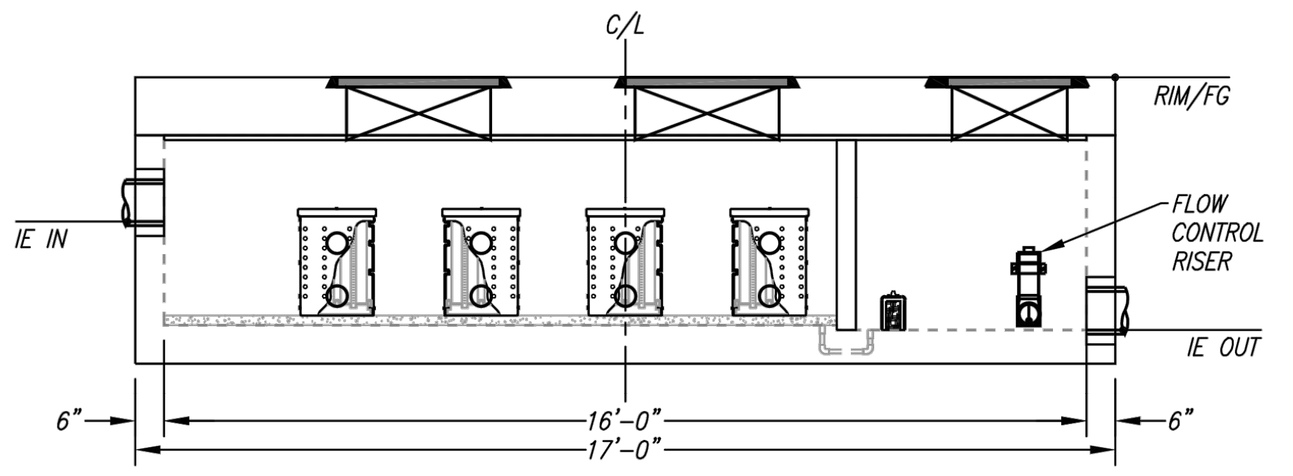
PLAN VIEW



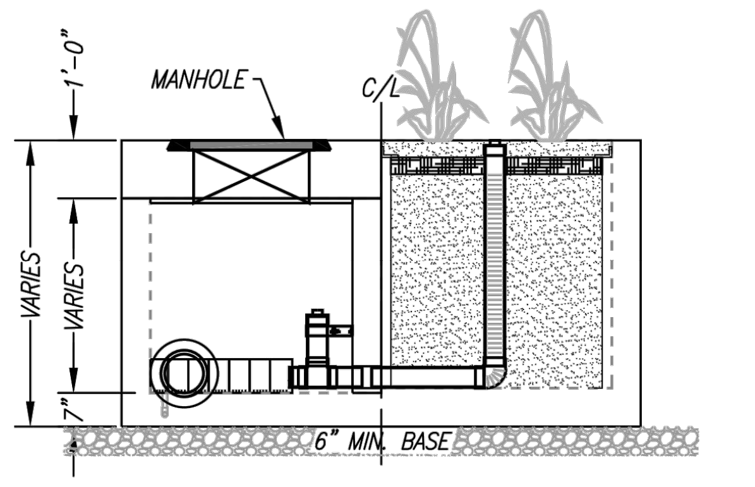
LEFT END VIEW

INSTALLATION NOTES

1. CONTRACTOR TO PROVIDE ALL LABOR, EQUIPMENT, MATERIALS AND INCIDENTALS REQUIRED TO OFFLOAD AND INSTALL THE SYSTEM AND APPURTENANCES IN ACCORDANCE WITH THIS DRAWING AND THE MANUFACTURERS SPECIFICATIONS, UNLESS OTHERWISE STATED IN MANUFACTURERS CONTRACT.
2. UNIT MUST BE INSTALLED ON LEVEL BASE. MANUFACTURER RECOMMENDS A MINIMUM 6" LEVEL ROCK BASE UNLESS SPECIFIED BY THE PROJECT ENGINEER. CONTRACTOR IS RESPONSIBLE TO VERIFY PROJECT ENGINEERS RECOMMENDED BASE SPECIFICATIONS.
4. CONTRACTOR TO SUPPLY AND INSTALL ALL EXTERNAL CONNECTING PIPES. ALL PIPES MUST BE FLUSH WITH INSIDE SURFACE OF CONCRETE. (PIPES CANNOT INTRUDE BEYOND FLUSH). INVERT OF OUTFLOW PIPE MUST BE FLUSH WITH DISCHARGE CHAMBER FLOOR. ALL PIPES SHALL BE SEALED WATER TIGHT PER MANUFACTURERS STANDARD CONNECTION DETAIL.
5. CONTRACTOR RESPONSIBLE FOR INSTALLATION OF ALL RISERS, MANHOLES, AND HATCHES. CONTRACTOR TO GROUT ALL MANHOLES AND HATCHES TO MATCH FINISHED SURFACE UNLESS SPECIFIED OTHERWISE.
6. VEGETATION SUPPLIED AND INSTALLED BY OTHERS. ALL UNITS WITH VEGETATION MUST HAVE DRIP OR SPRAY IRRIGATION SUPPLIED AND INSTALLED BY OTHERS.
7. CONTRACTOR RESPONSIBLE FOR CONTACTING BIO CLEAN FOR ACTIVATION OF UNIT. MANUFACTURERS WARRANTY IS VOID WITH OUT PROPER ACTIVATION BY A BIO CLEAN REPRESENTATIVE.



ELEVATION VIEW



RIGHT END VIEW

TREATMENT FLOW (CFS)	0.462
OPERATING HEAD (FT)	3.4
PRETREATMENT LOADING RATE (GPM/SF)	2.0
WETLAND MEDIA LOADING RATE (GPM/SF)	1.0

GENERAL NOTES

1. MANUFACTURER TO PROVIDE ALL MATERIALS UNLESS OTHERWISE NOTED.
2. ALL DIMENSIONS, ELEVATIONS, SPECIFICATIONS AND CAPACITIES ARE SUBJECT TO CHANGE. FOR PROJECT SPECIFIC DRAWINGS DETAILING EXACT DIMENSIONS, WEIGHTS AND ACCESSORIES PLEASE CONTACT BIO CLEAN.

5/23/19TOLEE

MODULAR WETLANDS
THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING US PATENTS: 7,425,262; 7,470,362; 7,674,378; 8,303,816; RELATED FOREIGN PATENTS OR OTHER PATENTS PENDING

PROPRIETARY AND CONFIDENTIAL:
THE INFORMATION CONTAINED IN THIS DOCUMENT IS THE SOLE PROPERTY OF FORTERRA AND ITS COMPANIES. THIS DOCUMENT, NOR ANY PART THEREOF, MAY BE USED, REPRODUCED OR MODIFIED IN ANY MANNER WITH OUT THE WRITTEN CONSENT OF FORTERRA.

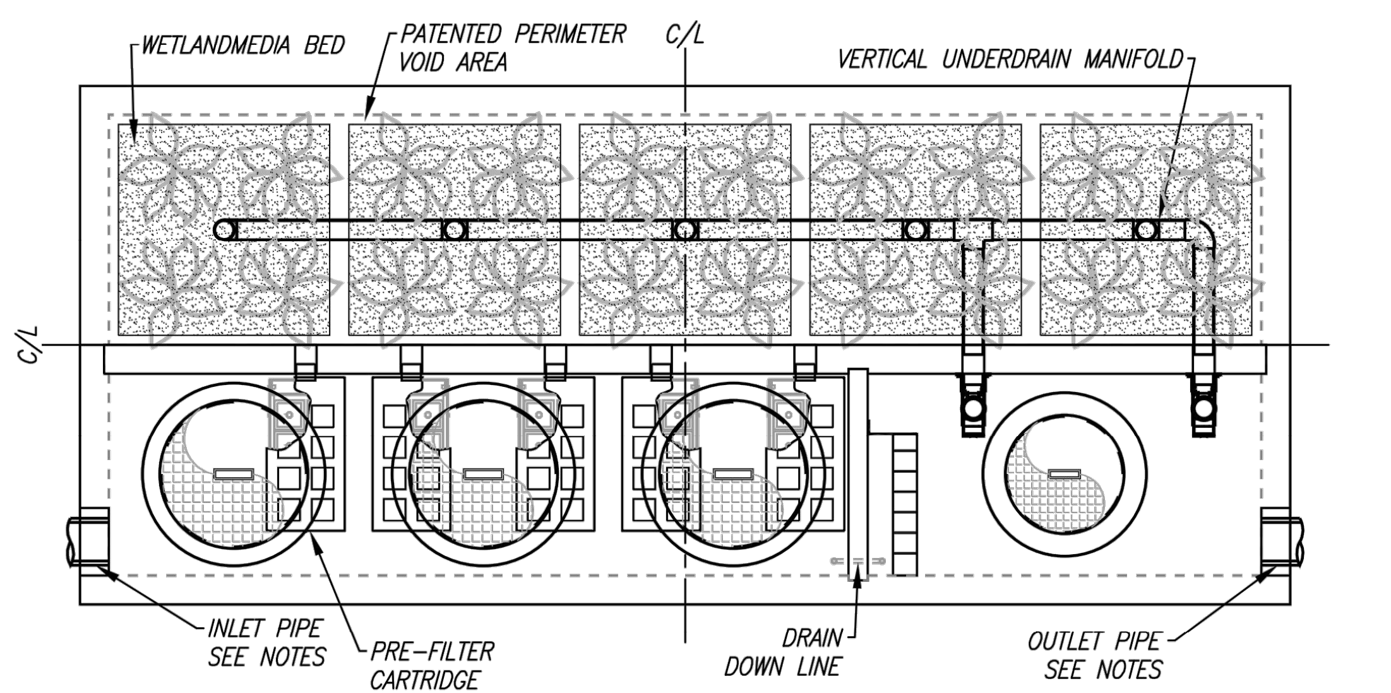
MWS-L-8-16-V
STORMWATER BIOFILTRATION SYSTEM
STANDARD DETAIL

BIOCLEAN MWS-L-8-16-V DETAIL

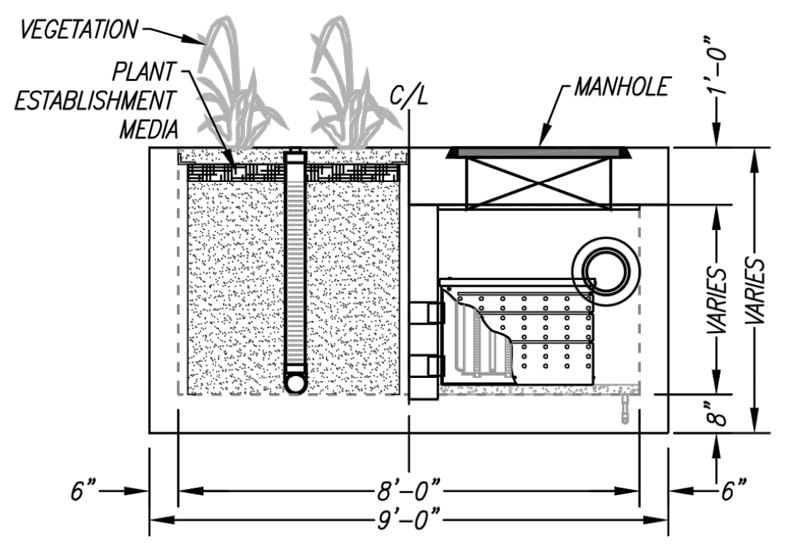
NTS

SITE SPECIFIC DATA			
PROJECT NUMBER			
PROJECT NAME			
PROJECT LOCATION			
STRUCTURE ID			
TREATMENT REQUIRED			
VOLUME BASED (CF)		FLOW BASED (CFS)	
N/A		0.577	
PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE			OFFLINE
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE 1			
INLET PIPE 2	N/A	N/A	N/A
OUTLET PIPE			
	PRETREATMENT	BIOFILTRATION	DISCHARGE
RIM ELEVATION			
SURFACE LOAD	PEDESTRIAN		
FRAME & COVER	3EA ø30"	OPEN PLANTER	ø24"
NOTES:			

* PRELIMINARY NOT FOR CONSTRUCTION



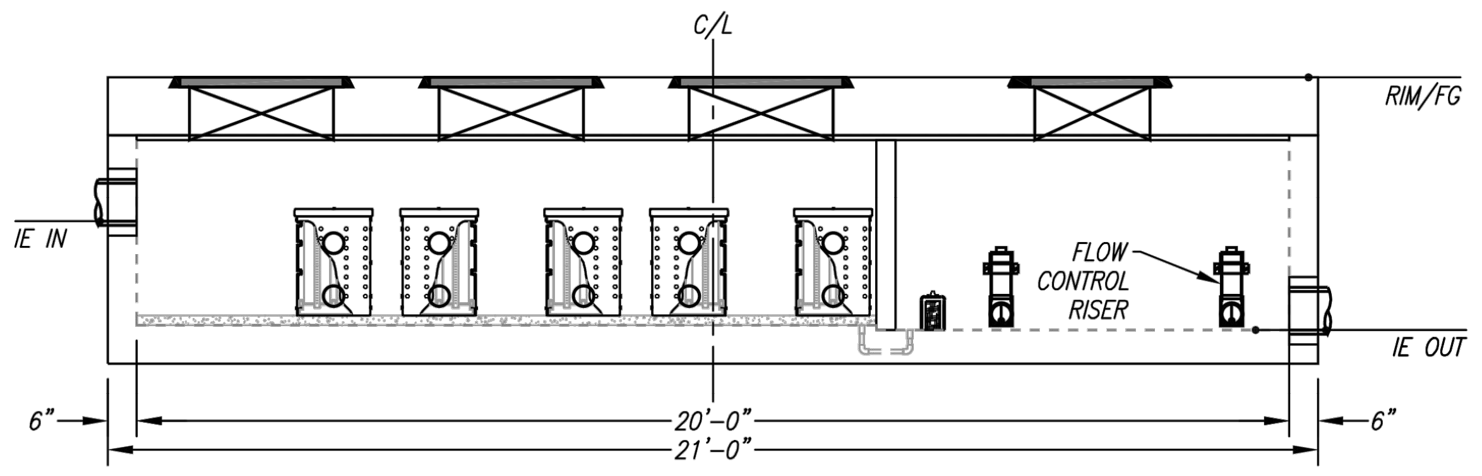
PLAN VIEW



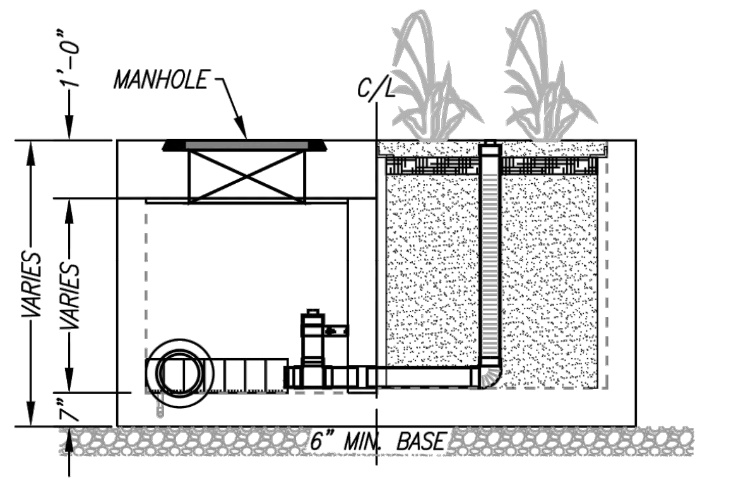
LEFT END VIEW

INSTALLATION NOTES

1. CONTRACTOR TO PROVIDE ALL LABOR, EQUIPMENT, MATERIALS AND INCIDENTALS REQUIRED TO OFFLOAD AND INSTALL THE SYSTEM AND APPURTENANCES IN ACCORDANCE WITH THIS DRAWING AND THE MANUFACTURERS SPECIFICATIONS, UNLESS OTHERWISE STATED IN MANUFACTURERS CONTRACT.
2. UNIT MUST BE INSTALLED ON LEVEL BASE. MANUFACTURER RECOMMENDS A MINIMUM 6" LEVEL ROCK BASE UNLESS SPECIFIED BY THE PROJECT ENGINEER. CONTRACTOR IS RESPONSIBLE TO VERIFY PROJECT ENGINEERS RECOMMENDED BASE SPECIFICATIONS.
4. CONTRACTOR TO SUPPLY AND INSTALL ALL EXTERNAL CONNECTING PIPES. ALL PIPES MUST BE FLUSH WITH INSIDE SURFACE OF CONCRETE. (PIPES CANNOT INTRUDE BEYOND FLUSH). INVERT OF OUTFLOW PIPE MUST BE FLUSH WITH DISCHARGE CHAMBER FLOOR. ALL PIPES SHALL BE SEALED WATER TIGHT PER MANUFACTURERS STANDARD CONNECTION DETAIL.
5. CONTRACTOR RESPONSIBLE FOR INSTALLATION OF ALL RISERS, MANHOLES, AND HATCHES. CONTRACTOR TO GROUT ALL MANHOLES AND HATCHES TO MATCH FINISHED SURFACE UNLESS SPECIFIED OTHERWISE.
6. VEGETATION SUPPLIED AND INSTALLED BY OTHERS. ALL UNITS WITH VEGETATION MUST HAVE DRIP OR SPRAY IRRIGATION SUPPLIED AND INSTALLED BY OTHERS.
7. CONTRACTOR RESPONSIBLE FOR CONTACTING BIO CLEAN FOR ACTIVATION OF UNIT. MANUFACTURERS WARRANTY IS VOID WITH OUT PROPER ACTIVATION BY A BIO CLEAN REPRESENTATIVE.



ELEVATION VIEW



RIGHT END VIEW

TREATMENT FLOW (CFS)	0.577
OPERATING HEAD (FT)	3.4
PRETREATMENT LOADING RATE (GPM/SF)	2.0
WETLAND MEDIA LOADING RATE (GPM/SF)	1.0

GENERAL NOTES

1. MANUFACTURER TO PROVIDE ALL MATERIALS UNLESS OTHERWISE NOTED.
2. ALL DIMENSIONS, ELEVATIONS, SPECIFICATIONS AND CAPACITIES ARE SUBJECT TO CHANGE. FOR PROJECT SPECIFIC DRAWINGS DETAILING EXACT DIMENSIONS, WEIGHTS AND ACCESSORIES PLEASE CONTACT BIO CLEAN.

5/23/19TOLEE

MODULAR WETLANDS
THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING US PATENTS: 7,425,262; 7,470,362; 7,674,378; 8,303,816; RELATED FOREIGN PATENTS OR OTHER PATENTS PENDING

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MWS-L-8-20-V
STORMWATER BIOFILTRATION SYSTEM
STANDARD DETAIL

BIOCLEAN MWS-L-8-20-V DETAIL

NTS

Plotted By:Gappy, Maria Sheet Set:Kha Layout:SD DETAILS 4 January 28, 2022 11:44:32am \\SNDFP01\CA_SND\1SND_LDEV\195120004 - The Terraces Murrieta\Design\PlanSheets - Entitlements\STORM DETAILS .dwg

No.	REVISIONS	DATE	BY

401 B STREET, SUITE 600; SAN DIEGO, CA 92101
PHONE: 619-234-9411
WWW.KIMLEY-HORN.COM

KHA PROJECT 195120004
DATE 1/28/2022
SCALE AS SHOWN
DESIGNED BY ___
DRAWN BY ___
CHECKED BY ___

STORM DRAIN DETAILS
FOR
THE TERRACES MURRIETA

CITY OF MURRIETA CA

SHEET NUMBER
9
OF
9

Appendix 3: Soils Information

Geotechnical Study, Other Infiltration Testing Data, and/or Other Documentation

Examples of material to provide in Appendix 3 may include but are not limited to the following:

- Geotechnical Study/Report prepared for the project,
- Additional soils testing data (if not included in the Geotechnical Study),
- Exhibits/Maps/Other Documentation of the Hydrologic Soils Groups (HSG)s at the project site.

This information should support the Full Infiltration Applicability, and Biofiltration Applicability sections of this Template. Refer to Section 2.3 of the SMR WQMP and Sections A and D of this Template.

ALTA CALIFORNIA
GEOTECHNICAL INC.

170 North Maple Street, Suite 108
Corona, CA 92880
www.altageotechnical.com

GREYSTAR
620 Newport Center Drive, 15th Floor
Irvine, California 92660

October 25, 2021
Project No. 1-0410

Attention: Mr. Adam Covington

Subject: ***UPDATED GEOTECHNICAL REPORT***
The Terraces Murrieta
City of Murrieta, California

References: See Appendix A

Dear Mr. Covington:

Presented herein is Alta California Geotechnical, Inc.'s (Alta) updated geotechnical report for Terraces Murrieta project, a proposed development located near Murrieta Hot Springs Road and Interstate 15, in the City of Murrieta. This report is based on Alta's recent subsurface investigation, laboratory testing, a review of the Grading and Drainage Concept plan by Psomas, and a review of the referenced reports.

Also included in this report are:

- Discussion of the site geotechnical conditions.
- Seismic hazards evaluation.
- Recommendations for remedial and site grading, including unsuitable soil removals.
- Geotechnical site construction recommendations.
- Foundation design parameters.

If you have any questions or should you require any additional information, please contact the undersigned at (951) 509-7090. Alta appreciates the opportunity to provide geotechnical consulting services for your project.

Sincerely,
Alta California Geotechnical, Inc.

FERNANDO RUIZ
Civil Engineering Associate

JAMES COYNE
Engineering Geology Associate

Reviewed By:

SCOTT A. GRAY/RGE 2857
Reg. Exp.: 12-31-22
Registered Geotechnical Engineer
President

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THOMAS J. MCCARTHY/CEG 2080
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Engineering Geologist
Vice President

THOMAS J. McCARTHY
No. CEG 2080
Exp. 9-30-22

Distribution: (1) Addressee
JBC: 1-0410, October 25, 2021 (Updated Geotechnical Report, The Terraces Murrieta)

1.0 INTRODUCTION

The following report presents Alta's findings, conclusions, and geotechnical recommendations for the Terraces Murrieta project, the proposed development located near Murrieta Hot Springs Road and Interstate 15, in the City of Murrieta, California

1.1 Purpose

The purpose of this report is to examine the existing onsite geotechnical conditions and assess the impacts that the geotechnical conditions may have on the proposed development as depicted on the enclosed Grading and Drainage Concept plan (Plate 1) provided by Psomas. This report is suitable for use in developing grading plans and engineer's cost estimates.

1.2 Scope of Work

Alta's *Scope of Work* for this geotechnical investigation included the following:

- Review of the referenced literature, maps, reports and aerial photos (Appendix A).
- Site geologic mapping.
- Excavating, logging, and sampling twenty (20) hollow-stem auger borings to a maximum depth of 46-feet below the existing ground surface (Appendix B).
- Conducting laboratory testing on samples obtained during our investigation (Appendix C).
- Compiling previous subsurface and laboratory data from the referenced reports (Appendices B-1 and C-1).
- Performing an infiltration study on one (1) additional boring to provide an assessment of the infiltration characteristics of the onsite soil and it's impact on storm water disposal.
- Evaluating engineering geologic and geotechnical engineering data, including laboratory data, to develop recommendations for site remedial grading, import soil, foundations and utilities.
- Preparing this report and accompanying exhibits.

1.3 Report Limitations

The conclusions and recommendations presented in this report are based on the field and laboratory information generated during this investigation, and a review of the referenced reports. The information contained in this report is intended to be used for the development of grading plans and preliminary construction cost estimates.

2.0 PROJECT DESCRIPTION

2.1 Site Location and Existing Conditions

The irregular-shaped, approximately 42.0-acre site consists of two northwest trending ridges and intervening valleys. The site is located north of Murrieta Hot Springs Road and east of Interstate 15 in the City of Murrieta. Drainage is generally to the southwest. The site is bounded to the southeast and southwest by Interstate 15 and Murrieta Hot Springs Road, respectively, to the northwest by Vista Murrieta Road, and to the northeast by Sparkman Court.

Historic aerial photographs (Historic Aerials, 2021) indicate that the site was vacant until 1978 when several structures were constructed on the western ridge and central valley. By 1996, five structures were present along the western ridge. By 2002, some grading activities cleared vegetation on the eastern ridge and artificial fill was placed in portions of the central valley. By 2012, the onsite structures were demolished with only the concrete pads remaining and the site has remained relatively unchanged since.

2.2 Proposed Development

Based on the Grading and Drainage Concept plan, it is our understanding that the site will be developed to support eleven (11) multi-family structures with associated parking lots and roads. Alta anticipates that conventional cut-and-fill grading techniques will be used to develop the site for the support of wood-frame construction with shallow foundations and reinforced concrete slabs-on-grade, and associated improvements.

3.0 SITE INVESTIGATION

3.1 Current Subsurface Investigation

Alta conducted a subsurface investigation on September 27 through 29 of 2021, consisting of the excavation, logging and select sampling of twenty (20) hollow-stem auger borings up to a maximum depth of 46.0 feet below the existing ground surface. The locations of the exploratory excavations are shown on Plate 1 and the logs are presented in Appendix B.

Laboratory testing was performed on ring and bulk samples obtained during the field investigation. A brief description of the laboratory test procedures and the test results are presented in Appendix C.

3.2 Previous Subsurface Investigation

Alta reviewed the previous subsurface investigation reports prepared by Geocon, Inc. (Geocon, 2016). Geocon's investigation consisted of excavating, logging and select sampling of eight (8) hollow-stem auger borings and excavating six (6) additional borings for infiltration testing. Logs of their subsurface excavations are presented in Appendix B-1 of this report. The locations of their excavations are shown on Plate 1.

Laboratory testing was performed by Geocon on samples obtained during their field investigation. Their test results are presented in Appendix C-1 of this report.

3.3 Infiltration Testing

It is Alta's understanding that the project may utilize infiltration systems for storm water disposal. Details of the system are not known at this time.

Infiltration testing was undertaken using one (1) thirty-foot-deep boring (PH-1). The testing was performed in general accordance with the County of Riverside standards. The test well was presoaked at least 24 hours prior to testing. During testing, the water level readings were recorded every 30 minutes until the readings stabilized.

The data was then adjusted to provide an infiltration rate utilizing the Porchet Method. The resulting infiltration rate is presented in Table 3-1. The results do not include a factor of safety. Recommendations for infiltration BMP design are presented in Section 6.3.

Table 3-1-Summary of Infiltration Testing
(No Factor of Safety)

Test Designation	PH-1
Approximate Depth of Test	30 ft
Time Interval	30 minutes
Radius of Test Hole	4 inches
Tested Infiltration Rate	0.11 (in/hr)

4.0 GEOLOGIC CONDITIONS

4.1 Geologic and Geomorphic Setting

Regionally, the subject site is located in the Peninsular Ranges geomorphic province, which characterizes the southwest portion of southern California where major right lateral active fault zones predominately trend northwest southeast. The Peninsular Ranges province is composed of plutonic and metamorphic rock, with lesser amounts of Tertiary volcanic and sedimentary rock, Quaternary drainage in-fills and sedimentary veneers.

4.2 Stratigraphy

Based on Alta's review of geologic literature, our subsurface investigation and the previous investigation, the project site is underlain by undocumented artificial fill, alluvium and the Pauba Formation. The geologic units are briefly described below.

4.2.1 Undocumented Artificial Fill (Map symbol afu)

The undocumented artificial fill observed at the site consists mainly of brown to grayish brown silty sand in a dry, medium dense to dense condition. The unit was logged to a depth of 6 feet below the ground surface.

4.2.2 Alluvium (Map symbol Qal)

Alluvium exists in the northwestern and eastern portions of the site and consists of tan to brown Sand, Silty Sand, and Clayey Sand in a dry to slightly moist and medium dense to dense condition. The unit was encountered to a depth of fifteen (15) feet below the surface.

4.2.3 Pauba Formation (Sandstone Member) (Map symbol Qps)

Underlying the site is the Pleistocene age Pauba Formation which consists of a brown to dark brown, reddish brown, gray, and tan to orange fine to coarse grained sandstone, silty sandstone, and clayey sandstone in a dry to slightly moist and dense to very dense condition. The unit was encountered to a depth of forty-six (46) feet below the existing ground surface.

4.3 Geologic Structure

4.3.1 Tectonic Framework

Jennings (1985) defined eight structural provinces within California that have been classified by predominant regional fault trends and similar fold structure. These provinces are in turn divided into blocks and sub-blocks that are defined by “major Quaternary faults.” These blocks and sub-blocks exhibit similar structural features. Within this framework the site is located within Structural Province I, which is controlled by the dominant northwest trend of the San Andreas Fault and is divided into two blocks, the Coast Range Block and the Peninsular Range Block. The Peninsular Range Block, on which the site is located, is characterized by a series of parallel, northwest trending faults that exhibit right lateral dip-slip movement. These faults are terminated by the Transverse Range block to the north and extend southward into the Baja Peninsula. These northwest trending faults divide the Peninsular Range block into eight sub-blocks. The site is located on the Riverside sub-block, which is bound on the west by the Elsinore-Whittier fault zone and on the east by San Jacinto fault zone.

4.3.2 Regionally Mapped Active Faults

Several large, active fault systems, including the Elsinore-Whittier, the San Jacinto, and the San Andreas, occur in the region surrounding the site. These fault systems have been studied extensively and in a large part control the geologic structure of southern California.

4.3.3 Geologic Structure

Based upon our site investigation and literature review, the onsite sediments and bedrock are not folded or faulted.

4.4 Groundwater

Geocon encountered groundwater in boring B-2 at approximately 15.9 feet below the existing ground surface. Alta did not encounter groundwater during our investigation up to a depth of 46.0 feet below the ground surface. Groundwater data from two nearby wells, State Well No. 07S03W16H001S and 07S03W15N002S, showed that groundwater was approximately 33 and 101 feet below the ground surface, respectively, in February of 1968.

4.5 Earthquake Hazards

The subject site is located in southern California, which is a tectonically active area. The type and magnitude of seismic hazards affecting a site are dependent on the distance to the causative fault and the intensity and magnitude of the seismic event. The seismic hazard may be primary, such as surface rupture and/or ground shaking, or secondary, such as liquefaction and/or ground lurching.

4.5.1 Local and Regional Faulting

The site is located on the northern portion of the Riverside sub-block, approximately 6.5 miles east of the Elsinore Fault, 13.4 miles west of the San Jacinto Fault, and approximately 29.2 miles southwest of the San Andreas fault zone.

A review of the Riverside County mapping portal (RCIT, 2021) indicates that the northern portion of the site is within a Riverside County fault zone related to the Murrieta Hot Springs Fault which is located 0.08 miles north of the site. The previous investigation by Geocon (Geocon, 2016) concluded that faulting was not present onsite. However, no trenching was accomplished to verify this conclusion.

4.5.2 Seismicity

Ground shaking hazards caused by earthquakes along other active regional faults do exist. The 2019 California Building Code requires use-modified spectral accelerations and velocities for most structural designs. Seismic design parameters using soil profile types identified in the 2019 California Building Code are presented in Section 7.3.

4.5.3 Surface Rupture

Active faults are not known to exist within the project and a review of Special Publication 42 indicates the site is not within a California State designated Earthquake Fault Zone. Accordingly, the potential for fault surface rupture on the subject site is very low.

4.5.4 Liquefaction

Seismic agitation of relatively loose saturated sands, silty sands, and some silts can result in a buildup of pore pressure. If the pore pressure exceeds the overburden stresses, a temporary quick condition known as liquefaction can occur. Liquefaction effects can manifest in several ways including: 1) loss of bearing; 2) lateral spread; 3) dynamic settlement; and 4) flow failure. Lateral spreading has typically been the most damaging mode of failure.

In general, the more recent that a sediment has been deposited, the more likely it will be susceptible to liquefaction. Other factors that must be considered are groundwater, confining stresses, relative density, and the intensity and duration of seismically-induced ground shaking.

Based on the dense nature of the Pauba Formaiton, the potential for liquefaction to occur below the proposed residential development is considered nil upon the completion of the remedial grading recommended herein.

4.5.5 Dry Sand Settlement

Dry sand settlement is the process of settlement of the ground surface during a seismic event in sand layers. Based on our subsurface investigation, the previous subsurface investigation and our removal/recompaction recommendations, the potential for dry sand settlement is anticipated to be negligible.

4.6 Regional Subsidence

The southwestern portion of the site is located in an area designated as having active susceptibility to subsidence by the County of Riverside (RCIT, 2021). Upon implementation of the remedial grading recommendations presented herein, the effects of subsidence on the development are considered to be negligible.

5.0 ENGINEERING PROPERTIES AND ANALYSIS

5.1 Materials Properties

Presented herein is a general discussion of the engineering properties of the onsite materials that will be encountered during construction of the proposed project. Descriptions of the soil (Unified Soil Classification System) and in-place moisture/density results are presented on the boring logs in Appendix B.

5.1.1 Excavation Characteristics

Based on the data provided from the subsurface investigation, it is our opinion that a majority of the onsite materials possess favorable excavation characteristics such that conventional earth moving equipment can be utilized. However, given the density of the Pauba Formation, moderate to heavy ripping may be required, resulting in slower production rates.

5.1.2 Compressibility

The undocumented artificial fill, alluvium and the uppermost portions of the Pauba Formation are considered compressible and unsuitable to support the proposed improvements. Recommended removal depths are presented in Section 6.1.2.

5.1.3 Hydro-Consolidation

Hydro-consolidation is the effect of introducing water into soil that is prone to collapse. Upon loading and initial wetting, the soil structure and apparent strength are altered resulting in almost immediate settlement. That settlement can have adverse impacts on engineered structures, particularly in areas where it is manifested differentially. Differential settlements are typically associated with differential wetting, irregularities in the subsurface soil conditions, and/or irregular loading patterns.

Based on laboratory testing from our investigation and the previous investigation (Appendix C and C-1), there is potential for hydro-collapse in the uppermost portion of alluvium. As such, it is recommended to utilize the unsuitable soil removal recommendations presented in Section 6.1.2 to remove this condition.

5.1.4 Expansion Potential

Expansion index testing was performed on samples taken during our subsurface investigation and the previous investigation (Appendix C and C-1). Based on the results and review of the logs, it is anticipated that the majority of materials onsite vary from “very low” to “low” in expansion potential (0≤EI≤50) when tested per ASTM D: 4829. However, there are silt and claystone layers with medium to highly expansive soils. Recommendations for this material are presented in Section 6.2.3.

5.1.5 Shear Strength Characteristics

Direct shear testing was performed to assist in the development of shear strength characteristics of the onsite soils. The values presented in Table 5-1 are based on our laboratory testing, the previous laboratory testing and our experience in the area.

TABLE 5-1
Shear Strength Characteristics

Geologic Unit	Cohesion, C (psf)	Friction Angle, ϕ (degrees)
Engineered Artificial Fill	150	30
Pauba Formation (Qps)	180	32

5.1.6 Earthwork Adjustments

The values presented in Table 5-2 are deemed appropriate for estimating purposes and may be used in an effort to balance earthwork quantities. As is the case with every project, contingencies should be made to adjust the earthwork balance when grading is in-progress and actual conditions are better defined.

TABLE 5-2
Earthwork Adjustment Factors

Geologic Unit	Adjustment Factor Range	Average
Artificial Fill – Undocumented/Alluvium	Shrink 2% to 6%	4%
Pauba Formation	Shrink 0% to 4%	2%

5.1.7 Chemical Analyses

Chemical testing was performed on samples of material collected during our investigation and the previous investigation. Soluble sulfate test results indicate that the soluble sulfate concentrations of the soils tested are classified as negligible (Class S0) per ACI 318-14.

Negligible chloride levels were detected in the onsite soils. Resistivity testing conducted as part of this investigation, indicates that the soils are "mildly corrosive to corrosive" to buried metals (per Romanoff, 1989). Additional discussions on corrosion are presented in Section 7.9. Corrosion tests results are presented in Appendix C and C-1.

5.2 Engineering Analysis

Presented below is a general discussion of the engineering analysis methods that were utilized to develop the conclusions and recommendations presented in this report.

5.2.1 Bearing Capacity and Lateral Earth Pressures

Ultimate bearing capacity values were obtained using the graphs and formula presented in NAVFAC DM-7.1. Allowable bearing was determined by applying a factor of safety of at least 3 to the ultimate bearing capacity. Static lateral earth pressures were calculated using Rankine methods for active and passive cases. If it is desired to use Coulomb forces, a separate analysis specific to the application can be conducted.

5.2.2 Slope Stability

Slope stability analyses were performed using STEDwin in conjunction with GSTABL7V2 computer code. Slope stability analyses have been conducted on anticipated cut slopes. Slope stability calculation results are presented in Appendix D.

6.0 CONCLUSIONS AND RECOMMENDATIONS

Based on Alta's findings during our subsurface investigation, the laboratory test results, the previous investigation and our staff's experience in the area, it is Alta's opinion that the development of the site is feasible from a geotechnical perspective. Presented below are recommendations that should be incorporated into site development and construction plans.

6.1 Remedial Grading Recommendations

All grading shall be accomplished under the observation and testing of the project geotechnical consultant in accordance with the recommendations contained herein and the City of Murrieta criteria.

6.1.1 Site Preparation

Vegetation, construction debris, and other deleterious materials are unsuitable as structural fill material and should be disposed of off-site prior to commencing grading/construction. Any septic tanks, seepage pits or wells should be abandoned as per the County of Riverside Department of Health Services.

6.1.2 Unsuitable Soil Removals

Presented below are the unsuitable soil removal recommendations for the onsite geologic units below the proposed building pads. Removal bottoms should be observed by the Project Geotechnical Consultant to make a final determination that suitable, competent soils have been exposed. Removals should be completed as per Plate G-1 and G-2 (Appendix G). Anticipated removal depths are shown on the attached Plate 1. In general, removals shall expose competent alluvium or Pauba Formation.

6.1.2.1 **Undocumented Artificial Fill** (Map symbol afu)

The undocumented artificial onsite is compressible. As such, it is anticipated that this unit will require complete removal and recompaction to project specifications prior to fill placement. It is anticipated that removal depths will range from five (5) to seven (7) feet, with possible deeper localized areas.

6.1.2.2 **Alluvium** (Map Symbol Qal)

The uppermost portion of alluvium onsite is subject to hydro-collapse. As such, it is anticipated that this unit will require partial removal and recompaction to project specifications prior to fill placement. It is anticipated that removal depths in this unit will be three (3) to sixteen (16) feet.

6.1.2.3 **Pauba Formation** (Map Symbol Qps)

The highly weathered portions of the Pauba Formation are unsuitable to support the proposed fills and/or structures and should be removed and recompacted to project specifications. It is anticipated that the upper two (2) to three (3) feet will require removal and recompaction to project specifications prior to fill placement.

6.1.3 **Over-Excavation of Building Pads**

6.1.3.1 **Cut/Fill Transition Pads**

Where cut/fill transitions occur across building pads, Alta recommends that the cut and shallow fill portions be over-excavated and replaced with compacted fill in order to provide uniform bearing conditions.

The depth of the over-excavation should provide a minimum of three (3) feet of fill beneath the building and sufficiently deep to provide a minimum thickness of 1/3 of the maximum fill thickness beneath the building envelop, as shown on Plate G-16 (Appendix G).

The undercuts should be extended at least five (5) feet outside of perimeter footings. The proposed undercuts should be graded such that a gradient of at least one (1) percent is maintained towards deeper fill areas or toward the front of the pad. The final extent of the undercut should be verified in the field during grading. Replacement fills should be compacted to project specifications as discussed in Section 6.2.1.

6.1.3.2 Cut Pads

Alta recommends that the cut pads underlain by Pauba Formation should be over-excavated and replaced with compacted fill in order to facilitate improvement construction. The depth of the over-excavation should provide a minimum of three (3) feet of fill beneath the building pad. The undercuts should be extended at least five (5) outside of perimeter footings. The proposed undercuts should be graded such that a gradient of at least one (1) percent is maintained towards the front of the pad or toward deeper fill areas if present. The final extent of the undercut should be verified in the field during grading. Replacement fills should be compacted to project specifications as discussed in Section 6.2.1.

6.1.4 Over-Excavation of Street Areas

Deeper excavations within the Pauba Formation may encounter slow production rates due to the density of the unit, although it is anticipated that conventional heavy equipment can excavate these deposits. These potential slower production rates should be taken into consideration in determining if over-excavation of streets is beneficial. Consideration should be given to undercutting underground utility and storm drain zones to at least one (1) foot below the deepest utility within Pauba Formation areas in order to facilitate the construction of these improvements.

6.2 General Earthwork Recommendations

6.2.1 Compaction Standards

All fill and processed natural ground shall be compacted to a minimum relative compaction of 90 percent, as determined by ASTM Test Method: D-1557. Fills below subdrains, should be compacted to a minimum relative compaction of 93 percent, as determined by ASTM Test Method: D-1557, as detailed on Plate G-16 (Appendix G).

Fill material should be moisture conditioned to optimum moisture or above, and as generally discussed in Alta's Earthwork Specification Section presented in Appendix F. Compaction shall be achieved with the use of sheepsfoot rollers or similar kneading type equipment. Mixing and moisture conditioning will be required in order to achieve the recommended moisture conditions.

6.2.2 Groundwater/Seepage

It is anticipated that groundwater will not be encountered during construction of the project. It is possible that perched water conditions could be encountered depending on the time of year construction occurs.

6.2.3 Expansive Soils

As noted in Section 5.1.5, there are medium to high expansive soils onsite, particularly in the claystone layers shown on the boring logs. It is recommended that medium expansive soil be placed at least five (5) feet below finished pad grade and highly expansive material be placed at least seven (7) feet below finished pad grade to reduce costs on foundation design. Alternately, the foundations may be designed for the expansive material.

Expansive material can also be placed as engineered fill outside the building footprints, provided the improvement design recommendations presented in Section 7.0 are implemented.

6.2.4 Documentation of Removals

All removal/over-excavation bottoms should be observed and approved by the project Geotechnical Consultant prior to fill placement. Consideration should be given to surveying the removal bottoms and undercuts after approval by the geotechnical consultant and prior to the placement of fill. Staking should be provided in order to verify undercut locations and depths.

6.2.5 Treatment of Removal Bottoms

At the completion of removals/over-excavation, the exposed removal bottom should be ripped to a minimum depth of eight (8) inches, moisture-conditioned to above optimum moisture content and compacted in-place to the project standards.

6.2.6 Fill Placement

After removals, scarification, and compaction of in-place materials are completed, additional fill may be placed. Fill should be placed in eight-inch bulk maximum lifts, moisture conditioned to optimum moisture content or above, compacted and tested as grading/construction progresses until final grades are attained.

6.2.7 Moisture Content

The moisture content of the upper in-situ soils varies, as shown on the boring logs presented in Appendix B and B-1. Moisture conditioning should be anticipated during grading to achieve optimum or above conditions. Most soils will require the addition of water and mixing prior to placement as compacted fill.

6.2.8 Mixing

Mixing of materials may be necessary to prevent layering of different soil types and/or different moisture contents. The mixing should be accomplished prior to and as part of compaction of each fill lift.

6.2.9 Import Soils

Import soils, if necessary, should consist of clean, structural quality, compactable materials similar to the on-site soils and should be free of trash, debris or other objectionable materials. The project Geotechnical Consultant should be notified not less than 72 hours in advance of the locations of any soils proposed for import. Import sources should be sampled, tested, and approved by the project Geotechnical Consultant at the source prior to the importation of the soils to the site. The project Civil Engineer should include these requirements on plans and specifications for the project.

6.2.10 Fill Slope Construction

Fill slopes should be overfilled to an extent determined by the contractor, but not less than two (2) feet measured perpendicular to the slope face, so that when trimmed back to the compacted core a minimum 90 percent relative compaction is achieved.

Compaction of each fill lift should extend out to the temporary slope face. Back-rolling during mass filling at intervals not exceeding four (4) feet in height is recommended, unless more extensive overfilling is undertaken.

As an alternative to overfilling, fill slopes may be built to the finish slope face in accordance with the following recommendations:

1. Compaction of each fill lift should extend to the face of the slopes.
2. Back-rolling during mass grading should be undertaken at intervals not exceeding four (4) feet in height. Back-rolling at more frequent intervals may be required.
3. Care should be taken to avoid spillage of loose materials down the face of any slopes during grading. Spill fill will require complete removal prior to compaction, shaping, and grid rolling.
4. At completion of mass filling, the slope surface should be watered, shaped, and compacted by track walking with a D-8 bulldozer, or equivalent, such that compaction to project standards is achieved to the slope face.

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

6.2.11 Utility Trenches

6.2.11.1 Excavation

Utility trenches should be supported, either by laying back excavations or shoring, in accordance with applicable OSHA standards. In general, existing site soils are classified as Soil Type "B" per OSHA standards. Upon completion of the recommended removals and re-compaction, the artificial fill will be classified as Soil Type "B". The Project Geotechnical Consultant should be consulted if geologic conditions vary from what is presented in this report.

6.2.11.2 Backfill

Trench backfill should be compacted to at least 90 percent of maximum dry density as determined by ASTM D-1557. Onsite soils will not be suitable for use as bedding material but will be suitable for use as backfill provided oversized materials are removed. No surcharge loads should be imposed above excavations. This includes spoil piles, lumber, concrete trucks, or other construction materials and equipment. Drainage above excavations should be directed away from the banks. Care should be taken to avoid saturation of the soils. Compaction should be accomplished by mechanical means. Jetting of native soils will not be acceptable.

Under-slab trenches should also be compacted to project specifications. If select granular backfill (SE > 30) is used, compaction by flooding will be acceptable.

6.2.12 Backcut Stability

Temporary backcuts, if required during unsuitable soil removals, should be made no steeper than 1:1 without review and approval of the geotechnical consultant. Flatter backcuts may be necessary where geologic conditions dictate and where minimum width dimensions are to be maintained.

Care should be taken during remedial grading operations in order to minimize risk of failure. Should failure occur, complete removal of the disturbed material will be required.

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

6.3 Slope Stability

The following is a preliminary discussion of slope stability onsite, based on the Grading and Drainage Concept plan.

6.3.1 Fill Slopes

It is anticipated that fill slopes on the project will be designed at a slope ratio of 2:1 (horizontal:vertical) or flatter to vertical heights of up to approximately 29-feet. Fill slopes, when properly constructed with onsite materials, are expected to be grossly stable as designed. Stability calculations supporting this conclusion are presented in On Plates D-1 and D-2. Surficial slope stability is presented on Plate D-3. Keys should be constructed at the toe of all fill slopes towing on existing or cut grade. Fill keys should have a minimum width equal to fifteen (15) feet or one-half (1/2) the height of the ascending slope, whichever is greater.

Skin-fill slope conditions should be avoided. If these conditions exist or are created during grading, they should be evaluated. Typical remediation for skin fill conditions are shown on Plate G-11 (Appendix G).

6.3.2 Cut Slopes

The grading and drainage concept plan depicts proposed cut slopes at the site at a 2:1 (horizontal:vertical) or flatter for vertical heights up to approximately 25-feet. Alta anticipates that cut slopes will be primarily excavated in the Pauba Formation. We have performed a slope stability analysis on cut slopes and the results are presented on Plates D-4 and D-5. The calculations indicate that the proposed cuts slopes will be grossly stable.

All cut slopes should be observed during grading by the Project Geotechnical Consultant. If adverse bedding, fracture or joint patterns, or other unstable geological conditions are exposed, then cut slopes may need to be replaced with a drained stabilization fill, as generally depicted on Plates G-8, G-9 and G-10 in Appendix G.

6.4 Storm Water Infiltration Systems

From a geotechnical perspective, allowing storm water to infiltrate the onsite soil in concentrated areas increases the potential for settlement, liquefaction, and water-related damage to structures/improvements, such as wet slabs or pumping subgrade, and should be avoided where possible. If infiltration systems are required on this site, care should be taken in designing systems that control the storm water as much as possible.

Preliminary infiltration testing was conducted at the site as part of this investigation, and the methodology is discussed in 3.2. The resulting infiltration rate for PH-1 was calculated to be 0.11-inches per hour. The results do not include a factor of safety. Test PH-1 was conducted in sand lenses of the Pauba Formation at approximately 30 feet below the ground surface. Six (6) Infiltration tests were previously conducted by Geocon, ranging in depth from approximately 15 to 20 feet below the ground surface. The results generated by Geocon were between 0.76 inches per hour to 10.03 inches per hour (Geocon, 2016).

Groundwater was not encountered during our investigation to a depth of approximately 46 feet below the ground surface. Ground water was encountered during the previous investigation in B-2, at approximately 15.9 feet below the ground surface. Nearby groundwater wells indicate that groundwater was deeper than 30-feet below the ground surface in 1968.

Based on our infiltration rate of the underlying soil and the infiltration rates from the previous investigation, infiltration-type WQMP’s may be feasible for the project depending on the layering of the Pauba Formation. Variable rates are expected. The Project Geotechnical Consultant should review the final WQMP design prior to construction

7.0 DESIGN CONSIDERATIONS

7.1 Structural Design

It is anticipated that multi-story, wood-framed residential structures with slab on-grade and shallow foundations will be constructed. Upon the completion of rough grading, finish grade samples should be collected and tested in order to provide specific recommendations as they relate to individual building pads. These test results and corresponding design recommendations should be presented in a final rough grading report. Final slab and foundation design recommendations should be made based upon specific structure sitings, loading conditions, and as-graded soil conditions.

It is anticipated that the majority of onsite soils will possess “very low” to “low” expansion potential when tested in general accordance with ASTM Test Method D: 4829 (See Section 6.2.4 for discussion on expansive soils). For budgeting purposes, the following foundation design requirements for a range of potential expansion characteristics are presented. If the medium to highly expansive soils are placed at grade, then alternate foundation design recommendations can be provided.

7.1.1 Foundation Design

Foundations may be preliminary designed based on the values presented in Table 7-1 below.

Table 7-1
Foundation Design Parameters*

Allowable Bearing	2000 lbs/ft^2 (assuming a minimum embedment depth and width of 12 inches)
Lateral Bearing	250 lbs/ft^2 at a depth of 12 inches plus 250 lbs/ft^2 for each additional 12 inches of embedment to a maximum of 2000 lbs/ft^2.
Sliding Coefficient	0.30
Settlement	Static Settlement - 0.5 inches in 40 feet Dynamic Settlement - 0.5 inches in 40 feet

*These values may be increased as allowed by Code to resist transient loads such as wind or seismic. Building code and structural design considerations may govern depth and reinforcement requirements and should be evaluated.

7.1.2 Conventional Foundation Systems

Based on the onsite soils conditions and information supplied by the 2019 CBC, conventional foundation systems may be designed in accordance with Tables 7-1 and 7-2.

TABLE 7-2
CONVENTIONAL FOUNDATION DESIGN PARAMETERS

Expansion Potential	***Very Low to Low***
Soil Category	I
Design Plasticity Index	12
Minimum Footing Embedment	18 inches
Minimum Footing Width	12-inches-The structural engineer should determine the minimum footing width based on loading and the latest California Building Code.
Footing Reinforcement	No. 4 rebar, two (2) on top, two (2) on bottom
Slab Thickness	4 inches (actual)
Slab Reinforcement**	No. 3 rebar spaced 18 inches on center, each way
Under-Slab Requirement	See Section 7.2
Slab Subgrade Moisture	Minimum of 110% of optimum moisture to a depth of 12 inches prior to placing concrete.
Footing Embedment Adjacent to Swales and Slopes	If exterior footings adjacent to drainage swales are to exist within five (5) feet horizontally of the swale, the footing should be embedded sufficiently to assure embedment below the swale bottom is maintained. Footings adjacent to slopes should be embedded such that at least five- (5) feet is provided horizontally from edge of the footing to the face of the slope.
Garages	A grade beam reinforced continuously with the garage footings shall be constructed across the garage entrance, tying together the ends of the perimeter footings and between individual spread footings. This grade beam should be embedded at the same depth as the adjacent perimeter footings. A thickened slab, separated by a cold joint from the garage beam, should be provided at the garage entrance. Minimum dimensions of the thickened edge shall be six (6) inches deep. Footing depth, width and reinforcement should be the same as the structure. Slab thickness, reinforcement and under-slab treatment should be the same as the structure.

7.1.3 Post-Tensioned Slabs/Foundation Design Recommendations

Post-tensioned slabs for the project may be designed utilizing the parameters presented in Tables 7-1 and 7-3. The parameters presented herein are based on methodology provided in the Design of Post-Tensioned Slabs-On-Ground, Third Edition, by the Post-Tensioning Institute, in accordance with the 2019 CBC.

TABLE 7-3
POST-TENSION SLAB DESIGN PARAMETERS

Category	**Expansion Potential**	**Minimum Embedment***	**Edge Lift**		**Center Lift**	
			Em (ft)	**Ym (inch)**	**Em (ft)**	**Ym (inch)**
I	Very Low to Low	12 inches	5.4	0.61	9.0	0.26
Slab Subgrade Moisture						
Category I	Minimum 110% of optimum moisture to a depth of 12 inches prior to pouring concrete					
Embedment*						
The minimum outer footing embedment presented herein are based on expansion indexes. The structural engineer should verify the minimum embedment based on the number of floors supported by the footings, the structural loading, and the requirements of the latest California Building Code. If mat slabs are utilized, alternate embedment depths can be provided.						
Moisture Barrier						
A moisture barrier should be provided in accordance with the recommendations presented in Section 7.2						
The parameters presented herein are based on procedures presented in the Design of Post-Tensioned Slabs-On-Ground, Third Edition. No corrections for vertical barriers at the edge of the slab, or for adjacent vegetation have been assumed. The design parameters are based on a Constant Suction Value of 3.9 pF.						

7.2 Moisture Barrier

A moisture and vapor retarding system should be placed below the slabs-on-grade in portions of the structure considered to be moisture sensitive and should be capable of effectively preventing the migration of water and reducing the transmission of water vapor to acceptable levels. Historically, a 10-mil plastic membrane, such as Visqueen, placed between two to four inches of clean sand, has been used for this purpose. The use of this system or other systems can be considered, at the discretion of the designer, provided the system reduces the vapor transmission rates to acceptable levels.

7.3 Seismic

In accordance with the requirements in Section 11.4.8 of ASCE 7-16 for sites with Site Class D and S1 values greater than 0.2, Alta has performed a site-specific ground motion analysis for the subject project. The analysis was performed in accordance with Chapter 21 of ASCE 7-16, the 2019 CBC, and the 2014 USGS Ground Acceleration Maps. The USGS Unified Hazard Tool (https://earthquake.usgs.gov/hazards/interactive/index.php) and the USGS National Seismic Hazard Map source model was utilized to perform the analysis.

The site class was determined based on the referenced reports and published geologic maps in the area in general conformance with Chapter 20 of ASCE 7-16. Based on density of the underlying soil, a Site Class of D was selected (shear wave velocity of 259 m/s).

Probabilistic (MCER) ground motions were determined in accordance with Method 2 of Section 21.2.1 of ACE 7-16. The site specific MCER was taken as the lesser of the probabilistic and deterministic ground motions.

The design response spectrum was determined per Section 21.3 of ASCE 7-16. Design acceleration parameters were determined per Section 21.4 of ASCE 7-16 and the results are presented in Table 7-4. These parameters should be verified by the structural engineer. Additional parameters should be determined by the structural engineer based on the Occupancy Category of the proposed structures.

TABLE 7-4 Seismic Ground Motion Values
2019 CBC and ASCE 7-16

Parameter	*Value*
Site Class	D
Site Latitude	33.5567
Site Longitude	-117.1906
Spectral Response Acceleration Parameter, S_S	1.6
Spectral Response Acceleration Parameter, S_1	0.6
Site Coefficient, F_a	1.0
Site Coefficient, F_v (Per Table 11.4-2 of ASCE 7-16. Site Specific Parameters Govern)	1.7
Site Specific Parameters Per Chapter 21 of ASCE 7-16	
MCE Spectral Response Acceleration Parameter, S_{MS}	1.770
MCE Spectral Response Acceleration Parameter, S_{M1}	1.734
Design Spectral Response Acceleration Parameter, S_{DS}	1.180
Design Spectral Response Acceleration Parameter, S_{D1}	1.156
Peak Ground Acceleration, PGA_M	0.78

7.4 Fence and Garden Walls

Block walls, if used, should be embedded a minimum of 2 feet below the lowest adjacent grade. Construction joints (not more than 20 feet apart) should be included in the block wall construction. Side yard walls should be structurally separated from the rear yard wall.

7.5 Footing Excavations

Soils from the footing excavations should not be placed in slab-on-grade areas unless properly compacted and tested. The excavations should be cleaned of all loose/sloughed materials and be neatly trimmed at the time of concrete placement. The Project Geotechnical Consultant should observe the footing excavations prior to the placement of concrete to determine that the excavations are founded in suitably compacted material.

7.6 Retaining Wall Design

Retaining walls should be founded on engineered fill and should be backfilled with granular soils that allow for drainage behind the wall. Foundations may be designed in accordance with the recommendations presented in Table 7-1, above. Unrestrained walls, free to horizontally move 0.0005H (for dense cohesionless backfill), may be designed to resist lateral pressures imposed by a fluid with a unit weight determined in accordance with the Table 7-5 below. The table also presents design parameters for restrained (at-rest) retaining walls. These parameters may be used to design retaining walls that may be considered as restrained due to the method of construction or location (corner sections of unrestrained retaining walls).

TABLE 7-5
Equivalent Fluid Pressures for 90% Compacted Fill (Select Material)

Backfill	Active Pressure (psf/ft)	At-Rest Pressure (psf/ft)
Level	35	55

Per the requirements of the 2019 CBC, the seismic force acting on the retaining walls with backfill exceeding 6-feet in height may be resolved utilizing the formula $16H^2$ lb/lineal ft (H=height of the wall). This force acts at approximately 0.6H above the base of the wall. The seismic value can be converted as required by the retaining wall engineer. Retaining walls should be designed in general accordance with Section 1807A.2 of the 2019 CBC.

- Restrained retaining walls should be designed for “at-rest” conditions.
- The design loads presented in the above table are to be applied on the retaining wall in a horizontal fashion and as such friction between wall and retained soils should not be allowed in the retaining wall analyses.

- Additional allowances should be made in the retaining wall design to account for the influence of construction loads, temporary loads, and possible nearby structural footing loads.
- Select backfill should be granular, structural quality backfill with a Sand Equivalent of 20 or better and an ASCE Expansion Index of 20 or less. The backfill must encompass the full active wedge area. The upper one foot of backfill should be comprised of native on-site soils (see Plate A).
- The wall design should include waterproofing (where appropriate) and backdrains or weep holes for relieving possible hydrostatic pressures. The backdrain should be comprised of a 4-inch perforated PVC pipe in a 1 ft. by 1 ft., ¾-inch gravel matrix, wrapped with a geofabric. The backdrain should be installed with a minimum gradient of 2 percent and should be outletted to an appropriate location.
- No backfill should be placed against concrete until minimum design strengths are achieved.

It should be noted that the allowable bearing and lateral bearing values presented in Table 7-1 are based on level conditions at the toe. Modified design parameters can be presented for retaining walls with sloping condition at the toe. Other conditions should be evaluated on a case-by-case basis.

7.7 Exterior Slabs and Walkways

Exterior concrete slabs and walkways should be designed and constructed in consideration of the following recommendations.

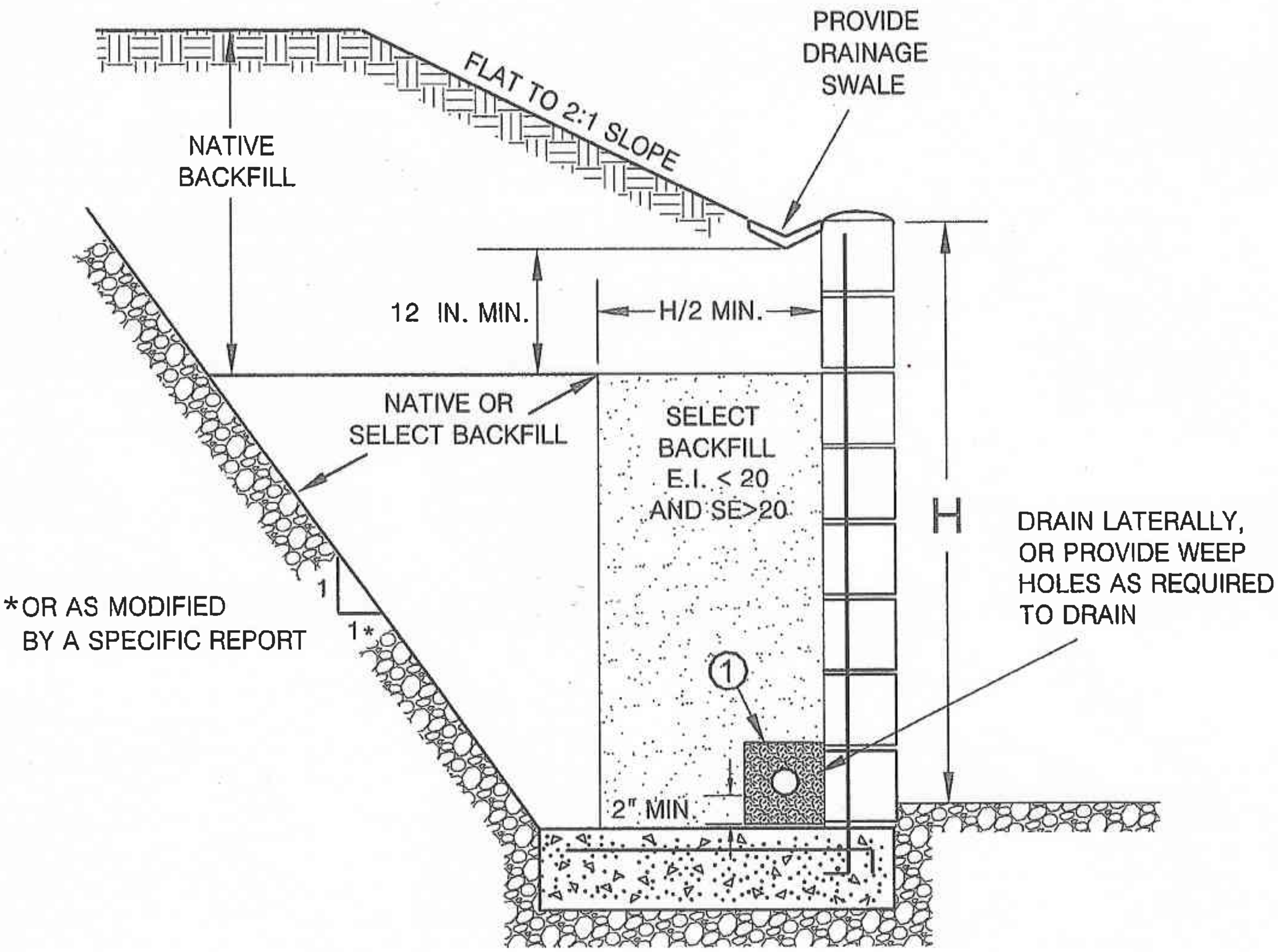
7.7.1 Subgrade Compaction

The subgrade below exterior concrete slabs should be compacted to a minimum of 90 percent relative compaction as determined by ASTM Test Method: D 1557.

7.7.2 Subgrade Moisture

The subgrade below concrete slabs should be moisture conditioned to a minimum of 110 percent of optimum moisture (very low to low expansion) or 120 percent of optimum moisture (medium expansion) prior to concrete placement.

RETAINING WALL BACKFILL DETAIL



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PIPE: 4-INCH PERFORATED PVC, SCHEDULE 40, SDR35 OR APPROVED ALTERNATE MINIMUM 8 PERFORATIONS (1/4-IN. DIA.) PER LINEAL FT. IN BOTTOM HALF OF PIPE

ROCK: MINIMUM VOLUME OF 1 CU. FT. OF 3/4-IN. MAX. ROCK PER. LINEAL FOOT OF PIPE, OR APPROVED ALTERNATE

FILTER FABRIC: MIRAFI 140 FILTER FABRIC OR APPROVED EQUIVALENT

ALTA CALIFORNIA GEOTECHNICAL, INC.
VER. 1/10

PLATE A

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7.7.3 Concrete Slab Thickness

Concrete flatwork and driveways should be designed utilizing four-inch minimum thickness.

7.7.4 Concrete Slab Reinforcement

Consideration should be given to reinforcing flatwork with 6x6 W.14/W1.4 welded wire mesh or and equivalent section of rebar.

7.7.5 Control Joints

Weakened plane joints should be installed on walkways at intervals of approximately eight feet (maximum) or less. Exterior slabs should be designed to withstand shrinkage of the concrete.

7.8 Concrete Design

As stated in Section 5.1.7, negligible concentrations of sulfates were detected in the onsite soils. Therefore, the use of sulfate resistant concrete is not required per ACI 318-14 at this time. Post-grading conditions should be evaluated, and final recommendations made at that time.

7.9 Corrosion

Based on preliminary testing, the onsite soils are mildly corrosive to corrosive to buried metal objects. Buried ferrous metals should be protected against the effects of corrosive soils in accordance with the manufacturer's recommendations. Typical measures may include using non-corrosive backfill, protective coatings, wrapping, plastic pipes, or a combination of these methods. A corrosion engineer should be consulted if specific design recommendations are required by the improvement designer.

Per ACI 318-14, an exposure class of C1 would be applicable to metals encased in concrete (rebar in footings) due to being exposed to moisture from surrounding soils. Per Table 19.3.2.1 of ACI 318-14, the requirements for concrete with an exposure class of C1 are a minimum compressive strength of 2500 psi and a maximum water-soluble chloride ion content in concrete of 0.30 (percent by weight of cement).

7.10 Pavement Design

It is our understanding that the pavement sections onsite may be composed of asphalt, concrete or concrete vehicular and pedestrian pavers. Presented herein are recommendations for all pavement types.

For all pavement types, the underlying subgrade soil should be suitably moisture conditioned, processed and compacted to a minimum 95 percent of the laboratory maximum density (ASTM: D 1557) to at least twelve (12) inches below subgrade. After subgrade compaction, the exposed grade should then be "proof"-rolled with heavy equipment to ensure the grade does not "pump" and is verified as non-yielding.

For the concrete paver pavement types, per the technical specifications provided by ICPI, an edge restraint should be provided along the perimeter of the pavers. The edge restraint should be constructed utilizing either precast concrete cut stone or poured concrete. It is recommended that construction traffic not be allowed to drive over the paver section if possible. Loading from construction traffic may cause distress in the pavers and require repair.

Preparation for compaction operations and pavement construction operations should be accomplished in accordance with the current requirements of the City of Murrieta and under the observation and testing of the project geotechnical consultant.

7.10.1 AC Pavement

Pavement sections for the proposed streets shall be designed based on laboratory testing conducted on samples taken from the soil subgrade. Preliminarily, based on a tested R-Value of 21, from the previous investigation, the pavement may be designed utilizing the sections presented in Table 7-6. These sections should be verified upon the completion of grading, based on R-Value testing.

Table 7-6
Preliminary Pavement Sections

Traffic Index	Pavement Section Options OR	
5.0	3-inch AC on 7-inch AB	4-inch AC on 5-inch AB
5.5	3-inch AC on 9-inch AB	4-inch AC on 6.5-inch AB
6.0	3.5-inch AC on 9.5-inch AB	4-inch AC on 8.5-inch AB
AC-Asphalt Concrete AB-Caltrans Class II Base		

Aggregate base material should be placed on the compacted subgrade and compacted in-place to a minimum 95 percent of the laboratory standard obtained per ASTM: D 1557.

7.10.2 Concrete Pavement

The following concrete pavement design recommendations are suitable to support typical loads from fire trucks, trash trucks, etc. The pavement section can consist of six (6) inches of Portland Cement Concrete (PCC) underlain by a minimum of four (4) inches of aggregate base (AB). The PCC should have a minimum compressive strength of 3000 psi and control/expansion joints should be provided at intervals of approximately 8 feet or less. Dowels with a minimum diameter of ½-inch should be provided at the joints and spaced at 12-inches on center. The base underlying the concrete should be moisture-conditioned and compacted to a minimum of 95% of the laboratory maximum density (ASTM Test Method D 1557).

7.10.3 Vehicular Pavers

ICPI Technical Specification Number 4 presents design tables that may be utilized to calculate the paver section. The gradation of the leveling sand should conform to the paver manufacturer's specifications. Per the ICPI's specifications, the vehicular pavers should be a minimum of 80-mm thick. Presented below are two alternative paver sections that may be considered:

- Alternative 1: The pavement section can consist of the concrete pavers overlying a minimum of one (1) inch of leveling sand, over eight (8) inches of Caltrans Class II base (AB). The base should be moisture-conditioned and compacted to a minimum of 95% of the laboratory maximum density (ASTM Test Method D 1557). A geofabric with characteristics similar to Mirafi 500x or Tensar TriAx should be placed between the subgrade and the base to assist in preserving the load bearing capacity of the base over a greater length of time. Additionally, a 12-inch wide geofabric with similar characteristics to Mirafi 500x should be placed between the leveling sand and the base along the perimeter of the pavers and turned up at the curb. Maintenance of the pavers may be required when they are underlain by Class II base due to the potential for saturated subgrade conditions to occur. This potential could be reduced by contour grading the subgrade to flow towards a drainage pipe.
- Alternative 2: The pavement section can consist of the concrete pavers overlying a minimum of one (1) inch of leveling sand, over four (4) inches of Portland cement concrete (PCC). The PCC should have a minimum compressive strength of 3000 psi and control/expansion joints should be provided at intervals of approximately 8 feet or less. Dowels with a minimum diameter of ½-inch should be provided at the joints and spaced at 12-inches on center. The base underlying the concrete should be moisture-conditioned and compacted to a minimum of 95% of the laboratory maximum density (ASTM Test Method D 1557). A geofabric with similar characteristics to Mirafi 500x should be placed between the leveling sand and the base/concrete, and turned up at the edges, to prevent migration of the sand within the concrete joints.

7.10.4 Pedestrian Pavers

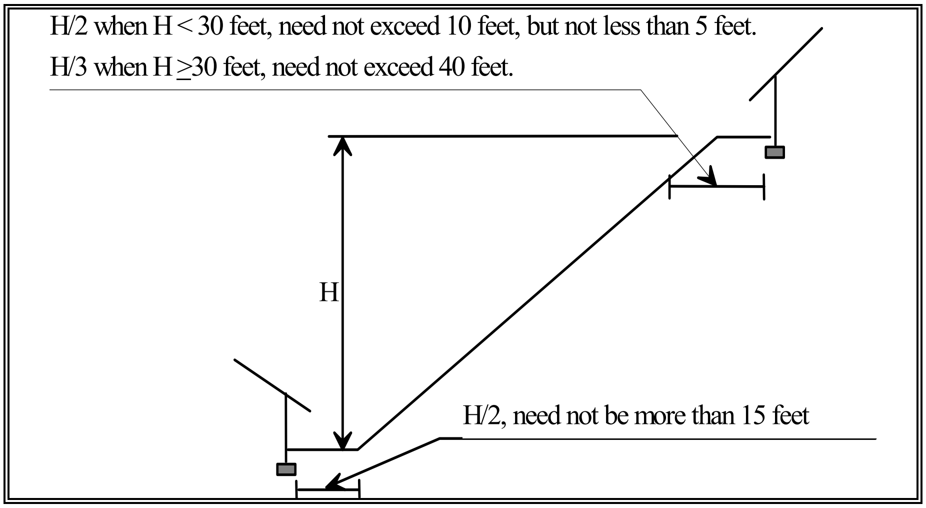
ICPI Technical Specification Number 4 presents design tables that may be utilized to calculate the paver section. The gradation of the leveling sand should conform to the paver manufacturer's specifications. Per the ICPI's specifications, the pedestrian pavers should be a minimum of 60-mm thick. The pavement section can consist of the concrete pavers overlying a minimum of one (1) inch of leveling sand, over four (4) inches of Caltrans Class II base (AB).

7.11 Site Drainage

Positive drainage away from the proposed structures should be provided and maintained. Roof, pad, and lot drainage should be collected and directed away from the structures toward approved disposal areas through drainage terraces, gutters, down drains, and other devices. Design fine grade elevations should be maintained through the life of the structure or if design fine grade elevations are altered, adequate area drains should be installed in order to provide rapid discharge of water, away from structures.

7.12 Deepened Footings and Setbacks

It is generally recognized that improvements constructed in proximity to properly constructed slopes can, over a period of time, be affected by natural processes including gravity forces, weathering of surficial soils and long term (secondary) settlement. Most building codes, including the California Building Code (CBC), require that structures be setback or footings deepened, where subject to the influence of these natural processes. For the subject site, where foundations for residential structures are to exist in proximity to slopes, the footings should be embedded to satisfy the requirements presented in the following figure.



Consideration of these natural processes should be undertaken in the design and construction of other improvements. Homeowners are advised to consult with qualified geotechnical engineers, designers, and contractors in the design and construction of future improvements. Each lot and proposed improvement should be evaluated in relation to the specific site conditions, accounting for the specific soil conditions.

8.0 LOT MAINTENANCE

Ongoing maintenance of the improvements is essential to the long-term performance of structures. The following recommendations should be implemented.

8.1 Lot Drainage

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

8.2 Burrowing Animals

Owners should undertake a program for the elimination of burrowing animals.

9.0 FUTURE PLAN REVIEWS

This report represents a geotechnical review of the site. As the project design for the project progresses, site specific geologic and geotechnical issues should be considered in the design and construction of the project. Consequently, future plan reviews may be necessary. These reviews may include reviews of:

- Grading Plans
- Foundation Plans
- Utility Plans

These plans should be forwarded to the project Geotechnical Consultant for review.

10.0 CLOSURE

10.1 Geotechnical Review

For the purposes of this report, multiple working hypotheses were established for the project, utilizing the available data and the most probable model is used for the analysis. Future information collected during the proposed grading operations is intended to evaluate the hypothesis and as such, some of the assumptions summarized in this report may need to be changed. Some modifications of the grading recommendations may become necessary, should the conditions encountered in the field differ from the conditions hypothesized in this report.

Plans and sections of the project specifications should be reviewed by Alta to evaluate conformance with the intent of the recommendations contained in this report. If the project description or final design varies from that described in herein, Alta must be consulted regarding the applicability of the recommendations contained herein and whether any changes are required. Alta accepts no liability for any use of its recommendations if the project description or final design varies and Alta is not consulted regarding the alterations.

10.2 Limitations

This report is based on the following: 1) the project as presented on the attached plans; 2) the information obtained from Alta's laboratory testing included herein; and 3) from the information presented in the referenced reports. The findings and recommendations are based on the results of the subsurface investigation, laboratory testing, and office analysis combined with an interpolation and extrapolation of conditions between and beyond the subsurface excavation locations. However, the materials adjacent to or beneath those observed may have different characteristics than those observed, and no precise representations are made as to the quality or extent of the materials not observed. The results reflect an interpretation of the direct evidence obtained. Work performed by Alta has been conducted in a manner consistent with the level of care and skill ordinarily exercised by members of the geotechnical profession currently practicing in the same locality under similar conditions. No other representation, either expressed or implied, and no warranty or guarantee is included or intended.

The recommendations presented in this report are based on the assumption that an appropriate level of field review will be provided by a geotechnical consultant who is familiar with the design and site geologic conditions. That field review shall be sufficient to confirm that geotechnical and geologic conditions exposed during grading are consistent with the geologic representations and corresponding recommendations presented in this report.

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

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

APPENDIX A

REFERENCES

APPENDIX A

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Riverside County Mapping Portal, https://gis.rivcoit.org/

APPENDIX B

Subsurface Investigation

APPENDIX B

Subsurface Investigation

Alta's subsurface investigation consisted of excavating, logging, and sampling twenty (20) hollow-stem auger borings. Details of the subsurface investigation are presented in Table B-1. The approximate locations of the exploratory excavations are shown on Plate 1 and the Geotechnical Logs are attached.

TABLE B-1
SURFACE INVESTIGATION DETAILS

Equipment	**Range of Depths**	**Sampling Methods**	**Sample Locations**
Hollow Stem Auger	Up to 46 feet	1. Bulk 2. Ring Samples	1. Bulk-Select Depth 2. Rings-Every 2.5 or 5 feet

UNIFIED SOIL CLASSIFICATION SYSTEM

Major Divisions		grf	ltr	Description
Coarse Grained Soils More than 50% retained on No. 200 sieve	Gravel and Gravelly Soils More than 50% of coarse fraction retained on No,. 4 sieve	●	GW	Well-graded gravels or gravel sand mixtures, little or no fines
		●	GP	Poorly-graded gravels or gravel sand mixture, little or no fines
		●	GM	Silty gravels, gravel-sand-silt mixtures
		▨	GC	Clayey gravels, gravel-sand-clay mixtures
	Sand and Sandy Soils More than 50% of coarse fraction passes on No,. 4 sieve	░	SW	Well-graded sands or gravelly sands, little or no fines
		░	SP	Poorly-graded sands or gravelly sands, little or no fines
		▥	SM	Silty sands, sand-silt mixtures
		▨	SC	Clayey sands, and-clay mixtures

Major Divisions		grf	ltr	
Fine Grained Soils More than 50% passes on No. 200 sieve	Silts And Clays LL,<50	▥	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
		▨	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
		▦	OL	Organic silts and organic silt-clays of low plasticity
	Silts And Clays LL,<50	▥	MH	Inorganic silts, micaceous or diatomaceous fine or silty soils, elastic silts
		▨	VH	Inorganic clays of high plasticity, fat clays
		▦	OH	Organic clays of medium to high plasticity
Highly Organic Soils		▦	PT	Peat and other highly organic soils

BOUNDARY CLASSIFICATION: Soils possessing characteristics of two groups are designated by combinations of group symbols.

PARTICLE SIZE LIMITS

U.S. STANDARD SERIES SIEVE — CLEAR SQUARE SIEVE OPENINGS

200 — 40 — 10 — 4 — 3/4" — 3" — 12"

Silts and Clays	Sand			Gravel		Cobbles	Boulders
	Fine	Medium	Coarse	Fine	Coarse		

RELATIVE DENSITY

Sands and Gravels	Blows/Foot (SPT)
Very Loose	<4
Loose	4-10
Medium Dense	11-30
Dense	31-50
Very Dense	>50

CONSISTENCY CLASSIFICATION

Silts and Clays	Criteria
Very Soft	Thumb penetrates soil >1 in.
Soft	Thumb penetrates soil 1 in.
Firm	Thumb penetrates soil 1/4 in.
Stiff	Readily indented with thumbnail
Very Stiff	Thumbnail will not indent soil

HARDNESS

Bedrock
Soft
Moderately Hard
Hard
Very Hard

LABORATORY TESTS

Symbol	Test
DS	Direct Shear
DSR	Direct Shear
CON	(Remolded)
SA	Sieve Analysis
MAX	Maximum Density
RV	Resistance (R) Value
EI	Expansion Index
SE	Sand Equivalent
AL	Atterberg Limits
CHEM	Chemical Analysis
HY	Hydrometer Analysis

SOIL MOISTURE

Increasing Visual Moisture Content ↓

Dry - Dry to touch

Moist - Damp, but no visible free water

wet - Visible free water

SIZE PROPORTIONS

Trace - <5%

Few - 5 to 10%

Some - 15 to 25%

KEY TO EXPLORATORY BORING LOGS

ALTA CALIFORNIA GEOTECHNICAL INC.

PLATE B

GEOTECHNICAL BORING LOG

SHEET 1 OF 1

PROJECT NO. 1-0410
DATE STARTED 9/27/21
DATE FINISHED 9/27/21
DRILLER 2R Drillng Inc.
TYPE OF DRILL RIG 8" Hollow Stem Auger

PROJECT NAME The Terraces
GROUND ELEV. 1151
GW DEPTH (FT)
DRIVE WT. 140lbs.
DROP 30 in.

BORING DESIG. BH-01
LOGGED BY JC
NOTE

DEPTH (Feet)	ELEV	SAMPLE TYPE	BLOWS	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
	1150					**PAUBA FORMATION**(Qps): SILTY SANDSTONE, very fine to fine grained, tannish brown, dry, medium dense.				
5	1145	R	77 for 11"			@5.0ft. very dense.	3.5	122	26	
10	1140	R	86 for 10"			@ 10.0ft. moist.	7.5	126	64	
15	1135	R	90 for 9"			@15.0ft. very fine to medium grained, slightly moist.	5.0	122	37	
20	1130	R	126 for 17"			@20.0ft. SANDSTONE, very fine to coarse grained, grayish brown, dry, very dense.	5.0	110	26	
25	1125	R	92 for 9"			@25.0ft. SANDY SILTSTONE, very fine, brown, dry, very stiff. @25.5ft. SANDSTONE, fine to coarse grained, gray, dry, dense.	4.5	109	23	

TOTAL DEPTH 26.0 FEET
NO GROUNDWATER ENCOUNTERED
NO CAVING OBSERVED

SAMPLE TYPES:
R RING (DRIVE) SAMPLE
S SPT (SPLIT SPOON) SAMPLE
B BULK SAMPLE
T TUBE SAMPLE

▼ GROUNDWATER
➤ SEEPAGE
J: JOINTING C: CONTACT
B: BEDDING F: FAULT
S: SHEAR RS: RUPTURE SURFACE

Alta California Geotechnical, Inc.

P.N. 1-0410

PLATE B-1

GEOTECHNICAL BORING LOG

SHEET 1 OF 1

PROJECT NO. 1-0410
DATE STARTED 9/27/21
DATE FINISHED 9/27/21
DRILLER 2R Drillng Inc.
TYPE OF DRILL RIG 8" Hollow Stem Auger

PROJECT NAME The Terraces
GROUND ELEV. 1144
GW DEPTH (FT)
DRIVE WT. 140lbs.
DROP 30 in.

BORING DESIG. BH-02
LOGGED BY JC
NOTE

DEPTH (Feet)	ELEV	SAMPLE TYPE	BLOWS	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
						PAUBA FORMATION(Qps): SILTY SANDSTONE, very fine to fine grained, tannish brown, dry, medium dense.				
	1140									
5		R	40			@5.0ft. SANDSTONE, fine to coarse grained, grayish brown, dry, dense.	2.1	113	12	
						@6.0ft. medium to coarse grained.				
	1135									
10		R	61			@10.0ft. tannish gray, very dense, few fine gravel <3/4".	2.7	109	14	
	1130									
15		R	47			@15.0ft. CLAYEY SANDSTONE, very fine grained, brown with orange mottling, moist, dense.	12.8	122	94	
	1125									
20		R	46			@20.0ft. very fine to fine grained.	14.8	115	90	
	1120									
25		R	82			@25.0ft. SANDSTONE, coarse grained, tannish gray, dry, very dense, few fine gravel <3/4".	3.9	109	20	
						TOTAL DEPTH 26.0 FEET NO GROUNDWATER ENCOUNTERED NO CAVING OBSERVED				

SAMPLE TYPES:
- R RING (DRIVE) SAMPLE
- S SPT (SPLIT SPOON) SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

▼ GROUNDWATER
➤ SEEPAGE
J: JOINTING C: CONTACT
B: BEDDING F: FAULT
S: SHEAR RS: RUPTURE SURFACE

Alta California Geotechnical, Inc.

P.N. 1-0410

PLATE B-2

GEOTECHNICAL BORING LOG

SHEET 1 OF 1

PROJECT NO. 1-0410
DATE STARTED 9/27/21
DATE FINISHED 9/27/21
DRILLER 2R Drillng Inc.
TYPE OF DRILL RIG 8" Hollow Stem Auger

PROJECT NAME The Terraces
GROUND ELEV. 1144
GW DEPTH (FT)
DRIVE WT. 140lbs.
DROP 30 in.

BORING DESIG. BH-03
LOGGED BY JC
NOTE

DEPTH (Feet)	ELEV	SAMPLE TYPE	BLOWS	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
						PAUBA FORMATION(Qps): SILTY SANDSTONE, very fine to medium grained, tannish brown, dry, medium dense.				
						@2.0ft. SANDSTONE, medium to coarse grained, tannish gray, dry, dense.				
	1140									
5		R	74			@5.0ft. SILTY SANDSTONE, very fine grained, brownish tan, moist, very dense.	11.0	119	75	
	1135									
10		R	47			@10.0ft. SANDSTONE, fine grained, grayish tan, moist, dense.	7.1	105	32	
	1130									
15		R	84			@15.0ft. very fine to fine grained, brown with trace orange mottling, dry, very dense.	2.1	114	12	
	1125									
20		R	85			@20.0ft. fine to coarse grained.	2.6	113	15	
	1120									
25		R	97 for 11"			@25.0ft. very fine to fine grained, grayish tan.	3.7	105	17	
						TOTAL DEPTH 26.0 FEET NO GROUNDWATER ENCOUNTERED NO CAVING OBSERVED				

SAMPLE TYPES:
R RING (DRIVE) SAMPLE
S SPT (SPLIT SPOON) SAMPLE
B BULK SAMPLE T TUBE SAMPLE

▼ GROUNDWATER
➤ SEEPAGE
J: JOINTING C: CONTACT
B: BEDDING F: FAULT
S: SHEAR RS: RUPTURE SURFACE

Alta California Geotechnical, Inc.

P.N. 1-0410 PLATE B-3

GEOTECHNICAL BORING LOG

SHEET 1 OF 2

PROJECT NO.	1-0410	PROJECT NAME	The Terraces		
DATE STARTED	9/27/21	GROUND ELEV.	1180	BORING DESIG.	BH-04
DATE FINISHED	9/27/21	GW DEPTH (FT)		LOGGED BY	JC
DRILLER	2R Drillng Inc.	DRIVE WT.	140lbs.	NOTE	
TYPE OF DRILL RIG	8" Hollow Stem Auger	DROP	30 in.		

DEPTH (Feet)	ELEV	SAMPLE TYPE	BLOWS	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
	1180					**PAUBA FORMATION**(Qps): SILTY SANDSTONE, very fine to fine grained, tannish brown, dry, dense.				
5	1175									
10	1170	R	46			@10.0ft. very fine grained, slightly moist.	6.1	118	40	
15	1165									
20	1160	R	50 for 5"			@20.0ft. SANDSTONE, fine to coarse grained, gray, moist, very dense, few fine gravel <3/4".	22.4	94	79	
25	1155									
30	1150	R	76 for 11"			@30.0ft. fine grained, tan.	9.3	119	63	
35	1145	R	50 for 5"				6.1	103	27	
	1140					Continued.				

SAMPLE TYPES:
R RING (DRIVE) SAMPLE
S SPT (SPLIT SPOON) SAMPLE
B BULK SAMPLE
T TUBE SAMPLE

▼ GROUNDWATER
► SEEPAGE
J: JOINTING C: CONTACT
B: BEDDING F: FAULT
S: SHEAR RS: RUPTURE SURFACE

Alta California Geotechnical, Inc.

P.N. 1-0410

PLATE B-4

GEOTECHNICAL BORING LOG

SHEET 2 OF 2

PROJECT NO. 1-0410
DATE STARTED 9/27/21
DATE FINISHED 9/27/21
DRILLER 2R Drillng Inc.
TYPE OF DRILL RIG 8" Hollow Stem Auger

PROJECT NAME The Terraces
GROUND ELEV. 1180
GW DEPTH (FT)
DRIVE WT. 140lbs.
DROP 30 in.

BORING DESIG. BH-04
LOGGED BY JC
NOTE

DEPTH (Feet)	ELEV	SAMPLE TYPE	BLOWS	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
	1140	R	65	▨		**PAUBA FORMATION**(Qps): Continued; NO RECOVERY.				
						TOTAL DEPTH 42.0 FEET NO GROUNDWATER ENCOUNTERED NO CAVING OBSERVED				

SAMPLE TYPES:
- R RING (DRIVE) SAMPLE
- S SPT (SPLIT SPOON) SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

▼ GROUNDWATER
➤ SEEPAGE
J: JOINTING C: CONTACT
B: BEDDING F: FAULT
S: SHEAR RS: RUPTURE SURFACE

Alta California Geotechnical, Inc.

P.N. 1-0410 PLATE B-4

GEOTECHNICAL BORING LOG

SHEET 1 OF 1

PROJECT NO. 1-0410
DATE STARTED 9/27/21
DATE FINISHED 9/27/21
DRILLER 2R Drillng Inc.
TYPE OF DRILL RIG 8" Hollow Stem Auger
PROJECT NAME The Terraces
GROUND ELEV. 1176
GW DEPTH (FT)
DRIVE WT. 140lbs.
DROP 30 in.
BORING DESIG. BH-05
LOGGED BY JC
NOTE

DEPTH (Feet)	ELEV	SAMPLE TYPE	BLOWS	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
	1175					**PAUBA FORMATION**(Qps): SANDSTONE, very fine to coarse grained, tan, dry, dense.				
						@2.0ft. brown, moist.				
5	1170					@5.0ft. CLAYSTONE, brown, moist, hard.				
						@8.0ft. SANDSTONE, very fine grained, brown, moist, very dense.				
10	1165	R	75 for 11"			@10.0ft. fine to coarse grained, tan, slightly moist, very dense.	9.4	116	59	
15	1160									
20	1155	R	32			@20.0ft. CLAYEY SANDSTONE, fine to coarse grained, brown, moist, dense.	17.3	110	91	
25	1150	R	36				14.6	119	98	
30	1145	R	57			@30.0ft. yellow brown, very dense.	13.0	123	99	
35	1140	R	82 for 11"			@35.0ft. SANDSTONE, coarse grained, gray, dry, very dense, few fine gravel <3/4".	7.6	112	43	
						TOTAL DEPTH 36.0 FEET NO GROUNDWATER ENCOUNTERED NO CAVING OBSERVED				

SAMPLE TYPES:
R RING (DRIVE) SAMPLE
S SPT (SPLIT SPOON) SAMPLE
B BULK SAMPLE
T TUBE SAMPLE

▼ GROUNDWATER
► SEEPAGE
J: JOINTING C: CONTACT
B: BEDDING F: FAULT
S: SHEAR RS: RUPTURE SURFACE

Alta California Geotechnical, Inc.

P.N. 1-0410

PLATE B-5

GEOTECHNICAL BORING LOG

SHEET 1 OF 1

PROJECT NO. 1-0410
DATE STARTED 9/27/21
DATE FINISHED 9/27/21
DRILLER 2R Drillng Inc.
TYPE OF DRILL RIG 8" Hollow Stem Auger

PROJECT NAME The Terraces
GROUND ELEV. 1187
GW DEPTH (FT)
DRIVE WT. 140lbs.
DROP 30 in.

BORING DESIG. BH-06
LOGGED BY JC
NOTE

DEPTH (Feet)	ELEV	SAMPLE TYPE	BLOWS	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
						PAUBA FORMATION(Qps): SILTY SANDSTONE, very fine to fine grained, tan brown, dry, dense, few fine to coarse gravel <3".				
						@1.0ft. SANDSTONE, very fine grained, yellow tan, dry, dense.				
	1185									
5		R	79 for 11"			@5.0ft. very dense, moist.	14.6	110	76	
	1180									
10										
	1175									
15		R	80 for 11"				5.7	118	38	
	1170									
20										
	1165									
25		R	79 for 10"			@25.0ft. very fine to fine grained.	12.9	120	89	
	1160									
30		R	92			@30.0ft. GRAVELLY SANDSTONE, coarse grained, gray, dry, very dense, fine gravel <3/4".	1.7	104	8	
	1155									
35		R	71			@35.0ft. SANDSTONE, coarse grained, orange gray, dry, very dense.	4.2	101	18	
						TOTAL DEPTH 36.0 FEET NO GROUNDWATER ENCOUNTERED NO CAVING OBSERVED				

SAMPLE TYPES:
R RING (DRIVE) SAMPLE
S SPT (SPLIT SPOON) SAMPLE
B BULK SAMPLE
T TUBE SAMPLE

▼ GROUNDWATER
➤ SEEPAGE
J: JOINTING C: CONTACT
B: BEDDING F: FAULT
S: SHEAR RS: RUPTURE SURFACE

Alta California Geotechnical, Inc.

P.N. 1-0410

PLATE B-6

GEOTECHNICAL BORING LOG

SHEET 1 OF 1

PROJECT NO. 1-0410
DATE STARTED 9/27/21
DATE FINISHED 9/27/21
DRILLER 2R Drillng Inc.
TYPE OF DRILL RIG 8" Hollow Stem Auger

PROJECT NAME The Terraces
GROUND ELEV. 1177
GW DEPTH (FT)
DRIVE WT. 140lbs.
DROP 30 in.

BORING DESIG. BH-07
LOGGED BY JC
NOTE

DEPTH (Feet)	ELEV	SAMPLE TYPE	BLOWS	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
						PAUBA FORMATION(Qps): SILTY SANDSTONE, very fine to medium grained, reddish brown, dry, dense, some coarse gravel <3".				
	1175									
5		R	35			@5.0ft. SANDSTONE, fine to coarse grained, orange brown, moist, dense.	6.8	119	47	
	1170									
10										
	1165									
15		R	82 for 11"				12.8	108	64	
						@16.0ft. very fine to fine grained, yellow brown.				
	1160									
20						@20.0ft. brown.				
	1155									
25		R	79 for 11"			@25.0ft. fine grained, brown with orange mottling, moist, some silt.	9.6	127	83	
	1150									
30		R	69			@30.0ft. CLAYEY SANDSTONE, very fine to fine grained, brown, moist, very dense.	11.0	112	62	
	1145									
35		R	27			@35.0ft. SILTY CLAYSTONE, brown, moist, very stiff.	32.4	85	91	
						TOTAL DEPTH 36.0 FEET NO GROUNDWATER ENCOUNTERED NO CAVING OBSERVED				

SAMPLE TYPES:
R RING (DRIVE) SAMPLE
S SPT (SPLIT SPOON) SAMPLE
B BULK SAMPLE
T TUBE SAMPLE

▼ GROUNDWATER
➤ SEEPAGE
J: JOINTING C: CONTACT
B: BEDDING F: FAULT
S: SHEAR RS: RUPTURE SURFACE

Alta California Geotechnical, Inc.

P.N. 1-0410

PLATE B-7

GEOTECHNICAL BORING LOG

SHEET 1 OF 2

PROJECT NO. 1-0410
DATE STARTED 9/27/21
DATE FINISHED 9/27/21
DRILLER 2R Drillng Inc.
TYPE OF DRILL RIG 8" Hollow Stem Auger
PROJECT NAME The Terraces
GROUND ELEV. 1182
GW DEPTH (FT)
DRIVE WT. 140lbs.
DROP 30 in.
BORING DESIG. BH-08
LOGGED BY JC
NOTE

DEPTH (Feet)	ELEV	SAMPLE TYPE	BLOWS	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
						PAUBA FORMATION(Qps): SANDSTONE, fine to coarse grained, slightly reddish brown, dry, dense, some fine gravel <3/4", trace silt.				
	1180									
5										
	1175									
						@8.0ft. reddish brown.				
10		R	60			@10.0ft. reddish brown and gray, very dense.	4.9	123	38	
	1170									
						@14.0ft. dark reddish brown.				
15										
	1165									
						@19.0ft. some coarse gravel <3".				
20		R	54			@20.0ft. medium to coarse grained, light orange gray, very dense.	3.4	106	16	
	1160									
25		R	32			@25.0ft. SILTY SANDSTONE, very fine grained, brown, moist, dense.	14.2	116	88	
	1155									
30		R	36			@30.0ft. SANDY CLAYSTONE, very fine grained, brown, moist, very stiff	23.2	101	96	
	1150									
35		R	20				24.9	95	90	
	1145									
						Continued.				

SAMPLE TYPES:
R RING (DRIVE) SAMPLE
S SPT (SPLIT SPOON) SAMPLE
B BULK SAMPLE
T TUBE SAMPLE

▼ GROUNDWATER
► SEEPAGE
J: JOINTING C: CONTACT
B: BEDDING F: FAULT
S: SHEAR RS: RUPTURE SURFACE

Alta California Geotechnical, Inc.

P.N. 1-0410

PLATE B-8

GEOTECHNICAL BORING LOG

SHEET 2 OF 2

PROJECT NO. 1-0410
DATE STARTED 9/27/21
DATE FINISHED 9/27/21
DRILLER 2R Drillng Inc.
TYPE OF DRILL RIG 8" Hollow Stem Auger

PROJECT NAME The Terraces
GROUND ELEV. 1182
GW DEPTH (FT)
DRIVE WT. 140lbs.
DROP 30 in.

BORING DESIG. BH-08
LOGGED BY JC
NOTE

DEPTH (Feet)	ELEV	SAMPLE TYPE	BLOWS	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
		R	34	▨		**PAUBA FORMATION**(Qps): Continued; tannish brown with orange mottling.	19.4	107	95	
						TOTAL DEPTH 41.0 FEET NO GROUNDWATER ENCOUNTERED NO CAVING OBSERVED				

SAMPLE TYPES:
- R RING (DRIVE) SAMPLE
- S SPT (SPLIT SPOON) SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

▼ GROUNDWATER
➤ SEEPAGE
J: JOINTING C: CONTACT
B: BEDDING F: FAULT
S: SHEAR RS: RUPTURE SURFACE

Alta California Geotechnical, Inc.

P.N. 1-0410 PLATE B-8

GEOTECHNICAL BORING LOG

PROJECT NO. 1-0410
DATE STARTED 9/28/21
DATE FINISHED 9/28/21
DRILLER 2R Drillng Inc.
TYPE OF DRILL RIG 8" Hollow Stem Auger

PROJECT NAME The Terraces
GROUND ELEV. 1186
GW DEPTH (FT)
DRIVE WT. 140lbs.
DROP 30 in.

BORING DESIG. BH-09
LOGGED BY JC
NOTE

DEPTH (Feet)	ELEV	SAMPLE TYPE	BLOWS	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
	1185					**PAUBA FORMATION**(Qps): SANDSTONE, fine to coarse grained, slightly reddish brown, dry, dense, some fine gravel <3/4", trace silt.				
5	1180									
						@7.0ft. reddish brown.				
10	1175									
						@14.0ft. medium to coarse grained.				
15	1170									
						@19.0ft. coarse grained.				
20	1165									
						@22.0ft. SILTY CLAYSTONE, brown, slightly moist, stiff.				
25	1160					@26.0ft. SILTY SANDSTONE, very fine to fine grained, tan, dry, dense.				
30	1155	R	30			@30.0ft. SANDY SILTSTONE, brownish tan with orange mottling, moist, stiff, few clay.	17.0	113	97	DS, HY
35	1150	R	74 for 11"			@35.0ft. fine grained, grayish brown, very dense.	12.1	117	78	
						Continued.				

SAMPLE TYPES:
R RING (DRIVE) SAMPLE
S SPT (SPLIT SPOON) SAMPLE
B BULK SAMPLE T TUBE SAMPLE

▼ GROUNDWATER
► SEEPAGE
J: JOINTING C: CONTACT
B: BEDDING F: FAULT
S: SHEAR RS: RUPTURE SURFACE

Alta California Geotechnical, Inc.

GEOTECHNICAL BORING LOG

SHEET 2 OF 2

PROJECT NO. 1-0410
DATE STARTED 9/28/21
DATE FINISHED 9/28/21
DRILLER 2R Drillng Inc.
TYPE OF DRILL RIG 8" Hollow Stem Auger

PROJECT NAME The Terraces
GROUND ELEV. 1186
GW DEPTH (FT)
DRIVE WT. 140lbs.
DROP 30 in.

BORING DESIG. BH-09
LOGGED BY JC
NOTE

DEPTH (Feet)	ELEV	SAMPLE TYPE	BLOWS	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
		R	59	▨		**PAUBA FORMATION**(Qps): Continued; SANDSTONE, coarse grained, tannish gray, dry, very dense, trace fine gravel <3/4", NO RECOVERY	3.1	104	14	
	1145			▨						
45		R	64	▨						
	1140									
						TOTAL DEPTH 46.0 FEET NO GROUNDWATER ENCOUNTERED NO CAVING OBSERVED				

SAMPLE TYPES:
- R RING (DRIVE) SAMPLE
- S SPT (SPLIT SPOON) SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

▼ GROUNDWATER
➤ SEEPAGE
J: JOINTING C: CONTACT
B: BEDDING F: FAULT
S: SHEAR RS: RUPTURE SURFACE

GEOTECHNICAL BORING LOG

SHEET 1 OF 1

PROJECT NO. 1-0410
DATE STARTED 9/28/21
DATE FINISHED 9/28/21
DRILLER 2R Drillng Inc.
TYPE OF DRILL RIG 8" Hollow Stem Auger

PROJECT NAME The Terraces
GROUND ELEV. 1150
GW DEPTH (FT)
DRIVE WT. 140lbs.
DROP 30 in.

BORING DESIG. BH-10
LOGGED BY JC
NOTE

DEPTH (Feet)	ELEV	SAMPLE TYPE	BLOWS	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
	1150				SM	**ARTIFICIAL FILL-UNDOCUMENTED**(afu): SILTY SAND, very fine to fine grained, grayish brown, dry, medium dense, few roots.				
		R	82 for 11"			**PAUBA FORMATION**(Qps): SILTY SANDSTONE, very fine to medium grained, brown, slightly moist, very dense.	6.8	125	57	
		B								
5	1145	R	59			@5.0ft. moderately porous.	5.5	112	31	
10	1140	R	31			@10.0ft. SANDSTONE, very fine to medium grained, tannish brown, slightly moist, dense some silt.	6.4	117	41	
						@13.0ft. SILTY SANDSTONE, very fine to fine grained, reddish brown, slightly moist, medium dense.				
15	1135	R	27				20.9	104	94	
						@15.5ft. CLAYEY SANDSTONE, medium to coarse grained, grayish brown, moist, medium dense.				
20	1130	R	67			@20.0ft. SANDSTONE, coarse grained, tan, slightly moist, very dense.	7.3	106	35	
25	1125	R	72				7.0	112	39	

TOTAL DEPTH 26.0 FEET
NO GROUNDWATER ENCOUNTERED
NO CAVING OBSERVED

SAMPLE TYPES:
R RING (DRIVE) SAMPLE
S SPT (SPLIT SPOON) SAMPLE
B BULK SAMPLE
T TUBE SAMPLE

▼ GROUNDWATER
➤ SEEPAGE
J: JOINTING C: CONTACT
B: BEDDING F: FAULT
S: SHEAR RS: RUPTURE SURFACE

Alta California Geotechnical, Inc.

P.N. 1-0410 PLATE B-10

GEOTECHNICAL BORING LOG

SHEET 1 OF 1

PROJECT NO. 1-0410
DATE STARTED 9/28/21
DATE FINISHED 9/28/21
DRILLER 2R Drillng Inc.
TYPE OF DRILL RIG 8" Hollow Stem Auger

PROJECT NAME The Terraces
GROUND ELEV. 1140
GW DEPTH (FT)
DRIVE WT. 140lbs.
DROP 30 in.

BORING DESIG. BH-11
LOGGED BY JC
NOTE

DEPTH (Feet)	ELEV	SAMPLE TYPE	BLOWS	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
	1140				SM	**ARTIFICIAL FILL-UNDOCUMENTED**(afu): SILTY SAND, very fine to fine grained, brown, dry, medium dense, few fine to coarse gravel <3", few roots.				
		R	63			**PAUBA FORMATION**(Qps): SILTY SANDSTONE, very fine to medium grained, brown, slightly moist, very dense.	5.2	113	29	
5	1135	R	49			@5.0ft. trace clay.	7.3	130	70	
10	1130	R	38			@10.0ft. CLAYEY SANDSTONE, very fine to medium grained, orange brown, moist, dense.	15.8	115	96	
15	1125	R	58			@15.0ft. SILTY SANDSTONE, very fine to fine grained, orange brown, moist, very dense.	12.7	121	93	
20	1120	R	79 for 11"			@20.0ft. SANDSTONE, fine to coarse grained, tan, slightly moist, very dense.	6.9	104	31	
25	1115	R	80			@25.0ft. some fine gravel <3/4", NO RECOVERY.				
						TOTAL DEPTH 26.0 FEET NO GROUNDWATER ENCOUNTERED NO CAVING OBSERVED				

SAMPLE TYPES:
R RING (DRIVE) SAMPLE
S SPT (SPLIT SPOON) SAMPLE
B BULK SAMPLE
T TUBE SAMPLE

▼ GROUNDWATER
➤ SEEPAGE
J: JOINTING C: CONTACT
B: BEDDING F: FAULT
S: SHEAR RS: RUPTURE SURFACE

Alta California Geotechnical, Inc.

P.N. 1-0410

PLATE B-11

GEOTECHNICAL BORING LOG

SHEET 1 OF 1

PROJECT NO. 1-0410
DATE STARTED 9/28/21
DATE FINISHED 9/28/21
DRILLER 2R Drillng Inc.
TYPE OF DRILL RIG 8" Hollow Stem Auger

PROJECT NAME The Terraces
GROUND ELEV. 1122
GW DEPTH (FT)
DRIVE WT. 140lbs.
DROP 30 in.

BORING DESIG. BH-12
LOGGED BY JC
NOTE

DEPTH (Feet)	ELEV	SAMPLE TYPE	BLOWS	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
				▥	ML	**ARTIFICIAL FILL-UNDOCUMENTED**(afu): SANDY SILT, tan, dry, firm to stiff. @1.0ft. very fine grained, medium dense.				
	1120									
		B								MAX, EI, HY, CHEM,
5		R	82 for 11"	▥▒		**PAUBA FORMATION**(Qps): SANDY SILTSTONE, very fine grained, tan, slightly moist, very stiff, few calcium carbonates.	8.8	122	66	DSR CON, HY
	1115									
10		R	90 for 10"				7.3	129	69	
	1110									
15		R	30	▒▨		@15.0ft. CLAYEY SANDSTONE, very fine grained, gray and brown, moist, dense.	10.2	117	66	
	1105									
20		R	75 for 11"	▒▥		@20.0ft. SILTY SANDSTONE, very fine grained, brown, moist, very dense.	11.3	123	87	
	1100									
25		R	29	▒		@25.0ft. SANDSTONE, fine grained, orange, slightly moist, medium dense.	6.7	108	34	

TOTAL DEPTH 26.0 FEET
NO GROUNDWATER ENCOUNTERED
NO CAVING OBSERVED

SAMPLE TYPES:
- R RING (DRIVE) SAMPLE
- S SPT (SPLIT SPOON) SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

▼ GROUNDWATER
➤ SEEPAGE
J: JOINTING C: CONTACT
B: BEDDING F: FAULT
S: SHEAR RS: RUPTURE SURFACE

Alta California Geotechnical, Inc.

P.N. 1-0410 PLATE B-12

GEOTECHNICAL BORING LOG

SHEET 1 OF 1

PROJECT NO. 1-0410
DATE STARTED 9/28/21
DATE FINISHED 9/28/21
DRILLER 2R Drillng Inc.
TYPE OF DRILL RIG 8" Hollow Stem Auger

PROJECT NAME The Terraces
GROUND ELEV. 1152
GW DEPTH (FT)
DRIVE WT. 140lbs.
DROP 30 in.

BORING DESIG. BH-13
LOGGED BY JC
NOTE

DEPTH (Feet)	ELEV	SAMPLE TYPE	BLOWS	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
					SM	**ARTIFICIAL FILL-UNDOCUMENTED**(afu): SILTY SAND, very fine to fine grained, tannish brown, dry, medium dense , with roots. @1.0ft. very fine grained, tan.				
	1150									
5		R	31				7.4	111	40	
						PAUBA FORMATION(Qps): SILTY SANDSTONE, very fine to medium grained, gray brown, slightly, dense.				
	1145									
10		R	34			@10.0ft. very fine to fine grained, dark brown.	6.9	117	45	
	1140									
15		R	13			@15.0ft. CLAYEY SANDSTONE, very fine to medium grained, dark brown, moist, medium dense, few pores.	9.0	123	69	
	1135									
20		R	36			@20.0ft. SANDSTONE, very fine to medium grained, tan and brown, moist, dense, some silt. @21.0ft. fine to coarse grained, gray.	6.7	117	43	
	1130									
						@23.0ft. SILTY SANDSTONE, very fine to medium grained, orange brown, slightly moist, dense, few pores.				
25		R	45			@25.5ft. SANDSTONE, fine to coarse grained, orange tan, slightly moist, dense.	6.7	114	39	
						TOTAL DEPTH 26.0 FEET NO GROUNDWATER ENCOUNTERED NO CAVING OBSERVED				

SAMPLE TYPES:
- R RING (DRIVE) SAMPLE
- S SPT (SPLIT SPOON) SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

▼ GROUNDWATER
➤ SEEPAGE
J: JOINTING C: CONTACT
B: BEDDING F: FAULT
S: SHEAR RS: RUPTURE SURFACE

Alta California Geotechnical, Inc.

P.N. 1-0410

PLATE B-13

GEOTECHNICAL BORING LOG

SHEET 1 OF 1

PROJECT NO. 1-0410
DATE STARTED 9/28/21
DATE FINISHED 9/28/21
DRILLER 2R Drillng Inc.
TYPE OF DRILL RIG 8" Hollow Stem Auger

PROJECT NAME The Terraces
GROUND ELEV. 1160
GW DEPTH (FT)
DRIVE WT. 140lbs.
DROP 30 in.

BORING DESIG. BH-14
LOGGED BY JC
NOTE

DEPTH (Feet)	ELEV	SAMPLE TYPE	BLOWS	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
	1160					**PAUBA FORMATION**(Qps): SANDSTONE, very fine to medium grained, grayish tan, dry, dense, few fine gravel <3/4", few roots.				
		R	36			@2.5ft. brown, slightly moist, moderately porous.	6.6	114	38	
5	1155	R	42				6.6	123	51	
10	1150	R	69			@10.0ft. coarse grained, tannish gray, dry, very dense.	2.7	113	15	
15	1145	R	57			@15.0ft. fine grained, yellow.	4.8	112	26	
20	1140	R	80 for 11"			@20.0ft. fine to coarse grained, gray.	2.6	102	11	
25	1135	R	79 for 11"			@25.0ft. NO RECOVERY.				
						TOTAL DEPTH 26.0 FEET NO GROUNDWATER ENCOUNTERED NO CAVING OBSERVED				

SAMPLE TYPES:
- R RING (DRIVE) SAMPLE
- S SPT (SPLIT SPOON) SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

▼ GROUNDWATER
➤ SEEPAGE
J: JOINTING C: CONTACT
B: BEDDING F: FAULT
S: SHEAR RS: RUPTURE SURFACE

Alta California Geotechnical, Inc.

P.N. 1-0410

PLATE B-14

GEOTECHNICAL BORING LOG

SHEET 1 OF 1

PROJECT NO. 1-0410
DATE STARTED 9/28/21
DATE FINISHED 9/28/21
DRILLER 2R Drillng Inc.
TYPE OF DRILL RIG 8" Hollow Stem Auger

PROJECT NAME The Terraces
GROUND ELEV. 1159
GW DEPTH (FT)
DRIVE WT. 140lbs.
DROP 30 in.

BORING DESIG. BH-15
LOGGED BY JC
NOTE

DEPTH (Feet)	ELEV	SAMPLE TYPE	BLOWS	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
					SM	**ARTIFICIAL FILL-UNDOCUMENTED**(afu): SILTY SAND, very fine to medium grained, tannish brown, dry, medium dense, few roots.				
	1155									
5		R	19			**PAUBA FORMATION**(Qps): SILTY SANDSTONE, fine to medium grained, brown, dry, medium dense, moderately porous.	4.0	110	21	
	1150									
10		R	32			@10.0ft. SANDY SILTSTONE w/CLAY, dark brown, moist, stiff, trace fine gravel <3/4".	11.2	129	104	CON, HY
	1145									
15		R	76			@15.0ft. SANDSTONE, fine to medium grained, orange tan, slightly moist, very dense.	5.0	116	31	

TOTAL DEPTH 16.0 FEET
NO GROUNDWATER ENCOUNTERED
NO CAVING OBSERVED

SAMPLE TYPES:
R RING (DRIVE) SAMPLE
S SPT (SPLIT SPOON) SAMPLE
B BULK SAMPLE
T TUBE SAMPLE

▼ GROUNDWATER
➤ SEEPAGE
J: JOINTING C: CONTACT
B: BEDDING F: FAULT
S: SHEAR RS: RUPTURE SURFACE

Alta California Geotechnical, Inc.

P.N. 1-0410 PLATE B-15

GEOTECHNICAL BORING LOG

SHEET 1 OF 1

PROJECT NO. 1-0410
DATE STARTED 9/28/21
DATE FINISHED 9/28/21
DRILLER 2R Drillng Inc.
TYPE OF DRILL RIG 8" Hollow Stem Auger

PROJECT NAME The Terraces
GROUND ELEV. 1166
GW DEPTH (FT)
DRIVE WT. 140lbs.
DROP 30 in.

BORING DESIG. BH-16
LOGGED BY JC
NOTE

DEPTH (Feet)	ELEV	SAMPLE TYPE	BLOWS	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
	1165			▨		**PAUBA FORMATION**(Qps): SILTY SANDSTONE, very fine to coarse grained, brown, dry, dense.				
		R	50	▨		@2.5ft. NO RECOVERY.				
5		R	40	▨		@ 5.0ft. slightly moist.	7.2	123	55	
	1160			▨						
10		R	26	▨		@10.0ft. very fine to fine grained, moist, medium dense, some clay.	11.8	118	78	
	1155			▨						
15		R	52	▨		@15.0ft. very dense.	9.6	125	79	
	1150									
						TOTAL DEPTH 16.0 FEET NO GROUNDWATER ENCOUNTERED NO CAVING OBSERVED				

SAMPLE TYPES:
R RING (DRIVE) SAMPLE
S SPT (SPLIT SPOON) SAMPLE
B BULK SAMPLE
T TUBE SAMPLE

▼ GROUNDWATER
► SEEPAGE
J: JOINTING C: CONTACT
B: BEDDING F: FAULT
S: SHEAR RS: RUPTURE SURFACE

Alta California Geotechnical, Inc.

P.N. 1-0410

PLATE B-16

GEOTECHNICAL BORING LOG

SHEET 1 OF 1

PROJECT NO. 1-0410
DATE STARTED 9/29/21
DATE FINISHED 9/29/21
DRILLER 2R Drillng Inc.
TYPE OF DRILL RIG 8" Hollow Stem Auger

PROJECT NAME The Terraces
GROUND ELEV. 1148
GW DEPTH (FT)
DRIVE WT. 140lbs.
DROP 30 in.

BORING DESIG. BH-17
LOGGED BY JC
NOTE

DEPTH (Feet)	ELEV	SAMPLE TYPE	BLOWS	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
					SM	**ALLUVIUM**(Qal): SILTY SAND, very fine to medium grained, tan, dry, dense.				
	1145	R B	38				3.4	114	20	MAX, EI, HY, CHEM, DSR
5		R	16			@5.0ft. very fine to medium grained, brown, dry, medium dense, moderately porous.	3.8	109	19	
	1140									
10		R	23		SP	@10.0ft. SAND, very fine to medium grained, brown, slightly moist, medium dense, trace fine gravel <3/4".	6.0	119	41	
	1135									
15		R	33			**PAUBA FORMATION**(Qps): SANDSTONE, very fine to medium grained, brown, slightly moist, dense.	6.3	125	52	
	1130									
20		R	80 for 11"			@20.0ft. very fine to fine grained, tan, very dense, trace silt.	5.7	117	37	
						TOTAL DEPTH 21.0 FEET NO GROUNDWATER ENCOUNTERED NO CAVING OBSERVED				

SAMPLE TYPES:
R RING (DRIVE) SAMPLE
S SPT (SPLIT SPOON) SAMPLE
B BULK SAMPLE
T TUBE SAMPLE

▼ GROUNDWATER
➤ SEEPAGE
J: JOINTING C: CONTACT
B: BEDDING F: FAULT
S: SHEAR RS: RUPTURE SURFACE

GEOTECHNICAL BORING LOG

SHEET 1 OF 1

PROJECT NO. 1-0410
DATE STARTED 9/29/21
DATE FINISHED 9/29/21
DRILLER 2R Drillng Inc.
TYPE OF DRILL RIG 8" Hollow Stem Auger

PROJECT NAME The Terraces
GROUND ELEV. 1124
GW DEPTH (FT)
DRIVE WT. 140lbs.
DROP 30 in.

BORING DESIG. BH-18
LOGGED BY JC
NOTE

DEPTH (Feet)	ELEV	SAMPLE TYPE	BLOWS	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
						PAUBA FORMATION(Qps): SANDSTONE, fine to coarse grained, tan, dry, dense, trace debris.				
		R	45			@2.5ft. very fine to fine grained, brown, some silt.	4.1	118	27	
	1120									
5		R	76			@5.0ft. very dense, some silt, trace pores.	5.5	132	58	
	1115									
10		R	84 for 11"			@10.0ft. SILTY SANDSTONE, very fine grained, tan, slightly moist, very dense, few calcium carbonates.	6.7	121	49	
	1110									
15		R	80 for 11"			@ 15.0ft. moist.	14.2	111	76	
						TOTAL DEPTH 16.0 FEET NO GROUNDWATER ENCOUNTERED NO CAVING OBSERVED				

SAMPLE TYPES:
R RING (DRIVE) SAMPLE
S SPT (SPLIT SPOON) SAMPLE
B BULK SAMPLE T TUBE SAMPLE

▼ GROUNDWATER
➤ SEEPAGE
J: JOINTING C: CONTACT
B: BEDDING F: FAULT
S: SHEAR RS: RUPTURE SURFACE

Alta California Geotechnical, Inc.

P.N. 1-0410 PLATE B-18

GEOTECHNICAL BORING LOG

SHEET 1 OF 1

PROJECT NO. 1-0410
DATE STARTED 9/29/21
DATE FINISHED 9/29/21
DRILLER 2R Drillng Inc.
TYPE OF DRILL RIG 8" Hollow Stem Auger

PROJECT NAME The Terraces
GROUND ELEV. 1122
GW DEPTH (FT)
DRIVE WT. 140lbs.
DROP 30 in.

BORING DESIG. BH-19
LOGGED BY JC
NOTE

DEPTH (Feet)	ELEV	SAMPLE TYPE	BLOWS	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
					SP	**ARTIFICIAL FILL-UNDOCUMENTED**(afu): SAND, very fine to coarse grained, tan, dry, medium dense.				
	1120									
		R	49			**PAUBA FORMATION**(Qps): SANDSTONE, coarse grained, gray, dry, dense.	1.5	112	8	
5		R	75 for 10"			@5.0ft. very fine to medium grained, slightly moist.	5.4	118	36	
	1115									
10		R	80 for 11"			@10.0ft. some orange mottling, moist.	8.0	122	59	
	1110									
15		R	98 for 11"			@15.0ft. medium to coarse grained, dry.	3.3	110	17	
	1105									
20		R	89 for 11"				2.8	106	13	
						TOTAL DEPTH 21.0 FEET NO GROUNDWATER ENCOUNTERED NO CAVING OBSERVED				

SAMPLE TYPES:
R RING (DRIVE) SAMPLE
S SPT (SPLIT SPOON) SAMPLE
B BULK SAMPLE
T TUBE SAMPLE

▼ GROUNDWATER
➤ SEEPAGE
J: JOINTING C: CONTACT
B: BEDDING F: FAULT
S: SHEAR RS: RUPTURE SURFACE

Alta California Geotechnical, Inc.

P.N. 1-0410

PLATE B-19

GEOTECHNICAL BORING LOG

SHEET 1 OF 1

PROJECT NO. 1-0410
DATE STARTED 9/29/21
DATE FINISHED 9/29/21
DRILLER 2R Drillng Inc.
TYPE OF DRILL RIG 8" Hollow Stem Auger
PROJECT NAME The Terraces
GROUND ELEV. 1131
GW DEPTH (FT)
DRIVE WT. 140lbs.
DROP 30 in.
BORING DESIG. BH-20
LOGGED BY JC
NOTE

DEPTH (Feet)	ELEV	SAMPLE TYPE	BLOWS	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
	1130					**PAUBA FORMATION**(Qps): SANDSTONE, very fine to coarse grained, brown, dry, dense, some silt, roots.				
		R	69			@2.5ft. very fine to medium grained, slightly moist, trace pores.	4.7			
5	1125	R	72			@5.0ft. fine to coarse grained, brown with orange mottling.	5.9	116	37	
10	1120	R	79			@10.0ft. gray with orange mottling, dry.	2.8	108	14	
15	1115	R	90 for 11"			@15.0ft. gray.	1.8	104	8	
20	1110	R	63			@20.0ft. coarse grained, some fine gravel <3/4".	0.9	108	4	

TOTAL DEPTH 21.0 FEET
NO GROUNDWATER ENCOUNTERED
NO CAVING OBSERVED

SAMPLE TYPES:
R RING (DRIVE) SAMPLE
S SPT (SPLIT SPOON) SAMPLE
B BULK SAMPLE
T TUBE SAMPLE

▼ GROUNDWATER
➤ SEEPAGE
J: JOINTING C: CONTACT
B: BEDDING F: FAULT
S: SHEAR RS: RUPTURE SURFACE

Alta California Geotechnical, Inc.

P.N. 1-0410 PLATE B-20

GEOTECHNICAL BORING LOG

SHEET 1 OF 1

PROJECT NO. 1-0410
DATE STARTED 9/29/21
DATE FINISHED 9/29/21
DRILLER 2R Drillng Inc.
TYPE OF DRILL RIG 8" Hollow Stem Auger

PROJECT NAME The Terraces
GROUND ELEV. 1140
GW DEPTH (FT)
DRIVE WT. 140lbs.
DROP 30 in.

BORING DESIG. PH-01
LOGGED BY JC
NOTE

DEPTH (Feet)	ELEV	SAMPLE TYPE	BLOWS	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
	1140					**PAUBA FORMATION**(Qps): SILTY SANDSTONE, very fine to fine grained, tannish brown, dry, medium dense.				
						@4.0ft. very dense.				
5	1135									
10	1130									
						@13.0ft. very fine to medium grained.				
15	1125									
						@17.0ft. SANDSTONE, very fine to coarse grained, grayish brown, dry, dense.				
20	1120									
						@21.0ft. medium to coarse grained, some silt, few calcium carbonates.				
25	1115									
30	1110									
						TOTAL DEPTH 30.0 FEET NO GROUNDWATER ENCOUNTERED NO CAVING OBSERVED				

SAMPLE TYPES:
- R RING (DRIVE) SAMPLE
- S SPT (SPLIT SPOON) SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

▼ GROUNDWATER
➤ SEEPAGE
J: JOINTING C: CONTACT
B: BEDDING F: FAULT
S: SHEAR RS: RUPTURE SURFACE

Alta California Geotechnical, Inc.

P.N. 1-0410

APPENDIX B-1

Previous Subsurface Investigation

(Geocon, 2016)

PROJECT NO. T2673-22-01

BORING B-1

ELEV. (MSL.) **1116** DATE COMPLETED **10/24/15**

EQUIPMENT **HOLLOW STEM AUGER** BY: **L.BATTIATO**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	B-1@0-5'			SM	**Undocumented Fill (afu)** Silty SAND, loose to medium dense, dry, strong brown; fine to medium sand			
2								
	B-1@2.5'			SP-SM	SAND, dense, slightly moist, strong brown; fine to coarse sand; poorly graded; cohessionless; interlayered with yellow silty SAND	50/5"	108.8	4.8
4								
	B-1@5'				- Becomes moist, orange brown; locally massive	50/6"	116.3	6.7
6								
8	B-1@7.5'				- Becomes strong brown; thin layered	72		
10	B-1@10'				- Becomes laminated	50/6"		
12								
				SM	**Pauba Formation (Qps)** Silty SANDSTONE, moist, strong brown; locally massive; fine-to medium-grained			
14								
	B-1@15'				- Becomes yellow brown	22	117.3	5.6
16								
18								
20	B-1@20'			SP-SM	SANDSTONE with silt, very dense, moist, strong brown; low cohession; medium-to coarse-grained	70		

Total depth: 21.5'
Groundwater not encountered
Penetration resistance for 140 lb hammer falling 30" by drop
Backfilled with native cuttings

Figure A-1,
Log of Boring B-1, Page 1 of 1

T2673-22-01.GPJ

SAMPLE SYMBOLS			
	☐ ... SAMPLING UNSUCCESSFUL	◧ ... STANDARD PENETRATION TEST	■ ... DRIVE SAMPLE (UNDISTURBED)
	☒ ... DISTURBED OR BAG SAMPLE	◪ ... CHUNK SAMPLE	▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. T2673-22-01

BORING B-2

ELEV. (MSL.) 1124 DATE COMPLETED 10/24/15

EQUIPMENT HOLLOW STEM AUGER BY: L.BATTIATO

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	B-2@0-5'			SM	**Alluvium (Qal)** Silty SAND, dense (cemented), dry, strong brown; fine to medium sand			
	B-2@2.5'				-Becomes medium dense	45	118.1	4.8
	B-2@5'					35	115.1	3.6
	B-2@7.5'					19	115.2	4.0
10	B-2@10'			SW	**Pauba Formation (Qps)** Well graded SANDSTONE, moist, light yellow brown; fine-to coarse-grained; cuttings become olive brown; cohesionless	22	107.1	2.5
				SP	Poorly graded SANDSTONE, dense, wet, olive brown; coarse-grained			
	B-2@15'		▽			33	110.0	16.6
					-Saturated			
20	B-2@20'			SP-SM	Poorly graded SANDSTONE with silt, very dense, moist, yellow brown; locally massive; fine-to medium-grained	50/5"		
	B-2@25'					50/5.5"		

Figure A-2,
Log of Boring B-2, Page 1 of 2

T2673-22-01.GPJ

SAMPLE SYMBOLS

☐ ... SAMPLING UNSUCCESSFUL
◧ ... STANDARD PENETRATION TEST
■ ... DRIVE SAMPLE (UNDISTURBED)
☒ ... DISTURBED OR BAG SAMPLE
◣ ... CHUNK SAMPLE
▼ ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. T2673-22-01

BORING B-2

ELEV. (MSL.) **1124** DATE COMPLETED **10/24/15**

EQUIPMENT **HOLLOW STEM AUGER** BY: **L.BATTIATO**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30	B-2@30'			ML	**Pauba Formation (Qps)** SILTSTONE, hard, wet, olive; some iron staining; some carbonate nodules	45		
36	B-2@35'			SP	SANDSTONE, very dense, moist, light olive; fine-grained; iron staining	61		
40	B-2@40'			SP	Poorly graded SANDSTONE, very dense, moist, light gray (granitic derived); coarse-grained; cohesionless	50/4.5"		
	B-2@45'			ML	SILTSTONE, very hard, moist, olive	50/6"		
				SP	Poorly graded SANDSTONE, very dense, moist, yellow brown; coarse-grained; cohesionless			
50	B-2@50'					50/6"		

Total depth: 50.5'
Groundwater encountered at 18.5' during drilling. When encountered, rose to 15.9' in 5 minutes.
Penetration resistance for 140 lb hammer falling 30" by drop
Backfilled with native cuttings

Figure A-2,
Log of Boring B-2, Page 2 of 2

T2673-22-01.GPJ

SAMPLE SYMBOLS

☐ ... SAMPLING UNSUCCESSFUL
◧ ... STANDARD PENETRATION TEST
■ ... DRIVE SAMPLE (UNDISTURBED)
☒ ... DISTURBED OR BAG SAMPLE
◪ ... CHUNK SAMPLE
▼ ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. T2673-22-01

BORING B-3

ELEV. (MSL.) 1162 DATE COMPLETED 10/24/15

EQUIPMENT HOLLOW STEM AUGER BY: L.BATTIATO

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	B-3@0-5'			SM	**Pauba Formation (Qps)** SILTSTONE, hard, dry, yellow brown; indurated			
2								
4								
	B-3@5'				-Becomes moist	50/5"	102.9	12.9
6								
8				SP	Poorly graded SANDSTONE (granitic derived), very dense, dry, gray to buff; coarse; cohesionless			
10	B-3@10'					71	102.4	3.3
12								
14								
	B-3@15'					50/6"		
16								

Total depth: 16'
Groundwater not encountered
Converted to P-5
Caved to 11.5' when installing pipe
Penetration resistance for 140 lb hammer falling 30" by drop
Backfilled with native cuttings

Figure A-3,
Log of Boring B-3, Page 1 of 1

T2673-22-01.GPJ

SAMPLE SYMBOLS

☐ ... SAMPLING UNSUCCESSFUL
◧ ... STANDARD PENETRATION TEST
■ ... DRIVE SAMPLE (UNDISTURBED)
☒ ... DISTURBED OR BAG SAMPLE
◩ ... CHUNK SAMPLE
▼ ... WATER TABLE OR SEEPAGE

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PROJECT NO. T2673-22-01

BORING B-4

ELEV. (MSL.) **1150** DATE COMPLETED **10/24/15**

EQUIPMENT **HOLLOW STEM AUGER** BY: **L.BATTIATO**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**Undocumented Fill (afu)** Silty SAND, very dense, dry, strong brown; fine to medium sand; some coarse sand			
2								
	B-4@2.5' ■					50/6"	123.6	0.4
4								
	B-4@5' ■			ML	SILT with abundant carbonate, hard, slightly moist, olive	75	118.6	7.6
6				SM	Silty SAND, very dense, moist, strong brown; fine to coarse sand; mottled texture			
8	B-4@7.5' ■					50/4"	103.6	18.6
10	B-4@10' ■			ML	SILT, hard, damp, olive; abundant carbonate	80/11.5"		
12								
14								
	B-4@15' ■			SM	Silty SAND, very dense, moist, strong brown; fine to coarse sand; mottled texture	90/11.5"	121.6	13.3
16								
18								
					- organic staining			
20	B-4@20' ■			SP	**Pauba Formation (Qps)** Poorly graded SANDSTONE, very dense, moist, yellow brown; fine-grained; micaceous	50/6"	113.4	10.3
22								
24								
	B-4@25' ■			ML	SILTSTONE, hard, moist, dark olive; laminated	82/11.5"		
26								
					Total depth: 26' 5.5" Groundwater not encountered Penetration resistance for 140 lb hammer falling 30" by drop Backfilled with native cuttings			

Figure A-4,
Log of Boring B-4, Page 1 of 1

T2673-22-01.GPJ

SAMPLE SYMBOLS			
	☐ ... SAMPLING UNSUCCESSFUL	◧ ... STANDARD PENETRATION TEST	■ ... DRIVE SAMPLE (UNDISTURBED)
	☒ ... DISTURBED OR BAG SAMPLE	◣ ... CHUNK SAMPLE	▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. T2673-22-01

BORING B-5

ELEV. (MSL.) **1152** DATE COMPLETED **10/24/15**

EQUIPMENT **HOLLOW STEM AUGER** BY: **L.BATTIATO**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**Undocumented Fill (afu)** Silty SAND, very dense, dry, strong brown; fine to medium sand; mottled texture			
	B-5@2.5'				-Becomes slightly moist	88	123.5	5.6
	B-5@5'			SM	Silty SAND, very dense (cemented), slightly moist, strong brown; organic stain	82	114.8	7.1
8	B-5@7.5'			ML	**Pauba Formation (Qps)** SILTSTONE, hard, moist, olive; fine-to medium-grained; trace carbonates	60	115.5	15.8
10	B-5@10'			SP-SM	Poorly graded SANDSTONE with silt, very dense, slightly moist, olive brown; coarse-grained	81/10"	122.5	7.7
	B-5@15'			SP	Poorly graded SANDSTONE, very dense, moist, yellow brown; cohessionless; fine-to medium-grained; trace coarse-grained sand	90/11"		
20	B-5@20'				- Becomes very coarse, light orange	95/11"		

Total depth: 20.9'
Groundwater not encountered
Penetration resistance for 140 lb hammer falling 30" by drop
Backfilled with native cuttings

Figure A-5,
Log of Boring B-5, Page 1 of 1

T2673-22-01.GPJ

SAMPLE SYMBOLS

☐ ... SAMPLING UNSUCCESSFUL
◧ ... STANDARD PENETRATION TEST
■ ... DRIVE SAMPLE (UNDISTURBED)
☒ ... DISTURBED OR BAG SAMPLE
◣ ... CHUNK SAMPLE
▼ ... WATER TABLE OR SEEPAGE

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PROJECT NO. T2673-22-01

BORING B-6

ELEV. (MSL.) **1120** DATE COMPLETED **10/24/15**

EQUIPMENT **HOLLOW STEM AUGER** BY: **L.BATTIATO**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	B-6@0-5' ☒			SM	**Undocumented Fill (afu)** Silty SAND, very dense (cemented), dry, strong brown; mottled texture			
2								
	B-6@2.5' ■				-Becomes slightly moist	50/4"	116.8	3.8
4								
	B-6@5' ■				-Clay development on parting surfaces (soil development)	83	115.4	7.6
6								
8	B-6@7.5' ■				-Becomes moist, yellow brown; fine to coarse sand (older generation undocumented fill)	59	119.7	6.2
10	B-6@10' ■				-Becomes fine sand; laminated	67	116.4	7.9
12								
14								
	B-6@15' ■				-Becomes dense, dark brown; organic stained; bits of charcoal; mottled texture	56	124.0	9.4
16								
18								
20	B-6@20' ■				-Becomes very dense; mottled coloring	50/5"	123.9	8.9
22				SM	**Pauba Formation (Qps)** Silty SANDSTONE, very dense, moist, yellow brown; fine-to coarse-grained			
24								
	B-6@25' ■			ML	SILTSTONE, hard, moist, olive; micaceous	68		
26								

Total depth: 26.5'
Groundwater not encountered
Penetration resistance for 140 lb hammer falling 30" by drop
Backfilled with native cuttings

Figure A-6,
Log of Boring B-6, Page 1 of 1

T2673-22-01.GPJ

SAMPLE SYMBOLS		
☐ ... SAMPLING UNSUCCESSFUL	◧ ... STANDARD PENETRATION TEST	■ ... DRIVE SAMPLE (UNDISTURBED)
☒ ... DISTURBED OR BAG SAMPLE	◪ ... CHUNK SAMPLE	▼ ... WATER TABLE OR SEEPAGE

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PROJECT NO. T2673-22-01

BORING B-7

ELEV. (MSL.) **1153** DATE COMPLETED **10/24/15**

EQUIPMENT **HOLLOW STEM AUGER** BY: **L.BATTIATO**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SC-SM	**Alluvium (Qal)** Silty, clayey SAND, dense (cemented), dry, strong brown; secondary porosity			
2								
	B-7@2.5'				-Becomes slightly moist	73/11"	118.6	4.2
4								
	B-7@5'			SC	Clayey SAND, dense, slightly moist, strong brown; fine to medium sand; cemented; some secondary porosity	66	123.8	6.9
6								
8	B-7@7.5'				-Becomes medium dense, moist, strong brown; abundant secondary porosity	31	124.3	9.3
10	B-7@10'			SC/CL	Clayey SAND to SANDY CLAY, medium dense to stiff, moist, strong brown; less porosity	36	119.3	12.6
12								
14								
	B-7@15'			SM	**Pauba Formation (Qps)** Silty SANDSTONE, medium dense, moist, yellow brown; medium-to coarse-grained	31	119.7	11.1
16								
18								
20	B-7@20'					50/6"		

Total depth: 21'
Groundwater not encountered
Penetration resistance for 140 lb hammer falling 30" by drop
Backfilled with native cuttings

Figure A-7,
Log of Boring B-7, Page 1 of 1

T2673-22-01.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◣ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

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BORING B-8

ELEV. (MSL.) **1188** DATE COMPLETED **10/24/15**

EQUIPMENT **HOLLOW STEM AUGER** BY: **L.BATTIATO**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0 2 4				SM	**Pauba Formation (Qps)** Silty SANDSTONE, medium dense, dry, brown			
6 8	B-8@5'			SP	Poorly graded SANDSTONE, medium dense, slightly moist, yellow; fine-grained; in near vertical contact with medium silty SAND; fine silty sand is indurated and laminated; medium silty sand is cohessionless	43	105.8	5.4
10 12	B-8@10'			SP-SM	Poorly graded SANDSTONE with silt, very dense, slightly moist, yellow brown; laminated; very fine-grained	77	120.4	7.0
14				SM	Silty SANDSTONE, medium dense, dry, brown			
16 18	B-8@15'			SP	Poorly graded SANDSTONE, very dense, dry, buff; cohessionless; coarse grained	72	119.7	1.8
20	B-8@20'			SP-SM	Poorly graded silty SANDSTONE, hard, slightly moist, yellow; laminated	77	122.6	6.7

Total depth: 21.5'
Groundwater not encountered
Converted to perc P-1
Penetration resistance for 140 lb hammer falling 30" by drop
Backfilled with native cuttings

Figure A-8,
Log of Boring B-8, Page 1 of 1

T2673-22-01.GPJ

SAMPLE SYMBOLS			
	☐ ... SAMPLING UNSUCCESSFUL	◧ ... STANDARD PENETRATION TEST	■ ... DRIVE SAMPLE (UNDISTURBED)
	⊠ ... DISTURBED OR BAG SAMPLE	◪ ... CHUNK SAMPLE	▼ ... WATER TABLE OR SEEPAGE

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Leach Line Percolation Data Sheet

Project	Terraces				**Job No.**	T2673-22-01	
Test Hole No.		P-1			**Date Excavated**		10/23/2015
Depth of Test Hole:		20.2' (top of pipe)			**Soil Classification**		
Check for Sandy Soil Criteria Tested by:				PDT	**Presoak**		10/28/2015
Actual Percolation Tested by:			PDT		**Date**		10/29/2015

Water level measured from BOTTOM of hole

Sandy Soil Criteria Test

Trial No.	Time	Time Interval (min)	Total Elapsed Time (min)	Initial Water Level (in)	Final Water Level (in)	∆ in Water Level (in)	Percolation Rate (min/inch)
1	9:48	0:25	0:25	31.2	4.8	26.4	0.95
	10:13						
2	10:13	0:25	0:50	21.6	3.6	18.0	1.39
	10:38						

Soil Criteria: Sandy

Reading No.	Time	Time Interval (min)	Total Elapsed Time (min)	Initial Water Level (in)	Final Water Level (in)	∆ in Water Level (in)	Percolation Rate (min/inch)
1	10:40	0:10	0:10	14.4	10.8	3.6	2.8
	10:50						
2	10:51	0:10	0:20	37.2	32.4	4.8	2.1
	11:01						
3	11:02	0:10	0:30	38.4	33.6	4.8	2.1
	11:12						
4	11:13	0:10	0:40	39.6	36.0	3.6	2.8
	11:23						
5	11:24	0:10	0:50	39.6	36.0	3.6	2.8
	11:34						
6	11:35	0:10	1:00	38.4	34.8	3.6	2.8
	11:45						
7							
8							
9							
10							
11							
12							

FIGURE A-9

Leach Line Percolation Data Sheet

Project	Terraces	**Job No.**	T2673-22-01
Test Hole No.	P-2	**Date Excavated**	10/23/2015
Depth of Test Hole:	20.2' (top of pipe)	**Soil Classification**	
Check for Sandy Soil Criteria Tested by:	PDT	**Presoak**	10/28/2015
Actual Percolation Tested by:	PDT	**Date**	10/29/2015

Water level measured from BOTTOM of hole

Sandy Soil Criteria Test

Trial No.	**Time**	**Time Interval (min)**	**Total Elapsed Time (min)**	**Initial Water Level (in)**	**Final Water Level (in)**	**Δ in Water Level (in)**	**Percolation Rate (min/inch)**
1	9:50 10:15	0:25	0:25	50.4	8.4	42.0	0.05
2	10:16 10:41	0:25	0:50	40.8	18.0	22.8	0.09

Soil Criteria: Sandy

Reading No.	**Time**	**Time Interval (min)**	**Total Elapsed Time (min)**	**Initial Water Level (in)**	**Final Water Level (in)**	**Δ in Water Level (in)**	**Percolation Rate (min/inch)**
1	10:44 10:54	0:10	0:10	25.2	21.6	3.6	2.8
2	10:55 11:05	0:10	0:20	27.6	24.0	3.6	2.8
3	11:06 11:16	0:10	0:30	33.6	30.0	3.6	2.8
4	11:17 11:27	0:10	0:40	39.6	36.0	3.6	2.8
5	11:28 11:38	0:10	0:50	38.4	34.8	3.6	2.8
6	11:39 11:49	0:10	1:00	37.2	34.8	2.4	4.2
7							
8							
9							
10							
11							
12							

FIGURE A-10

Leach Line Percolation Data Sheet

Project Terraces
Job No. T2673-22-01
Test Hole No. P-3
Date Excavated 10/23/2015
Depth of Test Hole: 20.2' (top of pipe)
Soil Classification
Check for Sandy Soil Criteria Tested by: PDT
Presoak 10/28/2015
Actual Percolation Tested by: PDT
Date 10/29/2015

Water level measured from BOTTOM of hole

Sandy Soil Criteria Test

Trial No.	Time	Time Interval (min)	Total Elapsed Time (min)	Initial Water Level (in)	Final Water Level (in)	Δ in Water Level (in)	Percolation Rate (min/inch)
1	9:59 10:24	0:25	0:25	38.4	14.4	24.0	1.04
2	10:25 10:50	0:25	0:50	26.4	8.4	18.0	1.39

Soil Criteria: Sandy

Reading No.	Time	Time Interval (min)	Total Elapsed Time (min)	Initial Water Level (in)	Final Water Level (in)	Δ in Water Level (in)	Percolation Rate (min/inch)
1	11:55 12:05	0:10	0:10	37.8	33.0	4.8	2.1
2	12:06 12:16	0:10	0:20	32.4	28.2	4.2	2.4
3	12:17 12:27	0:10	0:30	33.0	28.8	4.2	2.4
4	12:28 12:38	0:10	0:40	34.8	31.2	3.6	2.8
5	12:39 12:49	0:10	0:50	34.2	31.2	3.0	3.3
6	12:50 13:00	0:10	1:00	37.8	34.8	3.0	3.3
7							
8							
9							
10							
11							
12							

FIGURE A-11

Leach Line Percolation Data Sheet

Project Terraces
Job No. T2673-22-01
Test Hole No. P-4
Date Excavated 10/23/2015
Depth of Test Hole: 20.0' (top of pipe)
Soil Classification
Check for Sandy Soil Criteria Tested by: AO
Presoak 10/28/2015
Actual Percolation Tested by: CER
Date 10/29/2015

Water level measured from BOTTOM of hole

Sandy Soil Criteria Test

Trial No.	Time	Time Interval (min)	Total Elapsed Time (min)	Initial Water Level (in)	Final Water Level (in)	Δ in Water Level (in)	Percolation Rate (min/inch)
1	10:03 10:28	0:25	0:25	38.8	12.0	26.8	0.93
2	10:29 10:54	0:25	0:50	37.8	1.8	36.0	0.69

Soil Criteria: Sandy

Reading No.	Time	Time Interval (min)	Total Elapsed Time (min)	Initial Water Level (in)	Final Water Level (in)	Δ in Water Level (in)	Percolation Rate (min/inch)
1	11:58 12:08	0:10	0:10	10.2	5.4	4.8	2.1
2	12:09 12:19	0:10	0:20	14.4	13.2	1.2	8.3
3	12:20 12:30	0:10	0:30	26.4	22.8	3.6	2.8
4	12:31 12:41	0:10	0:40	39.6	19.8	19.8	0.5
5	12:42 12:52	0:10	0:50	87.6	42.6	45.0	0.2
6	12:52 13:02	0:10	1:00	42.6	30.0	12.6	0.8
7							
8							
9							
10							
11							
12							

* Low infiltration rate due to caving around bottom of percolation pipe.

FIGURE A-12

Leach Line Percolation Data Sheet

Project	Terraces				**Job No.**	T2673-22-01	
Test Hole No.		P-5			**Date Excavated**		10/23/2015
Depth of Test Hole:		15.4' (top of pipe)			**Soil Classification**		
Check for Sandy Soil Criteria Tested by:				PDT	**Presoak**		10/28/2015
Actual Percolation Tested by:			PDT		**Date**		10/29/2015

Water level measured from BOTTOM of hole

Sandy Soil Criteria Test

Trial No.	Time	Time Interval (min)	Total Elapsed Time (min)	Initial Water Level (in)	Final Water Level (in)	Δ in Water Level (in)	Percolation Rate (min/inch)
1	13:45 14:10	0:25	0:25	34.8	2.4	32.4	0.77
2	14:11 14:36	0:25	0:50	20.4	1.8	18.6	1.34

Soil Criteria: Sandy

Reading No.	Time	Time Interval (min)	Total Elapsed Time (min)	Initial Water Level (in)	Final Water Level (in)	Δ in Water Level (in)	Percolation Rate (min/inch)
1	14:37 14:47	0:10	0:10	28.2	0.0	28.2	0.4
2	14:48 14:58	0:10	0:20	34.8	18.6	16.2	0.6
3	14:59 15:09	0:10	0:30	36.0	20.4	15.6	0.6
4	15:10 15:20	0:10	0:40	38.4	24.6	13.8	0.7
5	15:21 15:31	0:10	0:50	30.0	17.4	12.6	0.8
6	15:32 15:42	0:10	1:00	36.0	23.4	12.6	0.8
7							
8							
9							
10							
11							
12							

FIGURE A-13

Leach Line Percolation Data Sheet

Project	Terraces	**Job No.**	T2673-22-01
Test Hole No.	P-6	**Date Excavated**	10/23/2015
Depth of Test Hole:	15.7' (top of pipe)	**Soil Classification**	
Check for Sandy Soil Criteria Tested by:	PDT	**Presoak**	10/28/2015
Actual Percolation Tested by:	PDT	**Date**	10/29/2015

Water level measured from BOTTOM of hole

Sandy Soil Criteria Test

Trial No.	Time	Time Interval (min)	Total Elapsed Time (min)	Initial Water Level (in)	Final Water Level (in)	Δ in Water Level (in)	Percolation Rate (min/inch)
1	13:50	0:25	0:25	13.2	3.6	9.6	2.60
	14:15						
2	14:16	0:25	0:50	22.8	5.4	17.4	1.44
	14:41						

Soil Criteria: Sandy

Reading No.	Time	Time Interval (min)	Total Elapsed Time (min)	Initial Water Level (in)	Final Water Level (in)	Δ in Water Level (in)	Percolation Rate (min/inch)
1	14:42	0:10	0:10	29.4	16.2	13.2	0.8
	14:52						
2	14:53	0:10	0:20	42.0	29.4	12.6	0.8
	15:03						
3	15:04	0:10	0:30	39.6	5.4	34.2	0.3
	15:14						
4	15:15	0:10	0:40	89.4	62.4	27.0	0.4
	15:25						
5	15:26	0:10	0:50	62.4	25.8	36.6	0.3
	15:36						
6	15:37	0:10	1:00	54.0	21.0	33.0	0.3
	15:47						
7							
8							
9							
10							
11							
12							

FIGURE A-14

APPENDIX C

Laboratory Testing

LABORATORY TESTING

The following laboratory tests were performed on a representative sample in accordance with the applicable latest standards or methods from the ASTM, California Building Code (CBC) and California Department of Transportation.

Classification

Soils were classified with respect to the Unified Soil Classification System (USCS) in accordance with ASTM D-2487 and D-2488.

Particle Size Analysis

Modified hydrometer testing was conducted to aid in classification of the soil. The results of the particle size analysis are presented in Table C.

Maximum Density/Optimum Moisture

The maximum dry density and optimum moisture content of two representative bulk samples were evaluated in accordance with ASTM D-1557. The results are summarized in Table C.

Expansion Index Tests

Two (2) expansion index tests were performed to evaluate the expansion potential of typical on-site soil. Testing was carried out in general conformance with ASTM Test Method D-4829. The results are presented in Table C.

Consolidation Tests

Consolidation testing was performed on two (2) relatively “undisturbed” soil samples at their natural moisture content in accordance with procedures outlined in ASTM D-2435. The samples were placed in a consolidometer and loads were applied incrementally in geometric progression. The samples (2.42-inches in diameter and 1-inch in height) were permitted to consolidate under each load increment until the slope of the characteristic linear secondary compression portion of the thickness versus log of time plot was apparent. The percent consolidation for each load cycle was recorded as the ratio of the amount of vertical compression to the original 1-inch height. The consolidation test results are shown on Plates C-1 and C-2.

Direct Shear Testing

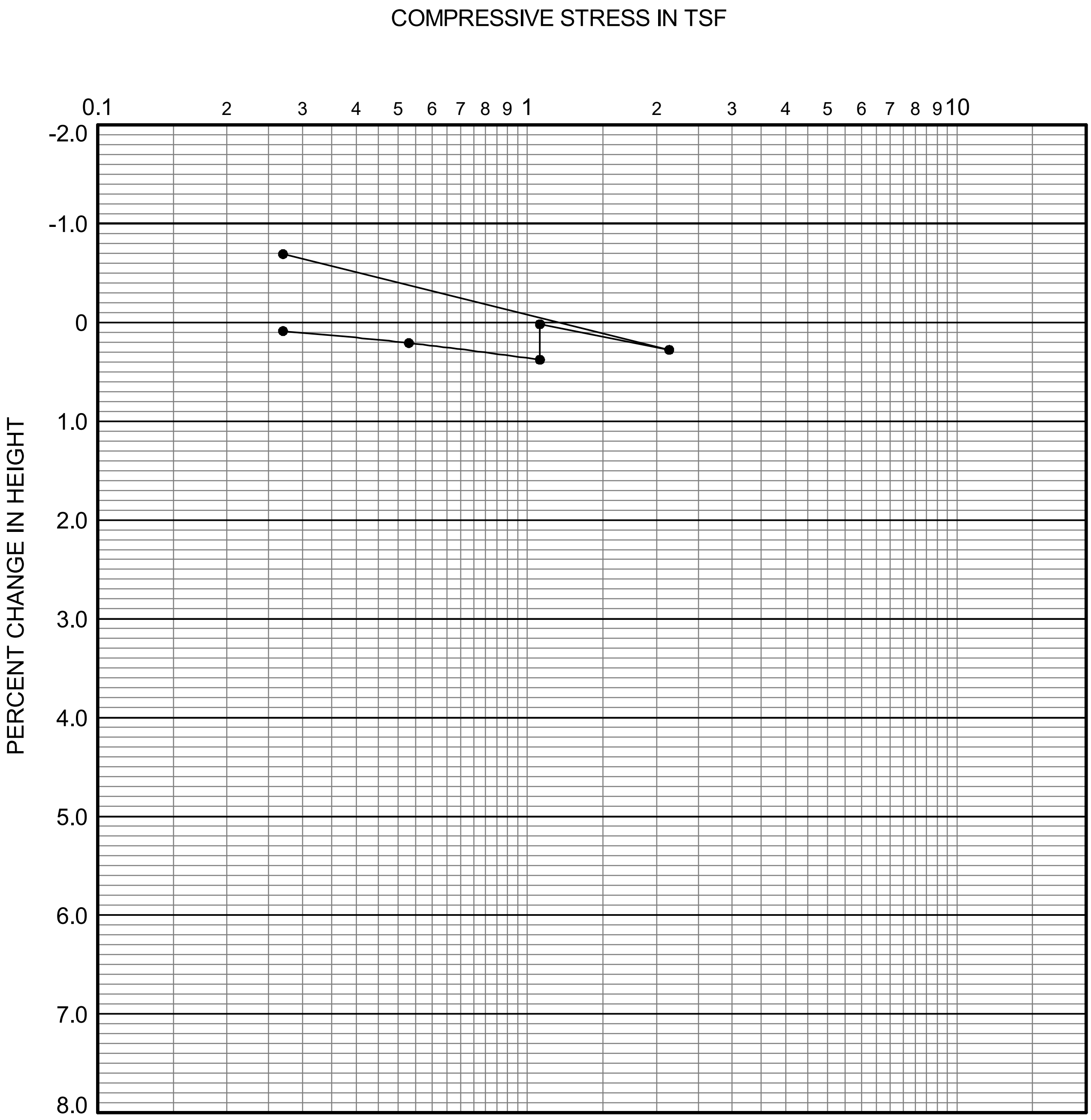
Direct shear testing was performed on three select samples. The testing was performed by Alta and the results are presented on Plates C-3 through 5.

Chemical Analyses

Chemical testing was performed on two select samples by Alta. The results of these tests (sulfate content, resistivity, chloride content and pH) are presented on Table C.

TABLE C
SUMMARY OF LABORATORY TEST DATA
P.N. 1-0410

Boring/Pit No.	Depth (Feet)	Soil Description	Group Symbol - Unified Soil Classification System	Maximum Dry Density		Direct Shear	Grain Size Analysis				Expansion Index	Sulfate Content (%)	Consolidation	Other Tests Remarks
				Maximum Density (pcf)	Optimum Moisture (%)		Gravel (% + No. 4 Screen)	% Sand	%Silt (0.074 to 0.005mm)	% Clay (-0.005 mm)				
B-9	30	Sandy Siltstone (Qps)	-	-	-	See Plate C-3	0	44	37	19	-	-	-	-
B-12	2-4	Sandy Silt (afu)	ML	115.7	14.0	See Plate C-4	0	25	56	19	114	ND	-	Min. Resistivity: 18,000 OHM-CM Chloride: 60ppm PH: 7.50
B-12	5	Sandy Siltstone (Qps)	-	-	-	-	0	41	46	13	-	-	See Plate C-1	-
B-15	10	Sandy Siltstone w/Clay (Qps)	-	-	-	-	0	50	25	25	-	-	See Plate C-2	-
B-17	3-5	Silty Sand (Qal)	SM	131.0	8.0	See Plate C-5	1	71	18	10	0	ND	-	Min. Resistivity: 1,800 OHM-CM Chloride: 0ppm PH: 6.78



boring	depth (ft.)	dry density (pcf)	in situ moist. (%)	in situ satur. (%)	-200 sieve (%)	group symbol	typical names
BH-12	5.0	122	8.8	66	59		Sandy Siltstone (Qps)

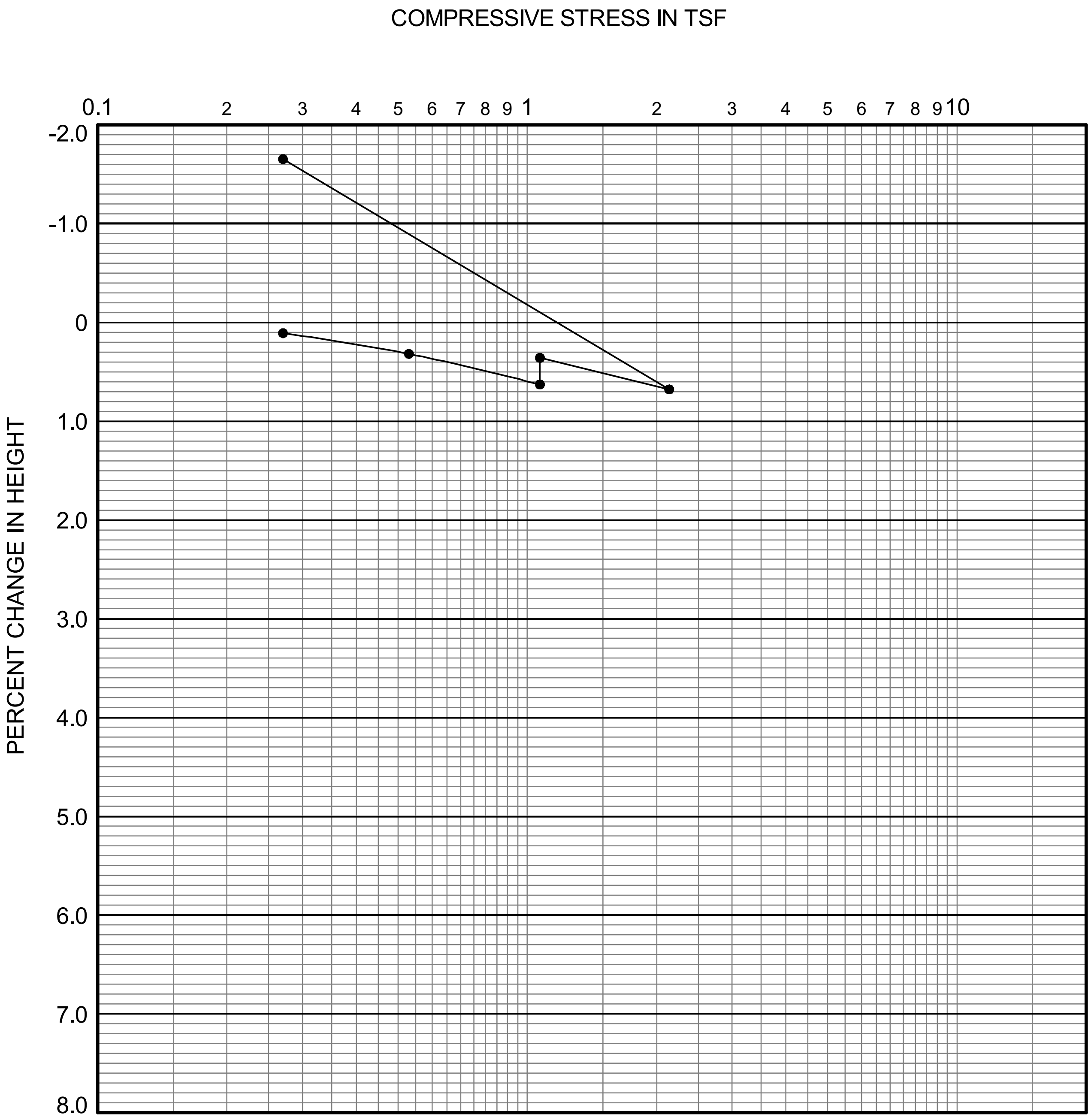
REMARKS: WATER ADDED AT 1.07 TSF

CONSOLIDATION CURVE

Alta California Geotechnical, Inc.

P.N. 1-0410

PLATE C-1



boring	depth (ft.)	dry density (pcf)	in situ moist. (%)	in situ satur. (%)	-200 sieve (%)	group symbol	typical names
BH-15	10.0	129	11.2	104			Sandy Siltstone w/Clay (Qps)

REMARKS: WATER ADDED AT 1.07 TSF

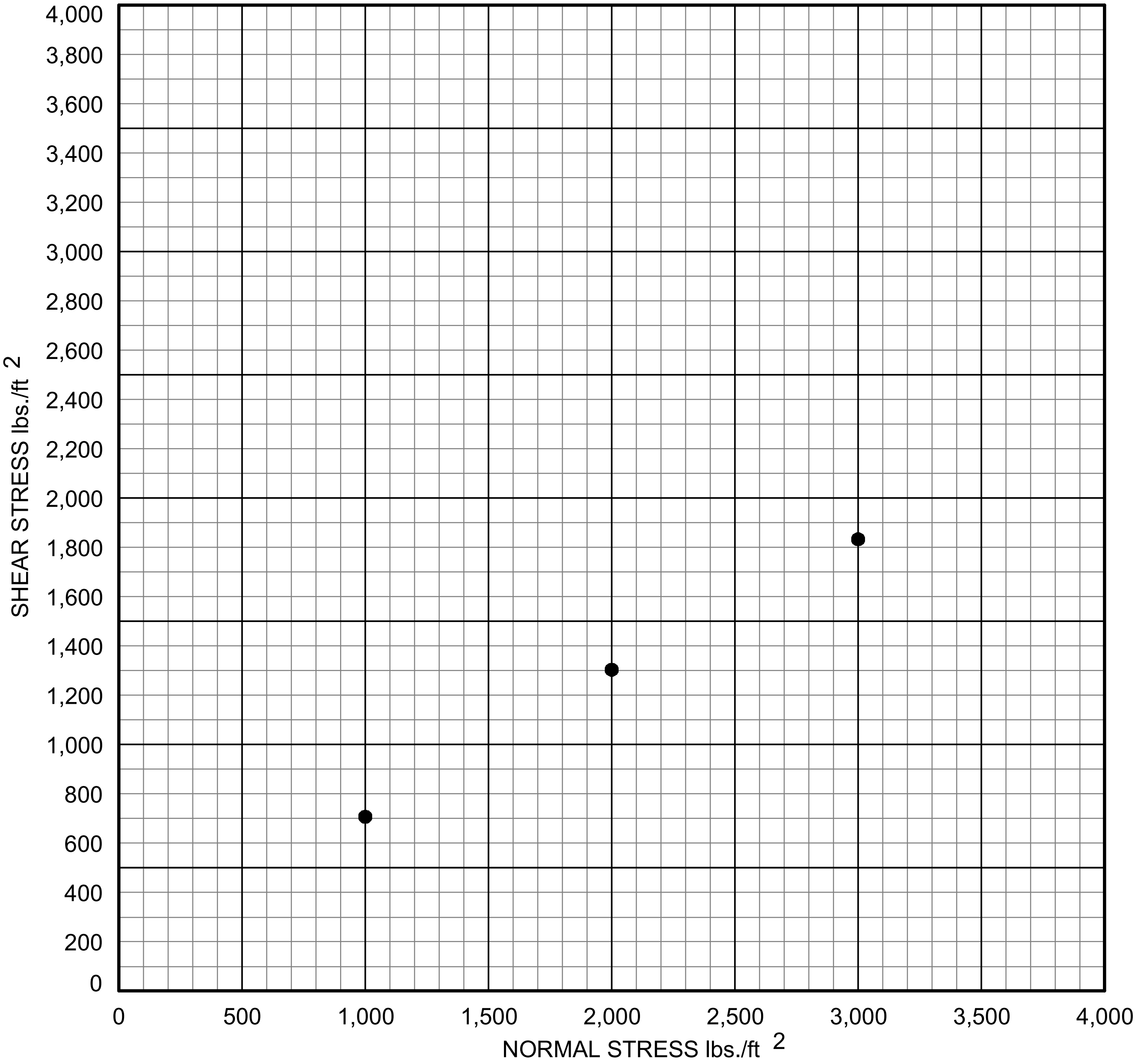
CONSOLIDATION CURVE

Alta California Geotechnical, Inc.

P.N. 1-0410

PLATE C-2

DIRECT SHEAR TEST
Undisturbed



boring	depth (ft.)	dry density (pcf)	in situ moist. (%)	-200 sieve (%)	group symbol	typical names
BH-09	30.0	113	17.0	81		Sandy Siltone (Qps)

COHESION	160	psf.
FRICTION ANGLE	29.0	degrees

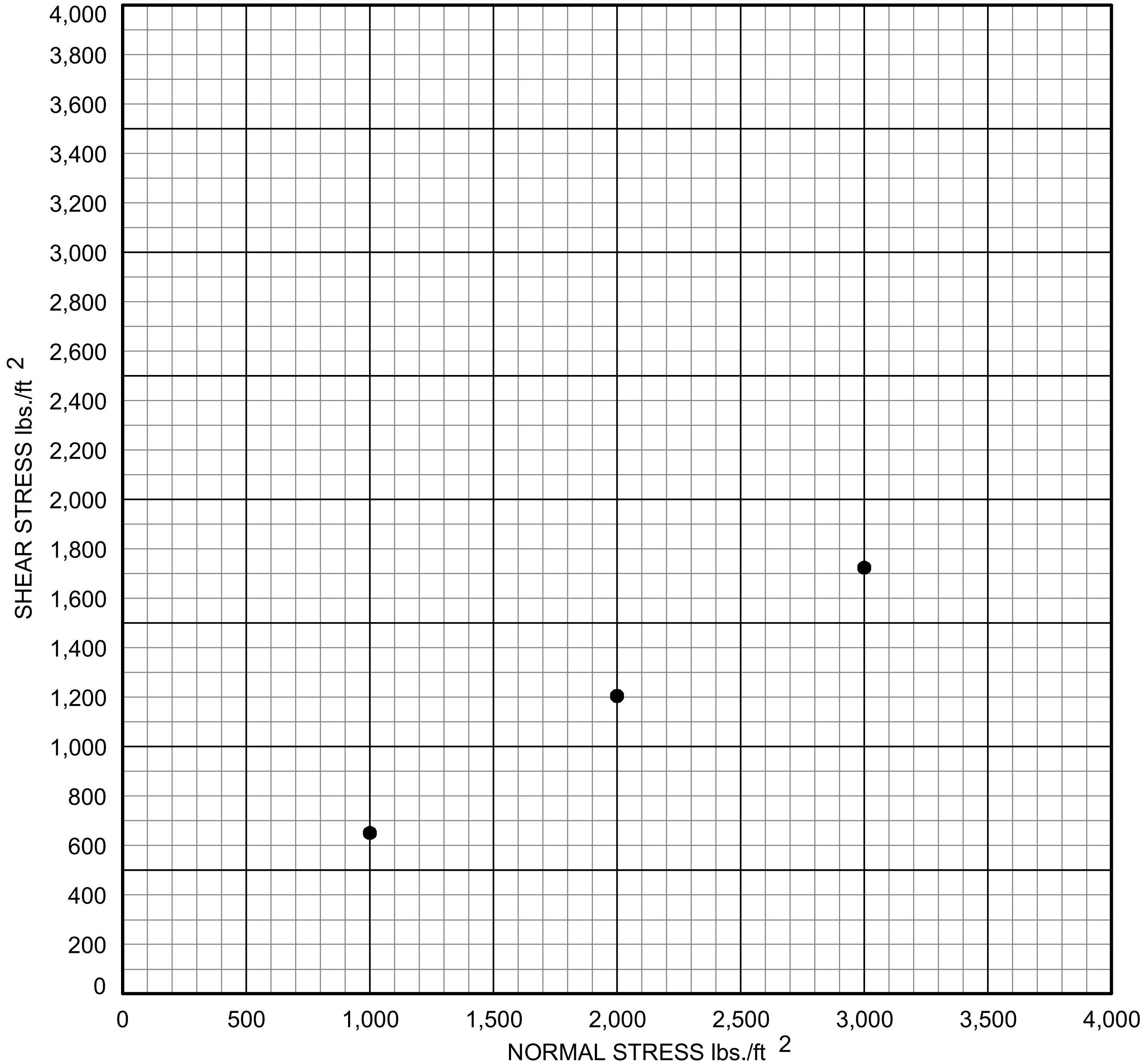
DIRECT SHEAR TEST

Alta California Geotechnical, Inc.

P.N. 1-0410

PLATE C-3

DIRECT SHEAR TEST
Remolded at 90% Relative Compaction



boring	depth (ft.)	dry density (pcf)	in situ moist. (%)	-200 sieve (%)	group symbol	typical names
BH-12	2.0-4.0			75	ML	Sandy Silt (afu)

COHESION	120	psf.
FRICTION ANGLE	28.0	degrees

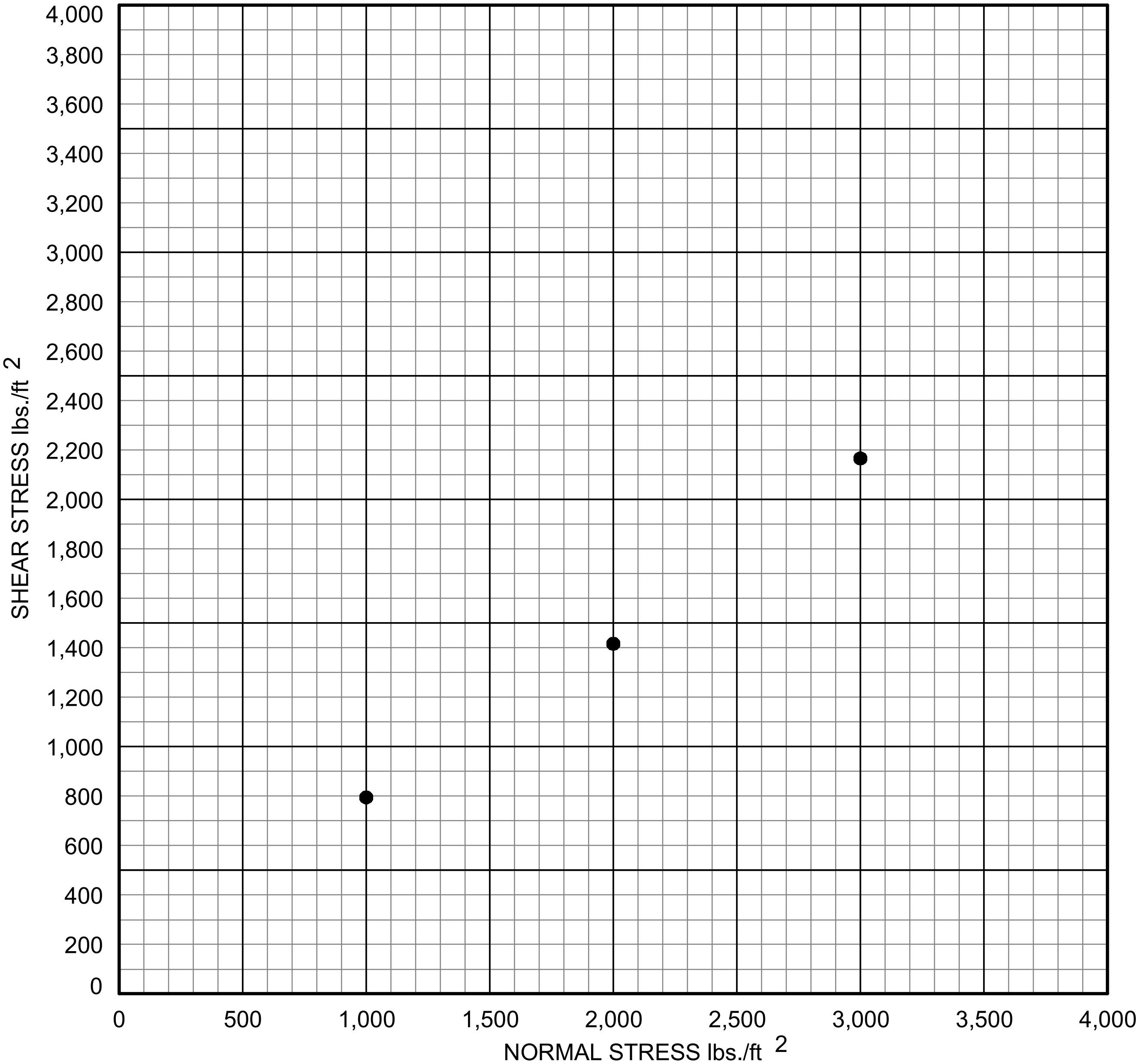
DIRECT SHEAR TEST

Alta California Geotechnical, Inc.

P.N. 1-0410

PLATE C-4

DIRECT SHEAR TEST
Remolded at 90% Relative Compaction



boring	depth (ft.)	dry density (pcf)	in situ moist. (%)	-200 sieve (%)	group symbol	typical names
BH-17	3.0-5.0			28	SM	Silty Sand (Qal)

COHESION	90	psf.
FRICTION ANGLE	34.0	degrees

DIRECT SHEAR TEST

Alta California Geotechnical, Inc.

P.N. 1-0410

PLATE C-5

APPENDIX C-1

Previous Laboratory Testing

(Geocon, 2016)

SUMMARY OF LABORATORY MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT TEST RESULTS
ASTM D1557

Sample No.	Description	Maximum Dry Density (pcf)	Optimum Moisture Content (% of dry wt.)
B-3 @ 0-5’	Silty SAND (SM), yellow brown	126.1	10.1

SUMMARY OF LABORATORY EXPANSION INDEX TEST RESULTS
ASTM D4829

Sample No.	Moisture Content		After Test Dry Density (pcf)	Expansion Index
	Before Test (%)	After Test (%)		
B-4 @ 10’	13.5	28.2	98.3	53

SUMMARY OF CORROSIVITY TEST RESULTS

Sample No.	Chloride Content (ppm)	Sulfate Content (%)	pH	Resistivity (ohm-centimeter)
B-6 @ 0-5’	55	0.002	7.74	4,820

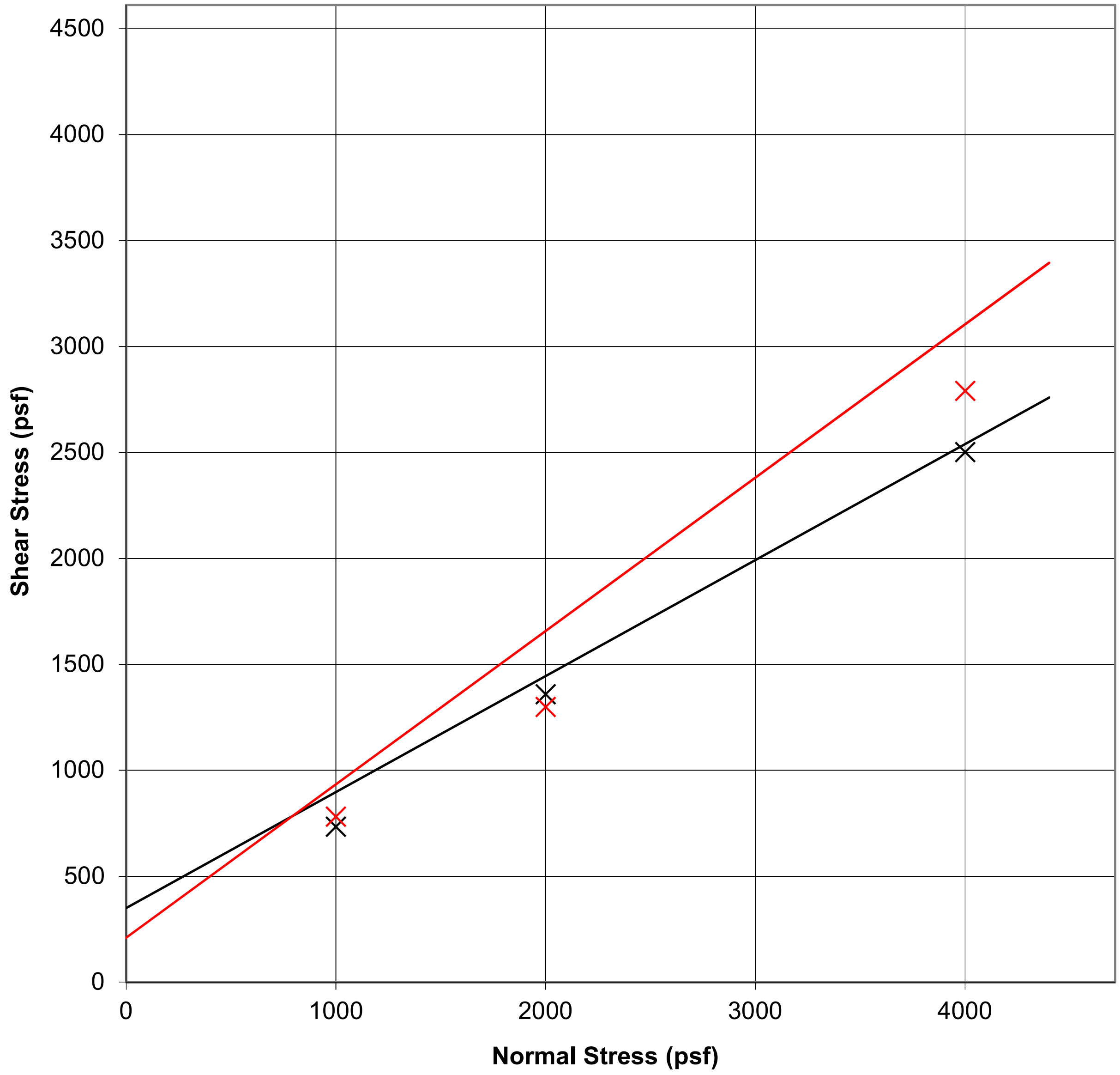
Chloride content determined by California Test 422.
Water-soluble sulfate determined by California Test 417.
Resistivity and pH determined by Caltrans Test 643.

SUMMARY OF LABORATORY R-VALUE TEST RESULTS
ASTM D2844

Sample No.	R-Value
B-1 @ 0-5’	21

SUMMARY OF ONE-DIMENSIONAL CONSOLIDATION (COLLAPSE) TESTS
ASTM D2435

Sample No.	In-situ Dry Density (pcf)	Moisture Content Before Test (%)	Final Moisture Content (%)	Axial Load with Water Added (psf)	Percent Collapse
B-7 @ 2.5’	118.6	4.2	12.6	2000	1.2
B-7 @ 5.0’	123.8	6.9	12.6	2500	0.6
B-7 @ 7.5’	124.3	9.3	11.9	2800	0.3
B-7 @ 10.0’	119.3	12.6	14.3	3000	0.2



SAMPLE ID	SOIL TYPE	INITIAL DRY DENSITY (pcf)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)	C (psf)	ϕ (deg)
*B-3 @ 0-5'	SM	111.4	12.2	21.3	350	28.7
B-3 @ 10'	SP	102.4	3.3	18.7	210	35.9

*Sample remolded to approximately 90% of the test maximum dry density at optimum moistur content.

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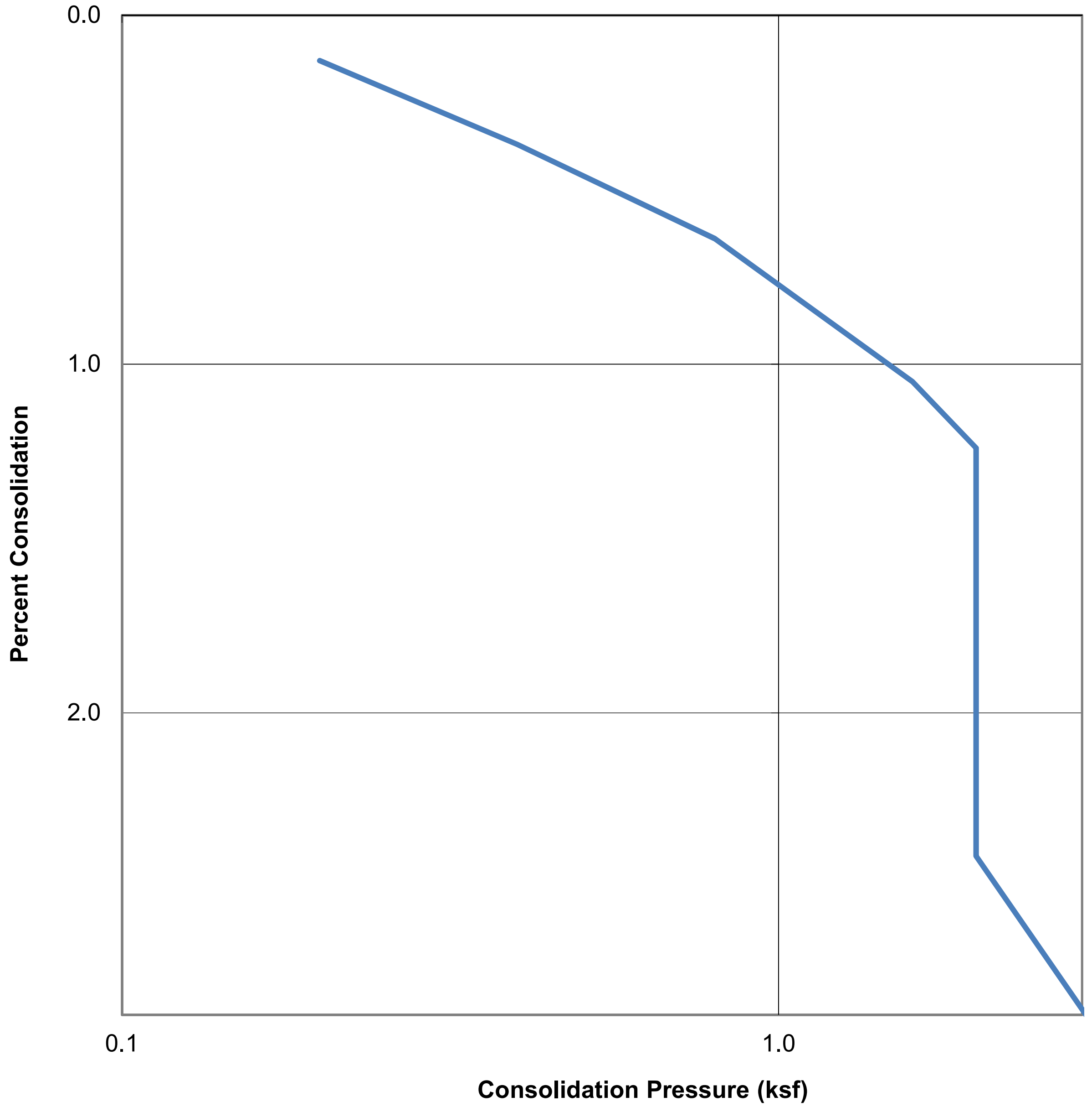
AMO		

DIRECT SHEAR TEST RESULTS

PRELIMINARY GEOTECHNICAL INVESTIGATION
TERRACES MIXED USE DEVELOPMENT
MURRIETA HOT SPRINGS ROAD & INTERSTATE 15
MURRIETA, CALIFORNIA

APRIL, 2016	PROJECT NO. T2673-22-01	FIG B-3

WATER ADDED AT 2 KSF



SAMPLE ID	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B-7 @ 2.5'	SC-SM	118.6	4.2	12.6

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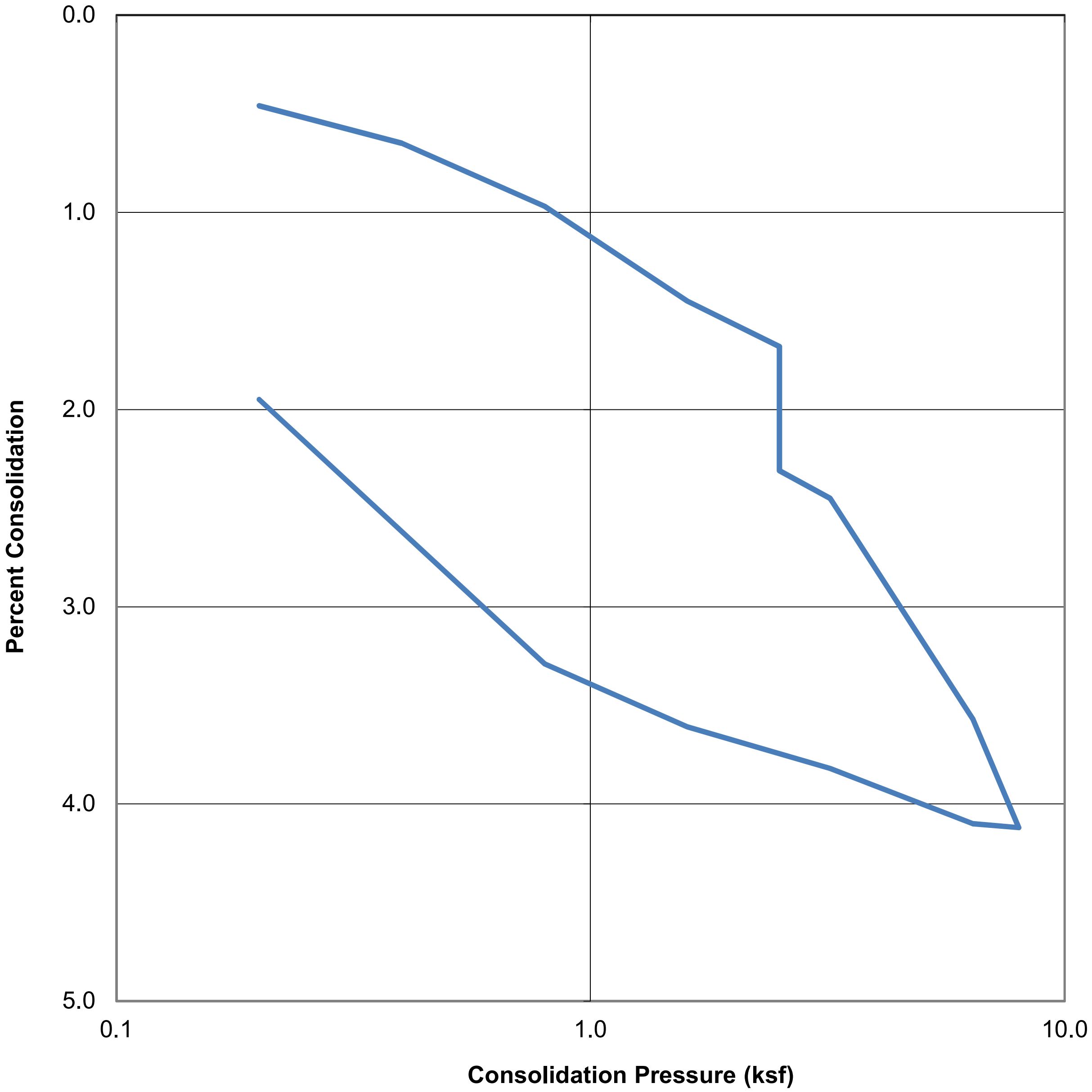
CONSOLIDATION TEST RESULTS

PRELIMINARY GEOTECHNICAL INVESTIGATION
TERRACES MIXED USE DEVELOPMENT
MURRIETA HOT SPRINGS ROAD & INTERSTATE 15
MURRIETA, CALIFORNIA

APRIL, 2016	PROJECT NO. T2673-22-01	FIG B4

WATER ADDED AT 2.5 KSF



SAMPLE ID	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B-7 @ 5'	SC	123.8	6.9	12.6

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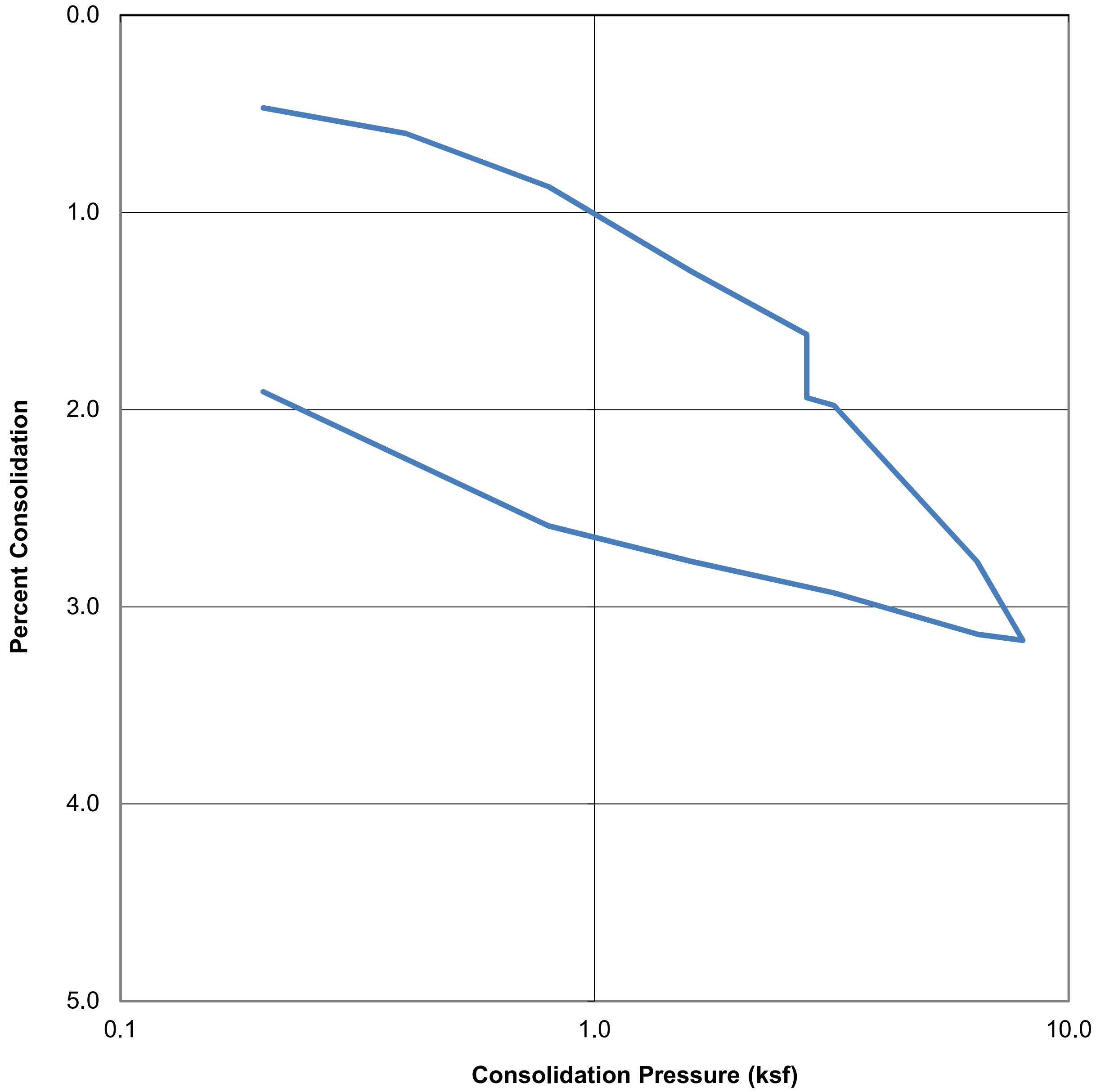
CONSOLIDATION TEST RESULTS

PRELIMINARY GEOTECHNICAL INVESTIGATION
TERRACES MIXED USE DEVELOPMENT
MURRIETA HOT SPRINGS ROAD & INTERSTATE 15
MURRIETA, CALIFORNIA

APRIL, 2016 | PROJECT NO. T2673-22-01 | FIG B5

WATER ADDED AT 2.8 KSF



SAMPLE ID	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B-7 @ 7.5'	SC	124.3	9.3	11.9

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CONSOLIDATION TEST RESULTS

PRELIMINARY GEOTECHNICAL INVESTIGATION
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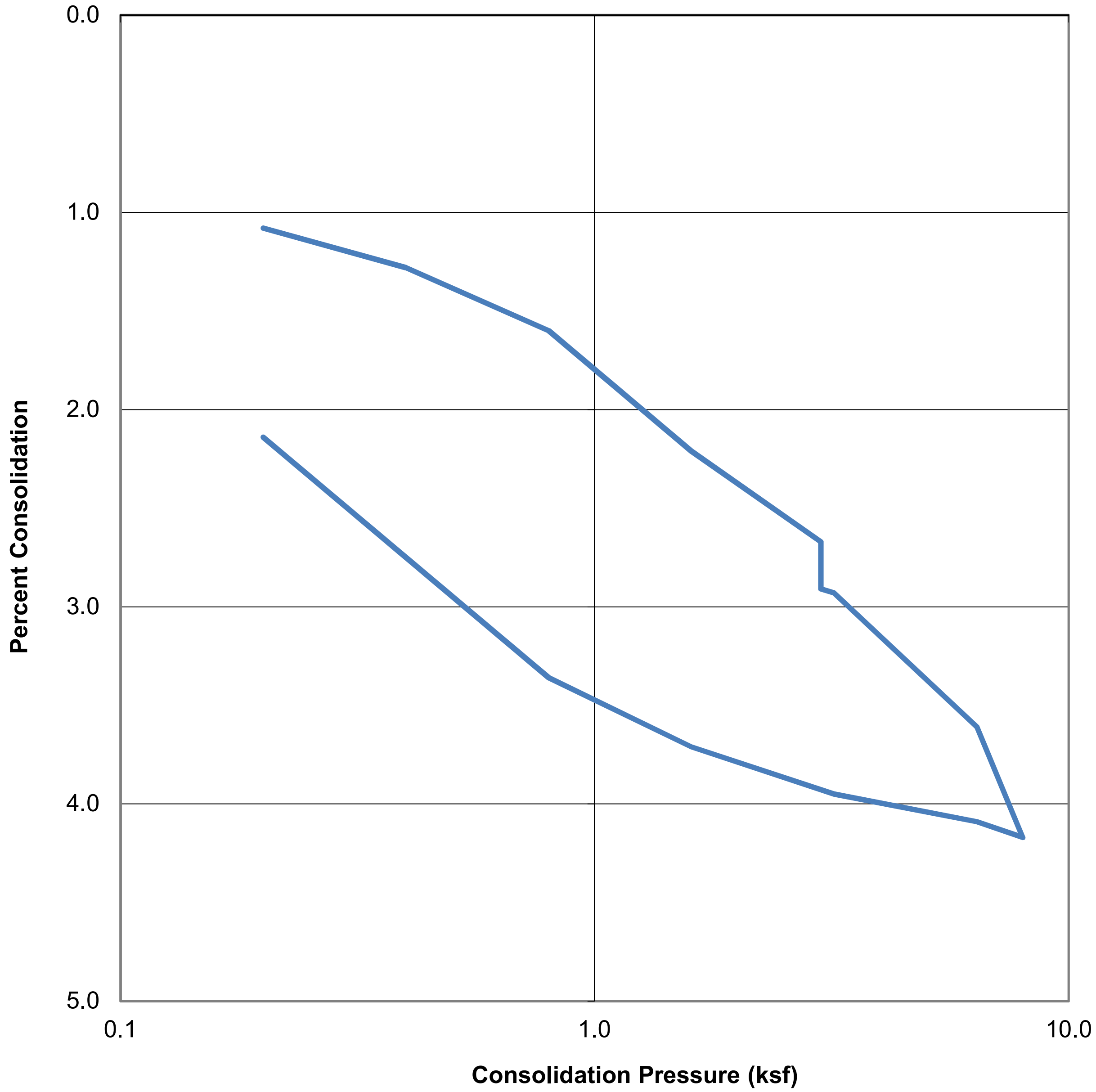
MURRIETA HOT SPRINGS ROAD & INTERSTATE 15
MURRIETA, CALIFORNIA

APRIL, 2016 | PROJECT NO. T2673-22-01 | FIG B6

WATER ADDED AT 3 KSF



SAMPLE ID	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B-7 @ 10'	SC/CL	119.3	12.6	14.3

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CONSOLIDATION TEST RESULTS

PRELIMINARY GEOTECHNICAL INVESTIGATION
TERRACES MIXED USE DEVELOPMENT
MURRIETA HOT SPRINGS ROAD & INTERSTATE 15
MURRIETA, CALIFORNIA

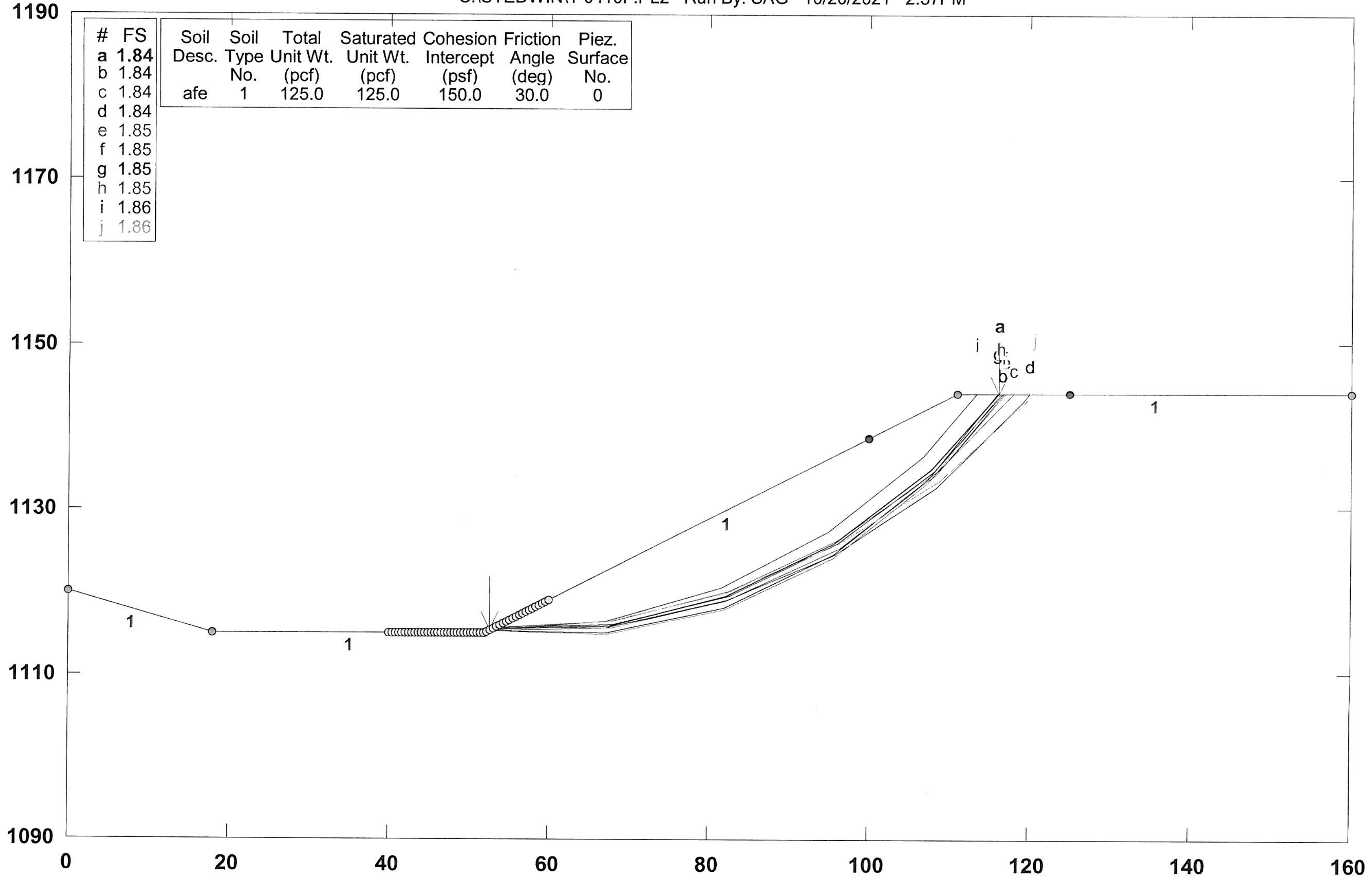
APRIL, 2016 | PROJECT NO. T2673-22-01 | FIG B7

APPENDIX D

SLOPE STABILITY ANALYSIS

1-0410 2:1 29-ft Fill Slope Static Analysis

C:\STEDWIN\1-0410F.PL2 Run By: SAG 10/20/2021 2:37PM



#	FS
a	**1.84**
b	1.84
c	1.84
d	1.84
e	1.85
f	1.85
g	1.85
h	1.85
i	1.86
j	1.86

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
afe	1	125.0	125.0	150.0	30.0	0

GSTABL7 v.2 FSmin=1.84

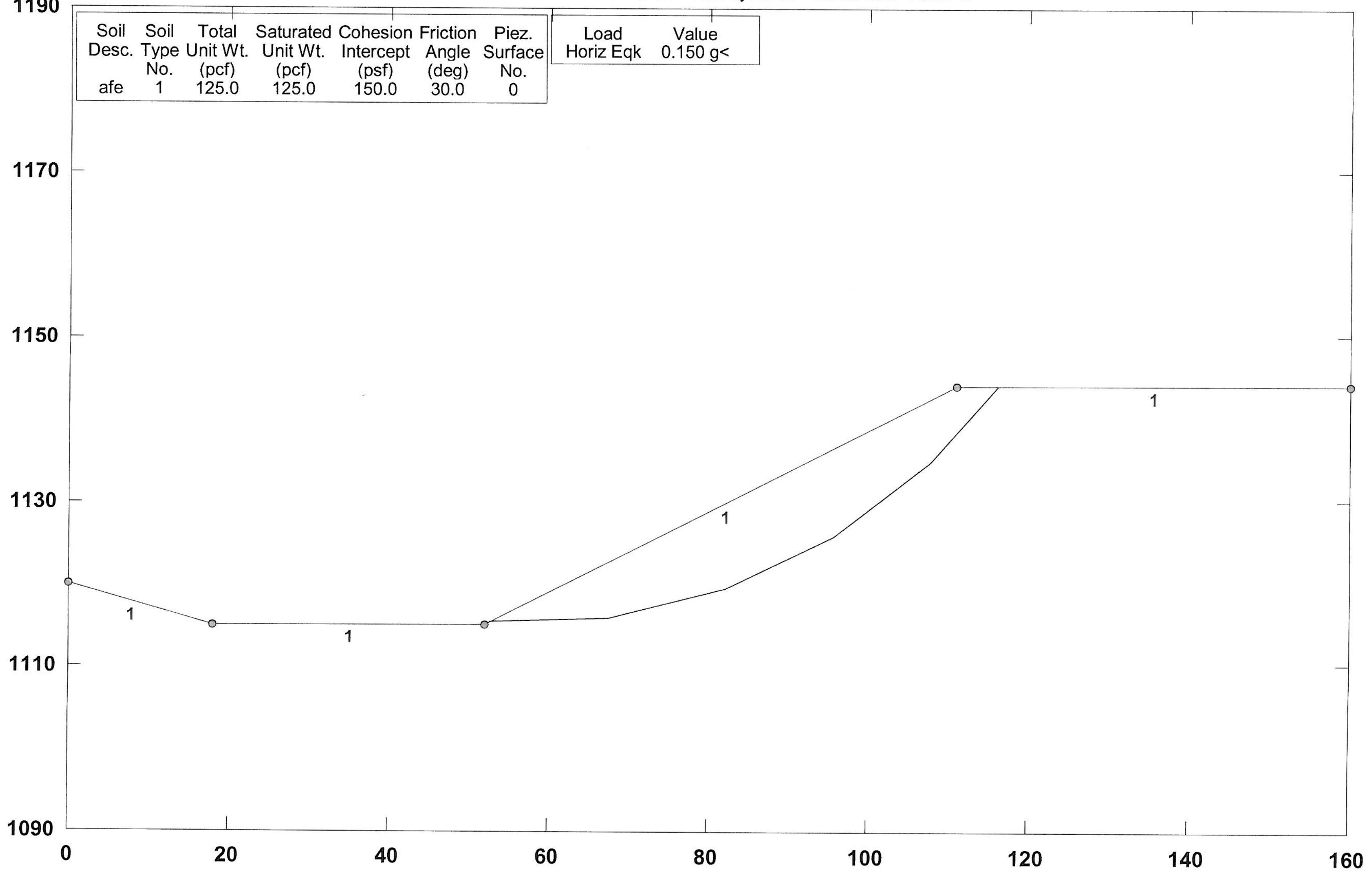
Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

Plate D-1

1-0410 2:1 29-ft Fill Slope Psuedostatic Analysis

C:\STEDWIN\1-0410FP.PLT Run By: SAG 10/20/2021 2:38PM



Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
afe	1	125.0	125.0	150.0	30.0	0

Load	Value
Horiz Eqk	0.150 g<

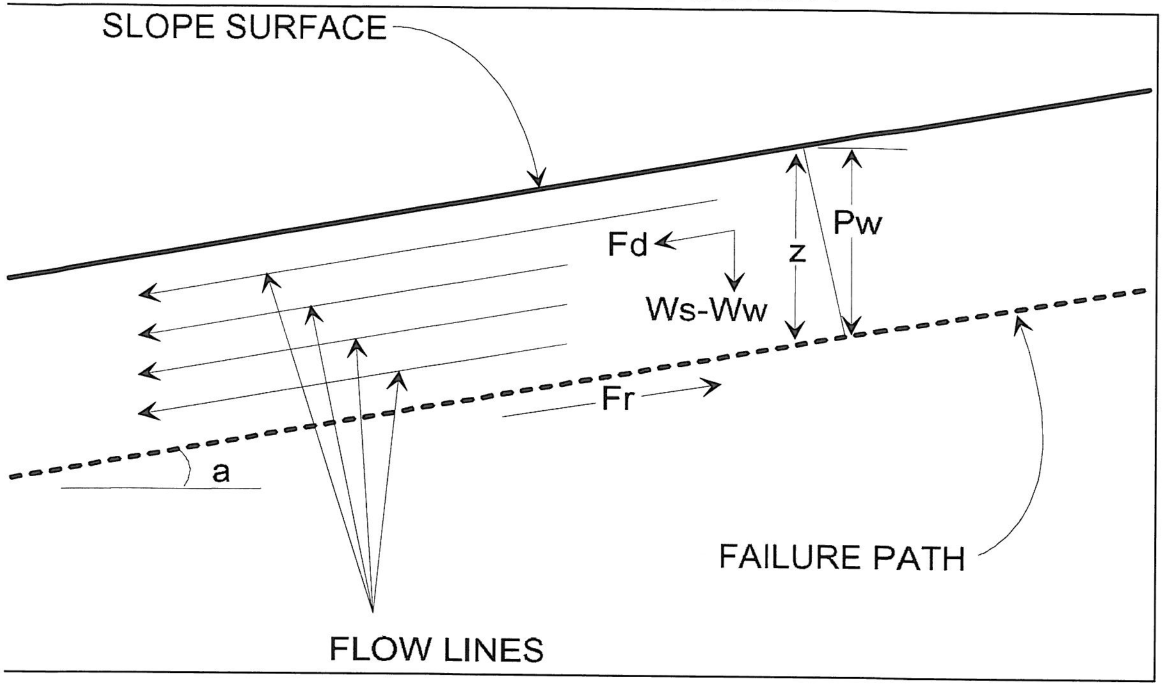
GSTABL7 v.2 FSmin=1.26

Factor Of Safety Is Calculated By The Simplified Janbu Method

GSTABL7

Plate D-2

SURFICIAL SLOPE STABILITY



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

Pw = Water Pressure Head=(z)(cos^2(a))
Ws = Saturated Soil Unit Weight
Ww = Unit Weight of Water (62.4 lb/cu.ft.)
u = Pore Water Pressure=(Ww)(z)(cos^2(a))
z = Layer Thickness
a = Angle of Slope
phi = Angle of Friction
c = Cohesion
Fd = (0.5)(z)(Ws)(sin(2a))
Fr = (z)(Ws-Ww)(cos^2(a))(tan(phi)) + c
Factor of Safety (FS) = Fr/Fd

Given:

Ws (pcf)	z (ft)	a (degrees)	(radians)	phi (degrees)	(radians)	c (psf)
125	3	26.565051	0.4636476	30	0.5235988	150

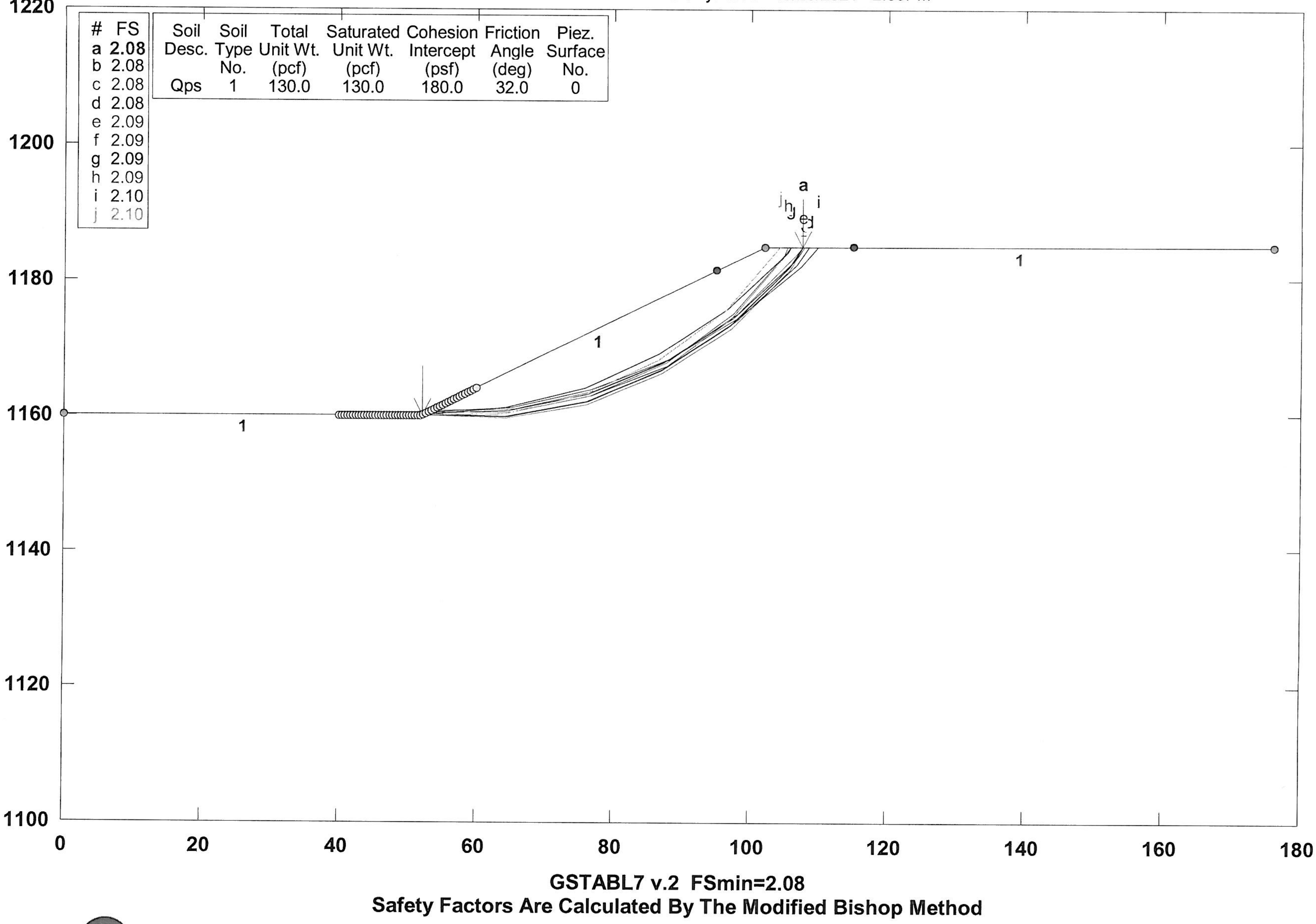
Calculations:

Pw	u	Fd	Fr	**FS**
2.40	149.76	150.00	236.74	**1.58**

Plate D-3

1-0410 2:1 25-ft Cut Slope Static Analysis

C:\STEDWIN\1-0410C.PL2 Run By: SAG 10/20/2021 2:39PM

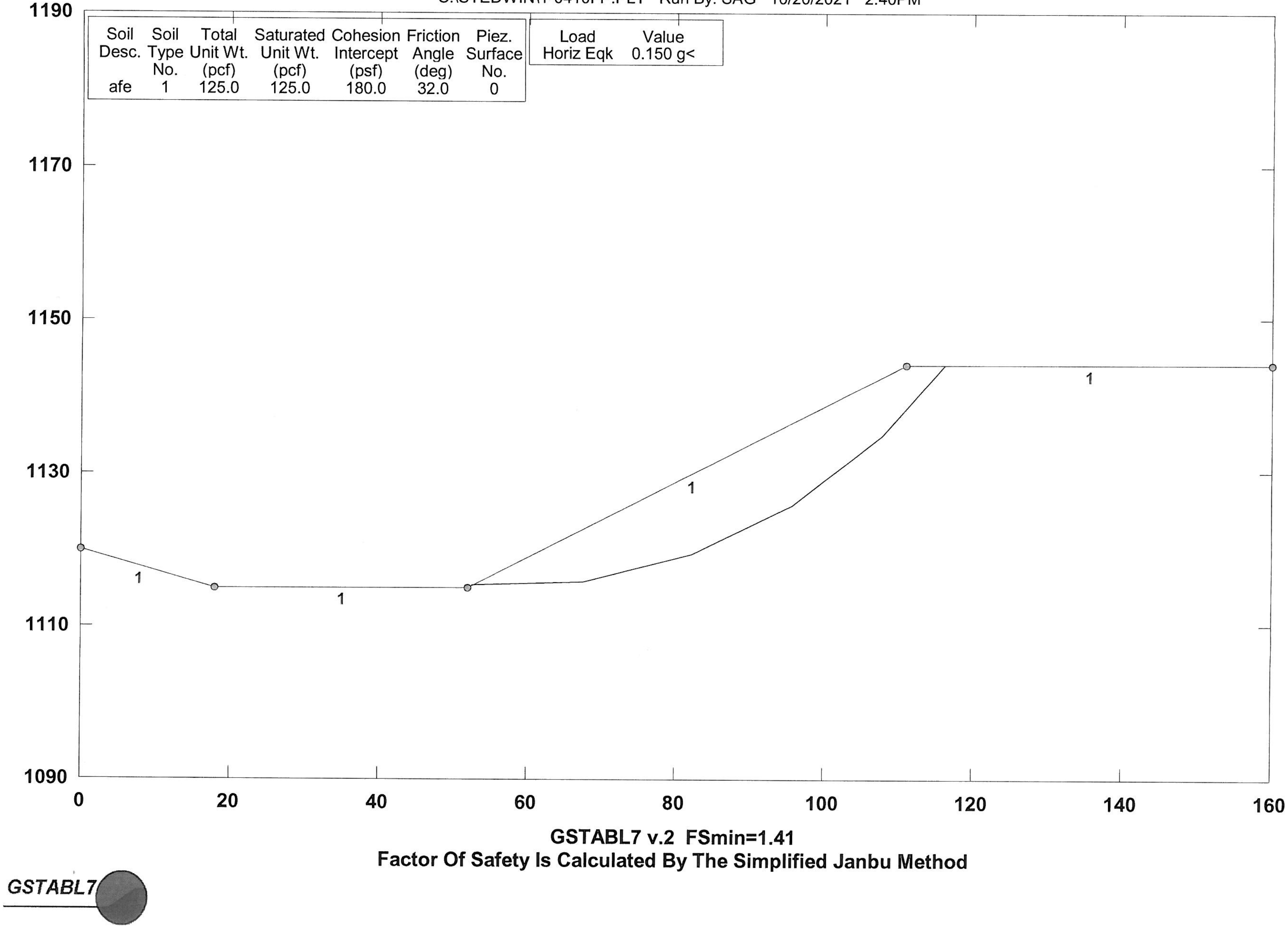


GSTABL7

Plate D-4

1-0410 2:1 29-ft Fill Slope Psuedostatic Analysis

C:\STEDWIN\1-0410FP.PLT Run By: SAG 10/20/2021 2:40PM



Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
afe	1	125.0	125.0	180.0	32.0	0

Load	Value
Horiz Eqk	0.150 g<

GSTABL7 v.2 FSmin=1.41

Factor Of Safety Is Calculated By The Simplified Janbu Method

Plate D-5

APPENDIX E

Maintenance and Improvement Considerations

MAINTENANCE AND IMPROVEMENT CONSIDERATIONS

General

Owners purchasing property must assume a certain degree of responsibility for improvements and for maintaining conditions around their home. Of primary importance from a geotechnical standpoint are maintaining drainage patterns and minimizing the soil moisture variation below all improvements. Such design, construction and owner maintenance provisions may include:

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

Sulfates

Owners should be cautioned against the import and use of certain inorganic fertilizers, soil amendments, and/or other soils from offsite sources in the absence of specific information relating to their chemical composition. Some fertilizers have been known to leach sulfate compounds into soils and increase the sulfate concentrations to potentially detrimental levels.

Site Drainage

- The owners should be made aware of the potential problems that may develop when drainage is altered through construction of hardscape improvements. Ponded water, drainage over the slope face, leaking irrigation systems, overwatering, or other conditions which could lead to ground saturation must be avoided.
- No water should be allowed to flow over the slopes. No alteration of pad gradients should be allowed that would prevent pad and roof runoff from being directed to approved disposal areas.
- Drainage patterns have been established at the time of the fine grading should be maintained throughout the life of the structure. No alterations to these drainage patterns should be made unless designed by qualified professionals in compliance with local code requirements and site-specific soils conditions.

Slope Drainage

- Residents should be made aware of the importance of maintaining and cleaning all interceptor ditches, drainage terraces, down drains, and any other drainage devices, which have been installed to promote slope stability.
- Subsurface drainage pipe outlets may protrude through slope surfaces and/or wall faces. These pipes, in conjunction with the graded features, are essential to slope and wall stability and must be protected in-place. They should not be altered or damaged in any way.

Planting and Irrigation of Slopes

- Seeding and planting of the slopes should be planned to achieve, as rapidly as possible, a well-established and deep-rooted vegetal cover requiring minimal watering.
- It is the responsibility of the landscape architect to provide such plants initially and of the residents to maintain such planting. Alteration of such a planting scheme is at the resident's risk.

- The resident is responsible for proper irrigation and for maintenance and repair of properly installed irrigation systems. Leaks should be fixed immediately.
- Sprinklers should be adjusted to provide maximum uniform coverage with a minimum of water usage and overlap. Overwatering with consequent wasteful runoff and serious ground saturation must be avoided.
- If automatic sprinkler systems are installed, their use must be adjusted to account for seasonal and natural rainfall conditions.

Burrowing Animals

- Residents must undertake a program to eliminate burrowing animals. This must be an ongoing program in order to promote slope stability.

Owner Improvement

Owner improvements (pools, spas, patio slabs, retaining walls, planters, etc.) should be designed to account for the terrain of the project, as well as expansive soil conditions and chemical characteristics. Design considerations on any given lot may need to include provisions for differential bearing materials, ascending/descending slope conditions, bedrock structure, perched (irrigation) water, special geologic surcharge loading conditions, expansive soil stresses, and long-term creep/settlement.

All owner improvements should be designed and constructed by qualified professionals utilizing appropriate design methodologies, which account for the on-site soils and geologic conditions. Each lot and proposed improvement should be evaluated on an individual basis.

Setback Zones

Manufactured slopes maybe subject to long-term settlement and creep that can manifest itself in the form of both horizontal and vertical movement. These movements typically are produced as a result of weathering, erosion, gravity forces, and other natural phenomenon. A setback adjacent to slopes is required by most building codes, including the California Building Code. This zone is intended to locate and support the residential structures away from these slopes and onto soils that are not subject to the potential adverse effects of these natural phenomena.

The owner may wish to construct patios, walls, walkways, planters, swimming pools, spas, etc. within this zone. Such facilities may be sensitive to settlement and creep and should not be constructed within the setback zone unless properly engineered. It is suggested that plans for such improvements be designed by a professional engineer who is familiar with grading ordinances and design and construction requirements. In addition, we recommend that the designer and contractor familiarize themselves with the site specific geologic and geotechnical conditions on the specific lot.

APPENDIX F

Earthwork Specifications

ALTA CALIFORNIA GEOTECHNICAL, INC.
EARTHWORK SPECIFICATIONS

These specifications present the generally accepted standards and minimum earthwork requirements for the development of the project. These specifications shall be the project guidelines for earthwork except where specifically superseded in preliminary geology and soils reports, grading plan review reports or by the prevailing grading codes or ordinances of the controlling agency.

A. GENERAL

1. The Contractor shall be responsible for the satisfactory completion of all earthwork in accordance with the project plans and specifications.

2. The project Geotechnical Engineer and Engineering Geologist, or their representatives, shall provide observation and testing services, and Geotechnical consultation for the duration of the project.

3. All clearing, grubbing, stripping and site preparation for the project shall be accomplished by the Contractor to the satisfaction of the Geotechnical Engineer/Engineering Geologist.

4. It is the Contractor's responsibility to prepare the ground surface to receive fill to the satisfaction of the Geotechnical Engineer and to place, spread, mix, moisture condition, and compact the fill in accordance with the job specifications and as required by the Geotechnical Engineer. The Contractor shall also remove all material considered by the Geotechnical Engineer to be unsuitable for use in the construction of engineered fills.

5. The Contractor shall have suitable and sufficient equipment in operation to handle the amount of fill being placed. When necessary, equipment will be shut down temporarily in order to permit the proper preparation of fills.

B. PREPARATION OF FILL AREAS

1. Excessive vegetation and all deleterious material should be disposed of offsite as required by the Geotechnical Engineer.

   Existing fill, soil, alluvium or rock materials determined by the Geotechnical Engineer as being unsuitable for placement in compacted fills shall be removed and hauled from the site. Where applicable, the Contractor may obtain the approval of the Soils Engineer and the controlling authorities for the project to dispose of the above described materials, or a portion thereof, in designated areas onsite.

After removal of the deleterious materials have been accomplished, earth materials deemed unsuitable in their natural, in-place condition, shall be removed as recommended by the Geotechnical Engineer/Engineering Geologist.

2. Upon achieving a suitable bottom for fill placement, the exposed removal bottom shall be disced or bladed by the Contractor to the satisfaction of the Geotechnical Engineer. The prepared ground surfaces shall then be brought to the specified moisture content mixed as required, and compacted and tested as specified. In localities where it is necessary to obtain the approval of the controlling agency prior to placing fill, it will be the Contractor's responsibility to contact the proper authorities to visit the site.

3. Any underground structure 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 prescribed by the Geotechnical Engineer and/or the controlling agency for the project.

C. ENGINEERED FILLS

1. Any material imported or excavated on the property may be utilized as fill, provided the material has been determined to be suitable by the Geotechnical Engineer. Deleterious materials shall be removed from the fill as directed by the Geotechnical Engineer.

2. Rock or rock fragments less than twelve inches in the largest dimension may be utilized in the fill, provided they are not placed in concentrated pockets and the distribution of the rocks is approved by the Geotechnical Engineer.

3. Rocks greater than twelve inches in the largest dimension shall be taken offsite, or placed in accordance with the recommendations of the Geotechnical Engineer in areas designated as suitable for rock disposal.

4. All materials to be used as fill, shall be tested in the laboratory by the Geotechnical Engineer. Proposed import materials shall be approved by the Geotechnical Engineer 48 hours prior to importation.

5. The fill materials shall be placed by the Contractor in lifts, that when compacted, shall not exceed six inches. Each lift shall be spread evenly and shall be

thoroughly mixed to achieve a near uniform moisture condition and a uniform blend of materials.

All compaction shall be achieved at or above the optimum moisture content, as determined by the applicable laboratory standard. The Contractor will be notified if the fill materials are too wet or too dry to achieve the required compaction standard.

6. When the moisture content of the fill material is below the limit specified by the Geotechnical Engineer, water shall be added and the materials shall be blended until a uniform moisture content, within specified limits, is achieved. When the moisture content of the fill material is above the limits specified by the Geotechnical Engineer, the fill materials shall be aerated by discing, blading, mixed with dryer fill materials, or other satisfactory methods until the moisture content is within the specified limits.

7. Each fill lift shall be compacted to the minimum project standards, in compliance with the testing methods specified by the controlling governmental agency, and in accordance with recommendations of the Geotechnical Engineer.

   In the absence of specific recommendations by the Geotechnical Engineer to the contrary, the compaction standard shall be the most recent version of ASTM:D 1557.

8. Where a slope receiving fill exceeds a ratio of five-horizontal to one-vertical, the fill shall be keyed and benched through all unsuitable materials into sound bedrock or firm material, in accordance with the recommendations and approval of the Geotechnical Engineer.

9. Side hill fills shall have a <u>minimum key width</u> of 15 feet into bedrock or firm materials, unless otherwise specified in the soil report and approved by the Geotechnical Engineer in the field.

10. Drainage terraces and subdrainage devices shall be constructed in compliance with the ordinances of the controlling governmental agency and/or with the recommendations of the Geotechnical Engineer and Engineering Geologist.

11. The Contractor shall be required to maintain the specified minimum relative compaction out to the finish slope face of fill slopes, buttresses, and stabilization fills as directed by the Geotechnical Engineer and/or the governing agency for the project. This may be achieved by either overbuilding the slope and cutting

back to the compacted core; by direct compaction of the slope face with suitable equipment; or by any other procedure which produces the required result.

12. The fill portion of fill-over-cut slopes shall be properly keyed into rock or firm material; and the fill area shall be stripped of all soil or unsuitable materials prior to placing fill.

    The design cut portion of the slope should be made first and evaluated for suitability by the Engineering Geologist prior to placement of fill in the keyway above the cut slope.

13. Pad areas in cut or natural ground shall be approved by the Geotechnical Engineer. Finished surfaces of these pads may require scarification and recompaction, or over excavation as determined by the Geotechnical Engineer.

D. CUT SLOPES

1. The Engineering Geologist shall observe all cut slopes and shall be notified by the Contractor when cut slopes are to be started.

2. If, during the course of grading, unforeseen adverse or potentially adverse geologic conditions are encountered, the Engineering Geologist and Soil Engineer shall investigate, analyze and make recommendations to remediate these problems.

3. Non-erodible interceptor swales shall be placed at the top of cut slopes that face the same direction as the superjacent, prevailing drainage.

4. Unless otherwise specified in specific geotechnical reports, no cut slopes shall be excavated higher or steeper than that allowed by the ordinances of controlling governmental agencies.

5. Drainage terraces shall be constructed in compliance with the ordinances of the controlling governmental agencies, and/or in accordance with the recommendations of the Geotechnical Engineer or Engineering Geologist.

E. GRADING CONTROL

1. Fill placement shall be observed and tested by the Geotechnical Engineer and/or his representative during grading.

   Field density tests shall be made by the Geotechnical Engineer and/or his representative to evaluate the compaction and moisture compliance of each fill lift. Density tests shall be conducted at intervals not to exceed two feet of fill height. Where sheepsfoot rollers are used, the fill may be disturbed to a depth of several inches. Density determinations shall be taken in the compacted material below the disturbed surface at a depth determined by the Geotechnical Engineer or his representative.

2. Where tests indicate that the density of any layer of fill, or portion thereof, is below the required relative compaction, or improper moisture content is in evidence, that particular layer or portion thereof shall be reworked until the required density and/or moisture content has been attained. Additional fills shall not be placed over an area until the previous lift of fill has been tested and found to meet the density and moisture requirements for the project and the previous lift is approved by the Geotechnical Engineer.

3. When grading activities are interrupted by heavy rains, fill operations shall not be resumed until field observations and tests by the Geotechnical Engineer indicate the moisture content and density of the fill are within the specified limits.

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

5. Observation and testing by the Geotechnical Engineer and/or his representative shall be conducted during filling and compacting operations in order that he will be able to state in his opinion that all cut and filled areas are graded in accordance with the approved specifications.

6. Upon the completion of grading activities and after the Geotechnical Engineer and Engineering Geologist have finished their observations of the work, final reports shall be submitted. No further excavation or fill placement shall be undertaken without prior notification of the Geotechnical Engineer and/or Engineering Geologist.

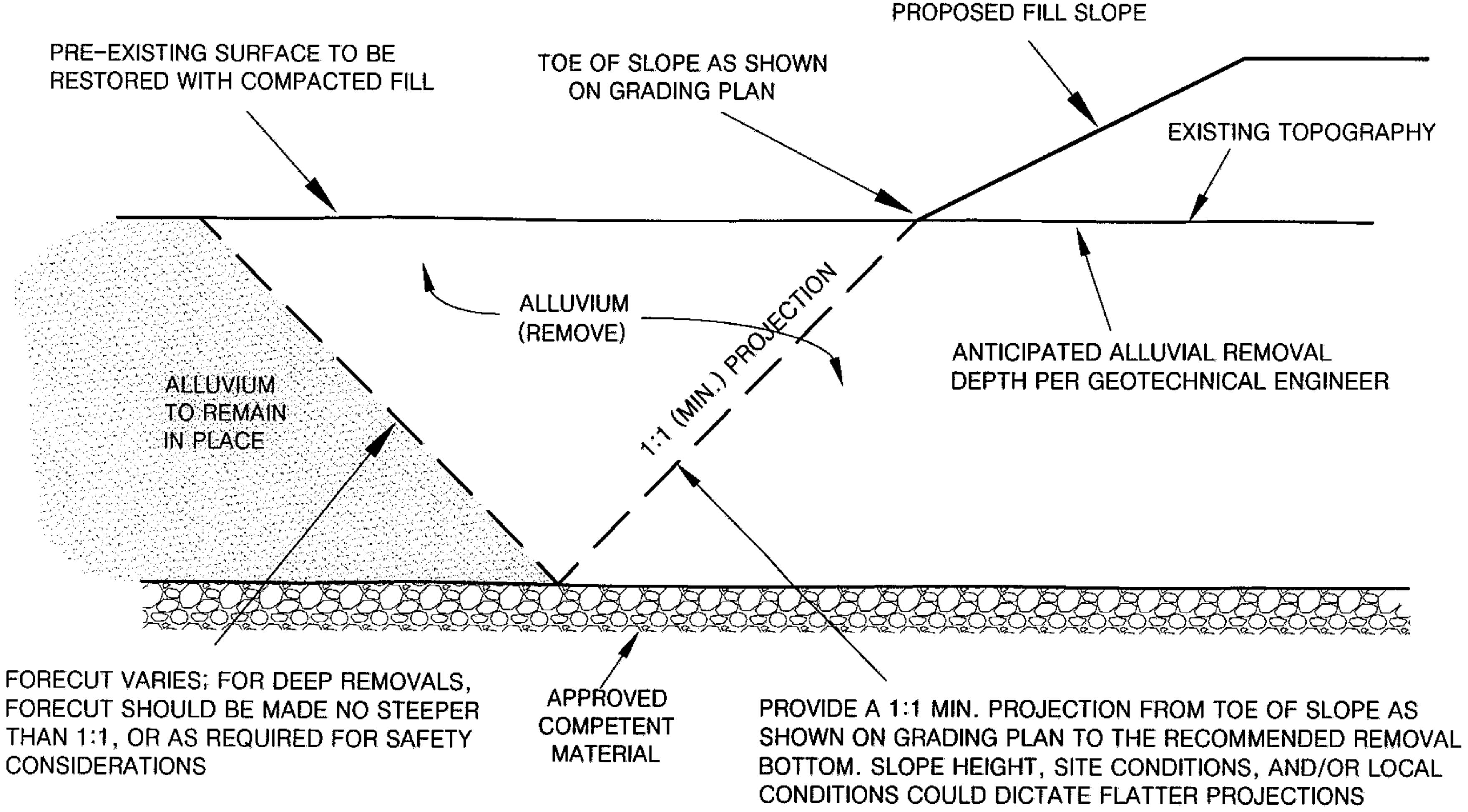
F. FINISHED SLOPES

All finished cut and fill slopes shall be planted and irrigated and/or protected from erosion in accordance with the project specifications, governing agencies, and/or as recommended by a landscape architect.

APPENDIX G

Grading Details

DETAIL FOR FILL SLOPE TOEING OUT ON FLAT ALLUVIATED CANYON



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VER. 3/12

PLATE G-1

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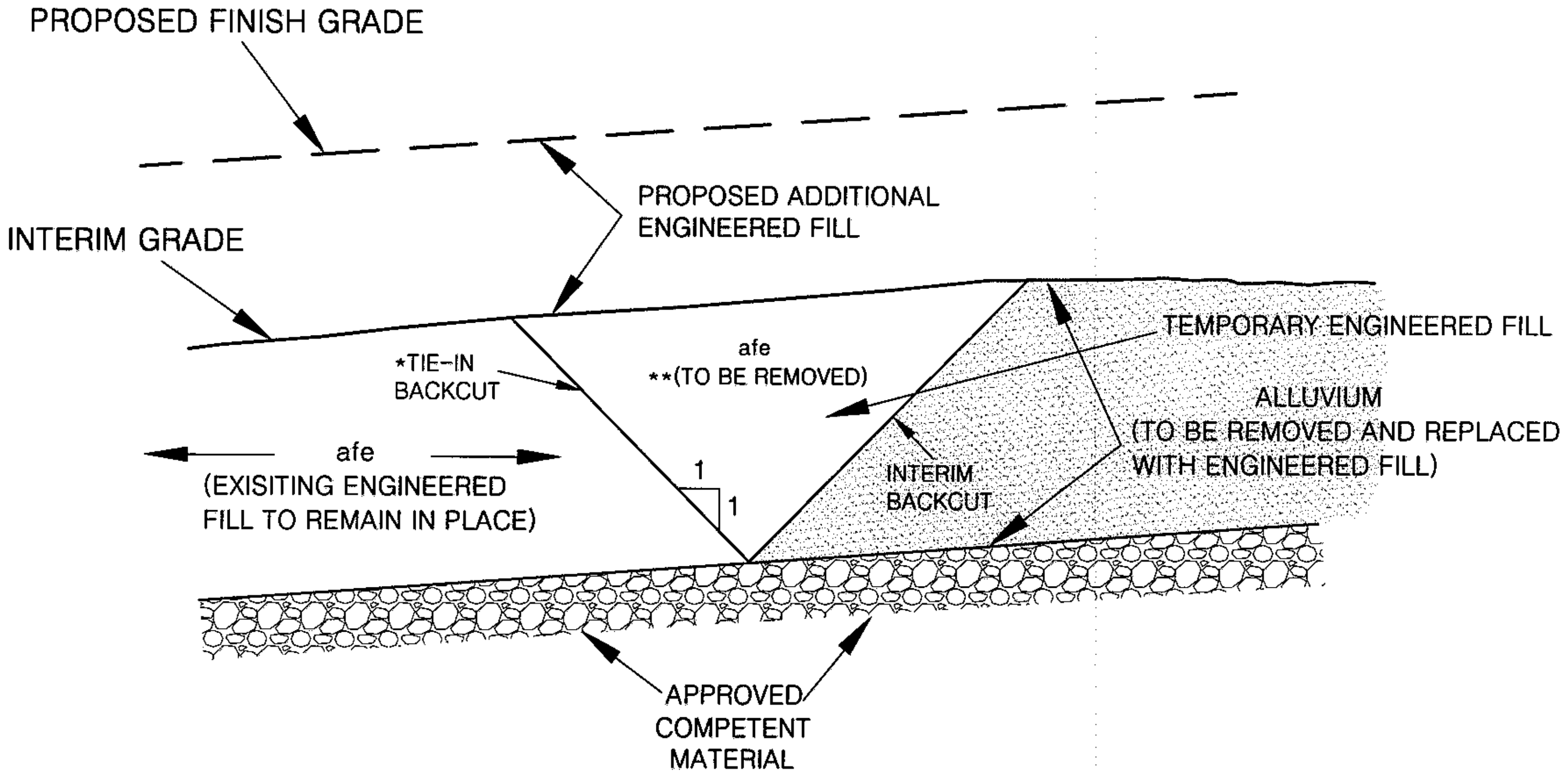
REMOVAL ADJACENT TO EXISTING FILL



*INITIATE 1:1 TIE-IN BACKCUT TO INTERCEPT TOE OF INTERIM BACKCUT

**AS PART OF TIE-IN FOR ADDITIONAL ENGINEERED FILL

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PLATE G-2

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CANYON SUBDRAIN

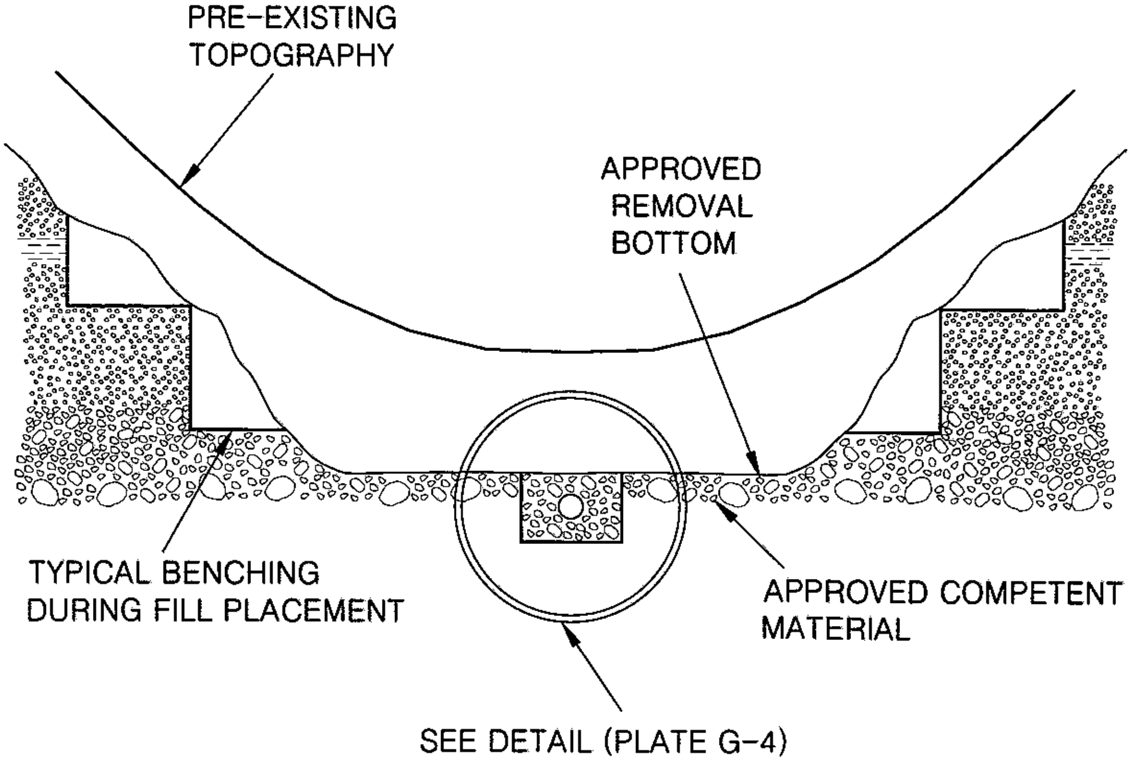

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PLATE G-3

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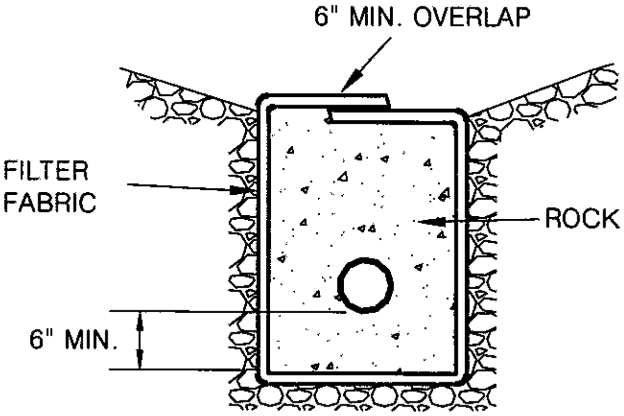
CANYON SUBDRAIN DETAIL



PERFORATED PIPE SURROUNDED WITH ROCK AND FILTER FABRIC

ROCK: MIN. VOLUME OF 9 CU.FT. PER LINEAR FT. OF 3/4 IN. MAX. ROCK
PIPE: 6 IN. ABS OR PVC PIPE WITH A MINIMUM OF 8 PERFORATIONS
(1/4-IN. DIA.) PER LINEAL FT. IN BOTTOM HALF OF PIPE
ASTM D2751, SDR 35, OR ASTM D3034 OR ASTM D1527,
SCHD. 40 ASTM D1785, SCHD. 40
FILTER FABRIC: MIRAFI 140 FILTER FABRIC OR APPROVED EQUIVALENT

NOTES:

1. FOR CONTINUOUS RUN IN EXCESS OF 500. FT USE 8 IN. DIA. PIPE
2. ENGINEERED FILL PLACED BELOW DRAINS SHALL BE COMPACTED TO 93% OF THE LABORATORY MAXIMUM DRY DENSITY (ASTM:D1557)

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PLATE G-4

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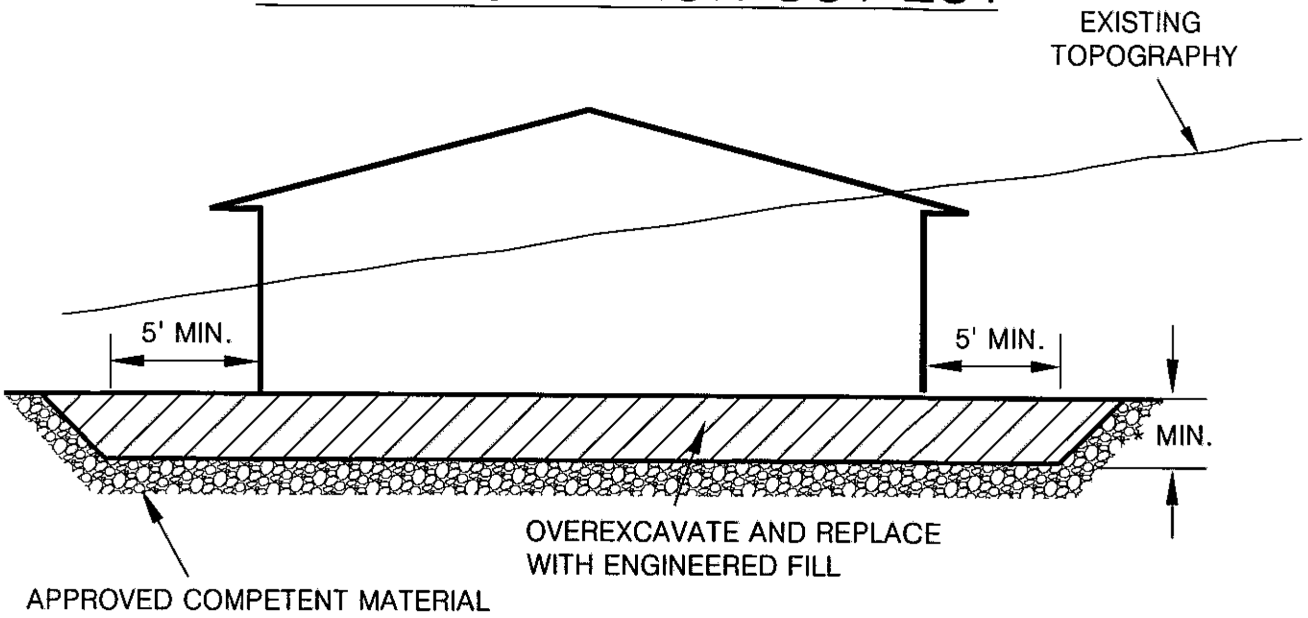
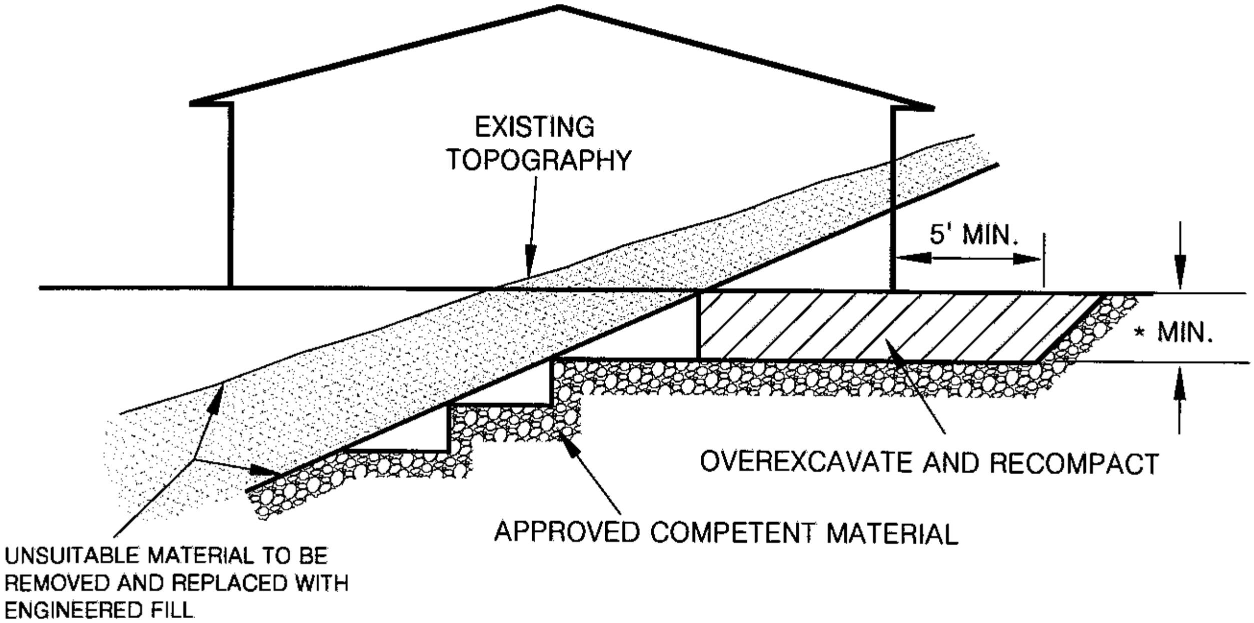
OVEREXCAVATION CUT LOT



CUT-FILL LOT (TRANSITION)



*NOTE ALL BUILDING PADS SHALL BE OVER EXCAVATED TO A MINIMUM OF ⅓ OF THE MAXIMUM DEPTH OF FILL BELOW THE BUILDING PAD TO A MAXIMUM OF 17 FEET (SEE PLATE G-16)

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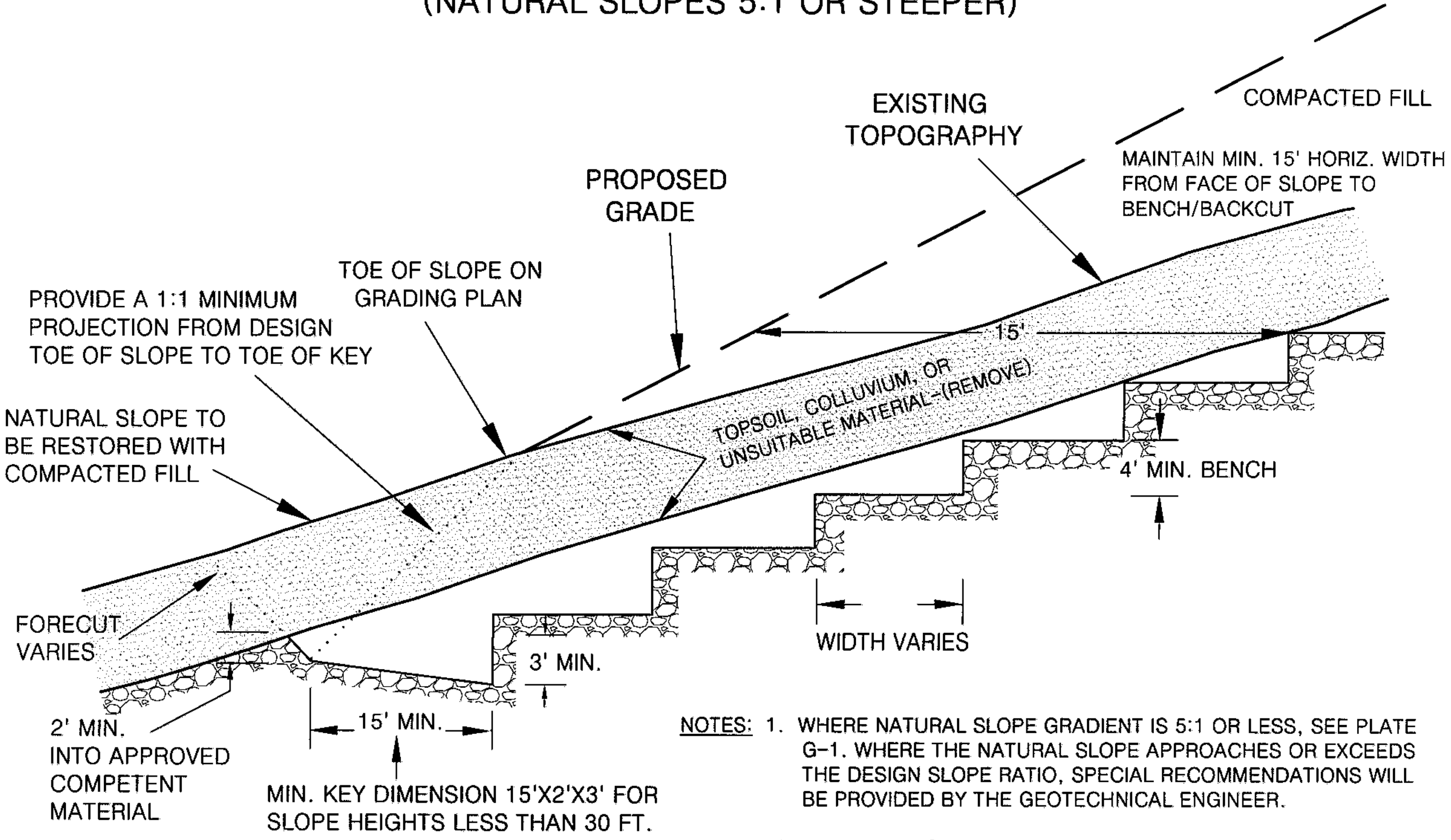
SIDE HILL SLOPE FILL DETAIL

(NATURAL SLOPES 5:1 OR STEEPER)



NOTES:

1. WHERE NATURAL SLOPE GRADIENT IS 5:1 OR LESS, SEE PLATE G-1. WHERE THE NATURAL SLOPE APPROACHES OR EXCEEDS THE DESIGN SLOPE RATIO, SPECIAL RECOMMENDATIONS WILL BE PROVIDED BY THE GEOTECHNICAL ENGINEER.

2. THE NEED FOR AND PLACEMENT OF DRAINS WILL BE DETERMINED BY THE GEOTECHNICAL ENGINEER OR GEOLOGIST BASED UPON EXPOSED FIELD CONDITIONS.

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PLATE G-6

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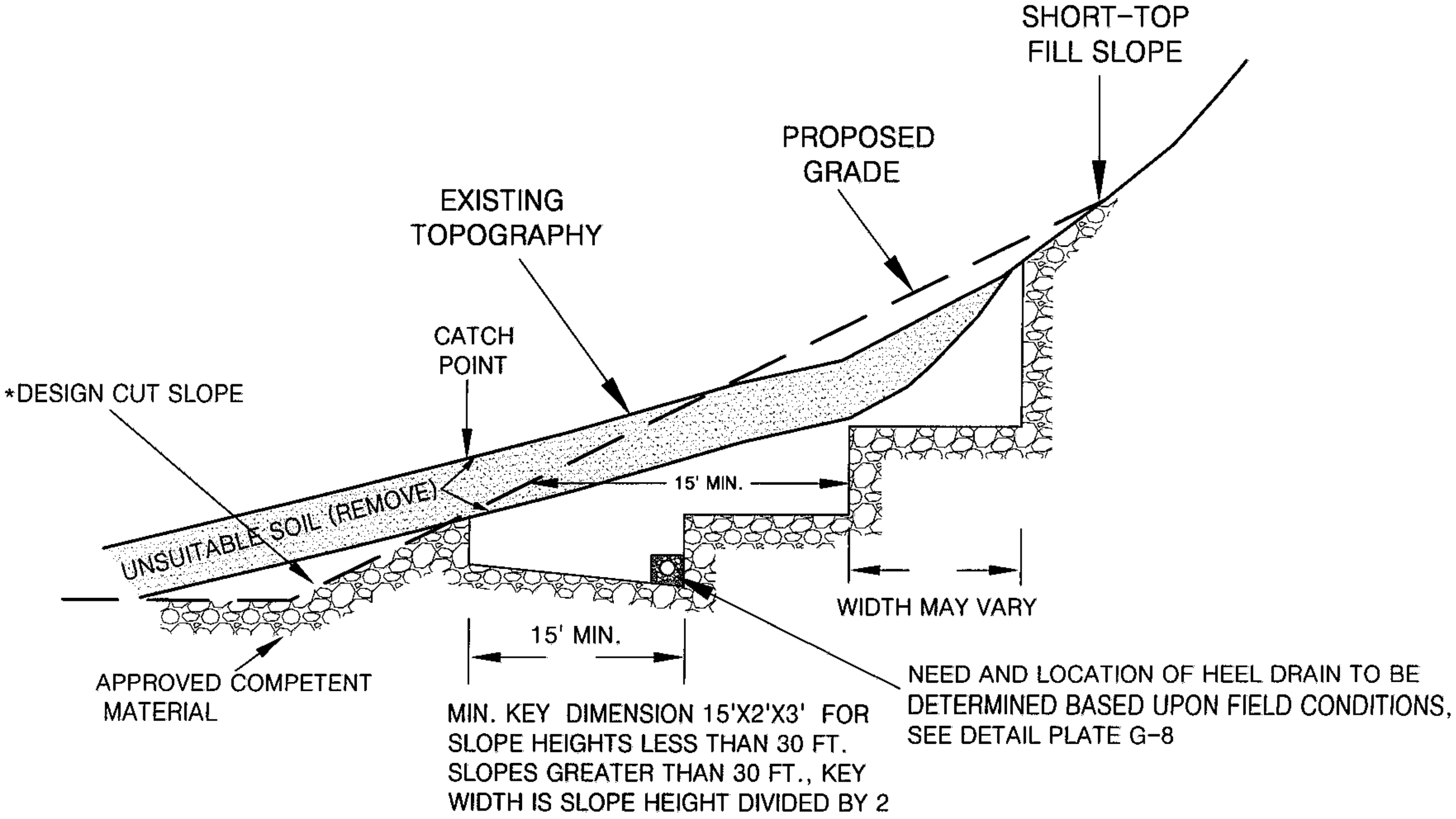
FILL OVER CUT SLOPE DETAIL



*THE CUT PORTION OF THE SLOPE SHOULD BE EXCAVATED AND EVALUATED BY THE ENGINEERING GEOLOGIST/GEOTECHNICAL ENGINEER PRIOR TO CONSTRUCTING THE FILL SLOPE

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PLATE G–7

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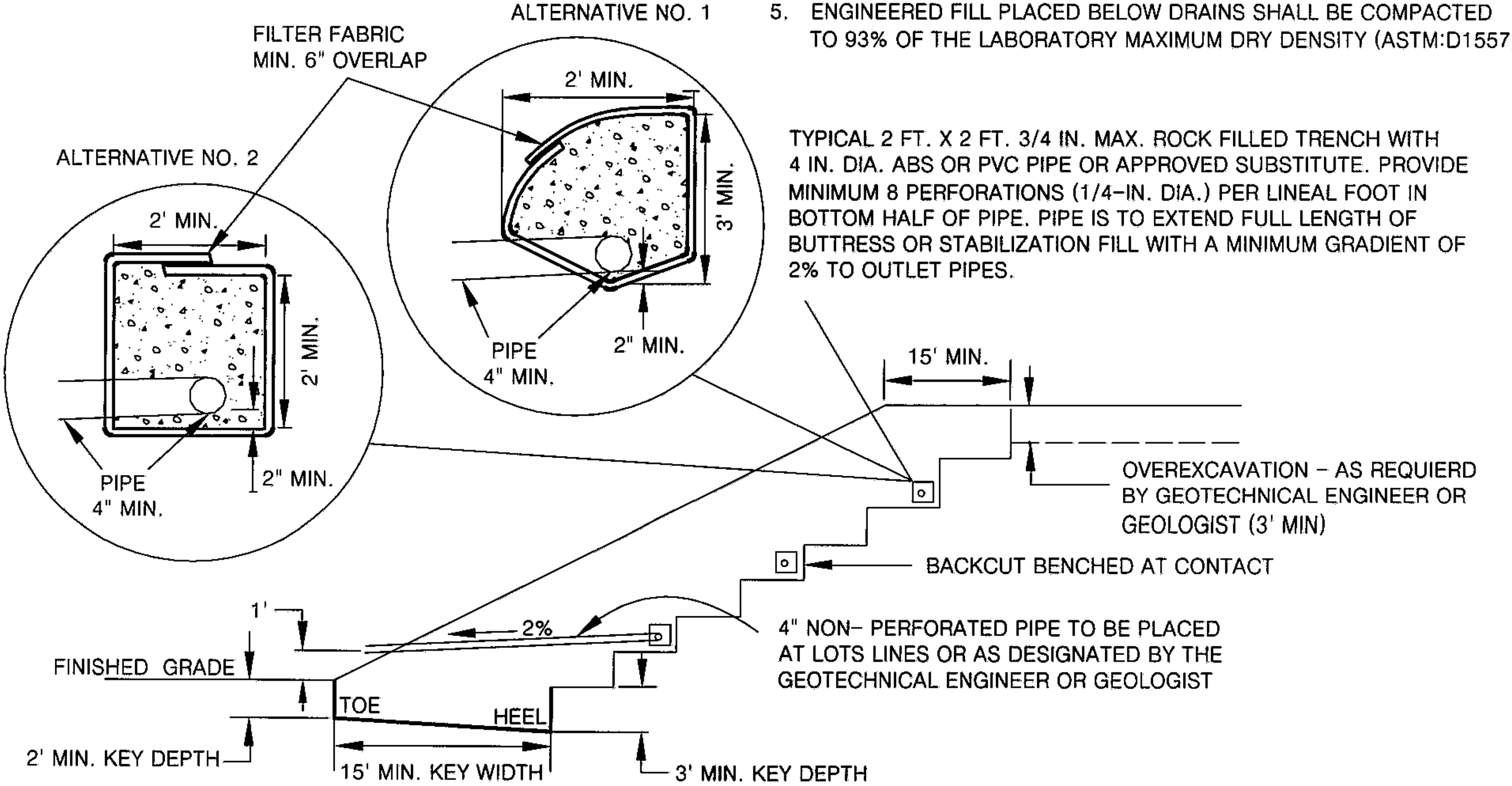
STABILIZATION/BUTTRESS FILL BACKDRAIN

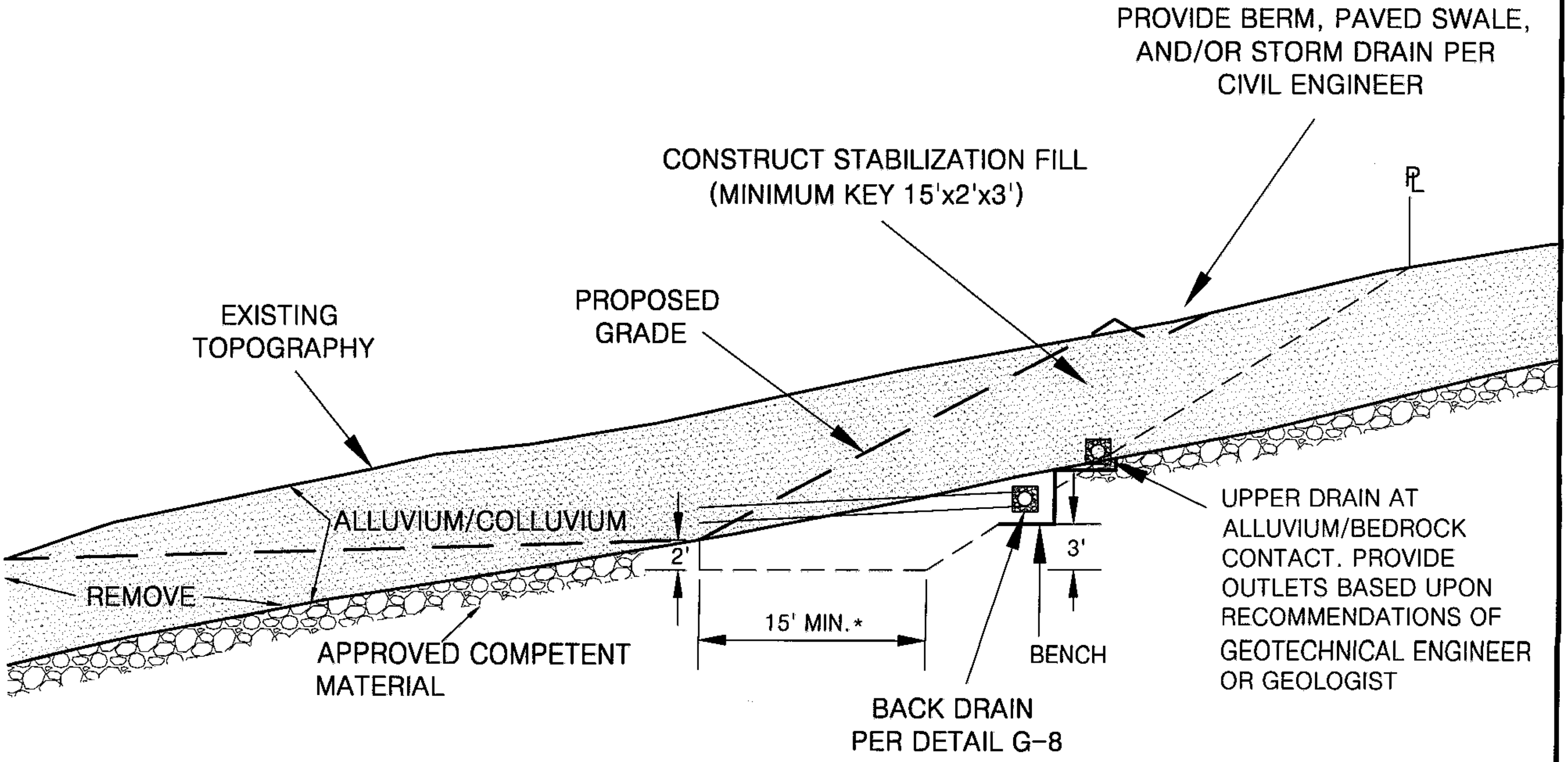
NOTE:

1. ASTM D2751, SDR 35, OR ASTM D3034 OR ASTM D1527, SCHD. 40 ASTM D1785, SCHD. 40
2. SOLID PIPE OUTLETS TO BE PROVIDED EVERY 100 FT. AND JOINED TO PERFORATED BACKDRAIN PIPE WITH "L" OR "T"s. MIN. 2% GRADIENT.
3. GRAVEL TRENCH TO BE FILLED WITH 3/4 IN. MAXIMUM ROCK
4. THE NECESSITY FOR UPPER TIER BACKDRAINS SHALL BE DETERMINED IN THE FIELD BY THE GEOTECHNICAL ENGINEER OR GEOLOGIST. UPPER TIER OUTLETS SHOULD DRAIN INTO PAVED TERRACE DRAINS.
5. ENGINEERED FILL PLACED BELOW DRAINS SHALL BE COMPACTED TO 93% OF THE LABORATORY MAXIMUM DRY DENSITY (ASTM:D1557)



TYPICAL 2 FT. X 2 FT. 3/4 IN. MAX. ROCK FILLED TRENCH WITH 4 IN. DIA. ABS OR PVC PIPE OR APPROVED SUBSTITUTE. PROVIDE MINIMUM 8 PERFORATIONS (1/4-IN. DIA.) PER LINEAL FOOT IN BOTTOM HALF OF PIPE. PIPE IS TO EXTEND FULL LENGTH OF BUTTRESS OR STABILIZATION FILL WITH A MINIMUM GRADIENT OF 2% TO OUTLET PIPES.

STABILIZATION FILL
(UPSLOPE ALLUVIATED AREA)



* FOR SLOPE HEIGHTS LESS THAN 30 FT.
SLOPES GREATER THAN 30 FT., KEY
WIDTH IS SLOPE HEIGHT DIVIDED BY 2

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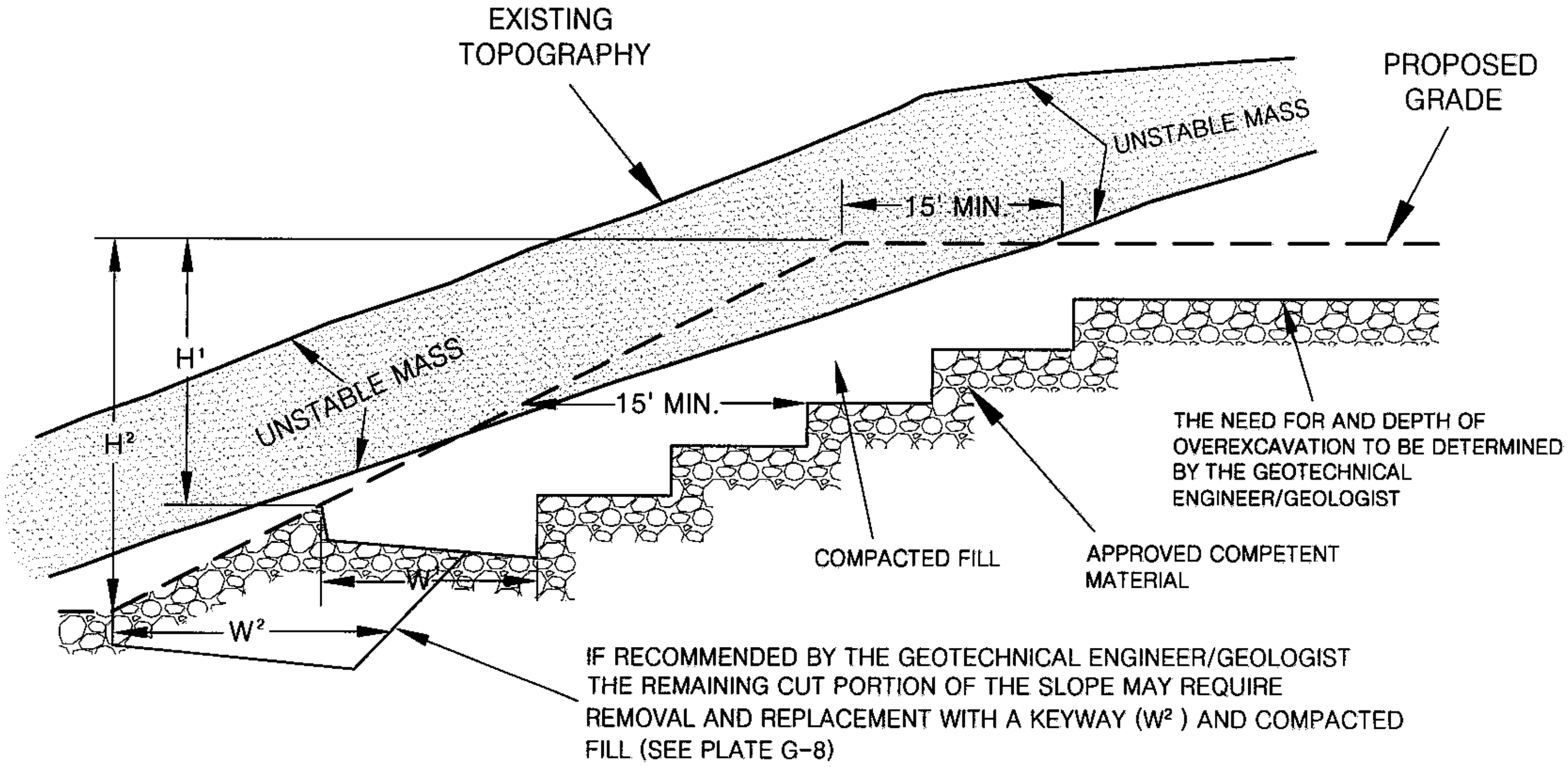
PLATE G-9

SELECTIVE GRADING DETAIL FOR STABILIZATION FILL UNSTABLE MATERIAL EXPOSED IN PORTION OF CUT SLOPE



NOTES:

1. BACKDRAINS ARE NOT REQUIRED UNLESS SPECIFIED.
2. "W" SHALL BE EQUIPMENT WIDTH (15') FOR SLOPE HEIGHT LESS THAN 25 FEET. FOR SLOPES GREATER THAN 25 FEET, "W" SHALL BE DETERMINED BY THE PROJECT GEOTECHNICAL ENGINEER/GEOLOGIST. AT NO TIME SHALL "W" BE LESS THAN H/2.

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VER. 3/12

PLATE G-10

SKIN FILL SLOPE OVER NATURAL GROUND

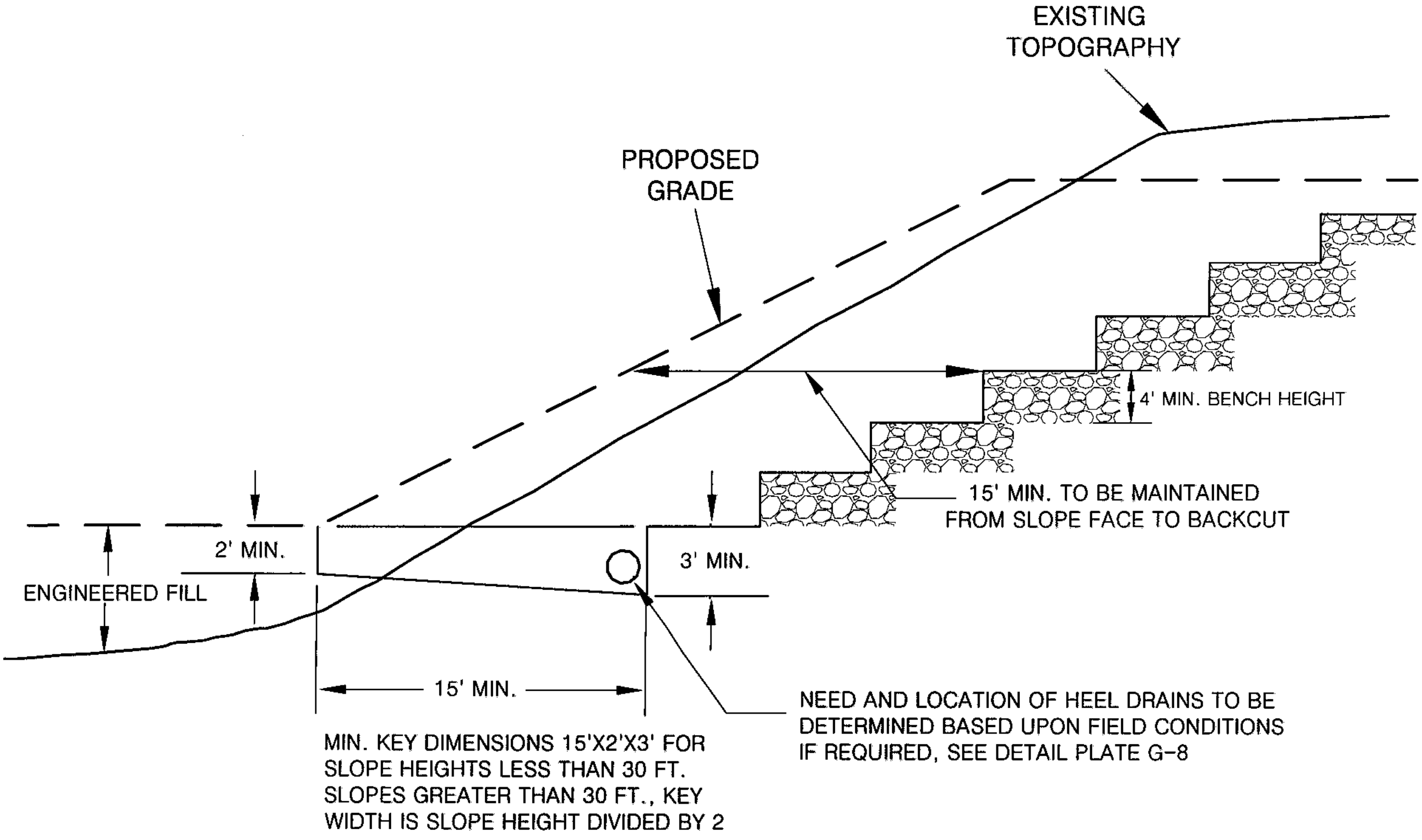

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PLATE G-11

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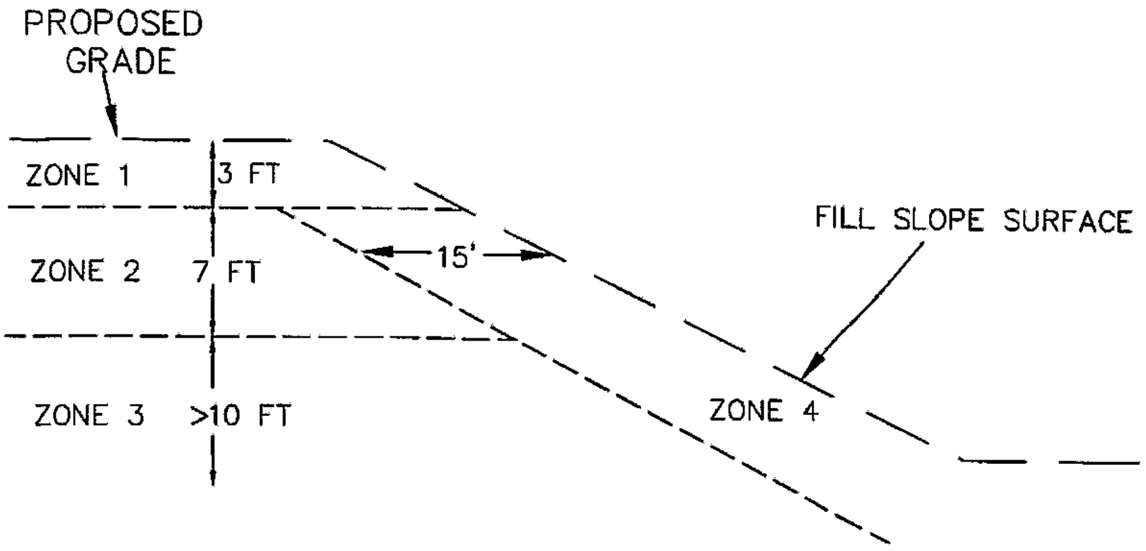
DETAIL FOR MAXIMUM PARTICLE DIMENSION



ZONE	DEPTH	PARTICLE MAX. DIMENSION	PLACEMENT METHOD
1	0-3 ft.	≤1.0 ft.	STANDARD OR CONVENTIONAL COMPACTION METHODS (SEE EARTHWORK SPECIFICATIONS)
2	3-10 ft.	≤2.0 ft.	ROCK BLANKETS (SEE PLATE G-13)
3	>10 ft.	≤8.0 ft.	ROCK BLANKETS (PLATE G-13) ROCK WINDROW (PLATE G-14) INDIVIDUAL ROCK BURIED (PLATE G-15)
4	15 HORIZONTAL FEET FROM FILL SLOPE FACE	≤1.0 ft.	STANDARD OR CONVENTIONAL COMPACTION METHODS (SEE EARTHWORK SPECIFICATIONS)

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PLATE G–12

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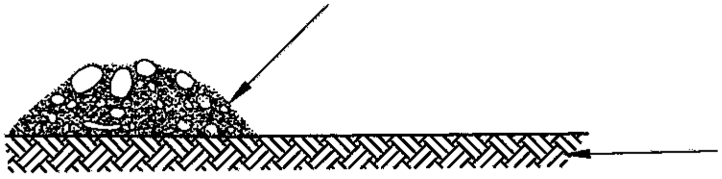
ROCK BLANKET DETAILS

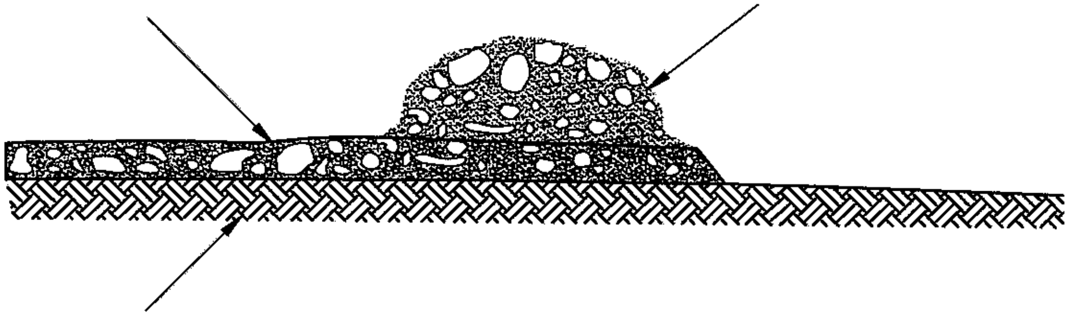
LOOSE PILE 1
LOOSE, DUMPED ROCK, GRAVEL AND SAND MIXTURE REMOVE FRAGMENTS LARGER THAT 2 FEET FOR ISOLATED BURIAL (PLATE G-15) OR WINDROW (PLATE G-10)



APPROVED BOTTOM, OR TOP OF PREVIOUSLY APPROVED BLANKET FILL

COMPACT PILE 1
SPREAD LOOSE PILE FORWARD WITH HEAVY TRACKED DOZER (D-8 OR LARGER). HEAVILY WATER, TRACK, AND APPLY ADDITIONAL SAND AND GRAVEL AS NECESSARY TO FILL VOIDS AND CREATE A DENSE MATRIX OF ROCK, COBBLES, GRAVEL AND SAND (2 FOOT MAXIMUM THICKNESS)

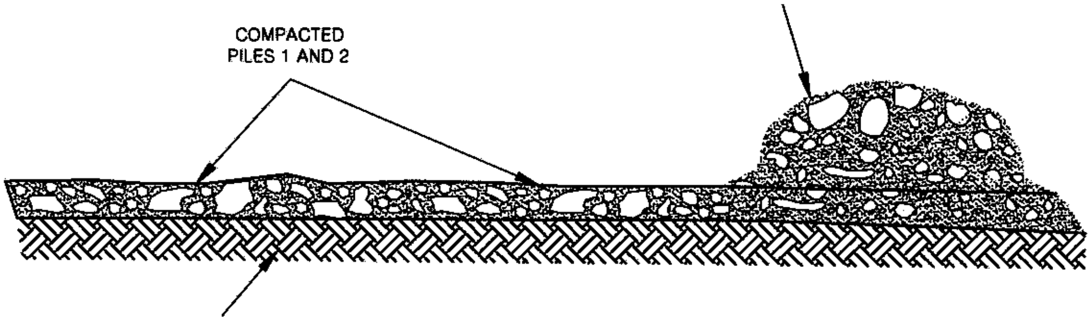
LOOSE PILE 2
DUMP SUCCESSIVE PILES OF LOOSE ROCK, GRAVEL AND SAND MIXTURE ON FORWARD EDGE OF PREVIOUSLY COMPACTED LIFT WITH TRUCKS AND/OR SCRAPERS. USE PREVIOUS LIFT TO ACCESS AND FURTHER COMPACT PILE 1.



APPROVED BOTTOM, OR TOP OF PREVIOUSLY APPROVED BLANKET FILL

LOOSE PILE 3
DUMP SUCCESSIVE PILES OF LOOSE ROCK, GRAVEL AND SAND MIXTURE ON FORWARD EDGE OF PREVIOUSLY COMPACTED LIFT WITH TRUCKS AND/OR SCRAPERS. USE PREVIOUS LIFT TO ACCESS AND FURTHER COMPACT EXISTING BLANKET.

COMPACTED PILES 1 AND 2



APPROVED BOTTOM, OR TOP OF PREVIOUSLY APPROVED BLANKET FILL

OBSERVATION TESTING AND APPROVAL PROCEDURES
OBSERVE EQUIPMENT. SCRAPERS AND TRUCKS SHOULD BE FULLY SUPPORTED ON BLANKET WITHOUT SIGNIFICANT YIELDING. EXCAVATE TEST/OBSERVATION PITS TO CONFIRM EXISTENCE OF MIXTURE OF VARIOUS PARTICLE SIZES, WITHOUT SIGNIFICANT VOIDS, AND FORMING A DENSE, COMPACTED FILL MATRIX. TEST BY ASTM D1556, D2922 AND/OR D3017 WHEN APPROPRIATE. RECORD LIMITS AND ELEVATION OF BLANKET. ALL FILL AND COMPACTION OPERATIONS TO BE CONDUCTED UNDER THE OBSERVATION OF THE GEOTECHNICAL ENGINEER. SUBSEQUENT LIFTS TO BE APPLIED ONLY AFTER OBSERVATION AND CONFIRMATION OF SUITABILITY OF FILL AND RELEASE BY THE GEOTECHNICAL ENGINEER. BLANKETS TO BE CONSTRUCTED IN ACCORDANCE WITH PLATE G-12.

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VER. 3/12

PLATE G-13

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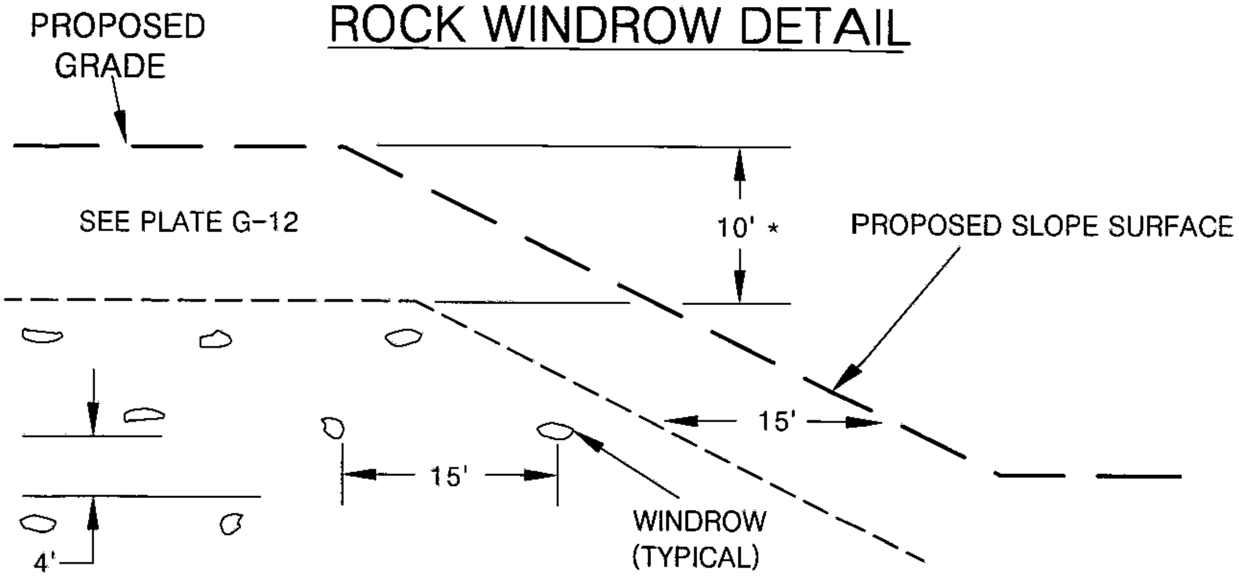
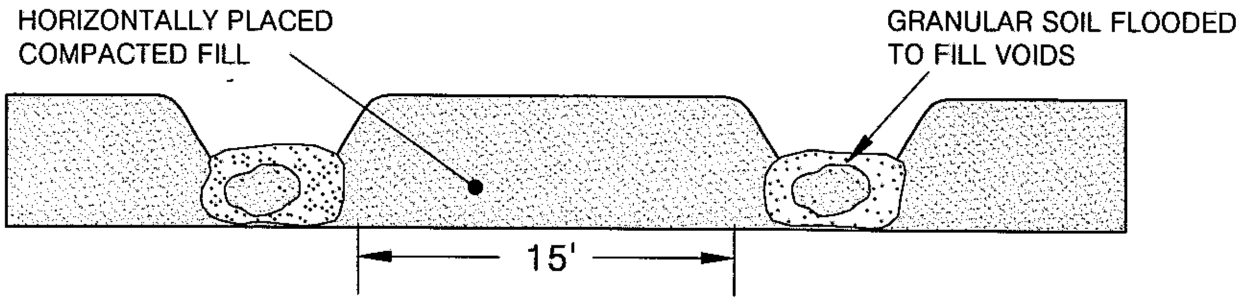
ROCK WINDROW DETAIL



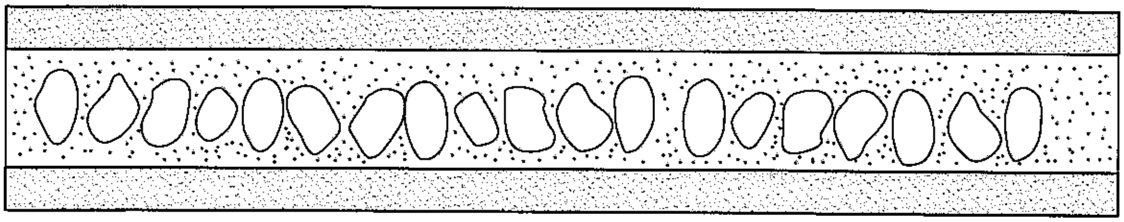
NOTE: OVERSIZED MATERIAL SHOULD BE REMOVED FROM THE 15' CLEAR ZONES WITH SPECIAL EQUIPMENT, SUCH AS A ROCK RAKE, PRIOR TO PLACING THE NEXT FILL LIFT.
*VARIANCES TO THE ABOVE ROCK HOLD DOWN MAY BE GRANTED SUBJECT TO APPROVAL BY THE OWNER, GEOTECHNICAL ENGINEER, AND GOVERNING AGENCY

TYPICAL WINDROW DETAIL (END VIEW)

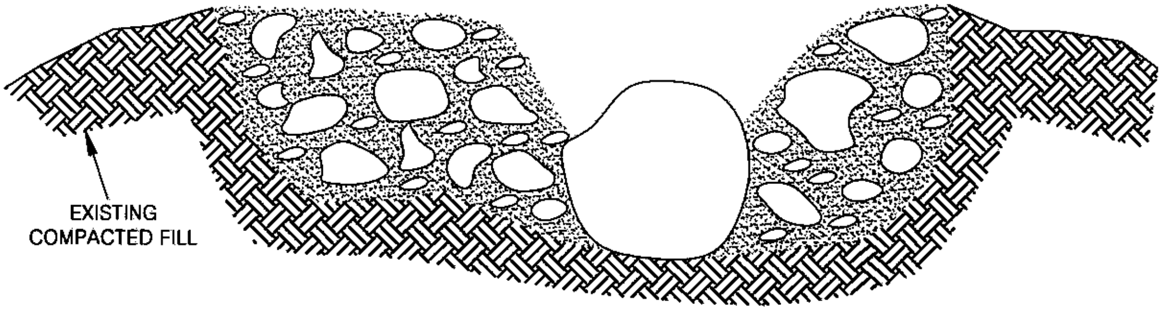


NOTE: COMPACTED FILL SHALL BE BROUGHT UP TO A HIGHER ELEVATION ALONG EACH WINDROW SO GRANULAR SOIL CAN BE FLOODED IN A "TRENCH CONDITION".

PROFILE VIEW



ISOLATED ROCK BURIAL DETAILS



EXCAVATE HOLE INTO EXISTING FILL PRISM, PLACE BOULDER (< 8 feet in maximum dimension) INTO EXISTING COMPACTED FILL. SURROUND WITH SAND, GRAVEL, COBBLES AND WATER HEAVILY. TRACK WITH D8 OR LARGER EQUIPMENT UNTIL RESULTING FILL FULLY SUPPORTS EQUIPMENT. OBSERVE AND/OR TEST IN ACCORDANCE WITH ASTM D1556, D2922 OR D3017. ROCKS LARGER THAN 8 FEET SHALL BE FURTHER REDUCED IN SIZE BY SECONDARY BREAKING.

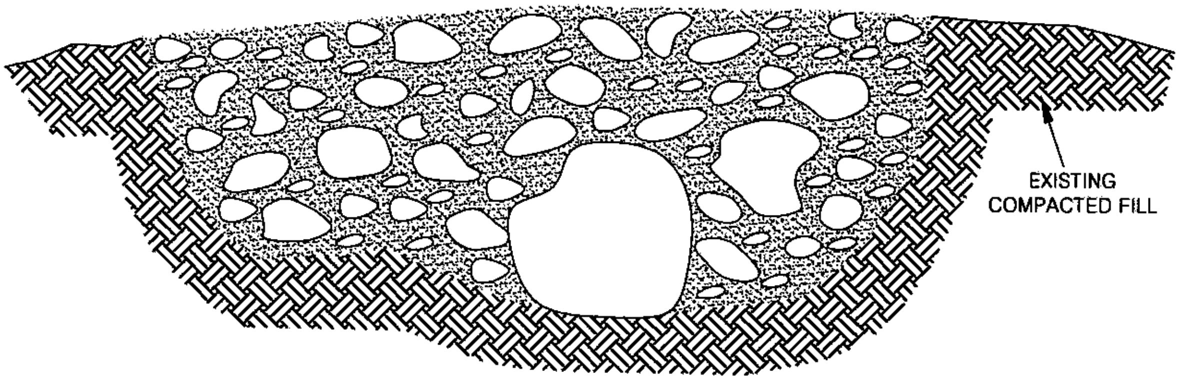


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PLATE G-15

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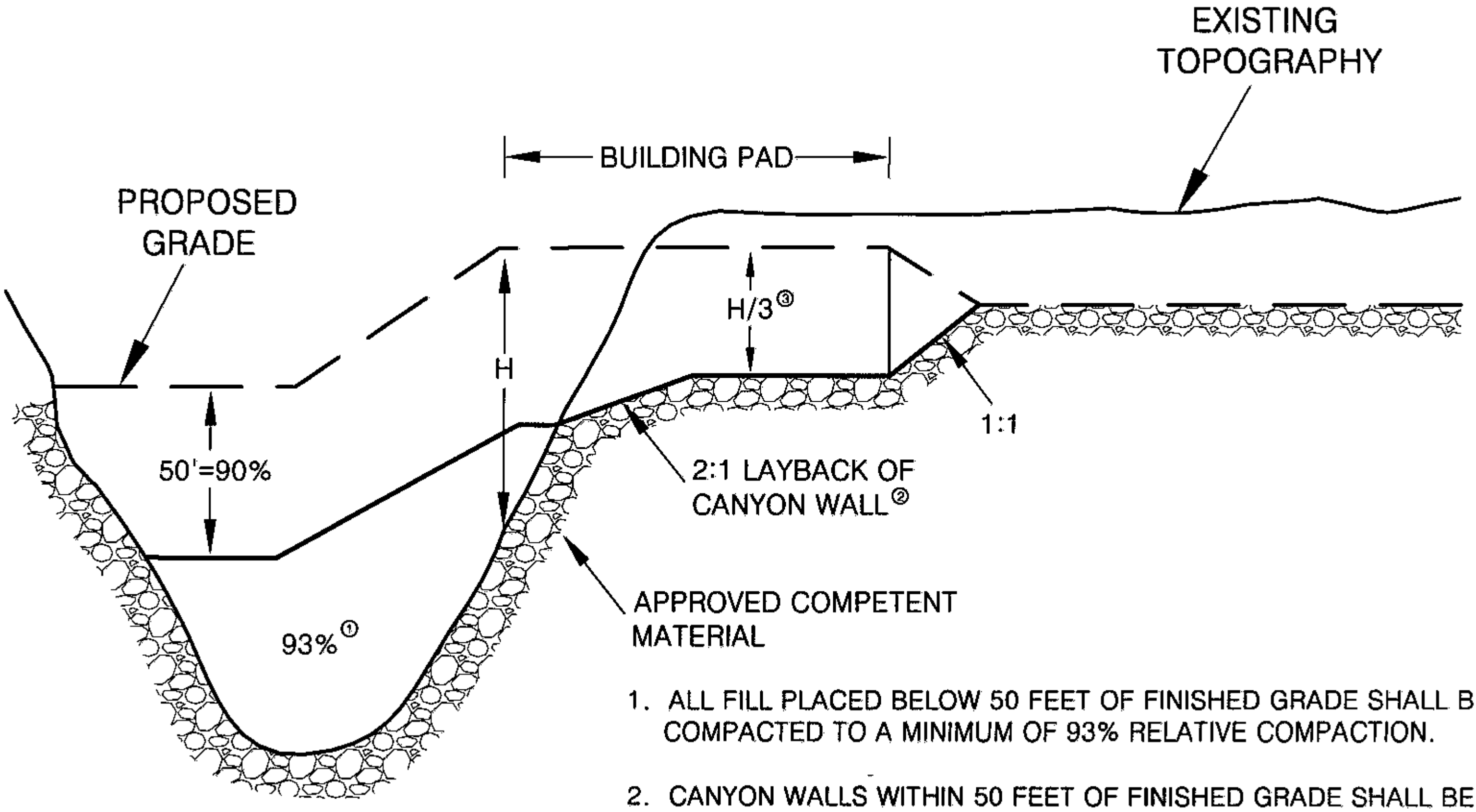
RELATIVE COMPACTION VS. DEPTH

CANYON WALL LAY BACK
DIFFERENTIAL FILL OVEREXCAVATION DETAILS



1. ALL FILL PLACED BELOW 50 FEET OF FINISHED GRADE SHALL BE COMPACTED TO A MINIMUM OF 93% RELATIVE COMPACTION.

2. CANYON WALLS WITHIN 50 FEET OF FINISHED GRADE SHALL BE LAID BACK TO A SLOPE RATIO OF 2:1 OR FLATTER.

3. ALL BUILDING PADS SHALL BE OVER EXCAVATED TO A MINIMUM OF 1/3 OF THE MAXIMUM DEPTH OF FILL BELOW THE BUILDING PAD TO A MAXIMUM OF 17 FEET.

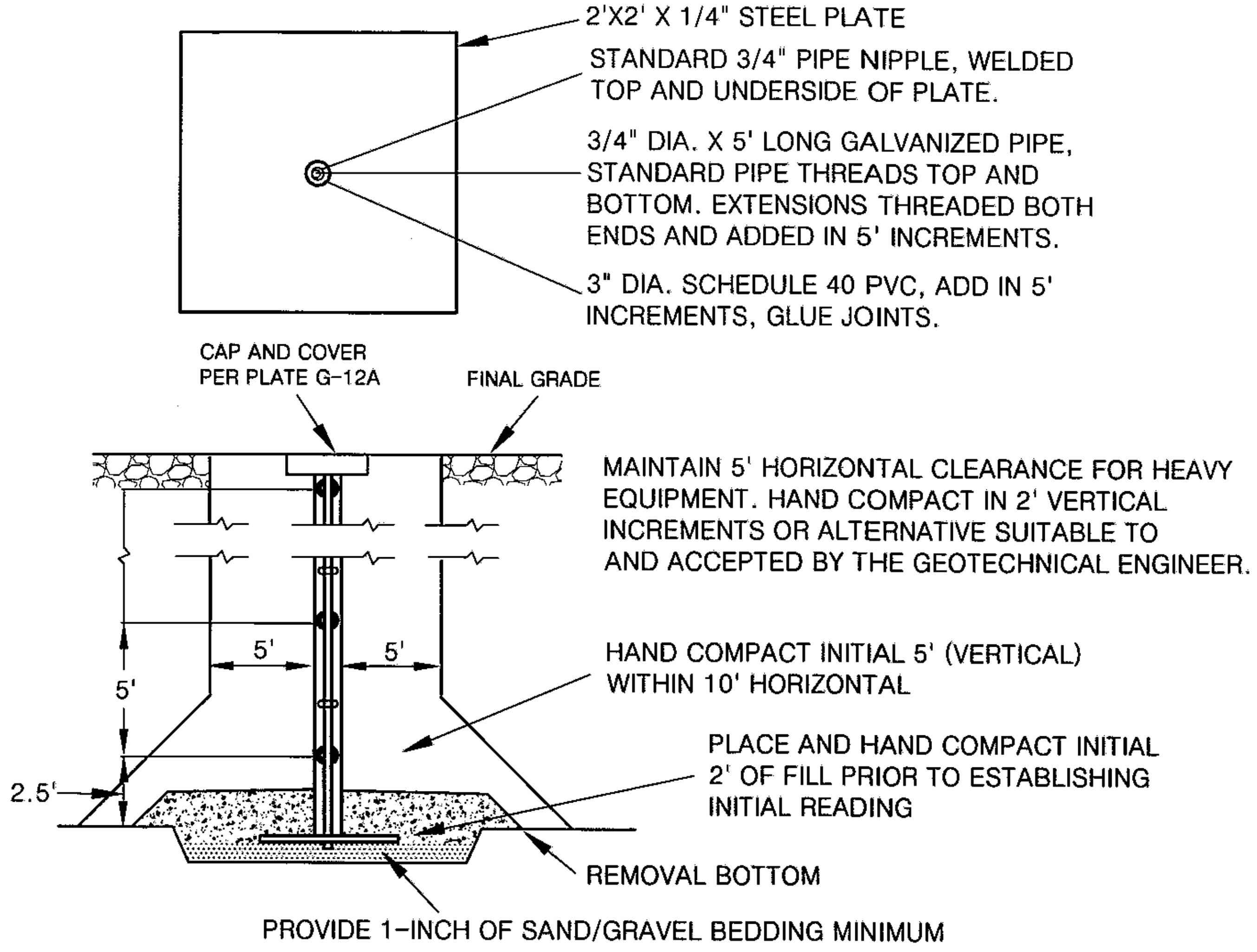
4. IF THE 2:1 LAY BACK OF THE CANYON WALL IS IMPRACTICAL, THEN AS AN ALTERNATIVE THE INCREASED COMPACTION STANDARDS IN NOTE 1 SHOULD BE EXTENDED UP TO H/3 AND THE LAY BACK WILL NOT BE REQUIRED.

ALTA CALIFORNIA GEOTECHNICAL, INC.
VER. 3/12

PLATE G-16

PATH:C:\Users\Jinks\Desktop\Drafting\GRADING DETAILS\G-16.dwg

SETTLEMENT PLATE DETAIL



NOTES:

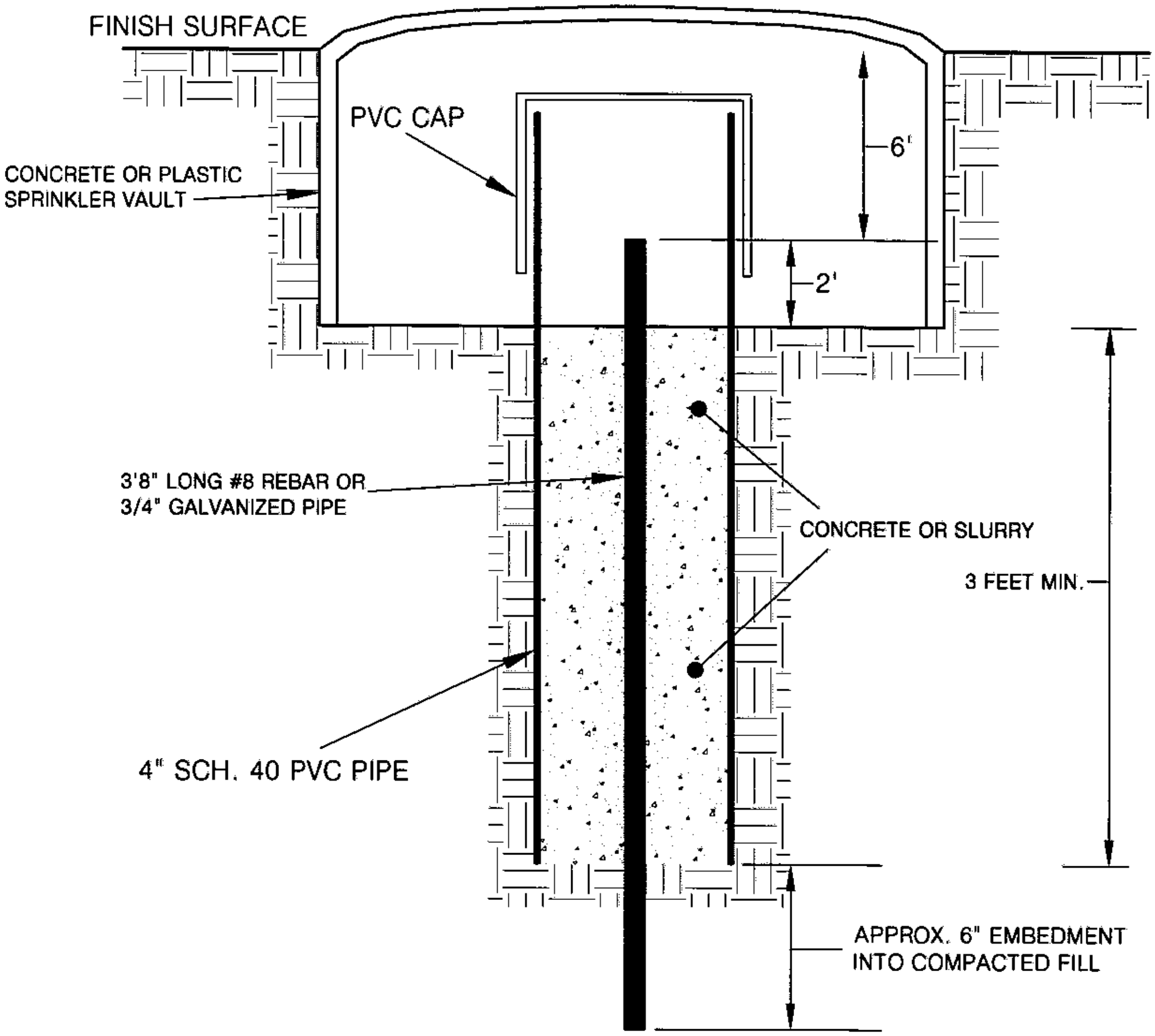
1) LOCATIONS OF SETTLEMENT PLATES SHALL BE CLEARLY MARKED AND READILY VISIBLE (RED FLAGGED) TO EQUIPMENT OPERATORS.

2) CONTRACTOR SHALL MAINTAIN 10' HORIZONTAL CLEARANCE FOR HEAVY EQUIPMENT WITHIN 5' (VERTICAL) OF PLATE BASE. FILL WITHIN CLEARANCE AREA SHALL BE HAND COMPACTED TO PROJECT SPECIFICATIONS OR COMPACTED BY ALTERNATIVE APPROVED BY THE GEOTECHNICAL ENGINEER.

3) AFTER 5' (VERTICAL) OF FILL IS IN PLACE, CONTRACTOR SHALL MAINTAIN 5' HORIZONTAL EQUIPMENT CLEARANCE. FILL IN CLEARANCE AREA SHALL BE HAND COMPACTED (OR APPROVED ALTERNATIVE) IN VERTICAL INCREMENTS NOT TO EXCEED 2 FEET.

4) IN THE EVENT OF DAMAGE TO SETTLEMENT PLATE OR EXTENSION RESULTING FROM EQUIPMENT OPERATING WITHIN PRESCRIBED CLEARANCE AREA, CONTRACTOR SHALL IMMEDIATELY NOTIFY GEOTECHNICAL ENGINEER AND SHALL BE RESPONSIBLE FOR RESTORING THE SETTLEMENT PLATE AND EXTENSION RODS TO WORKING ORDER.

SURFACE SETTLEMENT MONUMENT DETAIL



ALTA CALIFORNIA GEOTECHNICAL, INC .
VER. 3/12

PLATE G-18

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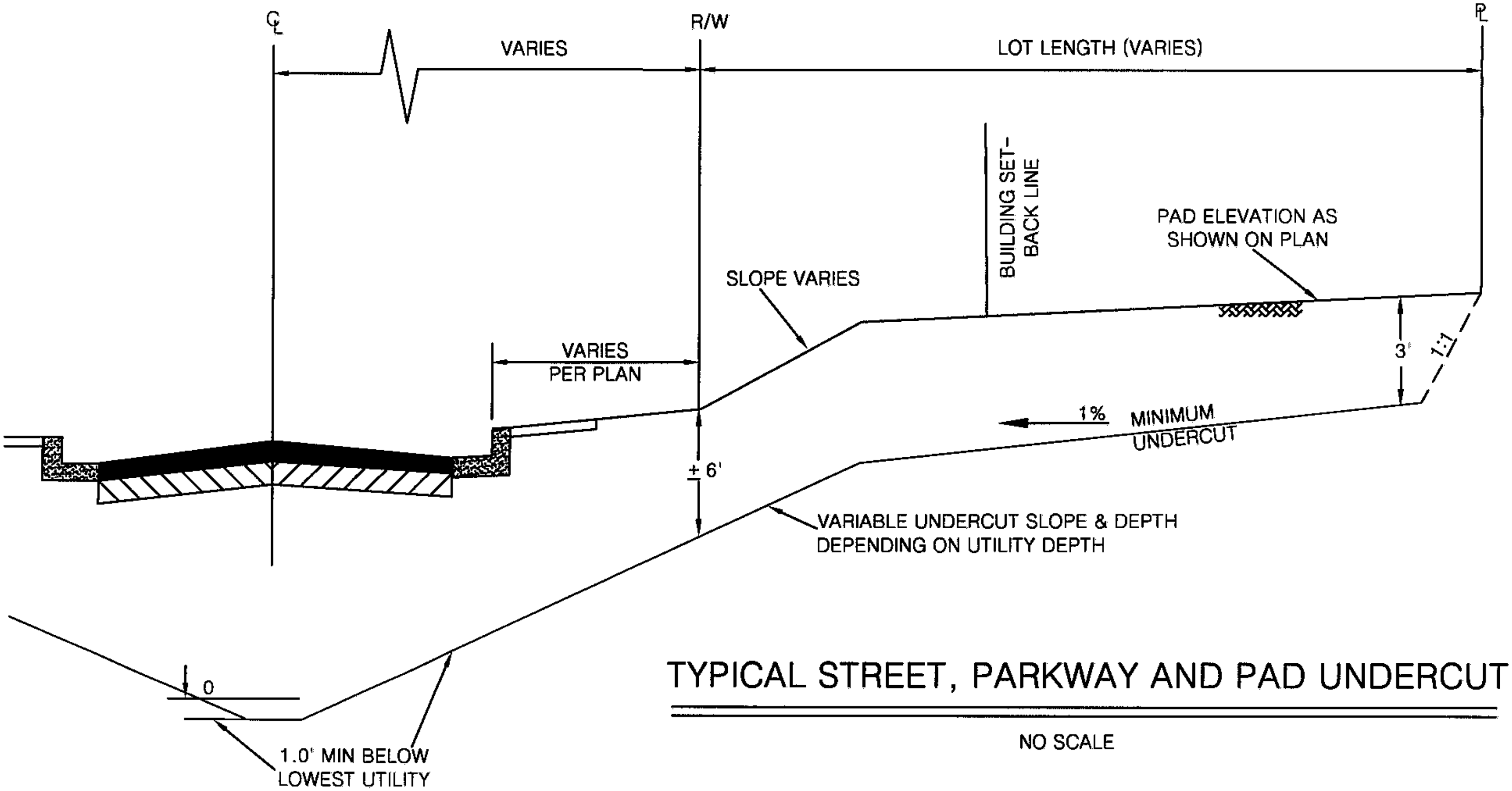

TYPICAL STREET, PARKWAY AND PAD UNDERCUT

NO SCALE

ALTA CALIFORNIA GEOTECHNICAL, INC .
VER. 3/13

PLATE G-19

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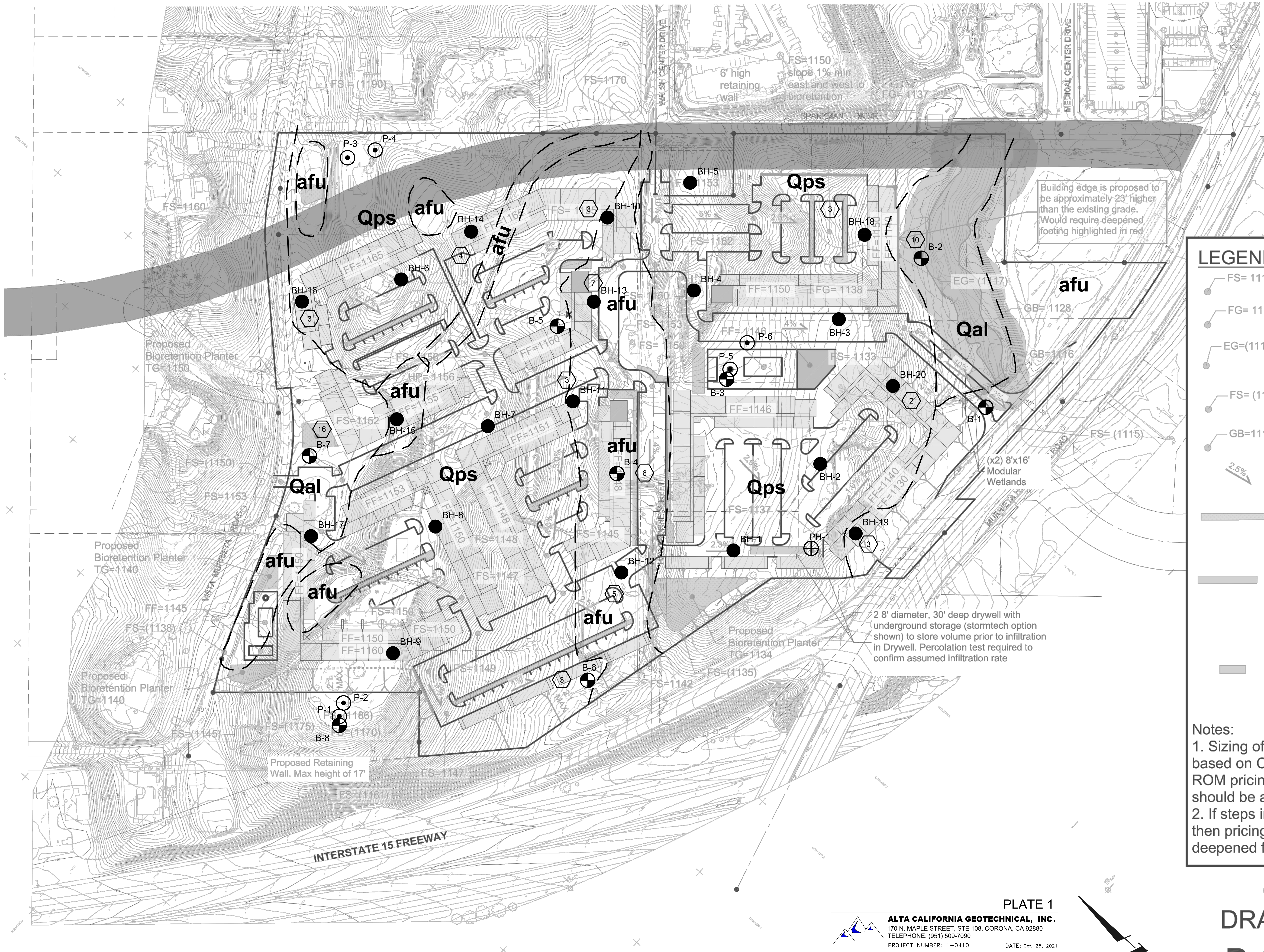

Building edge is proposed to be approximately 23' higher than the existing grade. Would require deepened footing highlighted in red

2 8' diameter, 30' deep drywell with underground storage (stormtech option shown) to store volume prior to infiltration in Drywell. Percolation test required to confirm assumed infiltration rate

LEGEND

afu	ARTIFICIAL FILL-UNDOCUMENTED
Qal	ALLUVIUM
Qps	PAUBA FORMATION
● BH-1	APPROXIMATE LOCATION OF HOLLOW STEM BORING (ALTA, THIS REPORT)
⊕ PH-1	APPROXIMATE LOCATION OF INFILTRATION TEST (ALTA, THIS REPORT)
B-4	APPROXIMATE LOCATION OF HOLLOW STEM BORING (GEOCON, 2016)
⊙ P-1	APPROXIMATE LOCATION OF INFILTRATION TEST (GEOCON, 2016)
— —	APPROXIMATE LOCATION OF GEOLOGIC CONTACT
⬡ 6	ANTICIPATED REMOVAL DEPTH (IN FEET)

LEGEND

FS= 1115	PROPOSED FINISHED SURFACE
FG= 1115	PROPOSED FINISHED GRADE
EG=(1117)	EXISTING GRADE
FS= (1115)	EXISTING FINISHED SURFACE
GB=1115	GRADE BREAK
2.5%	SLOPE (DIRECTION & GRADE AS NOTED)
▨	BIORETENTION PLANTER W/ UNDERDRAIN PER DETAIL IN SEWER & STORM CONCEPT **TOTAL AREA = 44,000 SF**
▨ ●	UNDERGROUND STORAGE AND DRYWELL SYSTEM PER DETAILS IN SEWER & STORM CONCEPT **TOTAL DRYWELLS = 2** **TOTAL STORAGE = 5,900 CF**
▨	MODULAR WETLAND PER DETAIL IN SEWER & STORM CONCEPT (SIZE AS NOTED)

Notes:

1. Sizing of Improvements are rough estimations based on Concept level design for purposes of ROM pricing exercise. Appropriate contingencies should be applied.
2. If steps in buildings are not desired as shown then pricing should include allocations for deepened footings and stem walls as appropriate.

PLATE 1

ALTA CALIFORNIA GEOTECHNICAL, INC.
170 N. MAPLE STREET, STE 108, CORONA, CA 92880
TELEPHONE: (951) 509-7090
PROJECT NUMBER: 1-0410 DATE: Oct. 25, 2021

80' 40' 0' 80' 160'
GRAPHIC SCALE
Note: For reduced sized prints, original scale is in inches

GRADING AND DRAINAGE CONCEPT

PSOMAS

DATE: 08/12/2021 REVISED ON:
JOB No: 2MAR300100

PRELIMINARY GEOTECHNICAL INVESTIGATION

TERRACES MIXED USE DEVELOPMENT
MURRIETA HOT SPRINGS ROAD & INTERSTATE 15
MURRIETA, CALIFORNIA

GEOCON
WEST, INC.

GEOTECHNICAL
ENVIRONMENTAL
MATERIALS

PREPARED FOR

STRATA EQUITY GROUP
SAN DIEGO, CALIFORNIA

APRIL 26, 2016
PROJECT NO. T2673-22-01

GEOCON
WEST, INC.
GEOTECHNICAL ■ ENVIRONMENTAL ■ MATERIALS

Project No. T2673-22-01
April 26, 2016

Strat Equity Group.
4310 La Jolla Village Drive, Suite 960
San Diego, California 92122

Attention: Mr. Eric Flodine

Subject: PRELIMINARY GEOTECHNICAL INVESTIGATION
TERRACES MIXED USE DEVELOPMENT
MURRIETA HOT SPRINGS ROAD & INTERSTATE 15
MURRIETA, CALIFORNIA

Dear Mr. Flodine:

In accordance with your authorization of Proposal IE-1518 dated October 14, 2015, Geocon West, Inc. (Geocon) herein submits the results of our preliminary geotechnical investigation and percolation testing for the proposed mixed use development known as the Terraces located east of the intersection of Murrieta Hot Springs Road and Interstate 15 in Murrieta, California. The accompanying report presents our findings, conclusions and recommendations pertaining to the geotechnical aspects of the proposed development. Based on the results of this study, it is our opinion the site is considered suitable for the proposed development provided the recommendations of this report are followed.

Should you have any questions regarding this report, or if we may be of further service, please contact the undersigned at your convenience.

Very truly yours,

GEOCON WEST, INC.

LISA A. BATTIATO
No. 2316
CERTIFIED ENGINEERING GEOLOGIST

CHET E. ROBINSON
No. 2890
GEOTECHNICAL

Lisa A. Battiato
CEG 2316

Chet E. Robinson
GE 2890

LAB:PDT:CER:hd

(email) Addressee

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

PRELIMINARY GEOTECHNICAL INVESTIGATION

1. PURPOSE AND SCOPE

This report presents the results of our preliminary geotechnical investigation and percolation testing for the proposed multi-use Terraces development located immediately east of the intersection of Murrieta Hot Springs Road and Interstate 15 (I-15) in Murrieta, California as depicted on the *Vicinity Map,* Figure 1. The purpose of the investigation is to evaluate subsurface soil and geologic conditions at the site and, based on the conditions encountered, provide recommendations pertaining to the geotechnical aspects of developing the property to accommodate retail, cinema, medical, hotel, and multi-family residential housing developments. Detailed plans depicting the proposed improvements were not available at the time of our study, but a conceptual *Site Plan* of the development by Perkowitz + Ruth Architects was provided in the referenced *Updated Conceptual Site Development Budget* by J.T. Kruer & Company.

The scope of our investigation included review aerial photographs and available geotechnical reports in the vicinity of the site, geologic mapping, subsurface exploration, percolation testing, laboratory testing, engineering analyses, and the preparation of this report. A summary of the information reviewed for this study is presented in the *List of References*.

Our field investigation for Terraces included the excavation of eight small diameter geotechnical borings and six percolation borings. *Appendix A* presents a discussion of the field investigation, logs of the excavations, and percolation test data. The approximate locations of the exploratory excavations are presented on the *Geotechnical Map* (Figure 2). We performed laboratory tests on soil samples obtained from the exploratory excavations to evaluate pertinent physical and chemical properties for engineering analysis. The results of the laboratory testing are presented in *Appendix B*.

We utilized Google images of the site and the Alta survey prepared by TPC during our field investigation. We referred to the *Updated Conceptual Site Development Budget* prepared by J.T. Kruer & Company for site development plan and preliminary grading information. References to elevations presented in this report are based on the referenced topographic information. Geocon does not practice in the field of land surveying and is not responsible for the accuracy of such topographic information.

2. SITE AND PROJECT DESCRIPTION

The Terraces development is proposed to include retail, restaurants, a movie theater, health club, hotel, and multi-family residential with the associated infrastructure improvements. The conceptual *Site Plan* indicates that the commercial buildings will be located in the southern and western portions of the site, the cinema and medical offices will be located in the eastern portion of the site, the hotel will be in the northwest corner of the site, and the planned residential buildings will be in the northeast portion of the site. The site is approximately 42 acres and is located north of Murrieta Hot Springs Road, southwest of Sparkman Court, southeast of Vista Murrieta Road, and northeast of I-15 in the City of Murrieta.

Topography within the site is comprised of two northeast trending ridges with valley areas along the northern, central, and southern portions of the site. Drainage is generally toward the southwest. Site elevations range from a low of approximately 1,115 feet above mean sea level (MSL) in the southcentral portion of the site to a high of approximately 1,200 feet in the far western portion of the site.

The site will be graded to create level building pads to accommodate the various parts of the development. Maximum cuts and fills are anticipated to be approximately 18 feet each. Preliminary evaluation has determined that the site will be short by approximately 3,800 cubic yards (cy). However, this shortfall is anticipated to be accommodated by soil generated from improvement construction and no significant fill imports or exports are anticipated at this time.

We anticipate the residential buildings will be of typical wood or light metal frame construction and will be founded on conventional shallow foundations with concrete slabs-on-grade or post-tensioned foundation systems. The commercial and hotel buildings are similarly anticipated to be founded on shallow foundations, but the buildings may be constructed of tilt-up concrete or concrete masonry unit (CMU) walls with structural steel roofs. Infiltration basins/structures are preliminarily proposed: near the hotel in the western portion of the site, in the northern area of the residential area, and in the central portion of the site near the medical office.

3. GEOLOGIC SETTING

The site is located within the Perris Block of the Peninsular Ranges Geomorphic Province. The Perris Block is characterized by granitic highlands which display three elevated erosional surfaces surrounded by alluviated valleys. The Peninsular Ranges are bound by the Transverse Ranges (San Gabrielle and San Bernardino Mountains) to the north, the Colorado Desert Geomorphic Province to the east. The Province extends westward into the Pacific Ocean and southward to the tip of Baja California. Overall the Province is characterized by Cretaceous-age granitic rock and a lesser amount of Mesozoic-age metamorphic rock overlain buy terrestrial and marine sediments. Faulting within the province is typically northwest trending and includes the San Andreas, San Jacinto, Elsinore, and Newport-Inglewood faults. Locally, the site is within the northern portion of the Temecula Valley, southeast of the intersection of the Wildomar and Murrieta Hot Springs faults. Pleistocene terrestrial deposits of Pauba Formation, a predominately sandstone with lesser siltstone and claystone, comprise the hills and underlie the valley areas.

4. GEOLOGIC MATERIALS

4.1 General

Site geologic materials encountered consist of undocumented artificial fill, alluvium, and Pauba Formation. Undocumented artificial fill was encountered immediately north of Murrieta Hot Springs, within the valley in the central portion of the site, and in localized areas in the northern portion of the site. Alluvium is present within the drainage to the south and within the northern valley area along Vista Murrieta Road. Pauba Formation is exposed within higher elevations and underlies the site at depth. The central ridge appears to have been utilized as a borrow site for the retail development to the southeast resulting in rough cut pads. Colluvium is likely present along the undisturbed slopes as well. The lateral extent of the materials encountered is shown on the *Geotechnical Map* (Figure 2). The descriptions of the soil and geologic conditions are shown on the excavation logs located in Appendix A and described herein in order of increasing age.

4.2 Undocumented Artificial Fill - (afu)

Undocumented artificial fill was encountered within B-1 and B-4 through B-6 to depths of 7 to 22 feet. The fill appears to be locally derived silty sand which was found to be dry, medium dense to dense, and cemented. Some organic odor and staining was observed during the subsurface exploration. The artificial fill appears to have been placed in association with the previous residences within much of the site and for the storm drain immediately north of Murrieta Hot Springs Road. Although the fill was found to be dense at the locations explored, it is not documented and the consistency cannot be relied on. Therefore, the undocumented fill soils should be excavated during grading operations and replaced with documented fill in conformance with the recommendations herein.

4.3 Alluvium – (Qal)

Alluvium was encountered within B-2 and B-7 within the northern and southern drainages to depths of 12.5 and 15 feet, respectively. The alluvium within the southern drainage consists of silty sand which was very moist to wet and medium dense. The alluvium within the northern drainage is predominantly clayey sand which was moist, medium dense to dense, and porous. Although the alluvium is medium dense, we anticipate the consistency, density, and moisture content to be variable and are therefore, recommending complete removal of the alluvial soils and replacement with compacted fill.

4.4 Pauba Formation - (Qps)

Pauba Formation forms the hills on the property and underlies the site at depth. The geotechnical engineering properties of the Pauba are soil-like, therefore, we have used soil descriptions for the Pauba throughout this study. As encountered during our investigation, it consists predominantly of poorly graded to silty sand with occasional layers of siltstone. Cohesionless sand was encountered within B-3 below a depth of 10 feet (elevation 1,152 feet MSL). The unit is moist and medium dense to very dense. Areas in which the cohesionless sand is exposed in cut slopes or back cuts may require stabilization during construction. The Pauba is considered suitable to provide support for fill and structural loads. The upper weathered portion of the Pauba will require remedial grading.

5. GEOLOGIC STRUCTURE

The geologic structure consists of generally massive to thickly bedded sandstone bedrock overlain by surficial soils. The bedding generally strikes northeast and is near horizontal with northwest dips of 2 to 5 degrees (Kennedy, 1977).

6. GROUNDWATER

We encountered groundwater during our exploration in B-2 at a depth of 15.9 feet BGS. However based on the lack of free water in samples at greater depths this appears to be a perched condition. Well record data in the vicinity of the site indicates ground water is on the order of 21 feet (07S03W15Q003S) to an average of 130 feet (Wells 07S03W15N008S, N002S, Q001S, Q002S) below ground surface in the vicinity of the site. Based on our experience in the vicinity of the site, it is common for perched water or seepage of infiltrated surface water to occur above less permeable units (siltstones and claystones). During the rainy season, localized perched water conditions may develop above less permeable units that may require special consideration during grading operations. Groundwater elevations are dependent on seasonal precipitation, irrigation, and land use, among other factors, and vary as a result.

7. GEOLOGIC HAZARDS

7.1 Seismic Hazard Analysis

It is our opinion, based on a review of published geologic maps and reports, that the site is not located on any known active, potentially active, or inactive fault traces. An active fault is defined by the California Geological Survey (CGS) is a fault showing evidence for activity within the last 11,000 years. The site is not located within a State of California Earthquake Special Study Zone.

The Murrieta Hot Springs (MHS) fault and associated Riverside County Fault Hazard Zone (FHZ) are present north of the site. The FHZ does encroach 165 feet into the northern corner of the site in the proposed multi-family area. We reviewed sequential stereoscopic aerial photographs available at Riverside County Flood Control & Water Conservation District (RCFC&WCD) as part of this study. We did not observe any topographical or tonal lineaments indicative of faulting on or projecting toward the site. We also conducted research at the city of Murrieta where we reviewed geotechnical reports for the apartments located southeast of Jackson and Walsh Center Drive adjacent the east central portion of the site, the Walsh Medical Building located east of the site, and the Home Depot shopping center located west of the site at the intersection of I-15 and Murrieta Hot Springs Road. The three reports did not locate or identify the MHS fault on the sites. Further, no subsurface fault hazard investigations were performed for any of the developments. The reports are in the *List of References* section of this report. Based on our research we do not believe the MHS fault is a design consideration for the site and proposed development.

7.2 Seismic Design Criteria

We used the computer program *U.S. Seismic Design Maps*, provided by the USGS. Table 7.2.1 summarizes site-specific design criteria obtained from the 2013 California Building Code (CBC; Based on the 2012 International Building Code [IBC] and ASCE 7-10), Chapter 16 Structural Design, Section 1613 Earthquake Loads. The short spectral response uses a period of 0.2 second. The building structure and improvements should be designed using a Site Class D. We evaluated the Site Class based on the discussion in Section 1613.3.2 of the 2013 CBC and Table 20.3-1 of ASCE 7-10. The values presented in Table 7.2.1 are for the risk-targeted maximum considered earthquake (MCE_R).

TABLE 7.2.1
2013 CBC SEISMIC DESIGN PARAMETERS

Parameter	Value	2013 CBC Reference
Site Class	D	Section 1613.3.2
MCE_R Ground Motion Spectral Response Acceleration – Class B (short), S_S	2.053g	Figure 1613.3.1(1)
MCE_R Ground Motion Spectral Response Acceleration – Class B (1 sec), S_1	0.835g	Figure 1613.3.1(2)
Site Coefficient, F_A	1.0	Table 1613.3.3(1)
Site Coefficient, F_V	1.5	Table 1613.3.3(2)
Site Class Modified MCE_R Spectral Response Acceleration (short), S_{MS}	2.053g	Section 1613.3.3 (Eqn 16-37)
Site Class Modified MCE_R Spectral Response Acceleration (1 sec), S_{M1}	1.253g	Section 1613.3.3 (Eqn 16-38)
5% Damped Design Spectral Response Acceleration (short), S_{DS}	1.369g	Section 1613.3.4 (Eqn 16-39)
5% Damped Design Spectral Response Acceleration (1 sec), S_{D1}	0.835g	Section 1613.3.4 (Eqn 16-40)

Table 7.2.2 presents additional seismic design parameters for projects located in Seismic Design Categories of D through F in accordance with ASCE 7-10 for the mapped maximum considered geometric mean (MCE_G).

TABLE 7.2.2
2013 CBC SITE ACCELERATION DESIGN PARAMETERS

Parameter	Value	ASCE 7-10 Reference
Mapped MCE_G Peak Ground Acceleration, PGA	0.830	Figure 22-7
Site Coefficient, F_{PGA}	1.0	Table 11.8-1
Site Class Modified MCE_G Peak Ground Acceleration, PGA_M	0.830g	Section 11.8.3 (Eqn 11.8-1)

Conformance to the criteria in Tables 7.2.1 and 7.2.2 for seismic design does not constitute any kind of guarantee or assurance that significant structural damage or ground failure will not occur if a large earthquake occurs. The primary goal of seismic design is to protect life, not to avoid all damage, since such design may be economically prohibitive.

7.3 Liquefaction

Liquefaction typically occurs when a site is located in a zone with seismic activity, onsite soils are cohesionless/silt or clay with low plasticity, static groundwater is encountered within 50 feet of the surface, and soil relative densities are less than about 70 percent. If the four previous criteria are met, a seismic event could result in a rapid pore-water pressure increase from the earthquake-generated ground accelerations. Seismically induced settlement may occur whether the potential for liquefaction exists or not. As a conservative measure we have assumed a groundwater depth of 15 feet below ground surface. Based on the dense to very dense consistency of the site soils below the depth of the assumed groundwater level, liquefaction and seismically induced settlement soil is not a design consideration.

7.4 Expansive Soil

The geologic units generally consisted of silty sands with localized areas of silty or clayey soil. Laboratory testing results indicate a sample of the fine-grained soil units exhibit a medium expansion potential of 53. Where expansive soils are encountered during grading they should be kept at least four feet below proposed structural, flatwork, or paving improvements.

7.5 Collapsible Soils

Alluvial soils obtained during our investigation were tested for consolidation and exhibited a collapse potential of 0.2% to 1.2% when loaded to the anticipated post-grading pressures. Remedial grading (removal of undocumented fill and alluvium) should be performed to mitigate the effects of the collapsible soils.

7.6 Landslides

The property is in an area of low ridges with intervening alluviated valleys. A mapped landslide is depicted on the western end of the northern ridge (west of the site) on the Seismic Hazard Zone Map of the Murrieta Quadrangle. This area was obscured by trees on the aerial photographs reviewed for the site and during our field exploration. The topographic maps show a small area of hummocky topography north of the cut slope. This area could be a localized slope failure which should be further analyzed during a development specific geotechnical exploration. We did not observe any other evidence of slope stability issues on or directed toward the site during our aerial photograph review or our field investigation.

7.7 Rock Fall Hazards

The hills on and adjacent to the site consist of Pauba sandstone and contain few cobbles and boulders (if any). Therefore, rock fall issues are not a design consideration for this project.

7.8 Slope Stability

We anticipate proposed grading at the project site will include cut and fill slopes with maximum heights of approximately 30 feet and maximum inclinations of 2:1 (h:v). In general, it is our opinion that cut and fill slopes constructed with on-site soils will possess Factors of Safety of 1.5 or greater under static conditions and 1.1 or greater under seismic conditions. General slope stability calculations are presented on Figures 3 and 4. Specific slope stability analyses should be performed as part of a development specific geotechnical investigation once grading plans have been developed. Cut slopes should be geologically mapped during grading to verify actual conditions are in accordance with assumptions made in the slope stability analyses. Fill keys should be constructed in accordance with the standard grading specifications in Appendix C. Grading of cut and fill slopes should be designed in accordance with the requirements of the local building codes of the City of Murrieta and the 2013 California Building Code (CBC).

The bedrock at the site is highly erodible and exhibited collapse upon wetting during drilling. The client should consider over-excavation of cut slope areas and replacement with compacted fill to reduce the potential for surficial erosion along the slopes.

7.9 Tsunamis and Seiches

A tsunami is a series of long period waves generated in the ocean by a sudden displacement of large volumes of water. Causes of tsunamis include underwater earthquakes, volcanic eruptions, or offshore slope failures. The first order driving force for locally generated tsunamis offshore southern California is expected to be tectonic deformation from large earthquakes (Legg, *et al.*, 2002). The site is located 20 miles from the nearest coastline, therefore, the negligible risk associated with tsunamis is not a design consideration.

A seiche is a run-up of water within a lake or embayment triggered by fault- or landslide-induced ground displacement. The site not located adjacent to a body of water, therefore, seiches are not a design consideration for the site.

8.0 SITE INFILTRATION

Percolation testing was performed in accordance with Table 1 Infiltration Basin Option 2 of Appendix A of Riverside County – Low Impact Development BMP Design Handbook (Handbook). The percolation tests were run in accordance with Section 2.3 Deep Percolation Test Method. This method requires two percolation tests and one deep (extending 10 feet below percolation test elevation) excavation per basin. We utilized the geotechnical borings placed throughout the site as the deep excavations for this study.

The test locations were determined by J.T. Kruer & Co. based on the most likely areas where storm water infiltration structures would be required. The elevations of the tests were determined by referring to the conceptual cut/fill exhibit prepared by J.T. Kruer & Co.

The boring and percolation test locations are depicted on the *Geotechnical Map,* Figure 2. Boring logs and percolation test data are presented in *Appendix A*. Descriptions of the testing procedures, and test results are provided below for each location.

8.1 Multi-Family Site:

A storm water infiltration structure is planned for the northern area of the proposed multi-family site at approximately 18 feet below existing grade. Geocon utilized a truck mounted eight-inch diameter hollow stem auger to excavate the two percolation test holes (P-1 and P-2) to depths of 20 feet below grade. Soils encountered within the excavations consisted of predominately dense poorly graded to silty sandstone of the Pauba Formation. No groundwater was observed within the excavations. A four-inch-diameter, perforated PVC pipe wrapped in filter fabric was placed in each percolation test hole. Native soil backfill was placed outside of the pipe within the excavation. The test locations were pre-saturated with five gallons of water. The percolation testing began approximately 24 hours after the holes were pre-saturated. Percolation data sheets are presented in *Appendix A* of this report. Calculations to convert the percolation test rate to infiltration test rate in accordance with Section 2.3 of the Handbook are presented in Table 8.1 below. Please note that the Handbook requires a factor of safety of 3 be applied to the values below based on the test method used.

Table 8.1 - Infiltration Test Rates for Multi-Family Site

	P-1	P-2
Soil Type	Sandy	Sandy
Change in head over time:ΔH	3.6 in	2.4 in
Time Interval (minutes): Δt	10 min	10 min
Radius of test hole: r	4 in	4 in
Average head over time interval: Havg	36.6 in	36.0 in
Tested Infiltration Rate: It	1.12 in/hr	0.76 in/hr

8.2 Hotel Site:

A storm water infiltration structure is planned for the southeastern area of the proposed hotel site at approximately 18 feet below existing grade. Geocon utilized a truck mounted eight-inch diameter hollow stem auger to excavate the two percolation test holes (P-3 and P-4) to depths of 20 feet below grade. Soils encountered within the excavations consisted of predominately dense poorly graded to silty sandstone of the Pauba Formation. No groundwater was observed within the excavations. A four-inch-diameter, perforated PVC pipe wrapped in filter fabric was placed in each percolation test hole. Native soil backfill was placed outside of the pipe within the excavation. The test locations were pre-saturated with five gallons of water. The percolation testing began approximately 24 hours after the holes were pre-saturated. Percolation data sheets are presented in *Appendix A* of this report. Calculations to convert the percolation test rate to infiltration test rate in accordance with Section 2.3 of the Handbook are presented in Table 8.2 below. Please note that the Handbook requires a factor of safety of 3 be applied to the values below based on the test method used.

Table 8.2 - Infiltration Test Rates for Hotel Site

	P-3	P-4
Soil Type	Sandy	Sandy
Change in head over time:ΔH	3.0 in	12.6 in
Time Interval (minutes): Δt	10 min	10 min
Radius of test hole: r	4 in	4 in
Average head over time interval: Havg	36.3 in	36.3 in
Tested Infiltration Rate: It	0.94 in/hr	3.95 in/hr

8.3 Medical Office Site:

A storm water infiltration structure is planned for the western area of the proposed medical office site at approximately 12 feet below existing grade. Geocon utilized a truck mounted eight-inch diameter hollow stem auger to excavate the two percolation test holes (P-5 and P-6) to depths of 15 feet below grade. Soils encountered within the excavations consisted of predominately dense poorly graded to silty sandstone of the Pauba Formation. No groundwater was observed within the excavations. A four-inch-diameter, perforated PVC pipe wrapped in filter fabric was placed in each percolation test hole. Native soil backfill was placed outside of the pipe within the excavation. The test locations were pre-saturated with five gallons of water. The percolation testing began approximately 24 hours after the holes were pre-saturated. Percolation data sheets are presented in *Appendix A* of this report. Calculations to convert the percolation test rate to infiltration test rate in accordance with Section 2.3 of the Handbook are presented in Table 8.3 below. Please note that the Handbook requires a factor of safety of 3 be applied to the values below based on the test method used.

Table 8.3 - Infiltration Test Rates for Medical Office Site

	P-5	P-6
Soil Type	Sandy	Sandy
Change in head over time:ΔH	12.6 in	33.0 in
Time Interval (minutes): Δt	10 min	10 min
Radius of test hole: r	4 in	4 in
Average head over time interval: Havg	29.7 in	37.5 in
Tested Infiltration Rate: It	4.77 in/hr	10.03 in/hr

9. CONCLUSIONS AND RECOMMENDATIONS

9.1 General

9.1.1 It is our opinion that soil or geologic conditions were not encountered during the investigation that would preclude the proposed development of the project provided the recommendations presented herein are followed and implemented during construction.

9.1.2 Potential geologic hazards at the site include seismic shaking, highly erodible soils, localized expansive soils, and compressible near surface soils.

9.1.3 A Riverside County Fault Hazard Zone is plotted in the northeastern corner of the site. Based on our review of aerial photographs and readily available geotechnical reports for existing developments along the FHZ, we do not believe that faulting is present on the site.

9.1.4 A landslide is geologically mapped immediately northwest of the site. This area could not be fully assessed during this study and will need to be addressed in a geotechnical study for the proposed development once plans become available. We anticipate hazard mitigation will be achievable.

9.1.5 The undocumented fill, alluvium, colluvium, and weathered Pauba Formation are considered unsuitable for the support of compacted fill or settlement-sensitive improvements based on the potential compressibility of the units. Remedial grading of the surficial soil will be required as discussed herein. Over excavation of cut fill transition building pads will be required. New documented fill is considered suitable to support additional fill and the proposed structures and improvements.

9.1.6 We did encounter perched groundwater within our boring in the southern drainage area and it is likely that this perched water will be encountered during grading. Seepage and perched groundwater conditions elsewhere on the site should be anticipated to be encountered during the grading operations, in particular during the rainy seasons.

9.1.7 Subdrains will be required in areas where fill is placed over bedrock such as keyways or in canyons. *Appendix C* provides general subdrain recommendations. The necessity and location of subdrains should be determined by Geocon during grading.

9.1.8 In general, slopes should possess calculated factors of safety of at least 1.5 in static conditions and 1.1 in seismic conditions with slopes inclined as steep as 2:1 (h:v) and with maximum heights of 30 feet. Slopes should be individually evaluated once grading plans have been prepared for the site.

9.1.9 If cut slopes expose cohesionless sand beds or adverse geologic conditions, stabilization fills will likely be required.

9.1.10 Proper drainage should be maintained in order to preserve the engineering properties of the fill in the sheet-graded pads and slope areas. Recommendations for site drainage are provided herein.

9.2 Soil Characteristics

9.2.1 The site soils soil encountered in the field investigation are considered to be "expansive" (Expansion Index [EI] greater than 20) as defined by 2013 California Building Code (CBC) Section 1803.5.3. Table 9.2.1 presents soil classifications based on the EI.

TABLE 9.2.1
SOIL CLASSIFICATION BASED ON EXPANSION INDEX

Expansion Index (EI)	Expansion Classification	2013 CBC Expansion Classification
0 – 20	Very Low	Non-Expansive
21 – 50	Low	Expansive
51 – 90	Medium	
91 – 130	High	
Greater Than 130	Very High	

9.2.2 Based on the material classifications and laboratory testing, fine grained site soils generally possess a medium expansion potential (EI greater than 50). Medium to highly expansive soils, if encountered, should not be placed within four feet of the proposed foundations, flatwork or paving improvements. Additional testing for expansion potential should be performed during a development specific geotechnical investigation and once final grades are achieved.

9.2.3 Laboratory tests on samples of the site materials to evaluate the percentage of water-soluble sulfate content. Results from the laboratory water-soluble sulfate content tests indicate that the on-site materials at the location tested possess a sulfate content of 0.002% equating to an exposure class of S0 (Negligible) to concrete structures as defined by 2013 CBC Section 1904.3 and ACI 318. Table 9.2.3 presents a summary of concrete requirements set forth by 2013 CBC Section 1904.3 and ACI 318. The presence of water-soluble sulfates is not a visually discernible characteristic; therefore, other soil samples from the site could yield different concentrations. Additionally, over time landscaping activities (i.e., addition of fertilizers and other soil nutrients) may affect the concentration.

TABLE 9.2.3
REQUIREMENTS FOR CONCRETE EXPOSED TO SULFATE-CONTAINING SOLUTIONS

Sulfate Exposure	Exposure Class	Water-Soluble Sulfate Percent by Weight	Cement Type	Maximum Water to Cement Ratio by Weight	Minimum Compressive Strength (psi)
Not Applicable	S0	0.00-0.10	--	--	2,500
Moderate	S1	0.10-0.20	II	0.50	4,000
Severe	S2	0.20-2.00	V	0.45	4,500
Very Severe	S3	> 2.00	V+ Pozzolan or Slag	0.45	4,500

9.2.4 Laboratory testing indicates the site soils have a pH of 7.74, and possess 55 parts per million chloride, and have a minimum electrical resistivity of 4,820 ohm-cm. Based on the minimum electrical resistivity test results, the site would not be classified as “corrosive” to metallic improvements, in accordance with the Caltrans Corrosion Guidelines (Caltrans, 2012).

9.2.5 Geocon does not practice in the field of corrosion engineering. Therefore, further evaluation by a corrosion engineer should be performed if improvements that could be susceptible to corrosion are planned.

9.3 Grading

9.3.1 Grading should be performed in accordance with the *Recommended Grading Specifications* contained in *Appendix C* and the Grading Ordinances of the City of Murrieta.

9.3.2 Prior to commencing grading, a preconstruction conference should be held at the site with the city inspector, owner or developer, grading contractor, civil engineer, and geotechnical engineer in attendance. Special soil handling and/or the grading plans can be discussed at that time.

9.3.3 Site preparation should begin with the removal of previous structures and infrastructure, deleterious material, debris, buried trash, and vegetation. The depth of removal should be such that material exposed in cut areas or soil to be used as fill is relatively free of organic matter. Material generated during stripping and/or site demolition should be exported from the site.

9.3.4 Any undocumented fill, alluvium, and colluvium within a 1:1 (h:v) projection the limits of grading should be removed to expose competent Pauba Formation. Further completely weathered bedrock should be removed to expose moderately intact bedrock. The anticipated depth of removals based on the subsurface excavation logs are noted on the *Geotechnical Map*. Areas of previously placed fill will be observed and evaluated during grading. Any areas of loose, dry, or compressible soils will require removal and processing prior to fill placement. The actual depth of removal should be evaluated by the engineering geologist during grading operations. We expect that removals will need to extend beyond grading at a 1:1 (h:v) projection. The bottom of the excavations should be scarified to a depth of at least 1 foot, moisture conditioned as necessary, and properly compacted.

9.3.5 Bedrock in cut fill transition areas within proposed structural areas should be over excavated to remove the differential support conditions. Over excavations should extend a minimum of three feet below pad grade or H/3 (H is deepest fill in building envelope area), whichever is greater. Over excavations should be sloped toward the front of the lots so a bath-tub like geometry does not result from the over excavation.

9.3.6 We should observe the removal bottoms to check the exposure. Deeper excavations may be required if dry, loose, or soft materials are present at the base of the removals.

9.3.7 The fill placed within 4 feet of proposed foundations should possess a “low” expansion potential (EI of 50 or less).

9.3.8 If perched groundwater or saturated materials are encountered during remedial grading, extensive drying and mixing with dryer soil will be required. The excavated materials should then be moisture conditioned as necessary to near optimum moisture content prior to placement as compacted fill.

9.3.9 The site should be brought to finish grade elevations with fill compacted in layers. Layers of fill should be no thicker than will allow for adequate bonding and compaction. Fill, including backfill and scarified ground surfaces, should be compacted to a dry density of at least 90 percent of the laboratory maximum dry density near to slightly above optimum moisture content as determined by ASTM D 1557. Fill materials placed below optimum moisture content may require additional moisture conditioning prior to placing additional fill.

9.3.10 Import fill (if necessary) should consist of granular materials with a “low” expansion potential (EI of 50 or less) generally free of deleterious material and rock fragments larger than 6 inches and should be compacted as recommended herein. Geocon should be notified of the import soil source and should perform laboratory testing of import soil prior to its arrival at the site to evaluate its suitability as fill material.

9.4 Graded Slopes

9.4.1 Fill slopes should be overbuilt at least 2 feet and cut back to grade. The slopes should be track-walked at the completion of each slope such that the fill is compacted to a dry density of at least 90 percent of the laboratory maximum dry density near to slightly above optimum moisture content to the face of the finished slope.

9.4.2 Finished slopes should be landscaped with drought-tolerant vegetation having variable root depths and requiring minimal landscape irrigation. In addition, the slopes should be drained and properly maintained to reduce erosion. Water should not be allowed to flow down slopes, construction of earth berms, lined v-ditches or similar are recommended.

9.4.3 Although the proposed slopes are anticipated to be grossly stable, natural factors may result in slope creep and/or lateral fill extension over time. Slope creep is due to alternate wetting and drying of fill soils resulting in downslope movement. Slope creep occurs throughout the life of the slope and may affect improvements within about 15 feet of the top of slope, depending on the slope height. Slope creep can results in differential settlement of the structures supported by the slope. Lateral fill extension (LFE) occurs when expansive soils within the slope experience deep wetting due to rainfall or irrigation. LFE is mitigated as much as practical during grading by placing expansive soils at slightly greater than optimum moisture content.

9.4.4 Landscaping activities should avoid over steepening of slopes or grade changes along slopes. Backfill of irrigation lines should be compacted to 90 percent of the maximum dry density as evaluated by ASTM D1557. Vegetation should be light weight with variable root depth.

9.4.5 Excessive watering should be avoided; only enough irrigation to support vegetation suitable to the prevailing climate should be applied. Irrigation of natural, ungraded slopes should not be performed. Drainage or irrigation from adjacent improvements should not be directed to the tops of slopes. Drainage should be directed toward streets and approved drainage devices. Areas of seepage may develop after periods of heavy rainfall or irrigation.

9.4.6 Homeowners and maintenance associations should be made aware of the potential for slope creep, LFE, and erosion and be provided with these recommendations on how to reduce the likelihood of its occurrence.

9.5 Earthwork Grading Factors

9.5.1 Estimates of shrinkage factors are based on empirical judgments comparing the material in its existing or natural state as encountered in the exploratory excavations to a compacted state. Variations in natural soil density and in compacted fill density render shrinkage value estimates very approximate. As an example, the contractor can compact the fill to a dry density of 90 percent or higher of the laboratory maximum dry density. Thus, the contractor has an approximately 10 percent range of control over the fill volume. Based on our experience and the densities measured during our investigation, the shrinkage of onsite soil (afu and Qal) and Pauba Formation (Qps) is anticipated to be on the order of 0 to 5 percent when compacted to at least 90 percent of the laboratory maximum dry density. Please note that this estimate is for preliminary quantity estimates only. Due to the variations in the actual shrinkage/bulking factors, a balance area should be provided to accommodate variations.

9.6 Settlement of Proposed Fill

9.6.1 The post-grading settlement (hydrocompression) could reach up to 1 inch. We expect the settlement will occur over 20 years depending on the influx of rain and irrigation water into the fill and Pauba Formation. The settlement will likely be linear from the time the fill is placed to the end of the settlement period depending on the permeability of the fill soil. We do not expect the settlement will impact proposed utilities with gradients of 1 percent or greater. In addition, foundation recommendations are provided herein based on the maximum and differential fill thickness to account for potential fill settlement.

9.7 Foundation and Concrete Slabs-On-Grade Recommendations

9.7.1 The foundation recommendations presented herein are for the various proposed buildings. We understand that the buildings will be supported on either conventional shallow foundations with concrete slabs-on-grade or post-tensioned foundation systems.

9.7.2 We separated the foundation recommendations into three categories based on either the maximum and differential fill thickness or Expansion Index. The foundation category criteria for the anticipated conditions are presented in Table 9.7.2. We anticipate that the majority of the structures will be designed for Foundation Category II. Final foundation categories will be evaluated once site grading has been completed.

TABLE 9.7.2
FOUNDATION CATEGORY CRITERIA

Foundation Category	Maximum Fill Thickness, T (Feet)	Differential Fill Thickness, D (Feet)	Expansion Index (EI)
I	T<20	D<10	EI≤50
II	20≤T<50	10≤D<20	50<EI≤90
III	T≥50	D≥20	90<EI≤130

9.7.3 Post-tensioned concrete slab and foundation systems may be used for the support of the proposed structures. The post-tensioned systems should be designed by a structural engineer experienced in post-tensioned slab design and design criteria of the Post-Tensioning Institute (PTI), as required by the 2013 California Building Code (CBC Section 1808.6). Although this procedure was developed for expansive soil conditions, we understand it can also be used to reduce the potential for foundation distress due to differential fill settlement. The post-tensioned design should incorporate the geotechnical parameters presented on Table 9.7.3 for the particular Foundation Category designated. The parameters presented in Table 9.7.3 are based on the guidelines presented in the PTI, Third Edition design manual. The foundations for the post-tensioned slabs should be embedded in accordance with the recommendations of the structural engineer.

TABLE 9.7.3
POST-TENSIONED FOUNDATION SYSTEM DESIGN PARAMETERS

Post-Tensioning Institute (PTI) Third Edition Design Parameters	Foundation Category		
	I	II	III
Thornthwaite Index	-20	-20	-20
Equilibrium Suction	3.9	3.9	3.9
Edge Lift Moisture Variation Distance, e_M (feet)	5.3	5.1	4.9
Edge Lift, y_M (inches)	0.61	1.10	1.58
Center Lift Moisture Variation Distance, e_M (feet)	9.0	9.0	9.0
Center Lift, y_M (inches)	0.30	0.47	0.66

9.7.4 Slabs that may receive moisture-sensitive floor coverings or may be used to store moisture-sensitive materials should be underlain by a vapor retarder. The vapor retarder design should be consistent with the guidelines presented in the American Concrete Institute's (ACI) *Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials* (ACI 302.2R-06). In addition, the membrane should be installed in accordance with manufacturer's recommendations and ASTM requirements and installed in a manner that prevents puncture.

The vapor retarder used should be specified by the project architect or developer based on the type of floor covering that will be installed and if the structure will possess a humidity-controlled environment.

9.7.5 The bedding sand thickness should be determined by the project foundation engineer, architect, and/or developer. However, we should be contacted to provide recommendations if the bedding sand is thicker than 6 inches. Placement of 3 inches and 4 inches of sand is common practice in Southern California for 5-inch and 4-inch thick slabs, respectively. The foundation engineer should provide appropriate concrete mix design criteria and curing measures that may be utilized to assure proper curing of the slab to reduce the potential for rapid moisture loss and subsequent cracking and/or slab curl. We suggest that the foundation engineer present concrete mix design and proper curing methods on the foundation plans. It is critical that the foundation contractor understands and follows the recommendations presented on the foundation plans.

9.7.6 The foundations for the post-tensioned slabs should be embedded in accordance with the recommendations of the structural engineer. A wall/column footing dimension detail is provided on Figure 5. If a post-tensioned mat foundation system is planned, the slab should possess a thickened edge with a minimum width of 12 inches and extend below the clean sand or crushed rock layer.

9.7.7 If the structural engineer proposes a post-tensioned foundation design method other than the 2013 CBC:

- The deflection criteria presented in Table 8.6.2 are still applicable.
- Interior stiffener beams should be used for Foundation Categories II and III.
- The width of the perimeter foundations should be at least 12 inches.
- The perimeter footing embedment depths should be at least 12 inches, 18 inches and 24 inches for foundation categories I, II, and III, respectively. The embedment depths should be measured from the lowest adjacent pad grade.

9.7.8 Our experience indicates post-tensioned slabs are susceptible to excessive edge lift, regardless of the underlying soil conditions. Placing reinforcing steel at the bottom of the perimeter footings and the interior stiffener beams may mitigate this potential. Because of the placement of the reinforcing tendons in the top of the slab, the resulting eccentricity after tensioning reduces the ability of the system to mitigate edge lift. The structural engineer should design the foundation system to reduce the potential of edge lift occurring for the proposed structures.

9.7.9 During the construction of the post-tension foundation system, the concrete should be placed monolithically. Under no circumstances should cold joints form between the footings/grade beams and the slab during the construction of the post-tension foundation system.

9.7.10 Foundations may be designed for an allowable soil bearing pressure of 3,000 pounds per square foot (psf) (dead plus live load). This value may be increased by 300 psf for each additional foot in depth and 200 psf for each additional foot of width to a maximum value of 4,000 psf. The allowable bearing pressure may be increased by one-third for transient loads due to wind or seismic forces. We estimate the total settlements under the imposed allowable loads to be about 1 inch with differential settlements on the order of ½ inch over a horizontal distance of 40 feet.

9.7.11 As an alternate to post-tensioned foundation systems, conventional shallow foundation with a concrete slab-on-grade may be used for support of the proposed structures. Conventional shallow foundations may be designed for an allowable soil bearing pressure of 3,000 pounds per square foot (psf) (dead plus live load). This value may be increased by 250 psf for each additional foot in depth and 200 psf for each additional foot of width to a maximum value of 4,000 psf. The allowable bearing pressure may be increased by one-third for transient loads due to wind or seismic forces. We estimate the total settlements under the imposed allowable loads to be about 1 inch with differential settlements on the order of ½ inch over a horizontal distance of 40 feet. Table 9.7.11 presents minimum foundation and interior concrete slab design criteria for conventional foundation systems.

TABLE 9.7.11
CONVENTIONAL FOUNDATION RECOMMENDATIONS BY CATEGORY

Foundation Category	Minimum Footing Embedment Depth (inches)	Continuous Footing Reinforcement	Interior Slab Reinforcement
I	12	Two No. 4 bars, one top and one bottom	6 x 6 – 10/10 welded wire mesh at slab mid-point
II	18	Four No. 4 bars, two top and two bottom	No. 3 bars at 24 inches on center, both directions at slab mid-point
III	24	Four No. 5 bars, two top and two bottom	No. 3 bars at 18 inches on center, both directions at slab mid-point

9.7.12 The embedment depths presented in Table 9.7.11 should be measured from the lowest adjacent pad grade for both interior and exterior footings. The conventional foundations should have a minimum width of 12 inches and 24 inches for continuous and isolated footings, respectively. Figure 5 presents a wall/column footing dimension detail depicting lowest adjacent pad grade.

9.7.13 Isolated footings, if present, should have the minimum embedment depth and width recommended for conventional foundations for a particular foundation category. The use of isolated footings, which are located beyond the perimeter of the building and support structural elements connected to the building, are not recommended for Category III. Where this condition cannot be avoided, the isolated footings should be connected to the building foundation system with grade beams.

9.7.14 Foundations near slopes should be deepened such that the bottom outside edge of the footing is at least 7 feet horizontally from the face of the slope.

9.7.15 Alternatively, the buildings may be supported on reinforced concrete mat foundation systems. It is anticipated that the buildings will impart an average pressure of less than 1,500 psf, which may be used as the allowable bearing pressure. Geocon should be contacted for additional recommendations if bearing pressures for mat foundations exceed this amount. The allowable bearing pressure may be increased by up to one third for transient loads due to wind or seismic forces.

9.7.16 It is recommended that a modulus of subgrade reaction of 150 pounds per cubic inch be utilized for the design of mat foundations. The modulus of subgrade reaction is based on the square-foot plate load method, and should be adjusted as needed to account for foundation size and location. The modulus should be reduced in accordance with the following equation when used with larger foundations:

$$K_R = K\left[\frac{B+1}{2B}\right]^2$$

Where: K_R = reduced subgrade modulus

K = unit subgrade modulus

B = foundation width in feet

9.7.17 The thickness of and reinforcement for the mat foundation should be designed by the project structural engineer.

9.7.18 Resistance to lateral loading may be provided by friction acting at the base of foundations, slabs and by passive earth pressure. An allowable coefficient of friction of 0.35 may be used with the dead load forces in newly compacted fill, Pauba Formation.

9.7.19 Passive earth pressure for the sides of foundations and slabs poured against newly placed engineered fill or Pauba Formation may be computed as an equivalent fluid having a density of 350 pounds per cubic foot with a maximum earth pressure of 3,500 pounds per square foot. When combining passive and friction for lateral resistance, the passive component should be reduced by one-third.

9.7.20 The maximum anticipated static settlement for mat foundations with a maximum allowable bearing value of 1,500 psf deriving support in newly placed engineered fill or Pauba Formation is estimated to be less than 1 inch. Settlement of the foundation system is expected to occur on initial application of loading. Differential settlement is not expected to exceed ½ inch over a horizontal distance of 40 feet.

9.7.21 Special subgrade presaturation is not deemed necessary prior to placing concrete; however, the exposed foundation and slab subgrade soil should be moisture conditioned, as necessary, to maintain a moist condition as would be expected in such concrete placement.

9.7.22 Where buildings or other improvements are planned near the top of a slope steeper than 3:1 (horizontal to vertical), special foundations and/or design considerations are recommended due to the tendency for lateral soil movement to occur.

- Building footings should be deepened such that the bottom outside edge of the footing is at least 7 feet horizontally from the face of the slope.
- Geocon should be contacted to review the pool plans and the specific site conditions to provide additional recommendations, if necessary.

- Swimming pools located within 7 feet of the top of cut or fill slopes are not recommended. Where such a condition cannot be avoided, the portion of the swimming pool wall within 7 feet of the slope face be designed assuming that the adjacent soil provides no lateral support.

- Although other improvements, which are relatively rigid or brittle, such as concrete flatwork or masonry walls, may experience some distress if located near the top of a slope, it is generally not economical to mitigate this potential. It may be possible, however, to incorporate design measures that would permit some lateral soil movement without causing extensive distress. Geocon should be consulted for specific recommendations.

9.7.23 The recommendations of this report are intended to reduce the potential for cracking of slabs due to expansive soil (if present), differential settlement of existing soil or soil with varying thicknesses. However, even with the incorporation of the recommendations presented herein, foundations, stucco walls, and slabs-on-grade placed on such conditions may still exhibit some cracking due to soil movement and/or shrinkage. The occurrence of concrete shrinkage cracks is independent of the supporting soil characteristics. Their occurrence may be reduced and/or controlled by limiting the slump of the concrete, proper concrete placement and curing, and by the placement of crack control joints at periodic intervals, in particular, where re-entrant slab corners occur.

9.7.24 Geocon should be consulted to provide additional design parameters as required by the structural engineer.

9.8 Exterior Concrete Flatwork

9.8.1 Exterior concrete flatwork not subject to vehicular traffic should be constructed in accordance with the recommendations herein assuming the subgrade materials possess an Expansion Index of 50 or less. Subgrade soils should be compacted to 90 percent relative compaction. Slab panels should be a minimum of 4 inches thick and when in excess of 8 feet square should be reinforced with 6x6-W2.9/W2.9 (6x6-6/6) welded wire mesh or No. 3 reinforcing bars spaced 18 inches center-to-center in both directions to reduce the potential for cracking. In addition, concrete flatwork should be provided with crack control joints to reduce and/or control shrinkage cracking. Crack control spacing should be determined by the project structural engineer based upon the slab thickness and intended usage. Criteria of the American Concrete Institute (ACI) should be taken into consideration when establishing crack control spacing. Subgrade soil for exterior slabs not subjected to vehicle loads should be compacted in accordance with criteria presented in the grading section prior to concrete placement. Subgrade soil should be properly compacted and the moisture content of subgrade soil should be verified prior to placing concrete. Base materials will not be required below concrete improvements.

9.8.2 Even with the incorporation of the recommendations of this report, the exterior concrete flatwork has a potential to experience some uplift due to expansive soil beneath grade or differential settlement. The steel reinforcement should overlap continuously in flatwork to reduce the potential for vertical offsets within flatwork.

9.8.3 Where exterior flatwork abuts the structure at entrant or exit points, the exterior slab should be dowelled into the structure’s foundation stemwall. This recommendation is intended to reduce the potential for differential elevations that could result from differential settlement or minor heave of the flatwork. Dowelling details should be designed by the project structural engineer.

9.8.4 The recommendations presented herein are intended to reduce the potential for cracking of exterior slabs as a result of differential movement. However, even with the incorporation of the recommendations presented herein, slabs-on-grade will still crack. The occurrence of concrete shrinkage cracks is independent of the soil supporting characteristics. Their occurrence may be reduced and/or controlled by limiting the slump of the concrete, the use of crack control joints and proper concrete placement and curing. Crack control joints should be spaced at intervals no greater than 12 feet. Literature provided by the Portland Concrete Association (PCA) and American Concrete Institute (ACI) present recommendations for proper concrete mix, construction, and curing practices, and should be incorporated into project construction.

9.9 Conventional Retaining Walls

9.9.1 Retaining walls not restrained at the top and having a level backfill surface should be designed for an active soil pressure equivalent to the pressure exerted by a fluid density of 35 pounds per cubic foot (pcf). Where the backfill will be inclined at no steeper than 2:1 (horizontal to vertical), an active soil pressure of 70 pcf is recommended. These soil pressures assume that the backfill materials within an area bounded by the wall and a 1:1 plane extending upward from the base of the wall possess an EI of 50 or less. For those lots where backfill materials do not conform to the criteria herein, Geocon should be consulted for additional recommendations.

9.9.2 Unrestrained walls are those that are allowed to rotate more than 0.001H (where H equals the height of the retaining portion of the wall in feet) at the top of the wall. Where walls are restrained from movement at the top, an additional uniform pressure of 30H psf should be added to the active soil pressure.

9.9.3 The structural engineer should determine the seismic design category for the project. If the project possesses a seismic design category of D, E, or F, the proposed retaining walls should be designed with seismic lateral pressure added to the active pressure. The seismic load exerted on the wall should be a triangular distribution with a pressure of 22H (where H is the height of the wall, in feet, resulting in pounds per square foot [psf]) exerted at the bottom of the wall and zero at the top of the wall. We used a peak site acceleration of 0.83g calculated from the 2013 California Building Code and applying a pseudo-static coefficient of 0.33.

9.9.4 Unrestrained walls will move laterally when backfilled and loading is applied. The amount of lateral deflection is dependent on the wall height, the type of soil used for backfill, and loads acting on the wall. The retaining walls and improvements above the retaining walls should be designed to incorporate an appropriate amount of lateral deflection as determined by the structural engineer.

9.9.5 Retaining walls should be provided with a drainage system adequate to prevent the buildup of hydrostatic forces and waterproofed as required by the project architect. The soil immediately adjacent to the backfilled retaining wall should be composed of free draining material completely wrapped in Mirafi 140 (or equivalent) filter fabric for a lateral distance of 1 foot for the bottom two-thirds of the height of the retaining wall. The upper one-third should be backfilled with less permeable compacted fill to reduce water infiltration. The use of drainage openings through the base of the wall (weep holes) is not recommended where the seepage could be a nuisance or otherwise adversely affect the property adjacent to the base of the wall. The recommendations herein assume a properly compacted backfill (EI of 50 or less) with no hydrostatic forces or imposed surcharge load. Figure 6 presents a typical retaining wall drainage detail. If conditions different than those described are expected or if specific drainage details are desired, Geocon should be contacted for additional recommendations.

9.9.6 In general, wall foundations having a minimum depth and width of 1.5 feet may be designed for an allowable soil bearing pressure of 3,000 psf. The proximity of the foundation to the top of a slope steeper than 3:1 could impact the allowable soil bearing pressure. Therefore, Geocon should be consulted where such a condition is expected.

9.9.7 The recommendations presented herein are generally applicable to the design of rigid concrete or masonry retaining walls having a maximum height of 12 feet. In the event that walls higher than 12 feet or other types of walls are planned, Geocon should be consulted for additional recommendations.

9.10 Lateral Loading

9.10.1 To resist lateral loads, a passive pressure exerted by an equivalent fluid weight of 350 pounds per cubic foot (pcf) should be used for the design of footings or shear keys poured neat against formational materials. The allowable passive pressure assumes a horizontal surface extending at least 5 feet, or three times the surface generating the passive pressure, whichever is greater. The upper 12 inches of material in areas not protected by floor slabs or pavement should not be included in design for passive resistance.

9.10.2 If friction is to be used to resist lateral loads, an allowable coefficient of friction between soil and concrete of 0.35 should be used for design.

9.11 Swimming Pool/Spa

9.11.1 If swimming pools or spas are planned, the proposed swimming pool shell bottom should be designed as a free-standing structure and may derive support in newly placed engineered fill or the Pauba Formation. It is recommended that uniformity be maintained beneath the proposed swimming pools where possible. However, swimming pool foundations may derive support in both engineered fill and Pauba Formation. It is the intent of the Geotechnical Engineer to allow swimming pool foundation systems to derive support in both the Pauba Formation and newly placed engineered fill as necessary.

9.11.2 Swimming pool foundations and walls may be designed in accordance with the *Foundation* and *Retaining Wall* sections of this report (See Sections 8.9 and 8.10). A hydrostatic relief valve should be considered as part of the swimming pool design unless a gravity drain system can be placed beneath the pool shell.

9.11.3 If a spa is proposed it should be constructed independent of the swimming pool and must not be cantilevered from the swimming pool shell.

9.11.4 If the proposed pool is in proximity to the proposed structure, consideration should be given to construction sequence. If the proposed pool is constructed after building foundation construction, the excavation required for pool construction could remove a component of lateral support from the foundations and would therefore require shoring. Once information regarding the pool locations and depth becomes available, this information should be provided to Geocon for review and possible revision of these recommendations.

9.12 Preliminary Pavement Recommendations

9.12.1 The final pavement sections for roadways should be based on the R-Value of the subgrade soils encountered at final subgrade elevation. Streets should be designed in accordance with the City of Murrieta specifications when final Traffic Indices and R-Value test results of subgrade soil are completed. Based on the soil types encountered during our investigation and the test results indicate an R-Value of 21 for the subgrade soil and 78 for aggregate base materials for the purposes of this preliminary analysis. Preliminary flexible pavement sections are presented in Table 9.12.1.

TABLE 9.12.1
PRELIMINARY FLEXIBLE PAVEMENT SECTIONS

Location	Assumed Traffic Index	Assumed Subgrade R-Value	Asphalt Concrete (inches)	Crushed Aggregate Base (inches)
Light-Duty Vehicles	5.0	21	3.5	6.0
Heavy Truck Vehicles	8.0	21	5.0	13.0
Arterial Roadways	10.0	21	6.0	18.0

9.12.2 The upper 12 inches of the subgrade soil should be compacted to a dry density of at least 95 percent of the laboratory maximum dry density near to slightly above optimum moisture content beneath pavement sections.

9.12.3 The crushed aggregated base and asphalt concrete materials should conform to Section 200-2.2 and Section 203-6, respectively, of the *Standard Specifications for Public Works Construction* (Greenbook) and the latest edition of the *County of Riverside Standard Specifications*. Base materials should be compacted to a dry density of at least 95 percent of the laboratory maximum dry density near to slightly above optimum moisture content. Asphalt concrete should be compacted to a density of 95 percent of the laboratory Hveem density in accordance with ASTM D 1561.

9.12.4 A rigid Portland cement concrete (PCC) pavement section should be placed in driveway aprons and cross gutters and where desired to support heavy vehicle loads. We calculated the rigid pavement section in general conformance with the procedure recommended by the American Concrete Institute report ACI 330R, *Guide for Design and Construction of Concrete Parking Lots* using the parameters presented in Table 9.12.4.

TABLE 9.12.4
RIGID PAVEMENT DESIGN PARAMETERS

Design Parameter	Design Value
Modulus of subgrade reaction, k	100 pci
Modulus of rupture for concrete, M_R	550 psi
Traffic Category, TC	C and D
Average daily truck traffic, ADTT	100 and 700

9.12.5 Based on the criteria presented herein, the PCC pavement sections should have a minimum thickness as presented in Table 9.12.5.

TABLE 9.12.5
RIGID PAVEMENT RECOMMENDATIONS

Location	Portland Cement Concrete (inches)
Roadways (TC=C)	6.0
Bus Stops and Truck Parking Areas (TC=D)	7.0

9.12.6 The PCC pavement should be placed over subgrade soil that is compacted to a dry density of at least 95 percent of the laboratory maximum dry density near to slightly above optimum moisture content. This pavement section is based on a minimum concrete compressive strength of approximately 3,500 psi (pounds per square inch). Base material will not be required beneath concrete improvements.

9.12.7 A thickened edge or integral curb should be constructed on the outside of concrete slabs subjected to wheel loads. The thickened edge should be 1.2 times the slab thickness or a minimum thickness of 2 inches, whichever results in a thicker edge, and taper back to the recommended slab thickness 4 feet behind the face of the slab (e.g., a 7-inch-thick slab would have an 9-inch-thick edge). Reinforcing steel will not be necessary within the concrete for geotechnical purposes with the possible exception of dowels at construction joints as discussed herein.

9.12.8 To control the location and spread of concrete shrinkage cracks, crack-control joints (weakened plane joints) should be included in the design of the concrete pavement slab. Crack-control joints should not exceed 30 times the slab thickness with a maximum spacing of 15 feet for the 7-inch-thick or greater slabs (e.g., a 9-inch-thick slab would have a 15-foot spacing pattern). The depth of the crack-control joints and need for sealing of the joints should be determined by the referenced ACI report.

9.12.9 To provide load transfer between adjacent pavement slab sections, a butt-type construction joint should be constructed. The butt-type joint should be thickened by at least 20 percent at the edge and taper back at least 4 feet from the face of the slab. As an alternative to the butt-type construction joint, dowelling can be used between construction joints for pavements of 7 inches or thicker as discussed in the referenced ACI guide.

9.12.10 The performance of pavement is highly dependent on providing positive surface drainage away from the edge of the pavement. Ponding of water on or adjacent to the pavement surfaces will likely result in pavement distress and subgrade failure. Drainage from landscaped areas should be directed to controlled drainage structures. Landscape areas adjacent to the edge of asphalt pavements are not recommended due to the potential for surface or irrigation water to infiltrate the underlying permeable aggregate base and cause distress. Where such a condition cannot be avoided, consideration should be given to incorporating measures that will significantly reduce the potential for subsurface water migration into the aggregate base. If planter islands are planned, the perimeter curb should extend at least 6 inches below the level of the base materials.

9.13 Site Drainage and Moisture Protection

9.13.1 Adequate site drainage is critical to reduce the potential for differential soil movement, erosion and subsurface seepage. Under no circumstances should water be allowed to pond adjacent to footings. The site should be graded and maintained such that surface drainage is directed away from structures in accordance with 2013 CBC 1804.3 or other applicable standards. In addition, surface drainage should be directed away from the top of slopes into swales or other controlled drainage devices. Roof and pavement drainage should be directed into conduits that carry runoff away from the proposed structure.

9.13.2 Underground utilities should be leak free. Utility and irrigation lines should be checked periodically for leaks, and detected leaks should be repaired promptly. Detrimental soil movement could occur if water is allowed to infiltrate the soil for prolonged periods of time.

9.13.3 Landscaping planters adjacent to paved areas are not recommended due to the potential for surface or irrigation water to infiltrate the pavement’s subgrade and base course. We recommend that area drains to collect excess irrigation water and transmit it to drainage structures or impervious above-grade planter boxes be used. In addition, where landscaping is planned adjacent to the pavement, we recommend construction of a cutoff wall along the edge of the pavement that extends at least 6 inches below the bottom of the base material.

9.13.4 If not properly constructed, there is a potential for distress to improvements and properties located hydrologically down gradient or adjacent to these devices. Factors such as the amount of water to be detained, its residence time, and soil permeability have an important effect on seepage transmission and the potential adverse impacts that may occur if the storm water management features are not properly designed and constructed. Based on our experience with similar clayey soil conditions, infiltration areas are considered infeasible due to the poor percolation and lateral migration characteristics. We have not performed a hydrogeology study at the site. Down-gradient and adjacent structures may be subjected to seeps, movement of foundations and slabs, or other impacts as a result of water infiltration.

9.14 Plan Review

9.14.1 Geocon should review the grading and structural foundation plans for the project prior to final submittal. Additional analyses may be required after review of the project plans.

LIMITATIONS AND UNIFORMITY OF CONDITIONS

1. The recommendations of this report pertain only to the site investigated and are based upon the assumption that the soil conditions do not deviate from those disclosed in the investigation. If any variations or undesirable conditions are encountered during construction, or if the proposed construction will differ from that anticipated herein, Geocon should be notified so that supplemental recommendations can be given. The evaluation or identification of the potential presence of hazardous materials was not part of the scope of services provided by Geocon.

2. This report is issued with the understanding that it is the responsibility of the owner, or of his representative, to ensure that the information and recommendations contained herein are brought to the attention of the architect and engineer for the project and incorporated into the plans, and the necessary steps are taken to see that the contractor and subcontractors carry out such recommendations in the field.

3. The findings of this report are valid as of the present date. However, changes in the conditions of a property can occur with the passage of time, whether they are due to natural processes or the works of man on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and should not be relied upon after a period of three years.

4. The firm that performed the geotechnical investigation for the project should be retained to provide testing and observation services during construction to provide continuity of geotechnical interpretation and to check that the recommendations presented for geotechnical aspects of site development are incorporated during site grading, construction of improvements, and excavation of foundations. If another geotechnical firm is selected to perform the testing and observation services during construction operations, that firm should prepare a letter indicating their intent to assume the responsibilities of project geotechnical engineer of record. A copy of the letter should be provided to the regulatory agency for their records. In addition, that firm should provide revised recommendations concerning the geotechnical aspects of the proposed development, or a written acknowledgement of their concurrence with the recommendations presented in our report. They should also perform additional analyses deemed necessary to assume the role of Geotechnical Engineer of Record.

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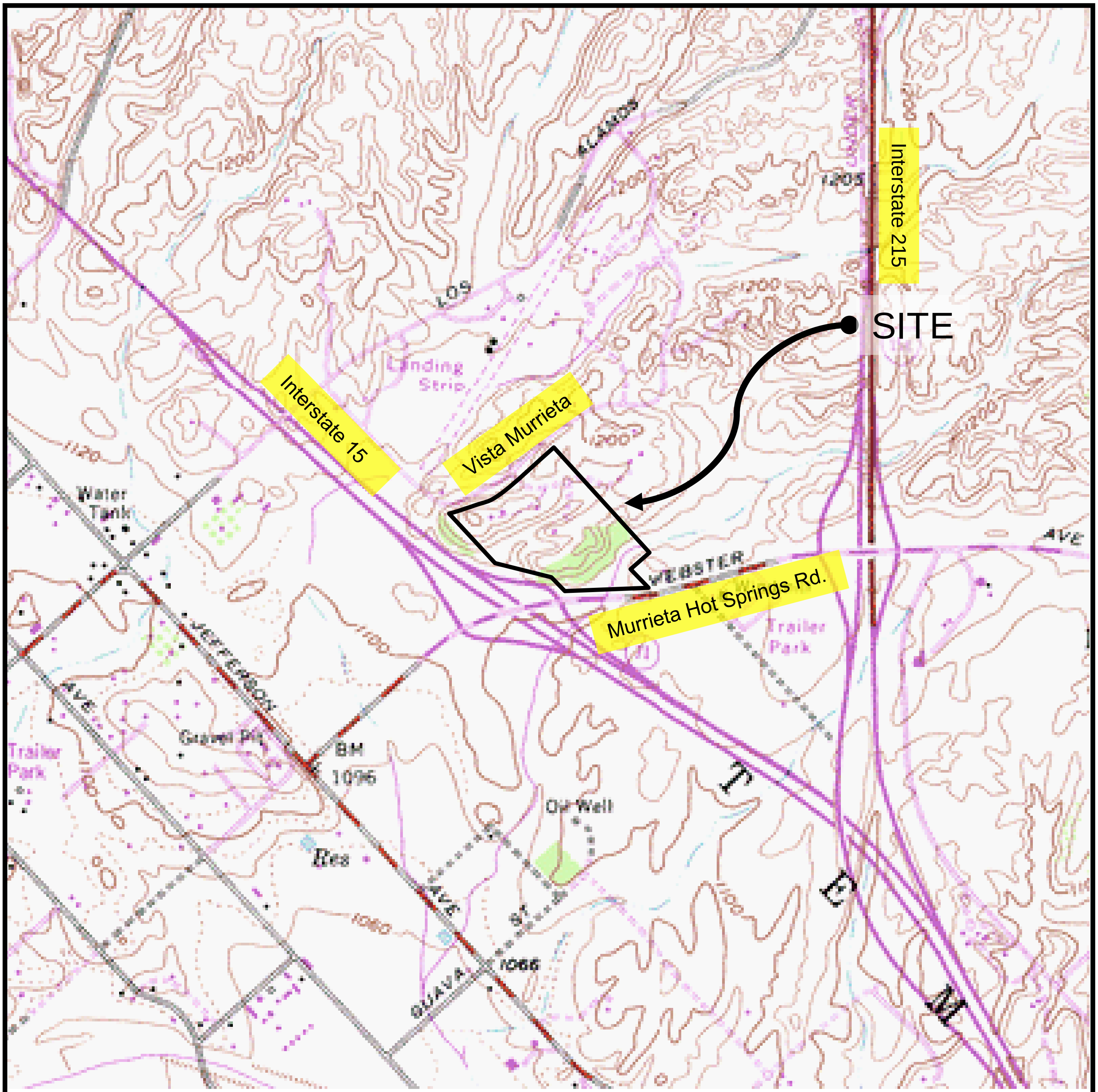

SOURCE: TopoQuest, 2015,
Murrieta, CA USGS Topographic Map, 1:24,000.

N

NOT TO SCALE

VICINITY MAP

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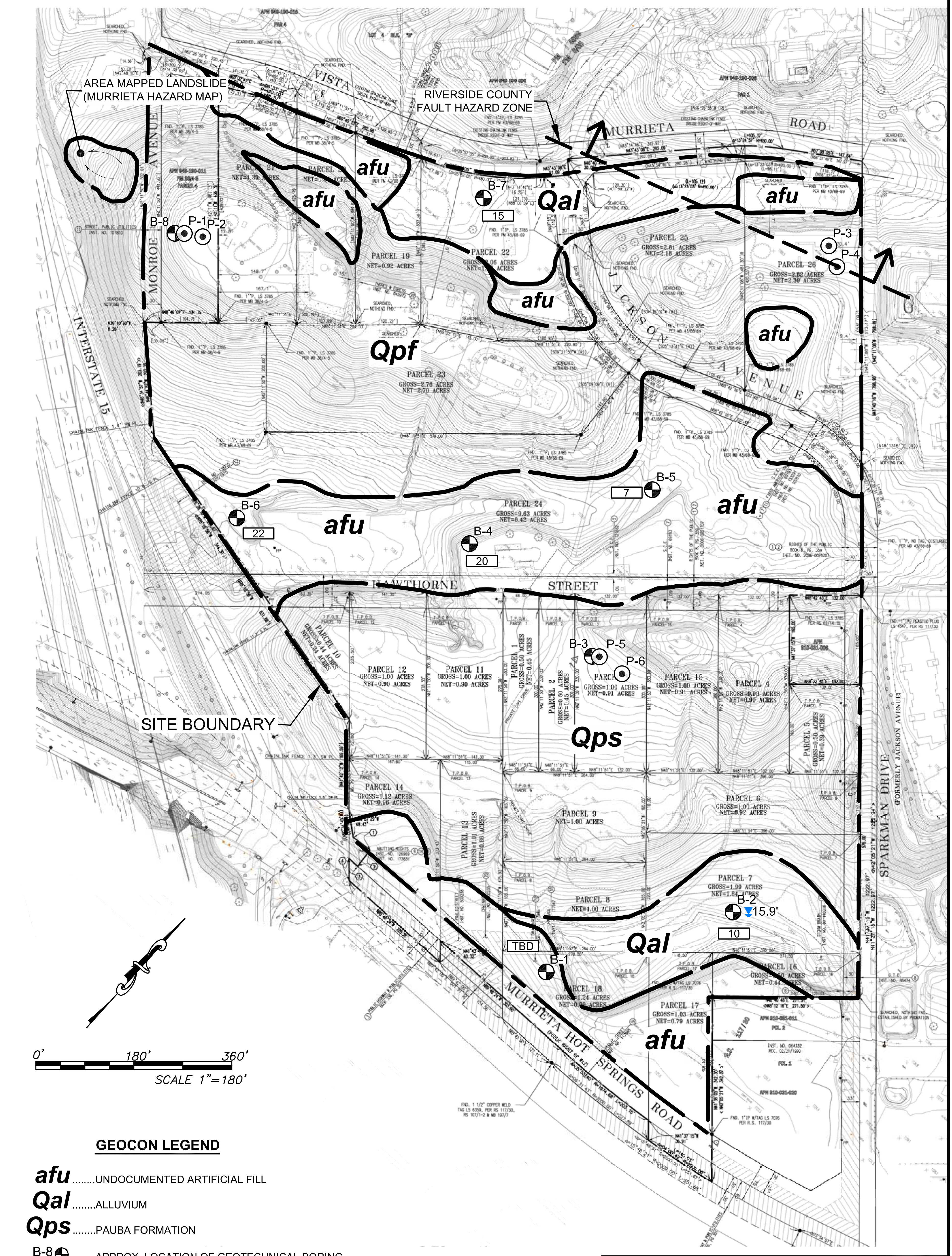
AMO

PRELIMINARY GEOTECHNICAL INVESTIGATION
TERRACES MIXED USE DEVELOPMENT
MURRIETA HOT SPRINGS ROAD & INTERSTATE 15
MURRIETA, CALIFORNIA

APRIL, 2016 | PROJECT NO. T2673-22-01 | FIG. 1

DUE DILIGENCE GEOTECHNICAL INVESTIGATION
TERRACES MIXED USED DEVELOPMENT
MURRIETA HOT SPRINGS ROAD & INTERSTATE 15
MURRIETA, CALIFORNIA



GEOCON LEGEND

afu ........UNDOCUMENTED ARTIFICIAL FILL

Qal ....ALLUVIUM

Qps ....PAUBA FORMATION

B-8 ◐ ....APPROX. LOCATION OF GEOTECHNICAL BORING

P-6 ◎ ....APPROX. LOCATION OF PERCOLATION TEST

(15.9') ▼ ....DEPTH OF GROUNDWATER, OCTOBER 2015

22 ....RECOMMENDED REMOVAL DEPTH
(TBD- To Be Determined Based On Proposed Development)

⌒ ⌣ ....APPROX. LOCATION OF GEOLOGIC CONTACT

GEOTECHNICAL MAP

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DATE APR, 2016	PROJECT NO. T2673 - 22 - 01	FIG. 2

Plotted:11/03/2015 4:43PM | By:JONATHAN WILKINS | File Location:Y:\PROJECTS\T2673-22-01\SHEETS\T2673-22-01-GETECHNICAL_MAP.dwg

ASSUMED CONDITIONS:

SLOPE HEIGHT H = 30 feet

SLOPE INCLINATION 2.0 : 1.0 (Horizontal : Vertical)

TOTAL UNIT WEIGHT OF SOIL γ_t = 125 pounds per cubic foot

ANGLE OF INTERNAL FRICTION ϕ = 28 degrees

APPARENT COHESION C = 150 pounds per square foot

NO SEEPAGE FORCES

ANALYSIS:

$\lambda_{c\phi} = \dfrac{\gamma H \tan\phi}{C}$ EQUATION (3-3), REFERENCE 1

$FS = \dfrac{NcfC}{\gamma H}$ EQUATION (3-2), REFERENCE 1

$\lambda_{c\phi}$ = 13.3 CALCULATED USING EQ. (3-3)

Ncf = 41 DETERMINED USING FIGURE 10, REFERENCE 2

FS = 1.6 FACTOR OF SAFETY CALCULATED USING EQ. (3-2)

REFERENCES:

1……Janbu, N., Stability Analysis of Slopes with Dimensionless Parameters, Harvard Soil Mechanics Series No. 46,1954

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SLOPE STABILITY ANALYSIS - FILL SLOPES

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MURRIETA, CALIFORNIA

APRIL, 2016 | PROJECT NO. T2673-22-01 | FIG. 3

ASSUMED CONDITIONS:

SLOPE HEIGHT H = 30 feet

SLOPE INCLINATION 2.0 : 1.0 (Horizontal : Vertical)

TOTAL UNIT WEIGHT OF SOIL γ_t = 125 pounds per cubic foot

ANGLE OF INTERNAL FRICTION ϕ = 28 degrees

APPARENT COHESION C = 150 pounds per square foot

PSEUDOSTATIC COEFFICIENT k_h = 0.15

PSEUDOSTATIC INCLINATION 1.4 : 1.0 (Horizontal : Vertical)

PSEUDOSTATIC UNIT WEIGHT γ_{ps} = 126 pounds per cubic foot

NO SEEPAGE FORCES

ANALYSIS:

$\lambda_{c\phi} = \frac{\gamma H \tan \phi}{C}$ EQUATION (3-3), REFERENCE 1

$FS = \frac{NcfC}{\gamma H}$ EQUATION (3-2), REFERENCE 1

$\lambda_{c\phi}$ = 13.4 CALCULATED USING EQ. (3-3)

Ncf = 32 DETERMINED USING FIGURE 10, REFERENCE 2

FS = 1.3 FACTOR OF SAFETY CALCULATED USING EQ. (3-2)

REFERENCES:

1……Janbu, N., Stability Analysis of Slopes with Dimensionless Parameters, Harvard Soil Mechanics Series No. 46,1954

2……Janbu, N., Discussion of J.M. Bell Dimensionless Parameters for Homogeneous Earth Slpes, Journal of Soil Mechanicx and Foundation Design, No. SM6, November 1967

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SLOPE STABILITY ANALYSIS - FILL SLOPES WITH SEISMIC

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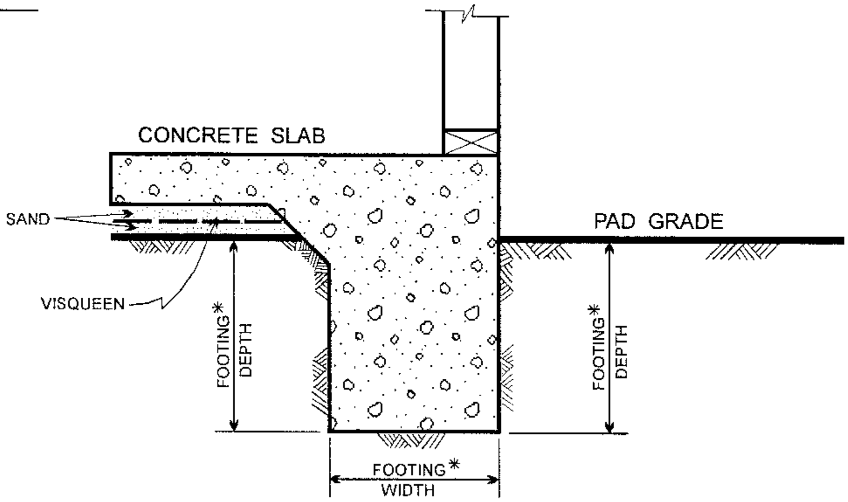
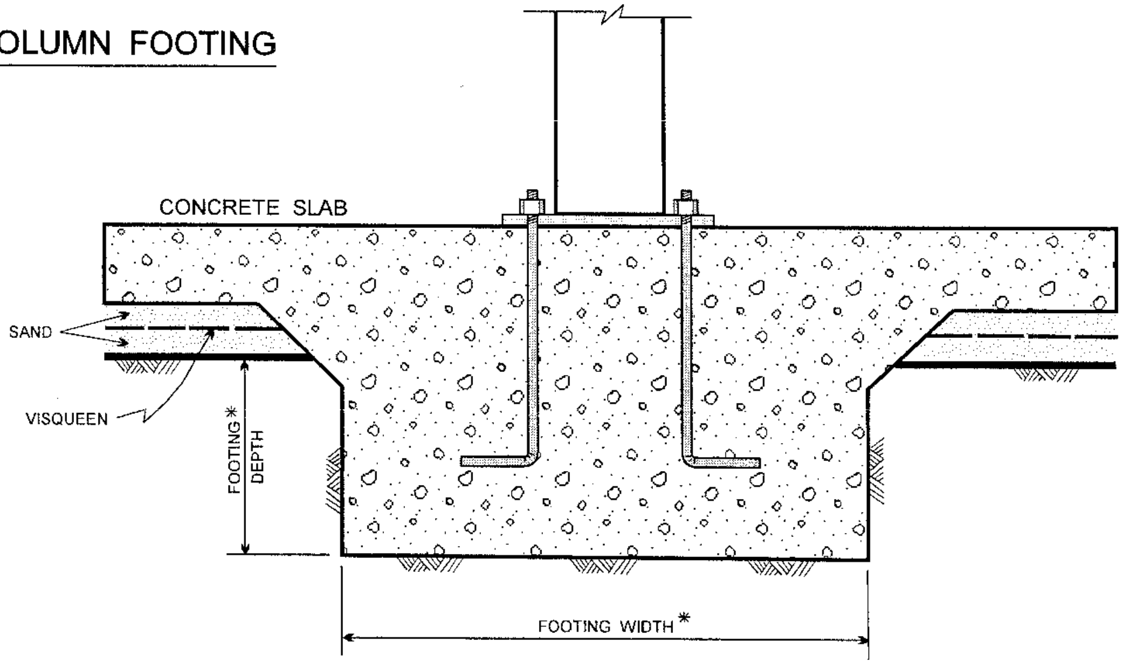
APRIL, 2016 | PROJECT NO. T2673-22-01 | FIG. 4

WALL FOOTING



COLUMN FOOTING



*……SEE REPORT FOR FOUNDATION WIDTH AND DEPTH RECOMMENDATION

NO SCALE

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WALL / COLUMN FOOTING DETAIL

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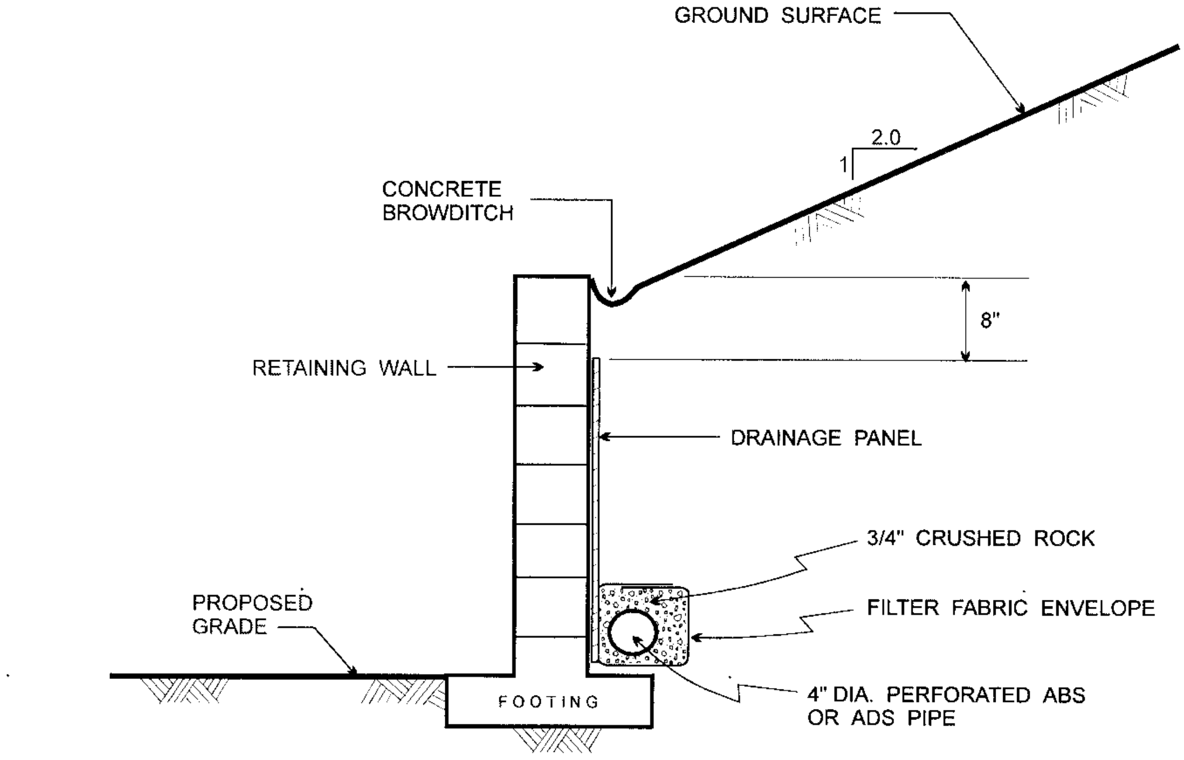
APRIL, 2016	PROJECT NO. T2673-22-01	FIG. 5



NOTES:

1.....WALL DRAINAGE PANELS SHOULD CONSISTS OF MIRADRAIN 6000 OR EQUIVALENT

2......FILTER FABRIC SHOULD CONSIST OF MIRAFI 140N OR APPROVED EQUIVALENT

3......VOLUME OF CRUSHED ROCK SHOULD BE AT LEAST 1 CUBIC FOOT PER FOOT OF PIPE

4......CONCRETE BROWDITCH RECOMMENDED FOR SLOPE HEIGHTS GREATER THAN 6 FEET

NO SCALE

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WALL DRAINAGE DETAL

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APRIL, 2016	PROJECT NO. T2673-22-01	FIG. 6

APPENDIX A

APPENDIX A

EXPLORATORY EXCAVATIONS

We performed the field investigation on October 24, 2015. Our subsurface exploration consisted of excavating 8 small diameter geotechnical borings throughout the site. Two borings were converted to percolation tests and an additional four percolation tests were excavated. Percolation testing was performed on October 28, 2015 in accordance with *Riverside County Flood Control and Water Conservation District Low Impact Development Handbook Appendix A (Handbook)*. The borings were excavated with a CME 75 truck mounted drill rig to depths up to 50.5 feet. Representative and relatively undisturbed samples were obtained by driving a 3 inch O. D., California Modified Sampler into the "undisturbed" soil mass with blows from a 140-pound hammer falling 30 inches or a slide hammer. The California Modified Sampler was equipped with 1-inch high by $2^3/_8$-inch inside diameter brass sampler rings to facilitate removal and testing. Relatively undisturbed samples and bulk samples of disturbed soils were transported to our laboratory for testing.

The soil conditions encountered in the borings were visually examined, classified and logged in general accordance with the Unified Soil Classification System (USCS). Logs of the borings are presented on Figures A-1 through A-8. The logs depict the soil and geologic conditions encountered and the depth at which samples were obtained. The approximate locations of the borings are indicated the *Geotechnical Map*, Figure 2.

Percolation testing was performed on October 29, 2015 in accordance with Table 1 Infiltration Basin Option 2 of Handbook. The percolation tests were run in accordance with Section 2.3 Deep Percolation Test Method. The percolation test data is presented on Figures A-9 through A-14.

PROJECT NO. T2673-22-01

BORING B-1

ELEV. (MSL.) **1116** DATE COMPLETED **10/24/15**

EQUIPMENT **HOLLOW STEM AUGER** BY: **L.BATTIATO**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	B-1@0-5'			SM	**Undocumented Fill (afu)** Silty SAND, loose to medium dense, dry, strong brown; fine to medium sand			
2								
	B-1@2.5'			SP-SM	SAND, dense, slightly moist, strong brown; fine to coarse sand; poorly graded; cohessionless; interlayered with yellow silty SAND	50/5"	108.8	4.8
4								
	B-1@5'				- Becomes moist, orange brown; locally massive	50/6"	116.3	6.7
6								
8	B-1@7.5'				- Becomes strong brown; thin layered	72		
10	B-1@10'				- Becomes laminated	50/6"		
12								
				SM	**Pauba Formation (Qps)** Silty SANDSTONE, moist, strong brown; locally massive; fine-to medium-grained			
14								
	B-1@15'				- Becomes yellow brown	22	117.3	5.6
16								
18								
20	B-1@20'			SP-SM	SANDSTONE with silt, very dense, moist, strong brown; low cohession; medium-to coarse-grained	70		

Total depth: 21.5'
Groundwater not encountered
Penetration resistance for 140 lb hammer falling 30" by drop
Backfilled with native cuttings

Figure A-1,
Log of Boring B-1, Page 1 of 1

SAMPLE SYMBOLS
☐ ... SAMPLING UNSUCCESSFUL
◧ ... STANDARD PENETRATION TEST
■ ... DRIVE SAMPLE (UNDISTURBED)
⊠ ... DISTURBED OR BAG SAMPLE
◩ ... CHUNK SAMPLE
▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

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PROJECT NO. T2673-22-01

BORING B-2

ELEV. (MSL.) **1124** DATE COMPLETED **10/24/15**

EQUIPMENT **HOLLOW STEM AUGER** BY: **L.BATTIATO**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	B-2@0-5' ☒			SM	**Alluvium (Qal)** Silty SAND, dense (cemented), dry, strong brown; fine to medium sand			
2	B-2@2.5' ■				-Becomes medium dense	45	118.1	4.8
4	☒							
	B-2@5' ■					35	115.1	3.6
6								
8	B-2@7.5' ■					19	115.2	4.0
10	B-2@10' ■			SW	**Pauba Formation (Qps)** Well graded SANDSTONE, moist, light yellow brown; fine-to coarse-grained; cuttings become olive brown; cohesionless	22	107.1	2.5
12								
				SP	Poorly graded SANDSTONE, dense, wet, olive brown; coarse-grained			
14								
	B-2@15' ■		▽			33	110.0	16.6
16					-Saturated			
18								
20	B-2@20' ■			SP-SM	Poorly graded SANDSTONE with silt, very dense, moist, yellow brown; locally massive; fine-to medium-grained	50/5"		
22								
24								
	B-2@25' ■					50/5.5"		
26								
28								

Figure A-2,
Log of Boring B-2, Page 1 of 2

T2673-22-01.GPJ

SAMPLE SYMBOLS

☐ ... SAMPLING UNSUCCESSFUL	◧ ... STANDARD PENETRATION TEST	■ ... DRIVE SAMPLE (UNDISTURBED)
☒ ... DISTURBED OR BAG SAMPLE	◪ ... CHUNK SAMPLE	▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. T2673-22-01

BORING B-2

ELEV. (MSL.) **1124** DATE COMPLETED **10/24/15**

EQUIPMENT **HOLLOW STEM AUGER** BY: **L.BATTIATO**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30 32 34	B-2@30'			ML	**Pauba Formation (Qps)** SILTSTONE, hard, wet, olive; some iron staining; some carbonate nodules	45		
36 38	B-2@35'			SP	SANDSTONE, very dense, moist, light olive; fine-grained; iron staining	61		
40 42 44	B-2@40'			SP	Poorly graded SANDSTONE, very dense, moist, light gray (granitic derived); coarse-grained; cohesionless	50/4.5"		
46 48	B-2@45'			ML	SILTSTONE, very hard, moist, olive	50/6"		
50	B-2@50'			SP	Poorly graded SANDSTONE, very dense, moist, yellow brown; coarse-grained; cohesionless	50/6"		

Total depth: 50.5'
Groundwater encountered at 18.5' during drilling. When encountered, rose to 15.9' in 5 minutes.
Penetration resistance for 140 lb hammer falling 30" by drop
Backfilled with native cuttings

Figure A-2,
Log of Boring B-2, Page 2 of 2

SAMPLE SYMBOLS

☐ ... SAMPLING UNSUCCESSFUL	◧ ... STANDARD PENETRATION TEST	■ ... DRIVE SAMPLE (UNDISTURBED)
⊠ ... DISTURBED OR BAG SAMPLE	◪ ... CHUNK SAMPLE	▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. T2673-22-01

BORING B-3

ELEV. (MSL.) **1162** DATE COMPLETED **10/24/15**

EQUIPMENT **HOLLOW STEM AUGER** BY: **L.BATTIATO**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	B-3@0-5'			SM	**Pauba Formation (Qps)** SILTSTONE, hard, dry, yellow brown; indurated			
2								
4								
	B-3@5'				-Becomes moist	50/5"	102.9	12.9
6								
8				SP	Poorly graded SANDSTONE (granitic derived), very dense, dry, gray to buff; coarse; cohesionless			
10	B-3@10'					71	102.4	3.3
12								
14								
	B-3@15'					50/6"		
16					Total depth: 16' Groundwater not encountered Converted to P-5 Caved to 11.5' when installing pipe Penetration resistance for 140 lb hammer falling 30" by drop Backfilled with native cuttings			

Figure A-3,
Log of Boring B-3, Page 1 of 1

T2673-22-01.GPJ

SAMPLE SYMBOLS

☐ ... SAMPLING UNSUCCESSFUL
◧ ... STANDARD PENETRATION TEST
■ ... DRIVE SAMPLE (UNDISTURBED)
☒ ... DISTURBED OR BAG SAMPLE
◩ ... CHUNK SAMPLE
▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. T2673-22-01

BORING B-4

ELEV. (MSL.) **1150** DATE COMPLETED **10/24/15**

EQUIPMENT **HOLLOW STEM AUGER** BY: **L.BATTIATO**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**Undocumented Fill (afu)** Silty SAND, very dense, dry, strong brown; fine to medium sand; some coarse sand			
2								
	B-4@2.5' ■					50/6"	123.6	0.4
4								
	B-4@5' ■			ML	SILT with abundant carbonate, hard, slightly moist, olive	75	118.6	7.6
6				SM	Silty SAND, very dense, moist, strong brown; fine to coarse sand; mottled texture			
8	B-4@7.5' ■					50/4"	103.6	18.6
10	B-4@10' ■			ML	SILT, hard, damp, olive; abundant carbonate	80/11.5"		
12								
14								
	B-4@15' ■			SM	Silty SAND, very dense, moist, strong brown; fine to coarse sand; mottled texture	90/11.5"	121.6	13.3
16								
18								
					- organic staining			
20	B-4@20' ■			SP	**Pauba Formation (Qps)** Poorly graded SANDSTONE, very dense, moist, yellow brown; fine-grained; micaceous	50/6"	113.4	10.3
22								
24								
	B-4@25' ■			ML	SILTSTONE, hard, moist, dark olive; laminated	82/11.5"		
26								
					Total depth: 26' 5.5" Groundwater not encountered Penetration resistance for 140 lb hammer falling 30" by drop Backfilled with native cuttings			

Figure A-4,
Log of Boring B-4, Page 1 of 1

T2673-22-01.GPJ

SAMPLE SYMBOLS			
	☐ ... SAMPLING UNSUCCESSFUL	◧ ... STANDARD PENETRATION TEST	■ ... DRIVE SAMPLE (UNDISTURBED)
	☒ ... DISTURBED OR BAG SAMPLE	◣ ... CHUNK SAMPLE	▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. T2673-22-01

BORING B-5

ELEV. (MSL.) 1152 DATE COMPLETED 10/24/15

EQUIPMENT HOLLOW STEM AUGER BY: L.BATTIATO

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**Undocumented Fill (afu)** Silty SAND, very dense, dry, strong brown; fine to medium sand; mottled texture			
2	B-5@2.5'				-Becomes slightly moist	88	123.5	5.6
4								
	B-5@5'			SM	Silty SAND, very dense (cemented), slightly moist, strong brown; organic stain	82	114.8	7.1
6								
8	B-5@7.5'			ML	**Pauba Formation (Qps)** SILTSTONE, hard, moist, olive; fine-to medium-grained; trace carbonates	60	115.5	15.8
10	B-5@10'			SP-SM	Poorly graded SANDSTONE with silt, very dense, slightly moist, olive brown; coarse-grained	81/10"	122.5	7.7
12								
14								
	B-5@15'			SP	Poorly graded SANDSTONE, very dense, moist, yellow brown; cohessionless; fine-to medium-grained; trace coarse-grained sand	90/11"		
16								
18								
20	B-5@20'				- Becomes very coarse, light orange	95/11"		

Total depth: 20.9'
Groundwater not encountered
Penetration resistance for 140 lb hammer falling 30" by drop
Backfilled with native cuttings

Figure A-5,
Log of Boring B-5, Page 1 of 1

T2673-22-01.GPJ

SAMPLE SYMBOLS

☐ ... SAMPLING UNSUCCESSFUL
◧ ... STANDARD PENETRATION TEST
■ ... DRIVE SAMPLE (UNDISTURBED)
☒ ... DISTURBED OR BAG SAMPLE
◪ ... CHUNK SAMPLE
▼ ... WATER TABLE OR SEEPAGE

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PROJECT NO. T2673-22-01

BORING B-6

ELEV. (MSL.) **1120** DATE COMPLETED **10/24/15**

EQUIPMENT **HOLLOW STEM AUGER** BY: **L.BATTIATO**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	B-6@0-5'			SM	**Undocumented Fill (afu)** Silty SAND, very dense (cemented), dry, strong brown; mottled texture			
2								
	B-6@2.5'				-Becomes slightly moist	50/4"	116.8	3.8
4								
	B-6@5'				-Clay development on parting surfaces (soil development)	83	115.4	7.6
6								
8	B-6@7.5'				-Becomes moist, yellow brown; fine to coarse sand (older generation undocumented fill)	59	119.7	6.2
10	B-6@10'				-Becomes fine sand; laminated	67	116.4	7.9
12								
14								
	B-6@15'				-Becomes dense, dark brown; organic stained; bits of charcoal; mottled texture	56	124.0	9.4
16								
18								
20	B-6@20'				-Becomes very dense; mottled coloring	50/5"	123.9	8.9
22				SM	**Pauba Formation (Qps)** Silty SANDSTONE, very dense, moist, yellow brown; fine-to coarse-grained			
24								
	B-6@25'			ML	SILTSTONE, hard, moist, olive; micaceous	68		
26								

Total depth: 26.5'
Groundwater not encountered
Penetration resistance for 140 lb hammer falling 30" by drop
Backfilled with native cuttings

Figure A-6,
Log of Boring B-6, Page 1 of 1

SAMPLE SYMBOLS

☐ ... SAMPLING UNSUCCESSFUL
◧ ... STANDARD PENETRATION TEST
■ ... DRIVE SAMPLE (UNDISTURBED)
▩ ... DISTURBED OR BAG SAMPLE
◪ ... CHUNK SAMPLE
▼ ... WATER TABLE OR SEEPAGE

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PROJECT NO. T2673-22-01

BORING B-7

ELEV. (MSL.) **1153** DATE COMPLETED **10/24/15**

EQUIPMENT **HOLLOW STEM AUGER** BY: **L.BATTIATO**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0 2				SC-SM	**Alluvium (Qal)** Silty, clayey SAND, dense (cemented), dry, strong brown; secondary porosity			
4	B-7@2.5'				-Becomes slightly moist	73/11"	118.6	4.2
6	B-7@5'			SC	Clayey SAND, dense, slightly moist, strong brown; fine to medium sand; cemented; some secondary porosity	66	123.8	6.9
8	B-7@7.5'				-Becomes medium dense, moist, strong brown; abundant secondary porosity	31	124.3	9.3
10 12 14	B-7@10'			SC/CL	Clayey SAND to SANDY CLAY, medium dense to stiff, moist, strong brown; less porosity	36	119.3	12.6
16 18	B-7@15'			SM	**Pauba Formation (Qps)** Silty SANDSTONE, medium dense, moist, yellow brown; medium-to coarse-grained	31	119.7	11.1
20	B-7@20'					50/6"		

Total depth: 21'
Groundwater not encountered
Penetration resistance for 140 lb hammer falling 30" by drop
Backfilled with native cuttings

Figure A-7,
Log of Boring B-7, Page 1 of 1

T2673-22-01.GPJ

SAMPLE SYMBOLS

☐ ... SAMPLING UNSUCCESSFUL
▨ ... DISTURBED OR BAG SAMPLE
◧ ... STANDARD PENETRATION TEST
◪ ... CHUNK SAMPLE
■ ... DRIVE SAMPLE (UNDISTURBED)
▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

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PROJECT NO. T2673-22-01

BORING B-8

ELEV. (MSL.) **1188** DATE COMPLETED **10/24/15**

EQUIPMENT **HOLLOW STEM AUGER** BY: **L.BATTIATO**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**Pauba Formation (Qps)** Silty SANDSTONE, medium dense, dry, brown			
2								
4								
	B-8@5'			SP	Poorly graded SANDSTONE, medium dense, slightly moist, yellow; fine-grained; in near vertical contact with medium silty SAND; fine silty sand is indurated and laminated; medium silty sand is cohessionless	43	105.8	5.4
6								
8								
10	B-8@10'			SP-SM	Poorly graded SANDSTONE with silt, very dense, slightly moist, yellow brown; laminated; very fine-grained	77	120.4	7.0
12								
14				SM	Silty SANDSTONE, medium dense, dry, brown			
	B-8@15'			SP	Poorly graded SANDSTONE, very dense, dry, buff; cohessionless; coarse grained	72	119.7	1.8
16								
18								
				SP-SM	Poorly graded silty SANDSTONE, hard, slightly moist, yellow; laminated			
20	B-8@20'					77	122.6	6.7

Total depth: 21.5'
Groundwater not encountered
Converted to perc P-1
Penetration resistance for 140 lb hammer falling 30" by drop
Backfilled with native cuttings

Figure A-8,
Log of Boring B-8, Page 1 of 1

T2673-22-01.GPJ

SAMPLE SYMBOLS

☐ ... SAMPLING UNSUCCESSFUL
◧ ... STANDARD PENETRATION TEST
■ ... DRIVE SAMPLE (UNDISTURBED)
☒ ... DISTURBED OR BAG SAMPLE
◪ ... CHUNK SAMPLE
▼ ... WATER TABLE OR SEEPAGE

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GEOCON

Leach Line Percolation Data Sheet

Project	Terraces	**Job No.**	T2673-22-01
Test Hole No.	P-1	**Date Excavated**	10/23/2015
Depth of Test Hole:	20.2' (top of pipe)	**Soil Classification**	
Check for Sandy Soil Criteria Tested by:	PDT	**Presoak**	10/28/2015
Actual Percolation Tested by:	PDT	**Date**	10/29/2015

Water level measured from BOTTOM of hole

Sandy Soil Criteria Test

Trial No.	Time	Time Interval (min)	Total Elapsed Time (min)	Initial Water Level (in)	Final Water Level (in)	Δ in Water Level (in)	Percolation Rate (min/inch)
1	9:48 10:13	0:25	0:25	31.2	4.8	26.4	0.95
2	10:13 10:38	0:25	0:50	21.6	3.6	18.0	1.39

Soil Criteria: Sandy

Reading No.	Time	Time Interval (min)	Total Elapsed Time (min)	Initial Water Level (in)	Final Water Level (in)	Δ in Water Level (in)	Percolation Rate (min/inch)
1	10:40 10:50	0:10	0:10	14.4	10.8	3.6	2.8
2	10:51 11:01	0:10	0:20	37.2	32.4	4.8	2.1
3	11:02 11:12	0:10	0:30	38.4	33.6	4.8	2.1
4	11:13 11:23	0:10	0:40	39.6	36.0	3.6	2.8
5	11:24 11:34	0:10	0:50	39.6	36.0	3.6	2.8
6	11:35 11:45	0:10	1:00	38.4	34.8	3.6	2.8
7							
8							
9							
10							
11							
12							

FIGURE A-9

Leach Line Percolation Data Sheet

Project	Terraces	**Job No.**	T2673-22-01
Test Hole No.	P-2	**Date Excavated**	10/23/2015
Depth of Test Hole:	20.2' (top of pipe)	**Soil Classification**	
Check for Sandy Soil Criteria Tested by:	PDT	**Presoak**	10/28/2015
Actual Percolation Tested by:	PDT	**Date**	10/29/2015

Water level measured from BOTTOM of hole

Sandy Soil Criteria Test

Trial No.	**Time**	**Time Interval (min)**	**Total Elapsed Time (min)**	**Initial Water Level (in)**	**Final Water Level (in)**	**Δ in Water Level (in)**	**Percolation Rate (min/inch)**
1	9:50 10:15	0:25	0:25	50.4	8.4	42.0	0.05
2	10:16 10:41	0:25	0:50	40.8	18.0	22.8	0.09

Soil Criteria: Sandy

Reading No.	**Time**	**Time Interval (min)**	**Total Elapsed Time (min)**	**Initial Water Level (in)**	**Final Water Level (in)**	**Δ in Water Level (in)**	**Percolation Rate (min/inch)**
1	10:44 10:54	0:10	0:10	25.2	21.6	3.6	2.8
2	10:55 11:05	0:10	0:20	27.6	24.0	3.6	2.8
3	11:06 11:16	0:10	0:30	33.6	30.0	3.6	2.8
4	11:17 11:27	0:10	0:40	39.6	36.0	3.6	2.8
5	11:28 11:38	0:10	0:50	38.4	34.8	3.6	2.8
6	11:39 11:49	0:10	1:00	37.2	34.8	2.4	4.2
7							
8							
9							
10							
11							
12							

FIGURE A-10

Leach Line Percolation Data Sheet

Project Terraces

Job No. T2673-22-01

Test Hole No. P-3

Date Excavated 10/23/2015

Depth of Test Hole: 20.2' (top of pipe)

Soil Classification

Check for Sandy Soil Criteria Tested by: PDT

Presoak 10/28/2015

Actual Percolation Tested by: PDT

Date 10/29/2015

Water level measured from BOTTOM of hole

Sandy Soil Criteria Test

Trial No.	Time	Time Interval (min)	Total Elapsed Time (min)	Initial Water Level (in)	Final Water Level (in)	Δ in Water Level (in)	Percolation Rate (min/inch)
1	9:59 10:24	0:25	0:25	38.4	14.4	24.0	1.04
2	10:25 10:50	0:25	0:50	26.4	8.4	18.0	1.39

Soil Criteria: Sandy

Reading No.	Time	Time Interval (min)	Total Elapsed Time (min)	Initial Water Level (in)	Final Water Level (in)	Δ in Water Level (in)	Percolation Rate (min/inch)
1	11:55 12:05	0:10	0:10	37.8	33.0	4.8	2.1
2	12:06 12:16	0:10	0:20	32.4	28.2	4.2	2.4
3	12:17 12:27	0:10	0:30	33.0	28.8	4.2	2.4
4	12:28 12:38	0:10	0:40	34.8	31.2	3.6	2.8
5	12:39 12:49	0:10	0:50	34.2	31.2	3.0	3.3
6	12:50 13:00	0:10	1:00	37.8	34.8	3.0	3.3
7							
8							
9							
10							
11							
12							

FIGURE A-11

Leach Line Percolation Data Sheet

Project	Terraces	**Job No.**	T2673-22-01
Test Hole No.	P-4	**Date Excavated**	10/23/2015
Depth of Test Hole:	20.0' (top of pipe)	**Soil Classification**	
Check for Sandy Soil Criteria Tested by:	AO	**Presoak**	10/28/2015
Actual Percolation Tested by:	CER	**Date**	10/29/2015

Water level measured from BOTTOM of hole

Sandy Soil Criteria Test

Trial No.	**Time**	**Time Interval (min)**	**Total Elapsed Time (min)**	**Initial Water Level (in)**	**Final Water Level (in)**	**Δ in Water Level (in)**	**Percolation Rate (min/inch)**
1	10:03 10:28	0:25	0:25	38.8	12.0	26.8	0.93
2	10:29 10:54	0:25	0:50	37.8	1.8	36.0	0.69

Soil Criteria: Sandy

Reading No.	**Time**	**Time Interval (min)**	**Total Elapsed Time (min)**	**Initial Water Level (in)**	**Final Water Level (in)**	**Δ in Water Level (in)**	**Percolation Rate (min/inch)**
1	11:58 12:08	0:10	0:10	10.2	5.4	4.8	2.1
2	12:09 12:19	0:10	0:20	14.4	13.2	1.2	8.3
3	12:20 12:30	0:10	0:30	26.4	22.8	3.6	2.8
4	12:31 12:41	0:10	0:40	39.6	19.8	19.8	0.5
5	12:42 12:52	0:10	0:50	87.6	42.6	45.0	0.2
6	12:52 13:02	0:10	1:00	42.6	30.0	12.6	0.8
7							
8							
9							
10							
11							
12							

* Low infiltration rate due to caving around bottom of percolation pipe.

FIGURE A-12

Leach Line Percolation Data Sheet

Project	Terraces	**Job No.**	T2673-22-01
Test Hole No.	P-5	**Date Excavated**	10/23/2015
Depth of Test Hole:	15.4' (top of pipe)	**Soil Classification**	
Check for Sandy Soil Criteria Tested by:	PDT	**Presoak**	10/28/2015
Actual Percolation Tested by:	PDT	**Date**	10/29/2015

Water level measured from BOTTOM of hole

Sandy Soil Criteria Test

Trial No.	Time	Time Interval (min)	Total Elapsed Time (min)	Initial Water Level (in)	Final Water Level (in)	Δ in Water Level (in)	Percolation Rate (min/inch)
1	13:45 14:10	0:25	0:25	34.8	2.4	32.4	0.77
2	14:11 14:36	0:25	0:50	20.4	1.8	18.6	1.34

Soil Criteria: Sandy

Reading No.	Time	Time Interval (min)	Total Elapsed Time (min)	Initial Water Level (in)	Final Water Level (in)	Δ in Water Level (in)	Percolation Rate (min/inch)
1	14:37 14:47	0:10	0:10	28.2	0.0	28.2	0.4
2	14:48 14:58	0:10	0:20	34.8	18.6	16.2	0.6
3	14:59 15:09	0:10	0:30	36.0	20.4	15.6	0.6
4	15:10 15:20	0:10	0:40	38.4	24.6	13.8	0.7
5	15:21 15:31	0:10	0:50	30.0	17.4	12.6	0.8
6	15:32 15:42	0:10	1:00	36.0	23.4	12.6	0.8
7							
8							
9							
10							
11							
12							

FIGURE A-13

Leach Line Percolation Data Sheet

Project Terraces
Job No. T2673-22-01
Test Hole No. P-6
Date Excavated 10/23/2015
Depth of Test Hole: 15.7' (top of pipe)
Soil Classification
Check for Sandy Soil Criteria Tested by: PDT
Presoak 10/28/2015
Actual Percolation Tested by: PDT
Date 10/29/2015

Water level measured from BOTTOM of hole

Sandy Soil Criteria Test

Trial No.	Time	Time Interval (min)	Total Elapsed Time (min)	Initial Water Level (in)	Final Water Level (in)	Δ in Water Level (in)	Percolation Rate (min/inch)
1	13:50 14:15	0:25	0:25	13.2	3.6	9.6	2.60
2	14:16 14:41	0:25	0:50	22.8	5.4	17.4	1.44

Soil Criteria: Sandy

Reading No.	Time	Time Interval (min)	Total Elapsed Time (min)	Initial Water Level (in)	Final Water Level (in)	Δ in Water Level (in)	Percolation Rate (min/inch)
1	14:42 14:52	0:10	0:10	29.4	16.2	13.2	0.8
2	14:53 15:03	0:10	0:20	42.0	29.4	12.6	0.8
3	15:04 15:14	0:10	0:30	39.6	5.4	34.2	0.3
4	15:15 15:25	0:10	0:40	89.4	62.4	27.0	0.4
5	15:26 15:36	0:10	0:50	62.4	25.8	36.6	0.3
6	15:37 15:47	0:10	1:00	54.0	21.0	33.0	0.3
7							
8							
9							
10							
11							
12							

FIGURE A-14

APPENDIX B

APPENDIX B

LABORATORY TESTING

We performed laboratory tests in accordance with current, generally accepted test methods of ASTM International (ASTM) or other suggested procedures. We analyzed selected soil samples for in-situ dry density and moisture content, maximum dry density and optimum moisture content, direct shear strength, expansion potential, consolidation corrosion, and R-Value. The results of the laboratory tests are presented on Figures B1 through B7. The in-place dry density and moisture content of the samples tested are presented on the boring in Appendix A.

SUMMARY OF LABORATORY MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT TEST RESULTS
ASTM D1557

Sample No.	Description	Maximum Dry Density (pcf)	Optimum Moisture Content (% of dry wt.)
B-3 @ 0-5’	Silty SAND (SM), yellow brown	126.1	10.1

SUMMARY OF LABORATORY EXPANSION INDEX TEST RESULTS
ASTM D4829

Sample No.	Moisture Content		After Test Dry Density (pcf)	Expansion Index
	Before Test (%)	After Test (%)		
B-4 @ 10’	13.5	28.2	98.3	53

SUMMARY OF CORROSIVITY TEST RESULTS

Sample No.	Chloride Content (ppm)	Sulfate Content (%)	pH	Resistivity (ohm-centimeter)
B-6 @ 0-5’	55	0.002	7.74	4,820

Chloride content determined by California Test 422.
Water-soluble sulfate determined by California Test 417.
Resistivity and pH determined by Caltrans Test 643.

SUMMARY OF LABORATORY R-VALUE TEST RESULTS
ASTM D2844

Sample No.	R-Value
B-1 @ 0-5’	21

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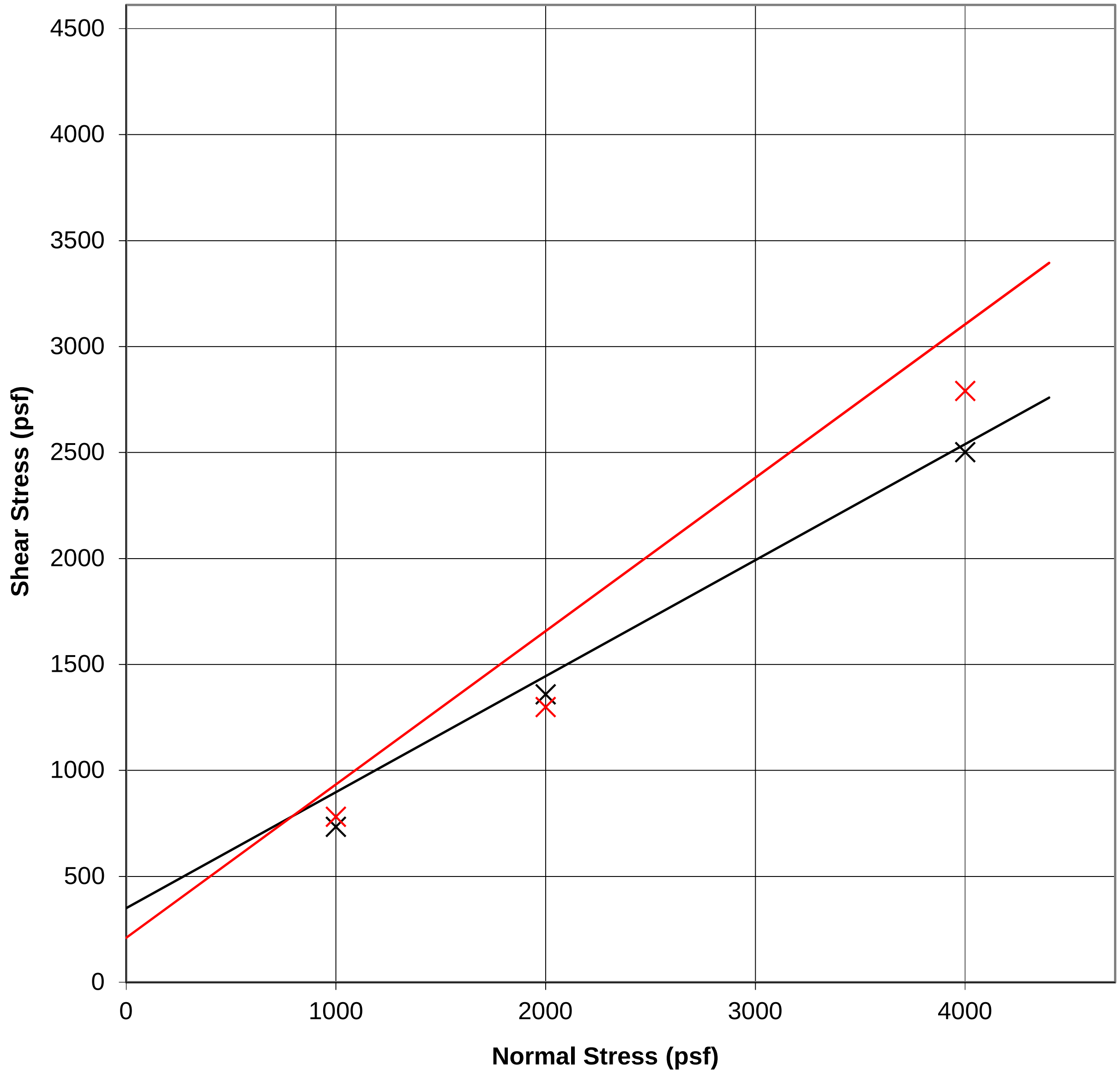
LABORATORY TEST RESULTS

PRELIMINARY GEOTECHNICAL INVESTIGATION
TERRACES MIXED USE DEVELOPMENT
MURRIETA HOT SPRINGS ROAD & INTERSTATE 15
MURRIETA, CALIFORNIA

APRIL, 2016 | PROJECT NO. T2673-22-01 | FIG B-1

SUMMARY OF ONE-DIMENSIONAL CONSOLIDATION (COLLAPSE) TESTS
ASTM D2435

Sample No.	In-situ Dry Density (pcf)	Moisture Content Before Test (%)	Final Moisture Content (%)	Axial Load with Water Added (psf)	Percent Collapse
B-7 @ 2.5’	118.6	4.2	12.6	2000	1.2
B-7 @ 5.0’	123.8	6.9	12.6	2500	0.6
B-7 @ 7.5’	124.3	9.3	11.9	2800	0.3
B-7 @ 10.0’	119.3	12.6	14.3	3000	0.2



SAMPLE ID	SOIL TYPE	INITIAL DRY DENSITY (pcf)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)	C (psf)	ϕ (deg)
*B-3 @ 0-5'	SM	111.4	12.2	21.3	350	28.7
B-3 @ 10'	SP	102.4	3.3	18.7	210	35.9

*Sample remolded to approximately 90% of the test maximum dry density at optimum moisture content.

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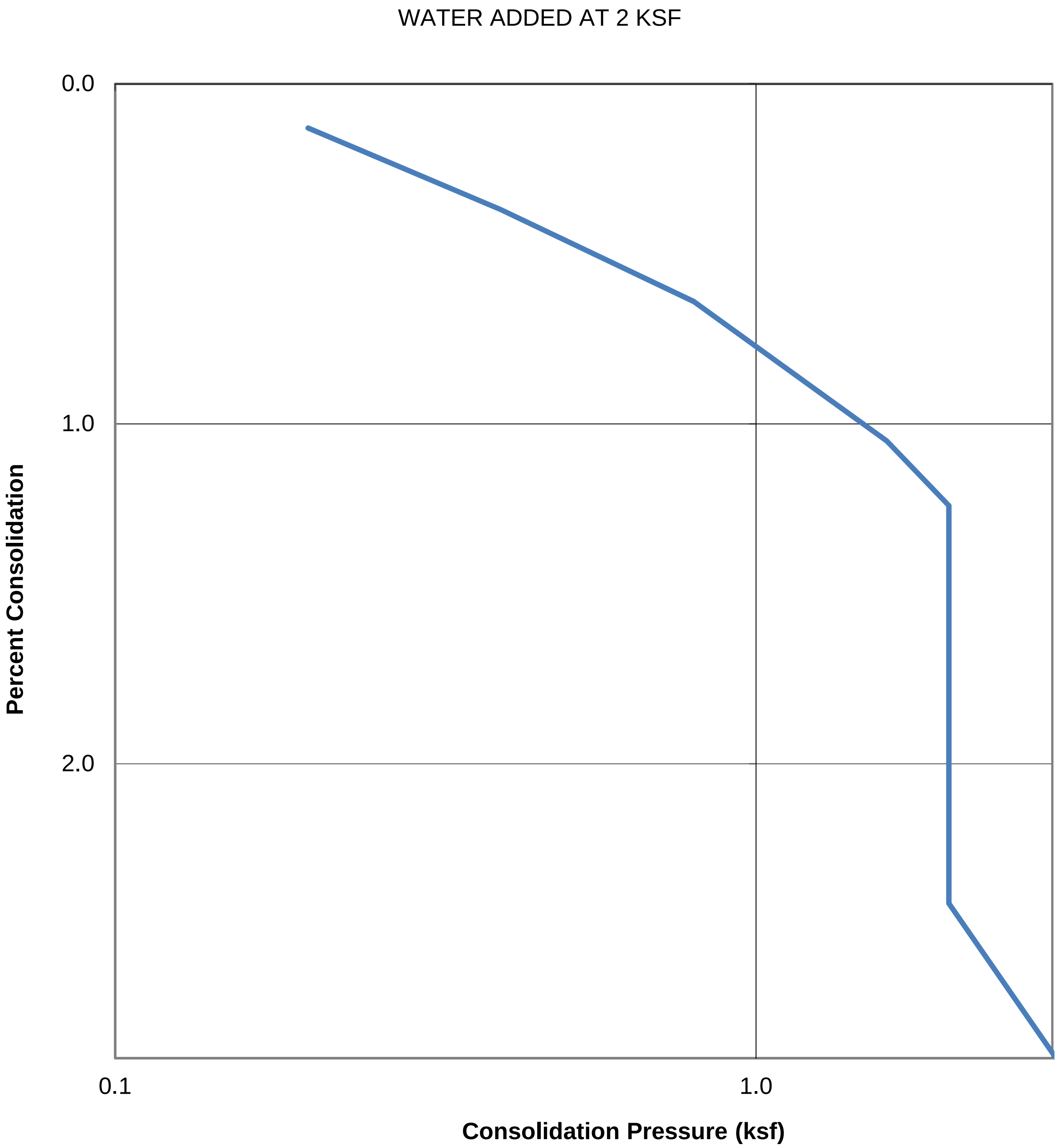
DIRECT SHEAR TEST RESULTS

PRELIMINARY GEOTECHNICAL INVESTIGATION
TERRACES MIXED USE DEVELOPMENT
MURRIETA HOT SPRINGS ROAD & INTERSTATE 15
MURRIETA, CALIFORNIA

APRIL, 2016	PROJECT NO. T2673-22-01	FIG B-3



SAMPLE ID	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B-7 @ 2.5'	SC-SM	118.6	4.2	12.6

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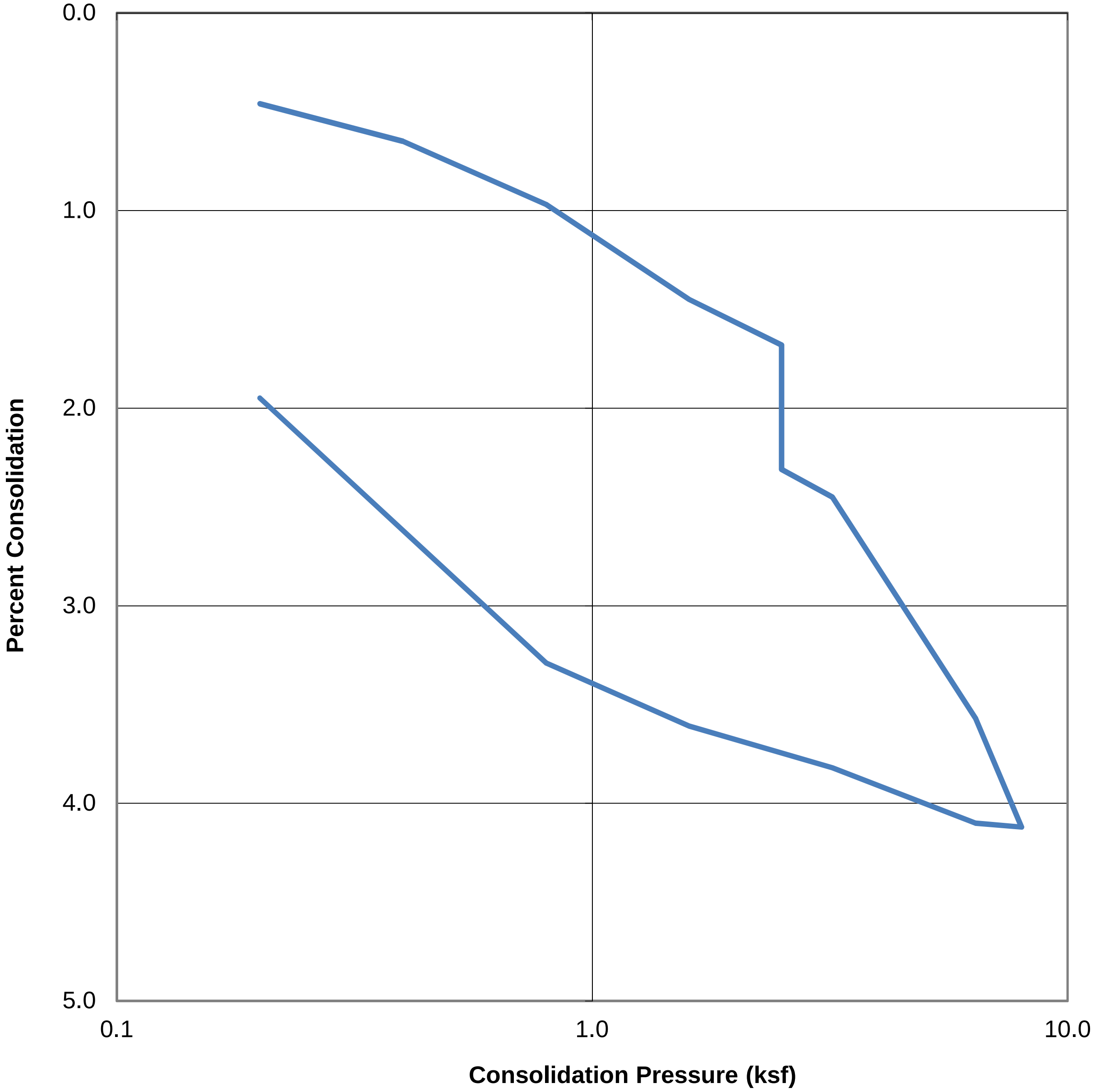
CONSOLIDATION TEST RESULTS

PRELIMINARY GEOTECHNICAL INVESTIGATION
TERRACES MIXED USE DEVELOPMENT
MURRIETA HOT SPRINGS ROAD & INTERSTATE 15
MURRIETA, CALIFORNIA

APRIL, 2016 | PROJECT NO. T2673-22-01 | FIG B4

WATER ADDED AT 2.5 KSF



SAMPLE ID	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B-7 @ 5'	SC	123.8	6.9	12.6

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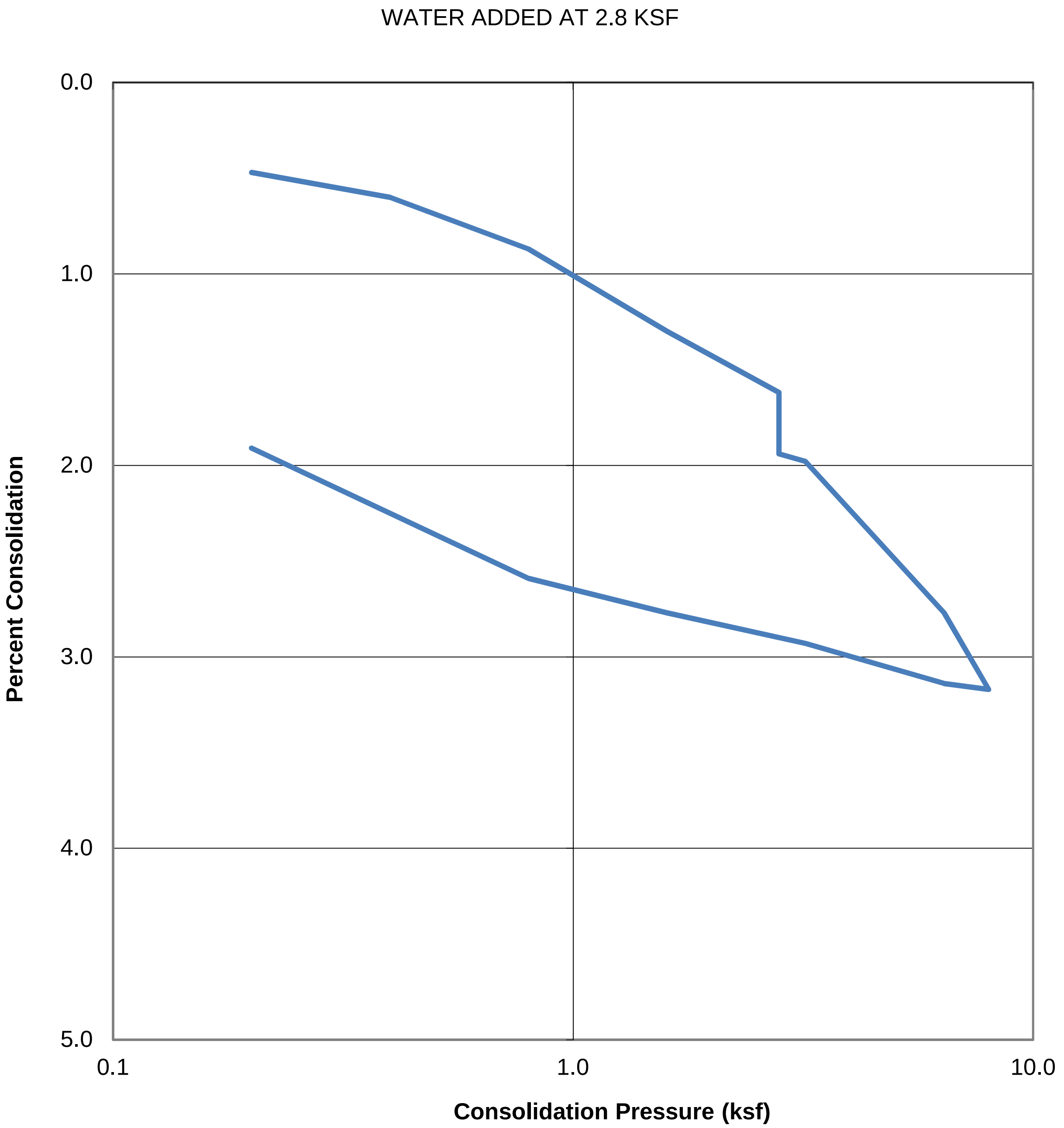
CONSOLIDATION TEST RESULTS

PRELIMINARY GEOTECHNICAL INVESTIGATION
TERRACES MIXED USE DEVELOPMENT
MURRIETA HOT SPRINGS ROAD & INTERSTATE 15
MURRIETA, CALIFORNIA

APRIL, 2016 | PROJECT NO. T2673-22-01 | FIG B5



SAMPLE ID	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B-7 @ 7.5'	SC	124.3	9.3	11.9

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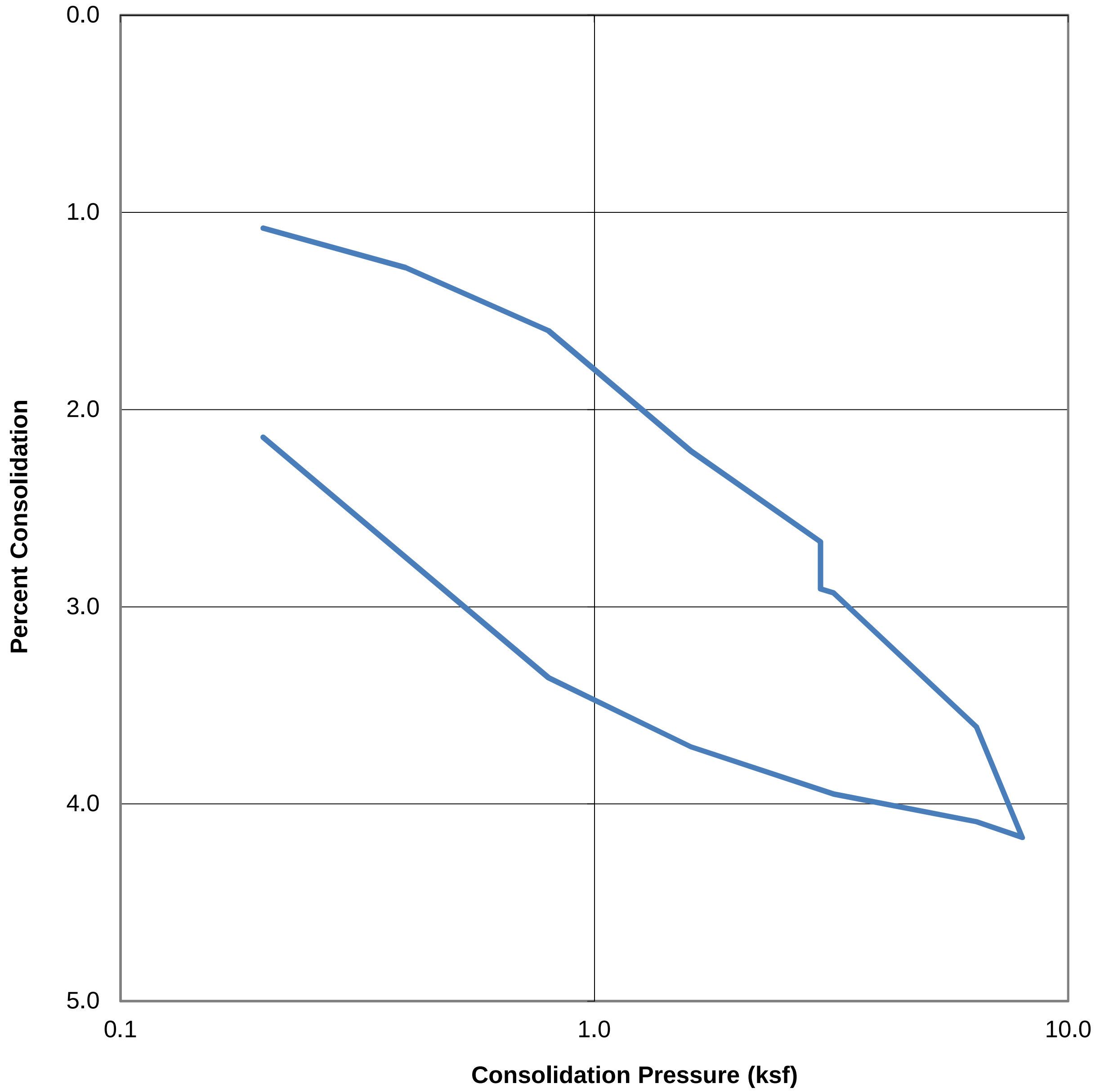
CONSOLIDATION TEST RESULTS

PRELIMINARY GEOTECHNICAL INVESTIGATION
TERRACES MIXED USE DEVELOPMENT
MURRIETA HOT SPRINGS ROAD & INTERSTATE 15
MURRIETA, CALIFORNIA

APRIL, 2016 | PROJECT NO. T2673-22-01 | FIG B6

WATER ADDED AT 3 KSF



SAMPLE ID	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B-7 @ 10'	SC/CL	119.3	12.6	14.3

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CONSOLIDATION TEST RESULTS

PRELIMINARY GEOTECHNICAL INVESTIGATION
TERRACES MIXED USE DEVELOPMENT
MURRIETA HOT SPRINGS ROAD & INTERSTATE 15
MURRIETA, CALIFORNIA

CER			APRIL, 2016	PROJECT NO. T2673-22-01	FIG B7

APPENDIX C

APPENDIX C

RECOMMENDED GRADING SPECIFICATIONS

FOR

TERRACES MIXED USE DEVELOPMENT
MURRIETA HOT SPRINGS ROAD & INTERSTATE 15
MURRIETA, CALIFORNIA

PROJECT NO. T2673-22-01

RECOMMENDED GRADING SPECIFICATIONS

1. GENERAL

1.1 These Recommended Grading Specifications shall be used in conjunction with the Geotechnical Report for the project prepared by Geocon. The recommendations contained in the text of the Geotechnical Report are a part of the earthwork and grading specifications and shall supersede the provisions contained hereinafter in the case of conflict.

1.2 Prior to the commencement of grading, a geotechnical consultant (Consultant) shall be employed for the purpose of observing earthwork procedures and testing the fills for substantial conformance with the recommendations of the Geotechnical Report and these specifications. The Consultant should provide adequate testing and observation services so that they may assess whether, in their opinion, the work was performed in substantial conformance with these specifications. It shall be the responsibility of the Contractor to assist the Consultant and keep them apprised of work schedules and changes so that personnel may be scheduled accordingly.

1.3 It shall be the sole responsibility of the Contractor to provide adequate equipment and methods to accomplish the work in accordance with applicable grading codes or agency ordinances, these specifications and the approved grading plans. If, in the opinion of the Consultant, unsatisfactory conditions such as questionable soil materials, poor moisture condition, inadequate compaction, and/or adverse weather result in a quality of work not in conformance with these specifications, the Consultant will be empowered to reject the work and recommend to the Owner that grading be stopped until the unacceptable conditions are corrected.

2. DEFINITIONS

2.1 **Owner** shall refer to the owner of the property or the entity on whose behalf the grading work is being performed and who has contracted with the Contractor to have grading performed.

2.2 **Contractor** shall refer to the Contractor performing the site grading work.

2.3 **Civil Engineer** or **Engineer of Work** shall refer to the California licensed Civil Engineer or consulting firm responsible for preparation of the grading plans, surveying and verifying as-graded topography.

2.4 **Consultant** shall refer to the soil engineering and engineering geology consulting firm retained to provide geotechnical services for the project.

2.5 **Soil Engineer** shall refer to a California licensed Civil Engineer retained by the Owner, who is experienced in the practice of geotechnical engineering. The Soil Engineer shall be responsible for having qualified representatives on-site to observe and test the Contractor's work for conformance with these specifications.

2.6 **Engineering Geologist** shall refer to a California licensed Engineering Geologist retained by the Owner to provide geologic observations and recommendations during the site grading.

2.7 **Geotechnical Report** shall refer to a soil report (including all addenda) which may include a geologic reconnaissance or geologic investigation that was prepared specifically for the development of the project for which these Recommended Grading Specifications are intended to apply.

3. MATERIALS

3.1 Materials for compacted fill shall consist of any soil excavated from the cut areas or imported to the site that, in the opinion of the Consultant, is suitable for use in construction of fills. In general, fill materials can be classified as *soil* fills, *soil-rock* fills or *rock* fills, as defined below.

3.1.1 **Soil fills** are defined as fills containing no rocks or hard lumps greater than 12 inches in maximum dimension and containing at least 40 percent by weight of material smaller than ¾ inch in size.

3.1.2 **Soil-rock fills** are defined as fills containing no rocks or hard lumps larger than 4 feet in maximum dimension and containing a sufficient matrix of soil fill to allow for proper compaction of soil fill around the rock fragments or hard lumps as specified in Paragraph 6.2. **Oversize rock** is defined as material greater than 12 inches.

3.1.3 **Rock fills** are defined as fills containing no rocks or hard lumps larger than 3 feet in maximum dimension and containing little or no fines. Fines are defined as material smaller than ¾ inch in maximum dimension. The quantity of fines shall be less than approximately 20 percent of the rock fill quantity.

3.2 Material of a perishable, spongy, or otherwise unsuitable nature as determined by the Consultant shall not be used in fills.

3.3 Materials used for fill, either imported or on-site, shall not contain hazardous materials as defined by the California Code of Regulations, Title 22, Division 4, Chapter 30, Articles 9 and 10; 40CFR; and any other applicable local, state or federal laws. The Consultant shall not be responsible for the identification or analysis of the potential presence of hazardous materials. However, if observations, odors or soil discoloration cause Consultant to suspect the presence of hazardous materials, the Consultant may request from the Owner the termination of grading operations within the affected area. Prior to resuming grading operations, the Owner shall provide a written report to the Consultant indicating that the suspected materials are not hazardous as defined by applicable laws and regulations.

3.4 The outer 15 feet of *soil-rock* fill slopes, measured horizontally, should be composed of properly compacted *soil* fill materials approved by the Consultant. *Rock* fill may extend to the slope face, provided that the slope is not steeper than 2:1 (horizontal:vertical) and a soil layer no thicker than 12 inches is track-walked onto the face for landscaping purposes. This procedure may be utilized provided it is acceptable to the governing agency, Owner and Consultant.

3.5 Samples of soil materials to be used for fill should be tested in the laboratory by the Consultant to determine the maximum density, optimum moisture content, and, where appropriate, shear strength, expansion, and gradation characteristics of the soil.

3.6 During grading, soil or groundwater conditions other than those identified in the Geotechnical Report may be encountered by the Contractor. The Consultant shall be notified immediately to evaluate the significance of the unanticipated condition

4. CLEARING AND PREPARING AREAS TO BE FILLED

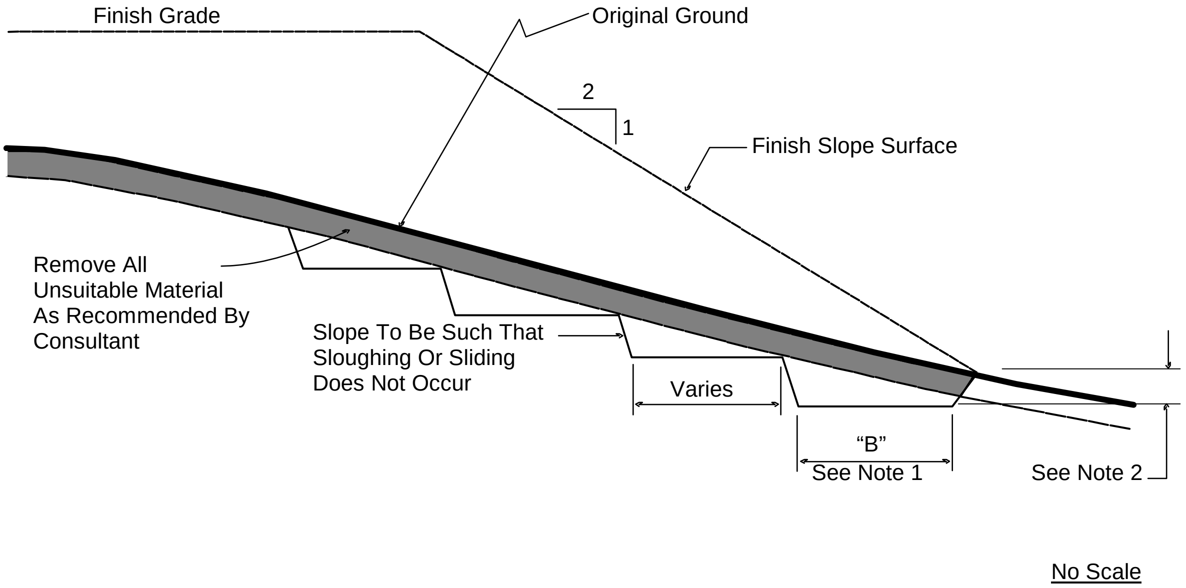
4.1 Areas to be excavated and filled shall be cleared and grubbed. Clearing shall consist of complete removal above the ground surface of trees, stumps, brush, vegetation, man-made structures, and similar debris. Grubbing shall consist of removal of stumps, roots, buried logs and other unsuitable material and shall be performed in areas to be graded. Roots and other projections exceeding 1½ inches in diameter shall be removed to a depth of 3 feet below the surface of the ground. Borrow areas shall be grubbed to the extent necessary to provide suitable fill materials.

4.2 Asphalt pavement material removed during clearing operations should be properly disposed at an approved off-site facility or in an acceptable area of the project evaluated by Geocon and the property owner. Concrete fragments that are free of reinforcing steel may be placed in fills, provided they are placed in accordance with Section 6.2 or 6.3 of this document.

4.3 After clearing and grubbing of organic matter and other unsuitable material, loose or porous soils shall be removed to the depth recommended in the Geotechnical Report. The depth of removal and compaction should be observed and approved by a representative of the Consultant. The exposed surface shall then be plowed or scarified to a minimum depth of 6 inches and until the surface is free from uneven features that would tend to prevent uniform compaction by the equipment to be used.

4.4 Where the slope ratio of the original ground is steeper than 5:1 (horizontal:vertical), or where recommended by the Consultant, the original ground should be benched in accordance with the following illustration.

TYPICAL BENCHING DETAIL



DETAIL NOTES: (1) Key width "B" should be a minimum of 10 feet, or sufficiently wide to permit complete coverage with the compaction equipment used. The base of the key should be graded horizontal, or inclined slightly into the natural slope.

(2) The outside of the key should be below the topsoil or unsuitable surficial material and at least 2 feet into dense formational material. Where hard rock is exposed in the bottom of the key, the depth and configuration of the key may be modified as approved by the Consultant.

4.5 After areas to receive fill have been cleared and scarified, the surface should be moisture conditioned to achieve the proper moisture content, and compacted as recommended in Section 6 of these specifications.

5. COMPACTION EQUIPMENT

5.1 Compaction of *soil* or *soil-rock* fill shall be accomplished by sheepsfoot or segmented-steel wheeled rollers, vibratory rollers, multiple-wheel pneumatic-tired rollers, or other types of acceptable compaction equipment. Equipment shall be of such a design that it will be capable of compacting the *soil* or *soil-rock* fill to the specified relative compaction at the specified moisture content.

5.2 Compaction of *rock* fills shall be performed in accordance with Section 6.3.

6. PLACING, SPREADING AND COMPACTION OF FILL MATERIAL

6.1 *Soil* fill, as defined in Paragraph 3.1.1, shall be placed by the Contractor in accordance with the following recommendations:

6.1.1 *Soil* fill shall be placed by the Contractor in layers that, when compacted, should generally not exceed 8 inches. Each layer shall be spread evenly and shall be thoroughly mixed during spreading to obtain uniformity of material and moisture in each layer. The entire fill shall be constructed as a unit in nearly level lifts. Rock materials greater than 12 inches in maximum dimension shall be placed in accordance with Section 6.2 or 6.3 of these specifications.

6.1.2 In general, the *soil* fill shall be compacted at a moisture content at or above the optimum moisture content as determined by ASTM D 1557.

6.1.3 When the moisture content of *soil* fill is below that specified by the Consultant, water shall be added by the Contractor until the moisture content is in the range specified.

6.1.4 When the moisture content of the *soil* fill is above the range specified by the Consultant or too wet to achieve proper compaction, the *soil* fill shall be aerated by the Contractor by blading/mixing, or other satisfactory methods until the moisture content is within the range specified.

6.1.5 After each layer has been placed, mixed, and spread evenly, it shall be thoroughly compacted by the Contractor to a relative compaction of at least 90 percent. Relative compaction is defined as the ratio (expressed in percent) of the in-place dry density of the compacted fill to the maximum laboratory dry density as determined in accordance with ASTM D 1557. Compaction shall be continuous over the entire area, and compaction equipment shall make sufficient passes so that the specified minimum relative compaction has been achieved throughout the entire fill.

6.1.6 Where practical, soils having an Expansion Index greater than 50 should be placed at least 3 feet below finish pad grade and should be compacted at a moisture content generally 2 to 4 percent greater than the optimum moisture content for the material.

6.1.7 Properly compacted *soil* fill shall extend to the design surface of fill slopes. To achieve proper compaction, it is recommended that fill slopes be over-built by at least 3 feet and then cut to the design grade. This procedure is considered preferable to track-walking of slopes, as described in the following paragraph.

6.1.8 As an alternative to over-building of slopes, slope faces may be back-rolled with a heavy-duty loaded sheepsfoot or vibratory roller at maximum 4-foot fill height intervals. Upon completion, slopes should then be track-walked with a D-8 dozer or similar equipment, such that a dozer track covers all slope surfaces at least twice.

6.2 *Soil-rock* fill, as defined in Paragraph 3.1.2, shall be placed by the Contractor in accordance with the following recommendations:

6.2.1 Rocks larger than 12 inches but less than 4 feet in maximum dimension may be incorporated into the compacted *soil* fill, but shall be limited to the area measured 15 feet minimum horizontally from the slope face and 5 feet below finish grade or 3 feet below the deepest utility, whichever is deeper.

6.2.2 Rocks or rock fragments up to 4 feet in maximum dimension may either be individually placed or placed in windrows. Under certain conditions, rocks or rock fragments up to 10 feet in maximum dimension may be placed using similar methods. The acceptability of placing rock materials greater than 4 feet in maximum dimension shall be evaluated during grading as specific cases arise and shall be approved by the Consultant prior to placement.

6.2.3 For individual placement, sufficient space shall be provided between rocks to allow for passage of compaction equipment.

6.2.4 For windrow placement, the rocks should be placed in trenches excavated in properly compacted *soil* fill. Trenches should be approximately 5 feet wide and 4 feet deep in maximum dimension. The voids around and beneath rocks should be filled with approved granular soil having a Sand Equivalent of 30 or greater and should be compacted by flooding. Windrows may also be placed utilizing an "open-face" method in lieu of the trench procedure, however, this method should first be approved by the Consultant.

6.2.5 Windrows should generally be parallel to each other and may be placed either parallel to or perpendicular to the face of the slope depending on the site geometry. The minimum horizontal spacing for windrows shall be 12 feet center-to-center with a 5-foot stagger or offset from lower courses to next overlying course. The minimum vertical spacing between windrow courses shall be 2 feet from the top of a lower windrow to the bottom of the next higher windrow.

6.2.6 Rock placement, fill placement and flooding of approved granular soil in the windrows should be continuously observed by the Consultant.

6.3 *Rock* fills, as defined in Section 3.1.3, shall be placed by the Contractor in accordance with the following recommendations:

6.3.1 The base of the *rock* fill shall be placed on a sloping surface (minimum slope of 2 percent). The surface shall slope toward suitable subdrainage outlet facilities. The *rock* fills shall be provided with subdrains during construction so that a hydrostatic pressure buildup does not develop. The subdrains shall be permanently connected to controlled drainage facilities to control post-construction infiltration of water.

6.3.2 *Rock* fills shall be placed in lifts not exceeding 3 feet. Placement shall be by rock trucks traversing previously placed lifts and dumping at the edge of the currently placed lift. Spreading of the *rock* fill shall be by dozer to facilitate *seating* of the rock. The *rock* fill shall be watered heavily during placement. Watering shall consist of water trucks traversing in front of the current rock lift face and spraying water continuously during rock placement. Compaction equipment with compactive energy comparable to or greater than that of a 20-ton steel vibratory roller or other compaction equipment providing suitable energy to achieve the required compaction or deflection as recommended in Paragraph 6.3.3 shall be utilized. The number of passes to be made should be determined as described in Paragraph 6.3.3. Once a *rock* fill lift has been covered with *soil* fill, no additional *rock* fill lifts will be permitted over the *soil* fill.

6.3.3 Plate bearing tests, in accordance with ASTM D 1196, may be performed in both the compacted *soil* fill and in the *rock* fill to aid in determining the required minimum number of passes of the compaction equipment. If performed, a minimum of three plate bearing tests should be performed in the properly compacted *soil* fill (minimum relative compaction of 90 percent). Plate bearing tests shall then be performed on areas of *rock* fill having two passes, four passes and six passes of the compaction equipment, respectively. The number of passes required for the *rock* fill shall be determined by comparing the results of the plate bearing tests for the *soil* fill and the *rock* fill and by evaluating the deflection variation with number of passes. The required number of passes of the compaction equipment will be performed as necessary until the plate bearing deflections are equal to or less than that determined for the properly compacted *soil* fill. In no case will the required number of passes be less than two.

6.3.4 A representative of the Consultant should be present during *rock* fill operations to observe that the minimum number of "passes" have been obtained, that water is being properly applied and that specified procedures are being followed. The actual number of plate bearing tests will be determined by the Consultant during grading.

6.3.5 Test pits shall be excavated by the Contractor so that the Consultant can state that, in their opinion, sufficient water is present and that voids between large rocks are properly filled with smaller rock material. In-place density testing will not be required in the *rock* fills.

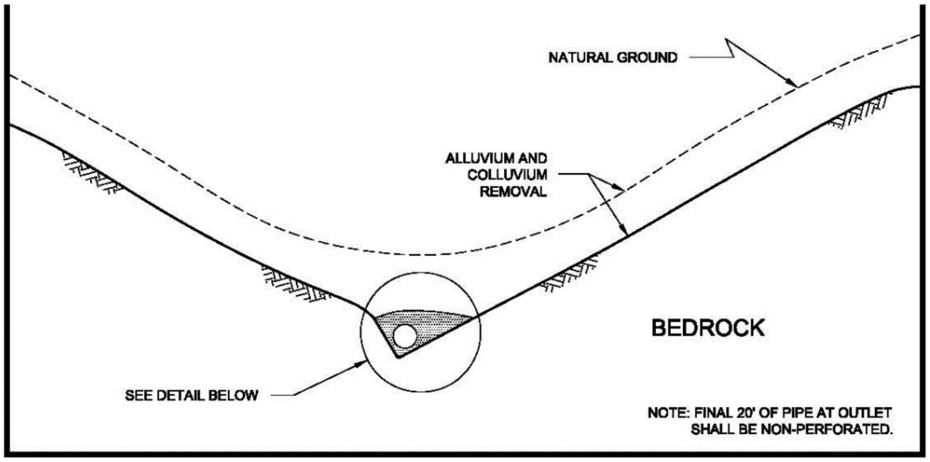
6.3.6 To reduce the potential for "piping" of fines into the *rock* fill from overlying *soil* fill material, a 2-foot layer of graded filter material shall be placed above the uppermost lift of *rock* fill. The need to place graded filter material below the *rock* should be determined by the Consultant prior to commencing grading. The gradation of the graded filter material will be determined at the time the *rock* fill is being excavated. Materials typical of the *rock* fill should be submitted to the Consultant in a timely manner, to allow design of the graded filter prior to the commencement of *rock* fill placement.

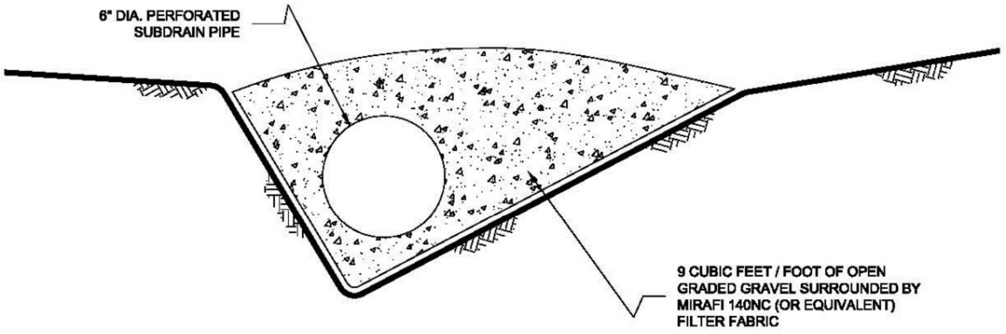
6.3.7 *Rock* fill placement should be continuously observed during placement by the Consultant.

7. SUBDRAINS

7.1 The geologic units on the site may have permeability characteristics and/or fracture systems that could be susceptible under certain conditions to seepage. The use of canyon subdrains may be necessary to mitigate the potential for adverse impacts associated with seepage conditions. Canyon subdrains with lengths in excess of 500 feet or extensions of existing offsite subdrains should use 8-inch-diameter pipes. Canyon subdrains less than 500 feet in length should use 6-inch-diameter pipes.

TYPICAL CANYON DRAIN DETAIL





NOTES:

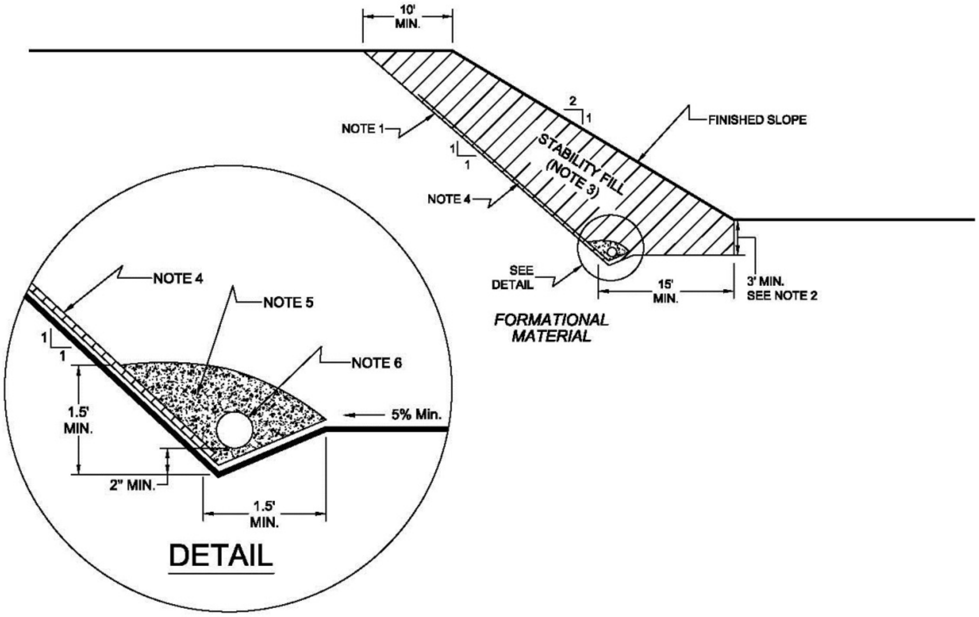
1......6-INCH DIAMETER, SCHEDULE 80 PVC PERFORATED PIPE FOR FILLS IN EXCESS OF 100-FEET IN DEPTH OR A PIPE LENGTH OF LONGER THAN 500 FEET.

2......6-INCH DIAMETER, SCHEDULE 40 PVC PERFORATED PIPE FOR FILLS LESS THAN 100-FEET IN DEPTH OR A PIPE LENGTH SHORTER THAN 500 FEET.

NO SCALE

7.2 Slope drains within stability fill keyways should use 4-inch-diameter (or lager) pipes.

TYPICAL STABILITY FILL DETAIL



NOTES:

1.....EXCAVATE BACKCUT AT 1:1 INCLINATION (UNLESS OTHERWISE NOTED).

2.....BASE OF STABILITY FILL TO BE 3 FEET INTO FORMATIONAL MATERIAL, SLOPING A MINIMUM 5% INTO SLOPE.

3.....STABILITY FILL TO BE COMPOSED OF PROPERLY COMPACTED GRANULAR SOIL.

4.....CHIMNEY DRAINS TO BE APPROVED PREFABRICATED CHIMNEY DRAIN PANELS (MIRADRAIN G200N OR EQUIVALENT) SPACED APPROXIMATELY 20 FEET CENTER TO CENTER AND 4 FEET WIDE. CLOSER SPACING MAY BE REQUIRED IF SEEPAGE IS ENCOUNTERED.

5.....FILTER MATERIAL TO BE 3/4-INCH, OPEN-GRADED CRUSHED ROCK ENCLOSED IN APPROVED FILTER FABRIC (MIRAFI 140NC).

6.....COLLECTOR PIPE TO BE 4-INCH MINIMUM DIAMETER, PERFORATED, THICK-WALLED PVC SCHEDULE 40 OR EQUIVALENT, AND SLOPED TO DRAIN AT 1 PERCENT MINIMUM TO APPROVED OUTLET.

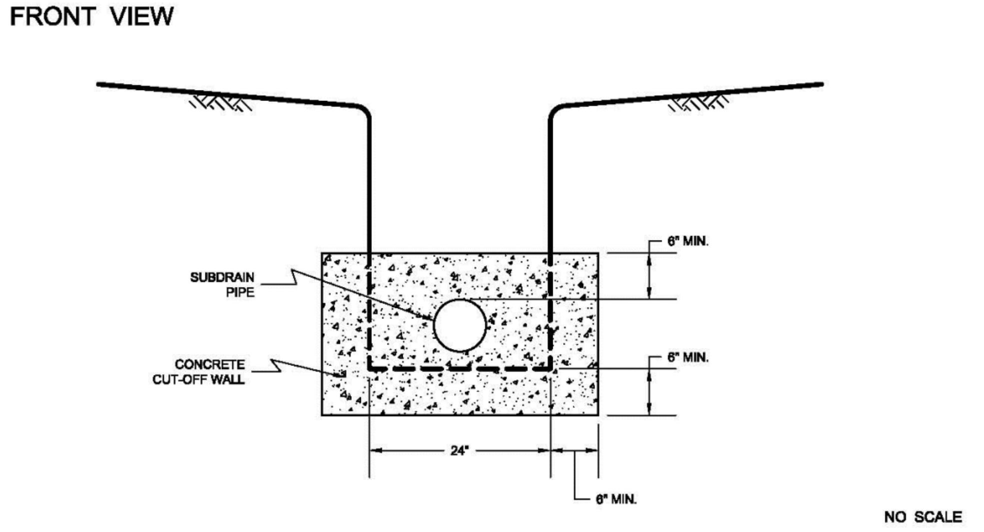
NO SCALE

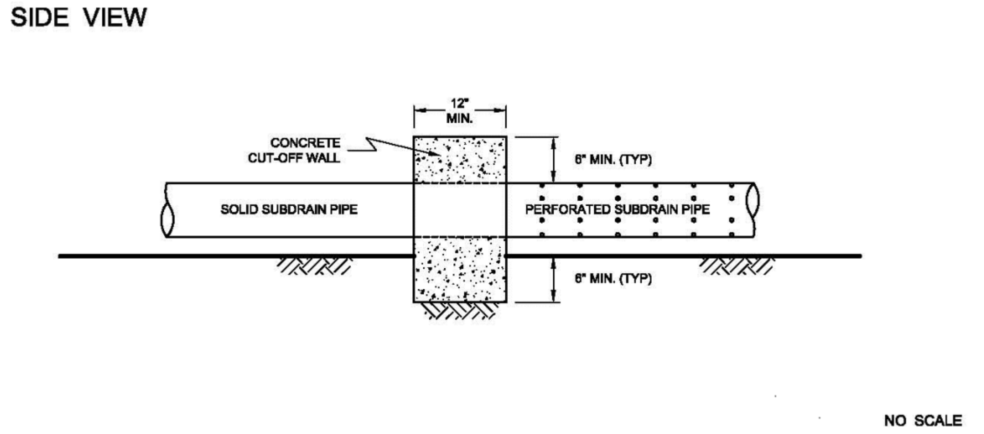
7.3 The actual subdrain locations will be evaluated in the field during the remedial grading operations. Additional drains may be necessary depending on the conditions observed and the requirements of the local regulatory agencies. Appropriate subdrain outlets should be evaluated prior to finalizing 40-scale grading plans.

7.4 *Rock* fill or *soil-rock* fill areas may require subdrains along their down-slope perimeters to mitigate the potential for buildup of water from construction or landscape irrigation. The subdrains should be at least 6-inch-diameter pipes encapsulated in gravel and filter fabric. *Rock* fill drains should be constructed using the same requirements as canyon subdrains.

7.5 Prior to outletting, the final 20-foot segment of a subdrain that will not be extended during future development should consist of non-perforated drainpipe. At the non-perforated/ perforated interface, a seepage cutoff wall should be constructed on the downslope side of the pipe.

TYPICAL CUT OFF WALL DETAIL

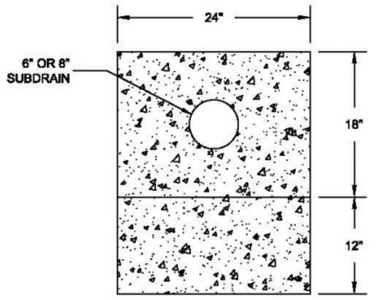




7.6 Subdrains that discharge into a natural drainage course or open space area should be provided with a permanent headwall structure.

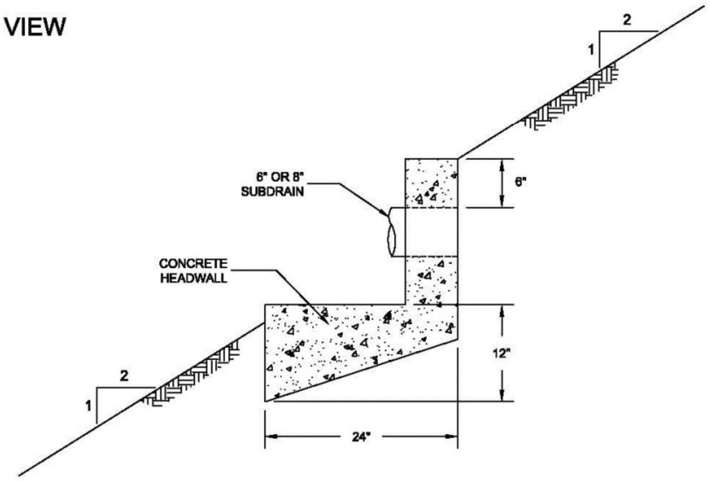
TYPICAL HEADWALL DETAIL

FRONT VIEW



NO SCALE

SIDE VIEW



NOTE: HEADWALL SHOULD OUTLET AT TOE OF FILL SLOPE
OR INTO CONTROLLED SURFACE DRAINAGE

NO SCALE

7.7 The final grading plans should show the location of the proposed subdrains. After completion of remedial excavations and subdrain installation, the project civil engineer should survey the drain locations and prepare an “as-built” map showing the drain locations. The final outlet and connection locations should be determined during grading operations. Subdrains that will be extended on adjacent projects after grading can be placed on formational material and a vertical riser should be placed at the end of the subdrain. The grading contractor should consider videoing the subdrains shortly after burial to check proper installation and functionality. The contractor is responsible for the performance of the drains.

8. OBSERVATION AND TESTING

8.1 The Consultant shall be the Owner's representative to observe and perform tests during clearing, grubbing, filling, and compaction operations. In general, no more than 2 feet in vertical elevation of *soil* or *soil-rock* fill should be placed without at least one field density test being performed within that interval. In addition, a minimum of one field density test should be performed for every 2,000 cubic yards of *soil* or *soil-rock* fill placed and compacted.

8.2 The Consultant should perform a sufficient distribution of field density tests of the compacted *soil* or *soil-rock* fill to provide a basis for expressing an opinion whether the fill material is compacted as specified. Density tests shall be performed in the compacted materials below any disturbed surface. When these tests indicate that the density of any layer of fill or portion thereof is below that specified, the particular layer or areas represented by the test shall be reworked until the specified density has been achieved.

8.3 During placement of *rock* fill, the Consultant should observe that the minimum number of passes have been obtained per the criteria discussed in Section 6.3.3. The Consultant should request the excavation of observation pits and may perform plate bearing tests on the placed *rock* fills. The observation pits will be excavated to provide a basis for expressing an opinion as to whether the *rock* fill is properly seated and sufficient moisture has been applied to the material. When observations indicate that a layer of *rock* fill or any portion thereof is below that specified, the affected layer or area shall be reworked until the *rock* fill has been adequately seated and sufficient moisture applied.

8.4 A settlement monitoring program designed by the Consultant may be conducted in areas of *rock* fill placement. The specific design of the monitoring program shall be as recommended in the Conclusions and Recommendations section of the project Geotechnical Report or in the final report of testing and observation services performed during grading.

8.5 We should observe the placement of subdrains, to check that the drainage devices have been placed and constructed in substantial conformance with project specifications.

8.6 Testing procedures shall conform to the following Standards as appropriate:

8.6.1 Soil and Soil-Rock Fills:

8.6.1.1 Field Density Test, ASTM D 1556, *Density of Soil In-Place By the Sand-Cone Method.*

8.6.1.2 Field Density Test, Nuclear Method, ASTM D 6938, *Density of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth).*

8.6.1.3 Laboratory Compaction Test, ASTM D 1557, *Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-Pound Hammer and 18-Inch Drop*.

8.6.1.4. Expansion Index Test, ASTM D 4829, *Expansion Index Test*.

9. PROTECTION OF WORK

9.1 During construction, the Contractor shall properly grade all excavated surfaces to provide positive drainage and prevent ponding of water. Drainage of surface water shall be controlled to avoid damage to adjoining properties or to finished work on the site. The Contractor shall take remedial measures to prevent erosion of freshly graded areas until such time as permanent drainage and erosion control features have been installed. Areas subjected to erosion or sedimentation shall be properly prepared in accordance with the Specifications prior to placing additional fill or structures.

9.2 After completion of grading as observed and tested by the Consultant, no further excavation or filling shall be conducted except in conjunction with the services of the Consultant.

10. CERTIFICATIONS AND FINAL REPORTS

10.1 Upon completion of the work, Contractor shall furnish Owner a certification by the Civil Engineer stating that the lots and/or building pads are graded to within 0.1 foot vertically of elevations shown on the grading plan and that all tops and toes of slopes are within 0.5 foot horizontally of the positions shown on the grading plans. After installation of a section of subdrain, the project Civil Engineer should survey its location and prepare an *as-built* plan of the subdrain location. The project Civil Engineer should verify the proper outlet for the subdrains and the Contractor should ensure that the drain system is free of obstructions.

10.2 The Owner is responsible for furnishing a final as-graded soil and geologic report satisfactory to the appropriate governing or accepting agencies. The as-graded report should be prepared and signed by a California licensed Civil Engineer experienced in geotechnical engineering and by a California Certified Engineering Geologist, indicating that the geotechnical aspects of the grading were performed in substantial conformance with the Specifications or approved changes to the Specifications.

Appendix 4: Historical Site Conditions

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

Examples of material to provide in Appendix 4 may include but are not limited to the following:

- Environmental Site Assessments conducted for the project,
- Other information on Past Site Use that impacts the feasibility of LID BMP implementation on the site.

This information should support the Full Infiltration Applicability, and Biofiltration Applicability sections of this Template. Refer to Section 2.3 of the SMR WQMP and Sections D of this Template.

N/A

Appendix 5: LID Feasibility Supplemental Information

Information that supports or supplements the determination of LID technical feasibility documented in Section D

Examples of material to provide in Appendix 5 may include but are not limited to the following:

- Technical feasibility criteria for DMAs
- Site specific analysis of technical infeasibility of all LID BMPs (if Alternative Compliance is needed)
- Documentation of Approval criteria for Proprietary Biofiltration BMPs

This information should support the Full Infiltration Applicability, and Biofiltration Applicability sections of this Template. Refer to Section 2.3 of the SMR WQMP and Sections D of this Template.

Appendix 6: LID BMP Design Details

BMP Sizing, Design Details and other Supporting Documentation to supplement Section D

Examples of material to provide in Appendix 6 may include but are not limited to the following:

- DCV calculations,
- LID BMP sizing calculations from Exhibit C of the SMR WQMP
- Design details/drawings from manufacturers for proprietary BMPs

This information should support the Full Infiltration Applicability, and Biofiltration Applicability sections of this Template. Refer to Section 3.4 of the SMR WQMP and Sections D.4 of this Template.

Santa Margarita Watershed

V_{BMP} and Q_{BMP} worksheets

These worksheets are to be used to determine the required

Design Capture Volume (V_{BMP})
or the
Design Flow Rate (Q_{BMP})

for BMPs in the Santa Margarita Watershed

To verify which watershed your project is located within, visit

www.rcflood.org/npdes

and use the 'Locate my Watershed' tool

If your project is not located in the Santa Margarita Watershed,

Do not use these worksheets! Instead visit

www.rcflood.org/npdes/developers.aspx

To access worksheets applicable to your watershed

Use the tabs across the bottom
to access the worksheets for the Santa Margarita Watershed

Santa Margarita Watershed

BMP Design Volume, V_{BMP} (Rev. 03-2012)

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	Kimley-Horn and Associates	Date	1/13/2022
Designed by	MAG	County/City Case No	
Company Project Number/Name	195120004 - The Terraces - Murrieta		
Drainage Area Number/Name	DMA B1		

Enter the Area Tributary to this Feature $A_T =$ 5.71 acres

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

Site Location

Township MURRIETA
Range R 03 W
Section T 07 S

Enter the 85^{th} Percentile, 24-hour Rainfall Depth $D_{85} =$ 0.81

Determine the Effective Impervious Fraction

Type of post-development surface cover (use pull down menu): Mixed Surface Types

Effective Impervious Fraction $I_f =$ 0.82

Calculate the composite Runoff Coefficient, C for the BMP Tributary Area

Use the following equation based on the WEF/ASCE Method

$C = 0.858I_f^3 - 0.78I_f^2 + 0.774I_f + 0.04$ $C =$ 0.62

Determine Design Storage Volume, V_{BMP}

Calculate V_U, the 85% Unit Storage Volume $V_U = D_{85} \times C$ $V_u =$ 0.50 (in*ac)/ac

Calculate the design storage volume of the BMP, V_{BMP}.

$$V_{BMP}\ (ft^3) = \frac{V_U\ (in\text{-}ac/ac) \times A_T\ (ac) \times 43{,}560\ (ft^2/ac)}{12\ (in/ft)}$$

$V_{BMP} =$ 10,364 ft^3

Notes:

Santa Margarita Watershed

BMP Design Volume, V_{BMP} (Rev. 03-2012)

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: Kimley-Horn and Associates
Date: 1/13/2022
Designed by: MAG
County/City Case No:
Company Project Number/Name: 195120004 - The Terraces - Murrieta
Drainage Area Number/Name: DMA B3

Enter the Area Tributary to this Feature $A_T =$ 3.91 acres

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

Site Location

Township: MURRIETA
Range: R 03 W
Section: T 07 S

Enter the 85^{th} Percentile, 24-hour Rainfall Depth $D_{85} =$ 0.81

Determine the Effective Impervious Fraction

Type of post-development surface cover (use pull down menu): Mixed Surface Types

Effective Impervious Fraction $I_f =$ 0.82

Calculate the composite Runoff Coefficient, C for the BMP Tributary Area

Use the following equation based on the WEF/ASCE Method

$C = 0.858I_f^3 - 0.78I_f^2 + 0.774I_f + 0.04$ $C =$ 0.62

Determine Design Storage Volume, V_{BMP}

Calculate V_U, the 85% Unit Storage Volume $V_U = D_{85} \times C$ $V_u =$ 0.50 (in*ac)/ac

Calculate the design storage volume of the BMP, V_{BMP}.

$$V_{BMP}\ (ft^3) = \frac{V_U\ (in\text{-}ac/ac) \times A_T\ (ac) \times 43{,}560\ (ft^2/ac)}{12\ (in/ft)}$$

$V_{BMP} =$ 7,097 ft^3

Notes:

Santa Margarita Watershed

BMP Design Volume, V_{BMP} (Rev. 03-2012)

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: Kimley-Horn and Associates

Date: 1/13/2022

Designed by: MAG

County/City Case No:

Company Project Number/Name: 195120004 - The Terraces - Murrieta

Drainage Area Number/Name: DMA B4

Enter the Area Tributary to this Feature $A_T =$ 2.91 acres

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

Site Location

Township: MURRIETA

Range: R 03 W

Section: T 07 S

Enter the 85th Percentile, 24-hour Rainfall Depth $D_{85} =$ 0.81

Determine the Effective Impervious Fraction

Type of post-development surface cover (use pull down menu): Mixed Surface Types

Effective Impervious Fraction $I_f =$ 0.82

Calculate the composite Runoff Coefficient, C for the BMP Tributary Area

Use the following equation based on the WEF/ASCE Method

$C = 0.858I_f^3 - 0.78I_f^2 + 0.774I_f + 0.04$ $C =$ 0.62

Determine Design Storage Volume, V_{BMP}

Calculate V_U, the 85% Unit Storage Volume $V_U = D_{85} \times C$ $V_u =$ 0.50 (in*ac)/ac

Calculate the design storage volume of the BMP, V_{BMP}.

$$V_{BMP}\ (ft^3) = \frac{V_U\ (in\text{-}ac/ac) \times A_T\ (ac) \times 43{,}560\ (ft^2/ac)}{12\ (in/ft)}$$

$V_{BMP} =$ 5,282 ft^3

Notes:

Santa Margarita Watershed

BMP Design Volume, V_{BMP} (Rev. 03-2012)

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 Kimley-Horn and Associates

Date 1/13/2022

Designed by MAG

County/City Case No

Company Project Number/Name 195120004 - The Terraces - Murrieta

Drainage Area Number/Name DMA B5

Enter the Area Tributary to this Feature $A_T =$ 4.16 acres

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

Site Location

Township MURRIETA

Range R 03 W

Section T 07 S

Enter the 85th Percentile, 24-hour Rainfall Depth $D_{85} =$ 0.81

Determine the Effective Impervious Fraction

Type of post-development surface cover (use pull down menu) Mixed Surface Types

Effective Impervious Fraction $I_f =$ 0.82

Calculate the composite Runoff Coefficient, C for the BMP Tributary Area

Use the following equation based on the WEF/ASCE Method

$C = 0.858I_f^3 - 0.78I_f^2 + 0.774I_f + 0.04$ $C =$ 0.62

Determine Design Storage Volume, V_{BMP}

Calculate V_U, the 85% Unit Storage Volume $V_U = D_{85} \times C$ $V_u =$ 0.50 (in*ac)/ac

Calculate the design storage volume of the BMP, V_{BMP}.

$$V_{BMP}\ (ft^3) = \frac{V_U\ (in\text{-}ac/ac) \times A_T\ (ac) \times 43,560\ (ft^2/ac)}{12\ (in/ft)}$$

$V_{BMP} =$ 7,550 ft^3

Notes:

Santa Margarita Watershed

BMP Design Volume, V_{BMP} (Rev. 03-2012)

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: Kimley-Horn and Associates
Date: 1/13/2022
Designed by: MAG
County/City Case No:
Company Project Number/Name: 195120004 - The Terraces - Murrieta
Drainage Area Number/Name: DMA D1

Enter the Area Tributary to this Feature $A_T =$ 3.22 acres

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

Site Location
Township: MURRIETA
Range: R 03 W
Section: T 07 S

Enter the 85^{th} Percentile, 24-hour Rainfall Depth $D_{85} =$ 0.79

Determine the Effective Impervious Fraction

Type of post-development surface cover (use pull down menu): Mixed Surface Types

Effective Impervious Fraction $I_f =$ 0.82

Calculate the composite Runoff Coefficient, C for the BMP Tributary Area

Use the following equation based on the WEF/ASCE Method

$C = 0.858I_f^3 - 0.78I_f^2 + 0.774I_f + 0.04$ $C =$ 0.62

Determine Design Storage Volume, V_{BMP}

Calculate V_U, the 85% Unit Storage Volume $V_U = D_{85} \times C$ $V_u =$ 0.49 (in*ac)/ac

Calculate the design storage volume of the BMP, V_{BMP}.

$$V_{BMP}\ (ft^3) = \frac{V_U\ (in\text{-}ac/ac) \times A_T\ (ac) \times 43{,}560\ (ft^2/ac)}{12\ (in/ft)}$$

$V_{BMP} =$ 5,727 ft^3

Notes:

Santa Margarita Watershed

BMP Design Volume, V_{BMP} (Rev. 03-2012)

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: Kimley-Horn and Associates
Date: 1/13/2022
Designed by: MAG
County/City Case No:
Company Project Number/Name: 195120004 - The Terraces - Murrieta
Drainage Area Number/Name: DMA D2

Enter the Area Tributary to this Feature $A_T =$ 3.34 acres

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

Site Location
Township: MURRIETA
Range: R 03 W
Section: T 07 S

Enter the 85^{th} Percentile, 24-hour Rainfall Depth $D_{85} =$ 0.79

Determine the Effective Impervious Fraction

Type of post-development surface cover (use pull down menu): Mixed Surface Types

Effective Impervious Fraction $I_f =$ 0.82

Calculate the composite Runoff Coefficient, C for the BMP Tributary Area

Use the following equation based on the WEF/ASCE Method

$C = 0.858I_f^3 - 0.78I_f^2 + 0.774I_f + 0.04$ $C =$ 0.62

Determine Design Storage Volume, V_{BMP}

Calculate V_U, the 85% Unit Storage Volume $V_U = D_{85} \times C$ $V_u =$ 0.49 (in*ac)/ac

Calculate the design storage volume of the BMP, V_{BMP}.

$$V_{BMP}\ (ft^3) = \frac{V_U\ (in\text{-}ac/ac) \times A_T\ (ac) \times 43{,}560\ (ft^2/ac)}{12\ (in/ft)}$$

$V_{BMP} =$ 5,941 ft^3

Notes:

Santa Margarita Watershed

BMP Design Flow Rate, Q_{BMP} (Rev. 03-2012)

Legend:
🟦 Required Entries
▨ Calculated Cells

Company Name Kimley-Horn
Date 1/6/2022
Designed by MAG
County/City Case No
Company Project Number/Name 195120004 - The Terraces - Murrieta
Drainage Area Number/Name DMA B2

Enter the Area Tributary to this Feature $A_T =$ 4.1 acres

Determine the Effective Impervious Fraction

Type of post-development surface cover (use pull down menu) Mixed Surface Types

Effective Impervious Fraction $I_f =$ 0.82

Calculate the composite Runoff Coefficient, C for the BMP Tributary Area

Use the following equation based on the WEF/ASCE Method

$C = 0.858I_f^3 - 0.78I_f^2 + 0.774I_f + 0.04$ $C =$ 0.62

BMP Design Flow Rate

$Q_{BMP} = C \times I \times A_T$ $Q_{BMP} =$ 0.5 ft^3/s

Notes:

Santa Margarita Watershed

BMP Design Flow Rate, Q_{BMP} (Rev. 03-2012)

Legend:
🟦 Required Entries
▨ Calculated Cells

Company Name Kimley-Horn

Date 1/6/2022

Designed by MAG

County/City Case No

Company Project Number/Name 195120004 - The Terraces - Murrieta

Drainage Area Number/Name DMA B5

Enter the Area Tributary to this Feature $A_T =$ 4.16 acres

Determine the Effective Impervious Fraction

Type of post-development surface cover (use pull down menu) Mixed Surface Types

Effective Impervious Fraction $I_f =$ 0.82

Calculate the composite Runoff Coefficient, C for the BMP Tributary Area

Use the following equation based on the WEF/ASCE Method

$C = 0.858I_f^3 - 0.78I_f^2 + 0.774I_f + 0.04$ C = 0.62

BMP Design Flow Rate

$Q_{BMP} = C \times I \times A_T$ $Q_{BMP} =$ 0.5 ft^3/s

Notes:

Santa Margarita Watershed

BMP Design Flow Rate, Q_{BMP} (Rev. 03-2012)

Legend:	
🟦	Required Entries
▨	Calculated Cells

Company Name Kimley-Horn

Date 1/6/2022

Designed by MAG

County/City Case No

Company Project Number/Name 195120004 - The Terraces - Murrieta

Drainage Area Number/Name DMA C1

Enter the Area Tributary to this Feature $A_T =$ 3.07 acres

Determine the Effective Impervious Fraction

Type of post-development surface cover (use pull down menu) Mixed Surface Types

Effective Impervious Fraction $I_f =$ 0.82

Calculate the composite Runoff Coefficient, C for the BMP Tributary Area

Use the following equation based on the WEF/ASCE Method

$C = 0.858I_f^3 - 0.78I_f^2 + 0.774I_f + 0.04$

C = 0.62

BMP Design Flow Rate

$Q_{BMP} = C \times I \times A_T$

$Q_{BMP} =$ 0.4 ft^3/s

Notes:

Bioretention Facility - Design Procedure	BMP ID B1	Legend:	Required Entries	🟦
			Calculated Cells	▨

Company Name: Kimley-Horn and Associates

Date: 1/14/2022

Designed by: MAG

County/City Case No.:

Design Volume

Enter the area tributary to this feature A_T= 5.7 acres

Enter V_{BMP} determined from Section 2.1 of this Handbook V_{BMP}= 10,364 ft^3

Enter the measured infiltration rate I= 0.50 in/hr

Enter the Factor of Safety (See Table 1, Appendix A: "Infiltration Testing" of this BMP Design Handbook) FS = 3.00

Enter factored infiltration rate (design) $I_{factored}$= 0.50 in/hr

Bioretention Facility Surface Area

Depth of Surface Ponding Layer (6" minimum, 12" maximum) d_P = 12.0 inches

Depth of Engineered Soil Media (24" to 36"; 18" allowed if vertically const d_s = 36.0 inches

Depth of Gravel Storage Layer (Optional Layer; up to 30") d_g = 9.0 inches

Note: Check that storage in gravel does not exceed the amount that can enter these systems during a typical storm event. The depth of effective stored water should be less than 12 inches (30 inch bulk depth) unless higher permeability media is used to allow faster filling of this layer.

Total Effective Depth, d_E

$$d_E(ft) = d_p(ft) + [(0.3) \times d_S(ft) + (0.4) \times d_g(ft)]$$

d_E = 2.20 feet

Required Effective Footprint Area, A_{BMP}

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

A_{BMP} = 4,711 ft^2

Proposed Surface Area (shall not be less than A_{BMP}) A= 4,980 ft^2

Note: This area shall be measured at the mid-ponding depth of the BMP. For systems with side-slopes, this should be the contour that is midway between the floor of the basin and the maximum water qualty ponding depth of the basin. The underlying gravel layer should extend to this contour. For systems with vertical walls, the effective area is the full footprint.

Message: Facility meets the Minimum Footprint

Drawdown Time (must be less than 72 hours) T_{Dd} = 52.8 hr

Message: Facility meets drawdown time limitations

Bioretention Facility Properties

Side Slopes in Bioretention Facility z = 4 :1

Longitudinal Slope of Site (3% maximum) 0.5 %

Check Dam Spacing 0 feet

Describe Vegetation:

Notes: If underdrain is capped, provide a Capped Underdrain checklist and supporting calculations.

Bioretention Facility - Design Procedure

BMP ID: B3

Legend:
Required Entries 🟦
Calculated Cells ▨

Company Name: Kimley-Horn and Associates
Date: 1/14/2022
Designed by: MAG
County/City Case No.:

Design Volume

Enter the area tributary to this feature	A_T=	3.9	acres
Enter V_{BMP} determined from Section 2.1 of this Handbook	V_{BMP}=	7,097	ft^3
Enter the measured infiltration rate	I=	0.50	in/hr
Enter the Factor of Safety (See Table 1, Appendix A: "Infiltration Testing" of this BMP Design Handbook)	FS =	3.00	
Enter factored infiltration rate (design)	$I_{factored}$=	0.50	in/hr

Bioretention Facility Surface Area

Depth of Surface Ponding Layer (6" minimum, 12" maximum)	d_P =	12.0	inches
Depth of Engineered Soil Media (24" to 36"; 18" allowed if vertically const	d_s =	36.0	inches
Depth of Gravel Storage Layer (Optional Layer; up to 30")	d_g =	9.0	inches

Note: Check that storage in gravel does not exceed the amount that can enter these systems during a typical storm event. The depth of effective stored water should be less than 12 inches (30 inch bulk depth) unless higher permeability media is used to allow faster filling of this layer.

Total Effective Depth, d_E

$$d_E(ft) = d_p(ft) + [(0.3) \times d_S(ft) + (0.4) \times d_g(ft)]$$

d_E = 2.20 feet

Required Effective Footprint Area, A_{BMP}

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

A_{BMP} = 3,226 ft^2

Proposed Surface Area (shall not be less than A_{BMP}) A= 3,310 ft^2

Note: This area shall be measured at the mid-ponding depth of the BMP. For systems with side-slopes, this should be the contour that is midway between the floor of the basin and the maximum water qualty ponding depth of the basin. The underlying gravel layer should extend to this contour. For systems with vertical walls, the effective area is the full footprint.

Message: Facility meets the Minimum Footprint

Drawdown Time (must be less than 72 hours) T_{Dd} = 52.8 hr

Message: Facility meets drawdown time limitations

Bioretention Facility Properties

Side Slopes in Bioretention Facility	z =	4	:1
Longitudinal Slope of Site (3% maximum)		0.5	%
Check Dam Spacing		0	feet

Describe Vegetation:

Notes: If underdrain is capped, provide a Capped Underdrain checklist and supporting calculations.

Bioretention Facility - Design Procedure	BMP ID B4	Legend:	Required Entries 🟦 Calculated Cells ▨

Company Name: Kimley-Horn and Associates
Date: 1/14/2022
Designed by: MAG
County/City Case No.:

Design Volume

Enter the area tributary to this feature A_T= 2.9 acres

Enter V_{BMP} determined from Section 2.1 of this Handbook V_{BMP}= 5,282 ft^3

Enter the measured infiltration rate I= 0.50 in/hr

Enter the Factor of Safety (See Table 1, Appendix A: "Infiltration Testing" of this BMP Design Handbook) FS = 3.00

Enter factored infiltration rate (design) $I_{factored}$= 0.50 in/hr

Bioretention Facility Surface Area

Depth of Surface Ponding Layer (6" minimum, 12" maximum) d_P = 12.0 inches
Depth of Engineered Soil Media (24" to 36"; 18" allowed if vertically const d_s = 36.0 inches
Depth of Gravel Storage Layer (Optional Layer; up to 30") d_g = 9.0 inches

Note: Check that storage in gravel does not exceed the amount that can enter these systems during a typical storm event. The depth of effective stored water should be less than 12 inches (30 inch bulk depth) unless higher permeability media is used to allow faster filling of this layer.

Total Effective Depth, d_E

$d_E(ft) = d_p(ft) + [(0.3) \times d_S(ft) + (0.4) \times d_g(ft)]$ d_E = 2.20 feet

Required Effective Footprint Area, A_{BMP}

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

A_{BMP} = 2,401 ft^2

Proposed Surface Area (shall not be less than A_{BMP}) A= 2,748 ft^2

Note: This area shall be measured at the mid-ponding depth of the BMP. For systems with side-slopes, this should be the contour that is midway between the floor of the basin and the maximum water qualty ponding depth of the basin. The underlying gravel layer should extend to this contour. For systems with vertical walls, the effective area is the full footprint.

Message: Facility meets the Minimum Footprint

Drawdown Time (must be less than 72 hours) T_{Dd} = 52.8 hr

Message: Facility meets drawdown time limitations

Bioretention Facility Properties

Side Slopes in Bioretention Facility z = 4 :1

Longitudinal Slope of Site (3% maximum) 0.5 %

Check Dam Spacing 0 feet

Describe Vegetation:

Notes: If underdrain is capped, provide a Capped Underdrain checklist and supporting calculations.

Bioretention Facility - Design Procedure	BMP ID D1	Legend:	Required Entries Calculated Cells

Company Name: Kimley-Horn and Associates
Date: 1/14/2022
Designed by: MAG
County/City Case No.:

Design Volume

Enter the area tributary to this feature A_T= 3.2 acres

Enter V_{BMP} determined from Section 2.1 of this Handbook V_{BMP}= 5,727 ft^3

Enter the measured infiltration rate I= 2.50 in/hr

Enter the Factor of Safety (See Table 1, Appendix A: "Infiltration Testing" of this BMP Design Handbook) FS = 3.00

Enter factored infiltration rate (design) $I_{factored}$= 2.50 in/hr

Bioretention Facility Surface Area

Depth of Surface Ponding Layer (6" minimum, 12" maximum) d_P = 12.0 inches
Depth of Engineered Soil Media (24" to 36"; 18" allowed if vertically const d_s = 36.0 inches
Depth of Gravel Storage Layer (Optional Layer; up to 30") d_g = 9.0 inches

Note: Check that storage in gravel does not exceed the amount that can enter these systems during a typical storm event. The depth of effective stored water should be less than 12 inches (30 inch bulk depth) unless higher permeability media is used to allow faster filling of this layer.

Total Effective Depth, d_E

$$d_E(ft) = d_p(ft) + [(0.3) \times d_S(ft) + (0.4) \times d_g(ft)]$$

d_E = 2.20 feet

Required Effective Footprint Area, A_{BMP}

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

A_{BMP} = 2,603 ft^2

Proposed Surface Area (shall not be less than A_{BMP}) A= 2,669 ft^2

Note: This area shall be measured at the mid-ponding depth of the BMP. For systems with side-slopes, this should be the contour that is midway between the floor of the basin and the maximum water qualty ponding depth of the basin. The underlying gravel layer should extend to this contour. For systems with vertical walls, the effective area is the full footprint.

Message: Facility meets the Minimum Footprint

Drawdown Time (must be less than 72 hours) T_{Dd} = 10.6 hr

Message: Facility meets drawdown time limitations

Bioretention Facility Properties

Side Slopes in Bioretention Facility z = 4 :1

Longitudinal Slope of Site (3% maximum) 0.5 %

Check Dam Spacing 0 feet

Describe Vegetation:

Notes: If underdrain is capped, provide a Capped Underdrain checklist and supporting calculations.

Bioretention Facility - Design Procedure	BMP ID D2	Legend:	Required Entries Calculated Cells

Company Name: Kimley-Horn and Associates

Date: 1/14/2022

Designed by: MAG

County/City Case No.:

Design Volume

Enter the area tributary to this feature A_T= 3.3 acres

Enter V_{BMP} determined from Section 2.1 of this Handbook V_{BMP}= 5,941 ft^3

Enter the measured infiltration rate I= 2.50 in/hr

Enter the Factor of Safety (See Table 1, Appendix A: "Infiltration Testing" of this BMP Design Handbook) FS = 3.00

Enter factored infiltration rate (design) $I_{factored}$= 2.50 in/hr

Bioretention Facility Surface Area

Depth of Surface Ponding Layer (6" minimum, 12" maximum) d_P = 12.0 inches

Depth of Engineered Soil Media (24" to 36"; 18" allowed if vertically const d_s = 36.0 inches

Depth of Gravel Storage Layer (Optional Layer; up to 30") d_g = 9.0 inches

Note: Check that storage in gravel does not exceed the amount that can enter these systems during a typical storm event. The depth of effective stored water should be less than 12 inches (30 inch bulk depth) unless higher permeability media is used to allow faster filling of this layer.

Total Effective Depth, d_E

$d_E(ft) = d_p(ft) + [(0.3) \times d_S(ft) + (0.4) \times d_g(ft)]$ d_E = 2.20 feet

Required Effective Footprint Area, A_{BMP}

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

A_{BMP} = 2,700 ft^2

Proposed Surface Area (shall not be less than A_{BMP}) A= 2,762 ft^2

Note: This area shall be measured at the mid-ponding depth of the BMP. For systems with side-slopes, this should be the contour that is midway between the floor of the basin and the maximum water qualty ponding depth of the basin. The underlying gravel layer should extend to this contour. For systems with vertical walls, the effective area is the full footprint.

Message: Facility meets the Minimum Footprint

Drawdown Time (must be less than 72 hours) T_{Dd} = 10.6 hr

Message: Facility meets drawdown time limitations

Bioretention Facility Properties

Side Slopes in Bioretention Facility z = 4 :1

Longitudinal Slope of Site (3% maximum) 0.5 %

Check Dam Spacing 0 feet

Describe Vegetation:

Notes: If underdrain is capped, provide a Capped Underdrain checklist and supporting calculations.

Bio Clean

A Forterra Company

Modular Wetlands® System Linear

A Stormwater Biofiltration Solution

OVERVIEW

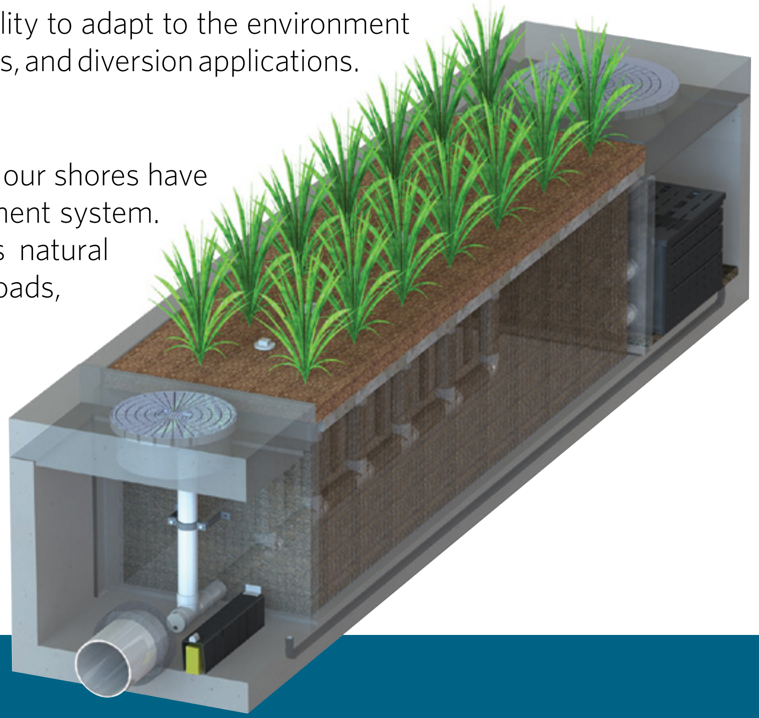
The Bio Clean Modular Wetlands® System Linear (MWS Linear) represents a pioneering breakthrough in stormwater technology as the only biofiltration system to utilize patented horizontal flow, allowing for a smaller footprint, higher treatment capacity, and a wide range of versatility. While most biofilters use little or no pretreatment, the Modular Wetlands System Linear incorporates an advanced pretreatment chamber that includes separation and pre-filter cartridges. In this chamber, sediment and hydrocarbons are removed from runoff before entering the biofiltration chamber, reducing maintenance costs and improving performance.

Horizontal flow also gives the system the unique ability to adapt to the environment through a variety of configurations, bypass orientations, and diversion applications.

The Urban Impact

For hundreds of years, natural wetlands surrounding our shores have played an integral role as nature's stormwater treatment system. But as cities grow and develop, our environment's natural filtration systems are blanketed with impervious roads, rooftops, and parking lots.

Bio Clean understands this loss and has spent years re-establishing nature's presence in urban areas, and rejuvenating waterways with the MWS Linear.



PERFORMANCE

The Modular Wetlands® System Linear continues to outperform other treatment methods with superior pollutant removal for TSS, heavy metals, nutrients, hydrocarbons, and bacteria. Since 2007 the MWS Linear has been field tested on numerous sites across the country and is proven to effectively remove pollutants through a combination of physical, chemical, and biological filtration processes. In fact, the MWS Linear harnesses some of the same biological processes found in natural wetlands in order to collect, transform, and remove even the most harmful pollutants.

66% REMOVAL OF DISSOLVED ZINC

69% REMOVAL OF TOTAL ZINC

38% REMOVAL OF DISSOLVED COPPER

64% REMOVAL OF TOTAL PHOSPHORUS

45% REMOVAL OF NITROGEN

50% REMOVAL OF TOTAL COPPER

95% REMOVAL OF MOTOR OIL

67% REMOVAL OF ORTHO PHOSPHORUS

85% REMOVAL OF TSS

APPROVALS

The Modular Wetlands® System Linear has successfully met years of challenging technical reviews and testing from some of the most prestigious and demanding agencies in the nation and perhaps the world. Here is a list of some of the most high-profile approvals, certifications, and verifications from around the country.

Washington State Department of Ecology TAPE Approved
The MWS Linear is approved for General Use Level Designation (GULD) for Basic, Enhanced, and Phosphorus treatment at 1 gpm/ft^2 loading rate. The highest performing BMP on the market for all main pollutant categories.

California Water Resources Control Board, Full Capture Certification
The Modular Wetlands® System is the first biofiltration system to receive certification as a full capture trash treatment control device.

Virginia Department of Environmental Quality, Assignment
The Virginia Department of Environmental Quality assigned the MWS Linear the highest phosphorus removal rating for manufactured treatment devices to meet the new Virginia Stormwater Management Program (VSMP) regulation technical criteria.

Maryland Department of the Environment, Approved ESD
Granted Environmental Site Design (ESD) status for new construction, redevelopment, and retrofitting when designed in accordance with the design manual.

MASTEP Evaluation
The University of Massachusetts at Amherst – Water Resources Research Center issued a technical evaluation report noting removal rates up to 84% TSS, 70% total phosphorus, 68.5% total zinc, and more.

Rhode Island Department of Environmental Management, Approved BMP
Approved as an authorized BMP and noted to achieve the following minimum removal efficiencies: 85% TSS, 60% pathogens, 30% total phosphorus, and 30% total nitrogen.

Texas Commission on Environmental Quality

Atlanta Regional Commission

ADVANTAGES

- HORIZONTAL FLOW BIOFILTRATION
- GREATER FILTER SURFACE AREA
- PRETREATMENT CHAMBER
- PATENTED PERIMETER VOID AREA
- FLOW CONTROL
- NO DEPRESSED PLANTER AREA
- AUTO DRAINDOWN MEANS NO MOSQUITO VECTOR

OPERATION

The Modular Wetlands® System Linear is the most efficient and versatile biofiltration system on the market, and it is the only system with horizontal flow which:

- Improves performance
- Reduces footprint
- Minimizes maintenance

Figure 1 & Figure 2 illustrate the invaluable benefits of horizontal flow and the multiple treatment stages.

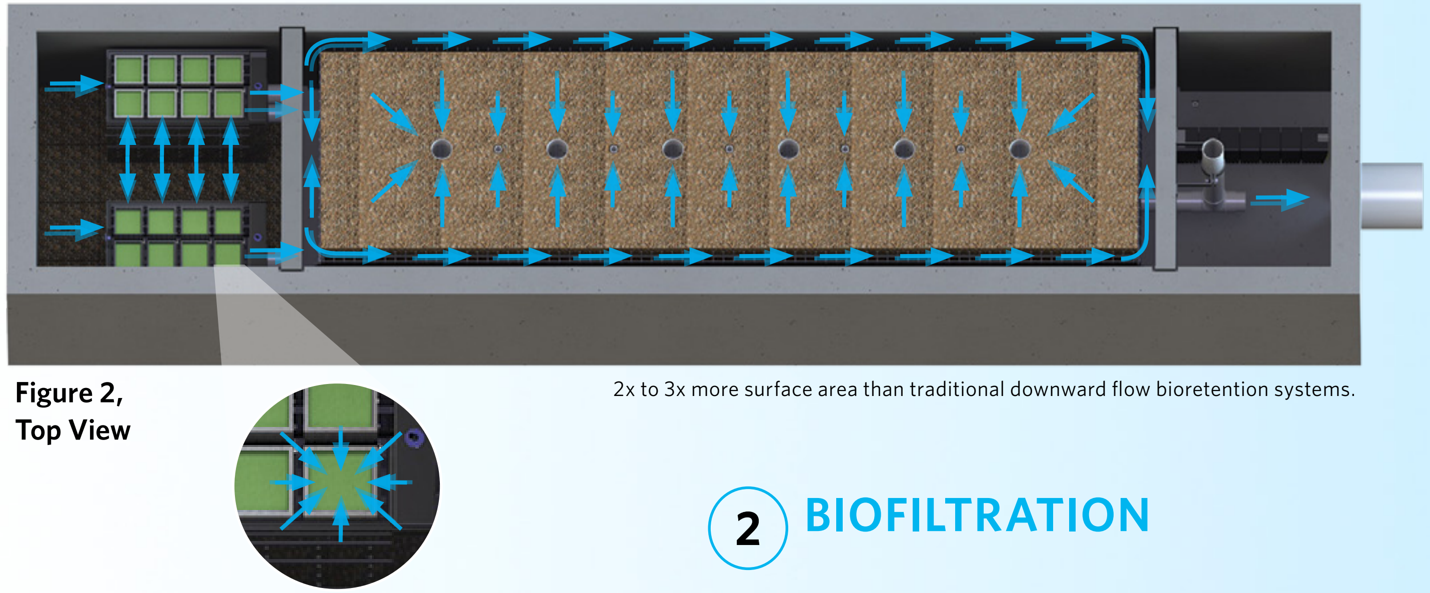


Figure 2,
Top View

2x to 3x more surface area than traditional downward flow bioretention systems.

1 PRETREATMENT

SEPARATION

- Trash, sediment, and debris are separated before entering the pre-filter boxes
- Designed for easy maintenance access

PRE-FILTER BOXES

- Over 25 sq. ft. of surface area per box
- Utilizes BioMediaGREEN™ filter material
- Removes over 80% of TSS and 90% of hydrocarbons
- Prevents pollutants that cause clogging from migrating to the biofiltration chamber

2 BIOFILTRATION

HORIZONTAL FLOW

- Less clogging than downward flow biofilters
- Water flow is subsurface
- Improves biological filtration

PATENTED PERIMETER VOID AREA

- Vertically extends void area between the walls and the WetlandMEDIA™ on all four sides
- Maximizes surface area of the media for higher treatment capacity

WETLANDMEDIA

- Contains no organics and removes phosphorus
- Greater surface area and 48% void space
- Maximum evapotranspiration
- High ion exchange capacity and lightweight

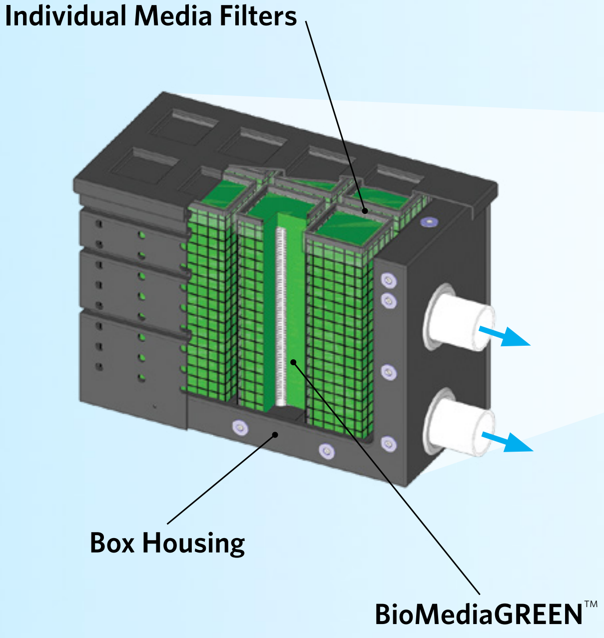
3 DISCHARGE

FLOW CONTROL

- Orifice plate controls flow of water through WetlandMEDIA™ to a level lower than the media's capacity
- Extends the life of the media and improves performance

DRAINDOWN FILTER

- The draindown is an optional feature that completely drains the pretreatment chamber
- Water that drains from the pretreatment chamber between storm events will be treated



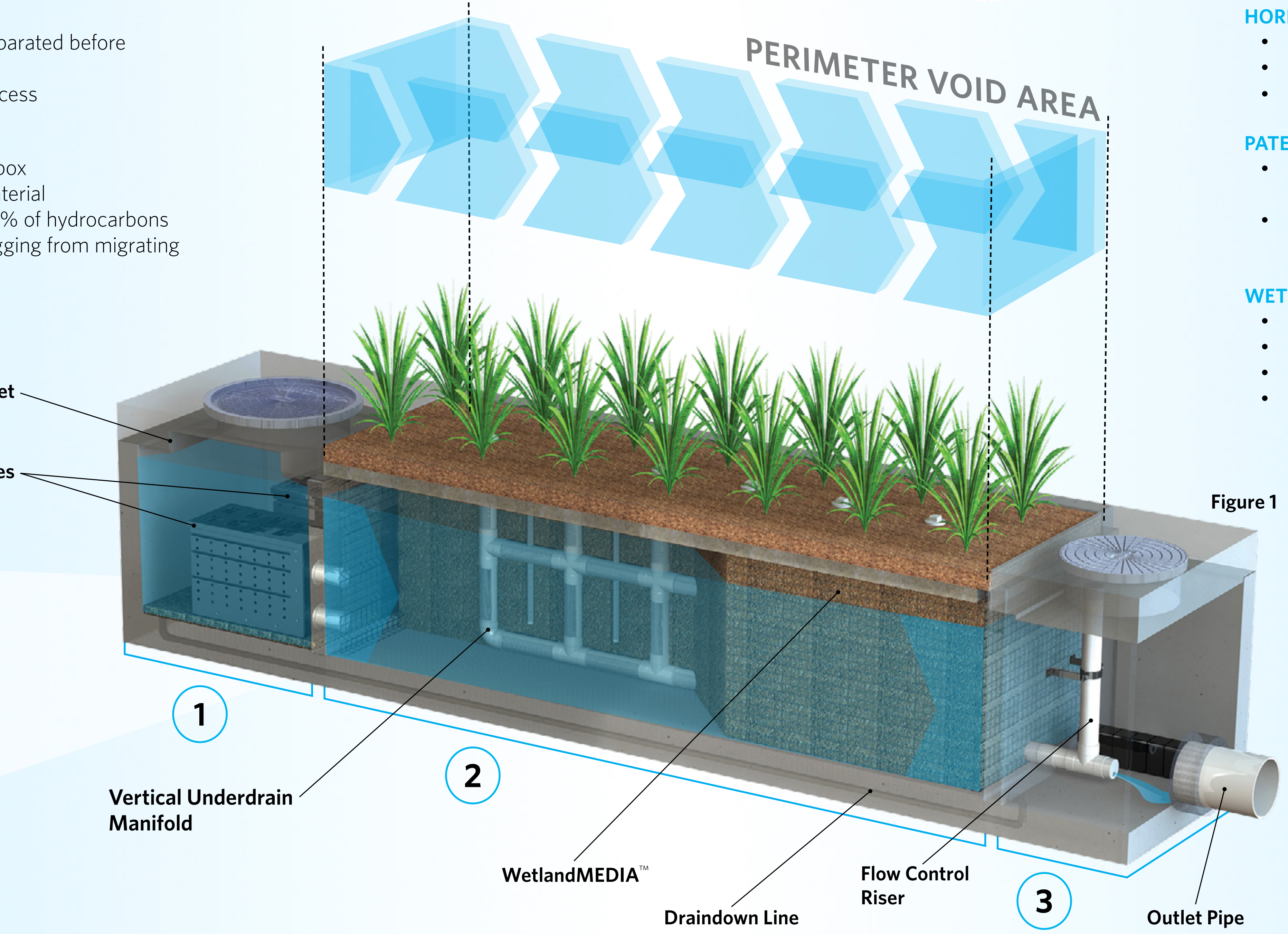
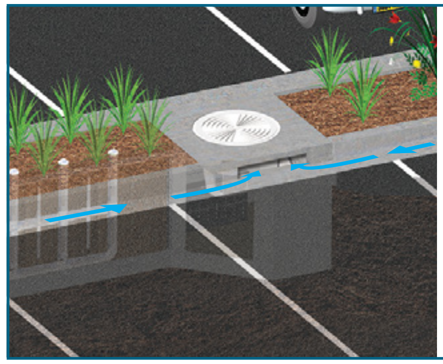


Figure 1

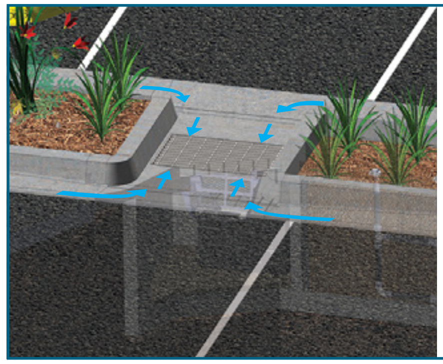
CONFIGURATIONS

The Modular Wetlands® System Linear is the preferred biofiltration system of civil engineers across the country due to its versatile design. This highly versatile system has available "pipe-in" options on most models, along with built-in curb or grated inlets for simple integration into your storm drain design.



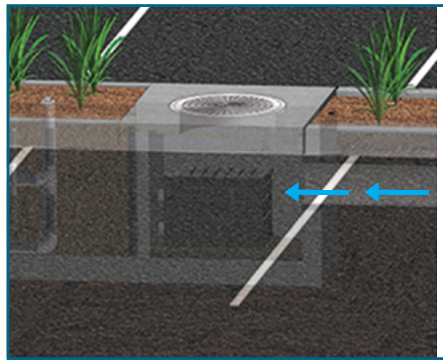
CURB TYPE

The Curb Type configuration accepts sheet flow through a curb opening and is commonly used along roadways and parking lots. It can be used in sump or flow-by conditions. Length of curb opening varies based on model and size.



GRATE TYPE

The Grate Type configuration offers the same features and benefits as the Curb Type but with a grated/drop inlet above the systems pretreatment chamber. It has the added benefit of allowing pedestrian access over the inlet. ADA-compliant grates are available to assure easy and safe access. The Grate Type can also be used in scenarios where runoff needs to be intercepted on both sides of landscape islands.



VAULT TYPE

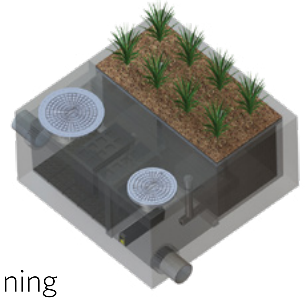
The system's patented horizontal flow biofilter is able to accept inflow pipes directly into the pretreatment chamber, meaning the Modular Wetlands® can be used in end-of-the-line installations. This greatly improves feasibility over typical decentralized designs that are required with other biofiltration/bioretention systems. Another benefit of the "pipe-in" design is the ability to install the system downstream of underground detention systems to meet water quality volume requirements.

DOWNSPOUT TYPE

The Downspout Type is a variation of the Vault Type and is designed to accept a vertical downspout pipe from rooftop and podium areas. Some models have the option of utilizing an internal bypass, simplifying the overall design. The system can be installed as a raised planter, and the exterior can be stuccoed or covered with other finishes to match the look of adjacent buildings.

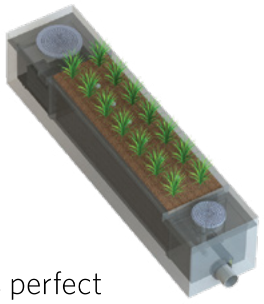
ORIENTATIONS

SIDE-BY-SIDE



The Side-By-Side orientation places the pretreatment and discharge chamber adjacent to one another with the biofiltration chamber running parallel on either side. This minimizes the system length, providing a highly compact footprint. It has been proven useful in situations such as streets with directly adjacent sidewalks, as half of the system can be placed under that sidewalk. This orientation also offers internal bypass options as discussed below.

END-TO-END



The End-To-End orientation places the pretreatment and discharge chambers on opposite ends of the biofiltration chamber, therefore minimizing the width of the system to 5 ft. (outside dimension). This orientation is perfect for linear projects and street retrofits where existing utilities and sidewalks limit the amount of space available for installation. One limitation of this orientation is that bypass must be external.

BYPASS

INTERNAL BYPASS WEIR (SIDE-BY-SIDE ONLY)

The Side-By-Side orientation places the pretreatment and discharge chambers adjacent to one another allowing for integration of internal bypass. The wall between these chambers can act as a bypass weir when flows exceed the system's treatment capacity, thus allowing bypass from the pretreatment chamber directly to the discharge chamber.

EXTERNAL DIVERSION WEIR STRUCTURE

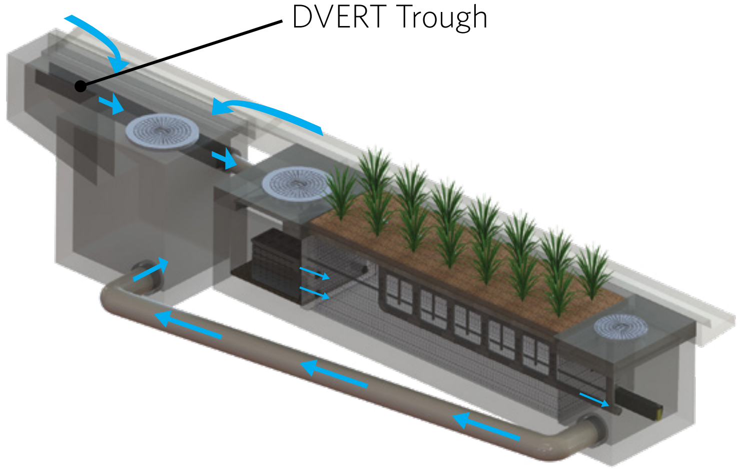
This traditional offline diversion method can be used with the Modular Wetlands® System Linear in scenarios where runoff is being piped to the system. These simple and effective structures are generally configured with two outflow pipes. The first is a smaller pipe on the upstream side of the diversion weir - to divert low flows over to the MWS Linear for treatment. The second is the main pipe that receives water once the system has exceeded treatment capacity and water flows over the weir.

FLOW-BY-DESIGN

This method is one in which the system is placed just upstream of a standard curb or grate inlet to intercept the first flush. Higher flows simply pass by the MWS Linear and into the standard inlet downstream.

DVERT LOW FLOW DIVERSION

This simple yet innovative diversion trough can be installed in existing or new curb and grate inlets to divert the first flush to the Modular Wetlands® System Linear via pipe. It works similar to a rain gutter and is installed just below the opening into the inlet. It captures the low flows and channels them over to a connecting pipe exiting out the wall of the inlet and leading to the MWS Linear. The DVERT is perfect for retrofit and green street applications that allow the system to be installed anywhere space is available.



SPECIFICATIONS

FLOW-BASED DESIGNS

The Modular Wetlands® System Linear can be used in stand-alone applications to meet treatment flow requirements, and since it is the only biofiltration system that can accept inflow pipes several feet below the surface, it can be used not only in decentralized design applications but also as a large central end-of-the-line application for maximum feasibility.

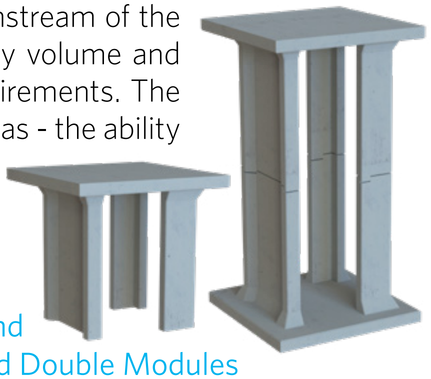
MODEL #	DIMENSIONS	WETLANDMEDIA SURFACE AREA (sq. ft.)	TREATMENT FLOW RATE (cfs)
MWS-L-4-4	4′ x 4′	23	0.052
MWS-L-4-6	4′ x 6′	32	0.073
MWS-L-4-8	4′ x 8′	50	0.115
MWS-L-4-13	4′ x 13′	63	0.144
MWS-L-4-15	4′ x 15′	76	0.175
MWS-L-4-17	4′ x 17′	90	0.206
MWS-L-4-19	4′ x 19′	103	0.237
MWS-L-4-21	4′ x 21′	117	0.268
MWS-L-6-8	7′ x 9′	64	0.147
MWS-L-8-8	8′ x 8′	100	0.230
MWS-L-8-12	8′ x 12′	151	0.346
MWS-L-8-16	8′ x 16′	201	0.462
MWS-L-8-20	9′ x 21′	252	0.577
MWS-L-8-24	9′ x 25′	302	0.693
MWS-L-10-20	10' x 20'	302	0.693

VOLUME-BASED DESIGNS

HORIZONTAL FLOW BIOFILTRATION ADVANTAGE

MODULAR WETLANDS® SYSTEM LINEAR WITH URBANPOND™ PRESTORAGE

In the example above, the Modular Wetlands® System Linear is installed downstream of the UrbanPond storage system. The MWS Linear is designed for the water quality volume and will treat and discharge the required volume within local draindown time requirements. The MWS Linear's unique horizontal flow design, gives it benefits no other biofilter has - the ability to be placed downstream of detention ponds, extended dry detention basins, underground storage systems and permeable paver reservoirs. The system's horizontal flow configuration and built-in orifice control allows it to be installed with just 6″ of fall between inlet and outlet pipe for a simple connection to projects with shallow downstream tie-in points.


UrbanPond
Single and Double Modules

DESIGN SUPPORT

Bio Clean engineers are trained to provide you with superior support for all volume sizing configurations throughout the country. Our vast knowledge of state and local regulations allow us to quickly and efficiently size a system to maximize feasibility. Volume control and hydromodification regulations are expanding the need to decrease the cost and size of your biofiltration system. Bio Clean will help you realize these cost savings with the MWS Linear, the only biofilter than can be used downstream of storage BMPs.

ADVANTAGES

- LOWER COST THAN FLOW-BASED DESIGN
- MEETS LID REQUIREMENTS
- BUILT-IN ORIFICE CONTROL STRUCTURE
- WORKS WITH DEEP INSTALLATIONS

APPLICATIONS

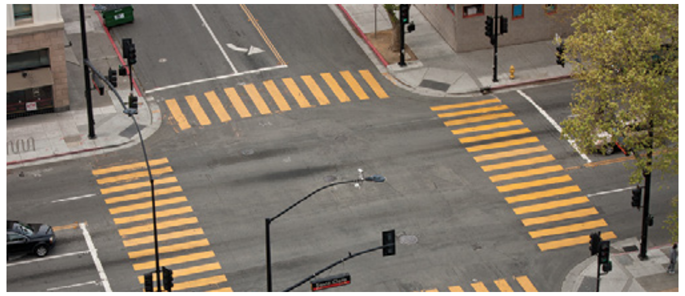
The Modular Wetlands® System Linear has been successfully used on numerous new construction and retrofit projects. The system's superior versatility makes it beneficial for a wide range of stormwater and waste water applications - treating rooftops, streetscapes, parking lots, and industrial sites.

INDUSTRIAL

Many states enforce strict regulations for discharges from industrial sites. The MWS Linear has helped various sites meet difficult EPA-mandated effluent limits for dissolved metals and other pollutants.

RESIDENTIAL

Low to high density developments can benefit from the versatile design of the MWS Linear. The system can be used in both decentralized LID design and cost-effective end-of-the-line configurations.



STREETS

Street applications can be challenging due to limited space. The MWS Linear is very adaptable, and it offers the smallest footprint to work around the constraints of existing utilities on retrofit projects.

PARKING LOTS

Parking lots are designed to maximize space and the Modular Wetlands'® 4 ft. standard planter width allows for easy integration into parking lot islands and other landscape medians.

COMMERCIAL

Compared to bioretention systems, the MWS Linear can treat far more area in less space, meeting treatment and volume control requirements.

MIXED USE

The MWS Linear can be installed as a raised planter to treat runoff from rooftops or patios, making it perfect for sustainable "live-work" spaces.

More applications include:

- Agriculture
- Reuse
- Low Impact Development
- Waste Water

PLANT SELECTION

Abundant plants, trees, and grasses bring value and an aesthetic benefit to any urban setting, but those in the Modular Wetlands® System Linear do even more - they increase pollutant removal. What's not seen, but very important, is that below grade, the stormwater runoff/flow is being subjected to nature's secret weapon: a dynamic physical, chemical, and biological process working to break down and remove non-point source pollutants. The flow rate is controlled in the MWS Linear, giving the plants more contact time so that pollutants are more successfully decomposed, volatilized, and incorporated into the biomass of the Modular Wetlands'® micro/macro flora and fauna.

A wide range of plants are suitable for use in the Modular Wetlands®, but selections vary by location and climate. View suitable plants by visiting biocleanenvironmental.com/plants.

INSTALLATION

The Modular Wetlands® System Linear is simple, easy to install, and has a space-efficient design that offers lower excavation and installation costs compared to traditional tree-box type systems. The structure of the system resembles precast catch basin or utility vaults and is installed in a similar fashion.

The system is delivered fully assembled for quick installation. Generally, the structure can be unloaded and set in place in 15 minutes. Our experienced team of field technicians is available to supervise installations and provide technical support.

MAINTENANCE

Reduce your maintenance costs, man hours, and materials with the Modular Wetlands® System Linear. Unlike other biofiltration systems that provide no pretreatment, the MWS Linear is a self-contained treatment train which incorporates simple and effective pretreatment.

Maintenance requirements for the biofilter itself are almost completely eliminated, as the pretreatment chamber removes and isolates trash, sediments, and hydrocarbons. What's left is the simple maintenance of an easily accessible pretreatment chamber that can be cleaned by hand or with a standard vac truck. Only periodic replacement of low-cost media in the pre-filter boxes is required for long-term operation, and there is absolutely no need to replace expensive biofiltration media.

Bio Clean
A Forterra Company

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855.566.3938
stormwater@forterrabp.com
biocleanenvironmental.com

Appendix 7: Hydromodification

Supporting Detail Relating to compliance with the Hydromodification Performance Standards

Examples of material to provide in Appendix 7 may include but are not limited to the following:

- Hydromodification Exemption Exhibit,
- Potential Critical Coarse Sediment Yield Area Mapping
- Hydromodification BMP sizing calculations,
- SMRHM report files,
- Site-Specific Critical Coarse Sediment Analysis,
- Design details/drawings from manufacturers for proprietary BMPs

This information should support the hydromodification exemption (if applicable) and hydrologic control BMP and Sediment Supply BMP sections of this Template. Refer to Section 2.4 and 3.6 of the SMR WQMP and Sections E of this Template.

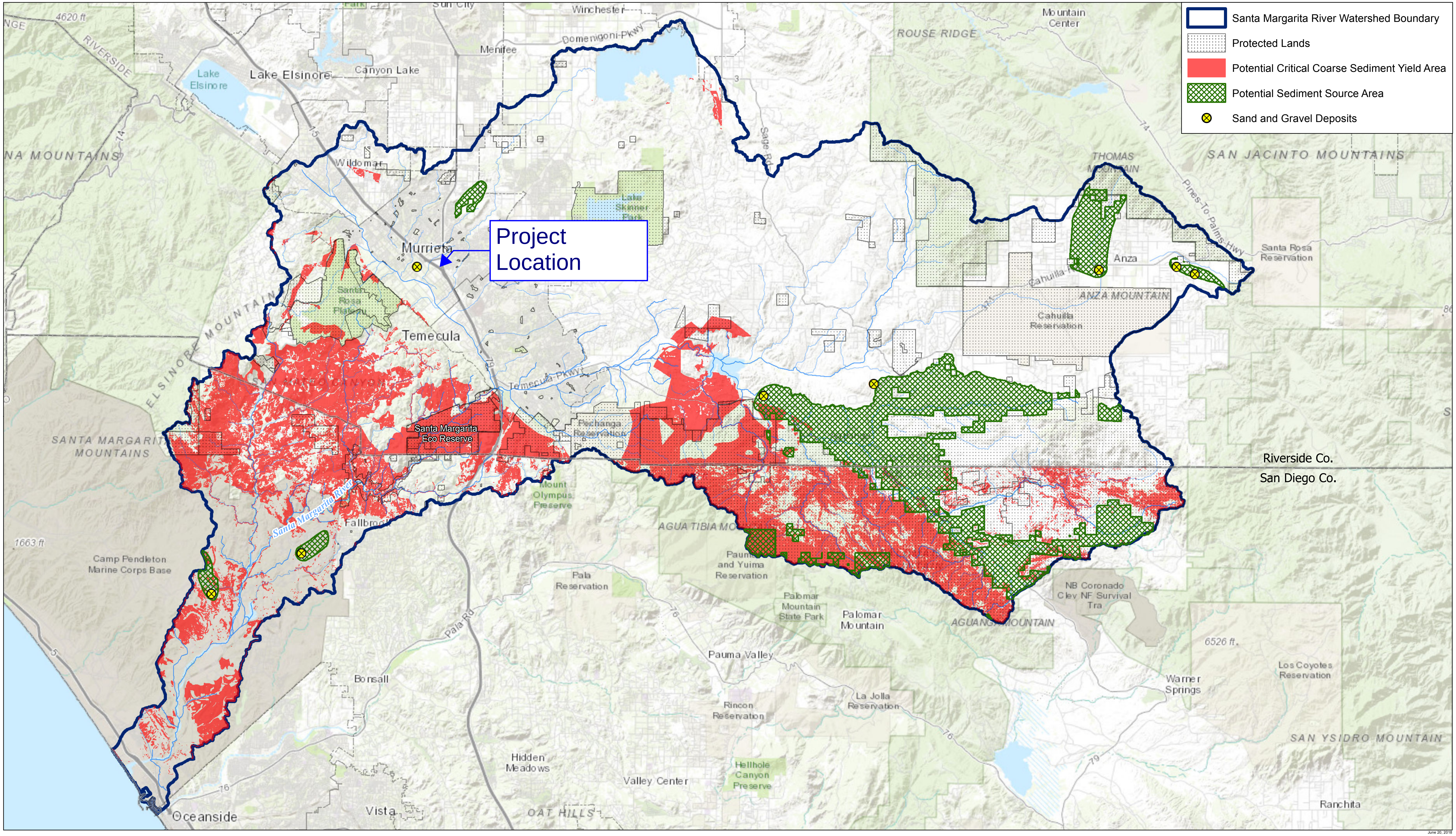


Exhibit G-1

SANTA MARGARITA RIVER WATERSHED
POTENTIAL CRITICAL COARSE SEDIMENT YIELD AREAS AND POTENTIAL SEDIMENT SOURCE AREAS

SMRHM

PROJECT REPORT

General Model Information

Project Name:	The Terraces - Murrieta
Site Name:	
Site Address:	40727 Murrieta Hot Springs Road
City:	Murrieta
Report Date:	1/20/2022
Gage:	Temecula Valley
Data Start:	1974/10/01
Data End:	2011/09/30
Timestep:	15 Minute
Precip Scale:	1.000
Version Date:	2021/06/14

POC Thresholds

Low Flow Threshold for POC1:	10 Percent of the 2 Year
High Flow Threshold for POC1:	10 Year
Low Flow Threshold for POC2:	10 Percent of the 2 Year
High Flow Threshold for POC2:	10 Year
Low Flow Threshold for POC3:	10 Percent of the 2 Year
High Flow Threshold for POC3:	10 Year
Low Flow Threshold for POC4:	10 Percent of the 2 Year
High Flow Threshold for POC4:	10 Year

Landuse Basin Data

Predeveloped Land Use

DMA A

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C D,Grass,Mod(5-10%)	7.95
Pervious Total	7.95
Impervious Land Use	acre
Impervious Total	0
Basin Total	7.95

Element Flows To:

Surface	Interflow	Groundwater

DMA C

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C D,Grass,Mod(5-10%)	11.31
Pervious Total	11.31
Impervious Land Use	acre
Impervious Total	0
Basin Total	11.31

Element Flows To:

Surface	Interflow	Groundwater

DMA B

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C D,Grass,Mod(5-10%)	3.98
Pervious Total	3.98
Impervious Land Use	acre
Impervious Total	0
Basin Total	3.98

Element Flows To:

Surface	Interflow	Groundwater

DMA D

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C D,Grass,Mod(5-10%)	7.16
Pervious Total	7.16
Impervious Land Use	acre
Impervious Total	0
Basin Total	7.16

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

DMA B1, B2

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
C D,Urban,Mod(5-10%)	1.59
Pervious Total	1.59

Impervious Land Use	acre
Roads,Flat(0-5%)	6.36
Impervious Total	6.36
Basin Total	7.95

Element Flows To:

Surface	Interflow	Groundwater
Vault B1, B2	Vault B1, B2	

DMA B3, B4, B5

Bypass: No

GroundWater: No

Pervious Land Use	acre
C D,Urban,Mod(5-10%)	2.26
Pervious Total	2.26

Impervious Land Use	acre
Roads,Flat(0-5%)	9.05
Impervious Total	9.05
Basin Total	11.31

Element Flows To:

Surface	Interflow	Groundwater
Vault B3, B4, B5	Vault B3, B4, B5	

DMA C1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C D,Urban,Mod(5-10%)	0.8
Pervious Total	0.8
Impervious Land Use	acre
Roads,Flat(0-5%)	3.18
Impervious Total	3.18
Basin Total	3.98

Element Flows To:

Surface	Interflow	Groundwater
Vault C1	Vault C1	

DMA D1, D2

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C D,Urban,Mod(5-10%)	1.43
Pervious Total	1.43
Impervious Land Use	acre
Roads,Flat(0-5%)	5.73
Impervious Total	5.73
Basin Total	7.16

Element Flows To:

Surface	Interflow	Groundwater
Vault D1, D2	Vault D1, D2	

Routing Elements

Predeveloped Routing

Mitigated Routing

Vault B1, B2

Width: 104.445606247503 ft.
Length: 104.445606247503 ft.
Depth: 7 ft.
Infiltration On
Infiltration rate: 0.5
Infiltration safety factor: 0.33
Total Volume Infiltrated (ac-ft.): 63.557
Total Volume Through Riser (ac-ft.): 232.122
Total Volume Through Facility (ac-ft.): 295.678
Percent Infiltrated: 21.5
Total Precip Applied to Facility: 0
Total Evap From Facility: 0
Discharge Structure
Riser Height: 6 ft.
Riser Diameter: 54 in.
Notch Type: Rectangular
Notch Width: 1.037 ft.
Notch Height: 1.643 ft.
Orifice 1 Diameter: 2.367 in. Elevation:0 ft.
Element Flows To:
Outlet 1 Outlet 2

Vault Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.250	0.000	0.000	0.000
0.0778	0.250	0.019	0.042	0.041
0.1556	0.250	0.039	0.060	0.041
0.2333	0.250	0.058	0.073	0.041
0.3111	0.250	0.077	0.084	0.041
0.3889	0.250	0.097	0.094	0.041
0.4667	0.250	0.116	0.103	0.041
0.5444	0.250	0.136	0.112	0.041
0.6222	0.250	0.155	0.119	0.041
0.7000	0.250	0.175	0.127	0.041
0.7778	0.250	0.194	0.134	0.041
0.8556	0.250	0.214	0.140	0.041
0.9333	0.250	0.233	0.146	0.041
1.0111	0.250	0.253	0.152	0.041
1.0889	0.250	0.272	0.158	0.041
1.1667	0.250	0.292	0.164	0.041
1.2444	0.250	0.311	0.169	0.041
1.3222	0.250	0.331	0.174	0.041
1.4000	0.250	0.350	0.179	0.041
1.4778	0.250	0.370	0.184	0.041
1.5556	0.250	0.389	0.189	0.041
1.6333	0.250	0.409	0.194	0.041
1.7111	0.250	0.428	0.198	0.041
1.7889	0.250	0.448	0.203	0.041
1.8667	0.250	0.467	0.207	0.041
1.9444	0.250	0.487	0.212	0.041
2.0222	0.250	0.506	0.216	0.041
2.1000	0.250	0.525	0.220	0.041

2.1778	0.250	0.545	0.224	0.041
2.2556	0.250	0.564	0.228	0.041
2.3333	0.250	0.584	0.232	0.041
2.4111	0.250	0.603	0.236	0.041
2.4889	0.250	0.623	0.239	0.041
2.5667	0.250	0.642	0.243	0.041
2.6444	0.250	0.662	0.247	0.041
2.7222	0.250	0.681	0.250	0.041
2.8000	0.250	0.701	0.254	0.041
2.8778	0.250	0.720	0.257	0.041
2.9556	0.250	0.740	0.261	0.041
3.0333	0.250	0.759	0.264	0.041
3.1111	0.250	0.779	0.268	0.041
3.1889	0.250	0.798	0.271	0.041
3.2667	0.250	0.818	0.274	0.041
3.3444	0.250	0.837	0.278	0.041
3.4222	0.250	0.857	0.281	0.041
3.5000	0.250	0.876	0.284	0.041
3.5778	0.250	0.896	0.287	0.041
3.6556	0.250	0.915	0.290	0.041
3.7333	0.250	0.935	0.293	0.041
3.8111	0.250	0.954	0.296	0.041
3.8889	0.250	0.973	0.299	0.041
3.9667	0.250	0.993	0.302	0.041
4.0444	0.250	1.012	0.305	0.041
4.1222	0.250	1.032	0.308	0.041
4.2000	0.250	1.051	0.311	0.041
4.2778	0.250	1.071	0.314	0.041
4.3556	0.250	1.090	0.317	0.041
4.4333	0.250	1.110	0.392	0.041
4.5111	0.250	1.129	0.531	0.041
4.5889	0.250	1.149	0.710	0.041
4.6667	0.250	1.168	0.922	0.041
4.7444	0.250	1.188	1.163	0.041
4.8222	0.250	1.207	1.429	0.041
4.9000	0.250	1.227	1.717	0.041
4.9778	0.250	1.246	2.027	0.041
5.0556	0.250	1.266	2.357	0.041
5.1333	0.250	1.285	2.706	0.041
5.2111	0.250	1.305	3.072	0.041
5.2889	0.250	1.324	3.456	0.041
5.3667	0.250	1.344	3.855	0.041
5.4444	0.250	1.363	4.270	0.041
5.5222	0.250	1.382	4.701	0.041
5.6000	0.250	1.402	5.145	0.041
5.6778	0.250	1.421	5.604	0.041
5.7556	0.250	1.441	6.076	0.041
5.8333	0.250	1.460	6.562	0.041
5.9111	0.250	1.480	7.061	0.041
5.9889	0.250	1.499	7.572	0.041
6.0667	0.250	1.519	8.470	0.041
6.1444	0.250	1.538	10.27	0.041
6.2222	0.250	1.558	12.64	0.041
6.3000	0.250	1.577	15.48	0.041
6.3778	0.250	1.597	18.70	0.041
6.4556	0.250	1.616	22.25	0.041
6.5333	0.250	1.636	26.08	0.041
6.6111	0.250	1.655	30.15	0.041

6.6889	0.250	1.675	34.42	0.041
6.7667	0.250	1.694	38.84	0.041
6.8444	0.250	1.714	43.38	0.041
6.9222	0.250	1.733	47.98	0.041
7.0000	0.250	1.753	52.61	0.041
7.0778	0.250	1.772	57.21	0.041
7.1556	0.000	0.000	61.75	0.108

Vault B3, B4, B5

Width: 124.832044884519 ft.
Length: 124.832044884519 ft.
Depth: 7 ft.
Infiltration On
Infiltration rate: 0.5
Infiltration safety factor: 0.33
Total Volume Infiltrated (ac-ft.): 92.033
Total Volume Through Riser (ac-ft.): 328.561
Total Volume Through Facility (ac-ft.): 420.593
Percent Infiltrated: 21.88
Total Precip Applied to Facility: 0
Total Evap From Facility: 0
Discharge Structure
Riser Height: 6 ft.
Riser Diameter: 54 in.
Notch Type: Rectangular
Notch Width: 1.486 ft.
Notch Height: 1.467 ft.
Orifice 1 Diameter: 2.793 in. Elevation:0 ft.
Element Flows To:
Outlet 1 Outlet 2

Vault Hydraulic Table

Stage(feet)	**Area(ac.)**	**Volume(ac-ft.)**	**Discharge(cfs)**	**Infilt(cfs)**
0.0000	0.357	0.000	0.000	0.000
0.0778	0.357	0.027	0.059	0.059
0.1556	0.357	0.055	0.083	0.059
0.2333	0.357	0.083	0.102	0.059
0.3111	0.357	0.111	0.118	0.059
0.3889	0.357	0.139	0.132	0.059
0.4667	0.357	0.166	0.144	0.059
0.5444	0.357	0.194	0.156	0.059
0.6222	0.357	0.222	0.167	0.059
0.7000	0.357	0.250	0.177	0.059
0.7778	0.357	0.278	0.186	0.059
0.8556	0.357	0.306	0.195	0.059
0.9333	0.357	0.333	0.204	0.059
1.0111	0.357	0.361	0.212	0.059
1.0889	0.357	0.389	0.220	0.059
1.1667	0.357	0.417	0.228	0.059
1.2444	0.357	0.445	0.236	0.059
1.3222	0.357	0.473	0.243	0.059
1.4000	0.357	0.500	0.250	0.059
1.4778	0.357	0.528	0.257	0.059
1.5556	0.357	0.556	0.264	0.059
1.6333	0.357	0.584	0.270	0.059
1.7111	0.357	0.612	0.276	0.059
1.7889	0.357	0.640	0.283	0.059
1.8667	0.357	0.667	0.289	0.059
1.9444	0.357	0.695	0.295	0.059
2.0222	0.357	0.723	0.301	0.059
2.1000	0.357	0.751	0.306	0.059
2.1778	0.357	0.779	0.312	0.059
2.2556	0.357	0.806	0.317	0.059

2.3333	0.357	0.834	0.323	0.059
2.4111	0.357	0.862	0.328	0.059
2.4889	0.357	0.890	0.334	0.059
2.5667	0.357	0.918	0.339	0.059
2.6444	0.357	0.946	0.344	0.059
2.7222	0.357	0.973	0.349	0.059
2.8000	0.357	1.001	0.354	0.059
2.8778	0.357	1.029	0.359	0.059
2.9556	0.357	1.057	0.363	0.059
3.0333	0.357	1.085	0.368	0.059
3.1111	0.357	1.113	0.373	0.059
3.1889	0.357	1.140	0.378	0.059
3.2667	0.357	1.168	0.382	0.059
3.3444	0.357	1.196	0.387	0.059
3.4222	0.357	1.224	0.391	0.059
3.5000	0.357	1.252	0.396	0.059
3.5778	0.357	1.279	0.400	0.059
3.6556	0.357	1.307	0.404	0.059
3.7333	0.357	1.335	0.409	0.059
3.8111	0.357	1.363	0.413	0.059
3.8889	0.357	1.391	0.417	0.059
3.9667	0.357	1.419	0.421	0.059
4.0444	0.357	1.446	0.425	0.059
4.1222	0.357	1.474	0.429	0.059
4.2000	0.357	1.502	0.433	0.059
4.2778	0.357	1.530	0.437	0.059
4.3556	0.357	1.558	0.441	0.059
4.4333	0.357	1.586	0.445	0.059
4.5111	0.357	1.613	0.449	0.059
4.5889	0.357	1.641	0.518	0.059
4.6667	0.357	1.669	0.698	0.059
4.7444	0.357	1.697	0.940	0.059
4.8222	0.357	1.725	1.233	0.059
4.9000	0.357	1.752	1.566	0.059
4.9778	0.357	1.780	1.938	0.059
5.0556	0.357	1.808	2.342	0.059
5.1333	0.357	1.836	2.778	0.059
5.2111	0.357	1.864	3.243	0.059
5.2889	0.357	1.892	3.735	0.059
5.3667	0.357	1.919	4.253	0.059
5.4444	0.357	1.947	4.796	0.059
5.5222	0.357	1.975	5.362	0.059
5.6000	0.357	2.003	5.950	0.059
5.6778	0.357	2.031	6.560	0.059
5.7556	0.357	2.059	7.192	0.059
5.8333	0.357	2.086	7.843	0.059
5.9111	0.357	2.114	8.514	0.059
5.9889	0.357	2.142	9.205	0.059
6.0667	0.357	2.170	10.13	0.059
6.1444	0.357	2.198	11.93	0.059
6.2222	0.357	2.225	14.31	0.059
6.3000	0.357	2.253	17.14	0.059
6.3778	0.357	2.281	20.36	0.059
6.4556	0.357	2.309	23.91	0.059
6.5333	0.357	2.337	27.74	0.059
6.6111	0.357	2.365	31.81	0.059
6.6889	0.357	2.392	36.08	0.059
6.7667	0.357	2.420	40.51	0.059

6.8444	0.357	2.448	45.04	0.059
6.9222	0.357	2.476	49.65	0.059
7.0000	0.357	2.504	54.28	0.059
7.0778	0.357	2.532	58.88	0.059
7.1556	0.000	0.000	63.42	0.153

Vault C1

Width:	71.1147092914305 ft.	
Length:	71.1147092914305 ft.	
Depth:	7 ft.	
Infiltration On		
Infiltration rate:	1	
Infiltration safety factor:	0.33	
Total Volume Infiltrated (ac-ft.):		101.63
Total Volume Through Riser (ac-ft.):		46.312
Total Volume Through Facility (ac-ft.):		147.941
Percent Infiltrated:		68.7
Total Precip Applied to Facility:		0
Total Evap From Facility:		0
Discharge Structure		
Riser Height:	6 ft.	
Riser Diameter:	54 in.	
Notch Type:	Rectangular	
Notch Width:	0.692 ft.	
Notch Height:	1.643 ft.	
Orifice 1 Diameter:	1.678 in. Elevation:0 ft.	
Element Flows To:		
Outlet 1	Outlet 2	

Vault Hydraulic Table

Stage(feet)	**Area(ac.)**	**Volume(ac-ft.)**	**Discharge(cfs)**	**Infilt(cfs)**
0.0000	0.116	0.000	0.000	0.000
0.0778	0.116	0.009	0.021	0.038
0.1556	0.116	0.018	0.030	0.038
0.2333	0.116	0.027	0.036	0.038
0.3111	0.116	0.036	0.042	0.038
0.3889	0.116	0.045	0.047	0.038
0.4667	0.116	0.054	0.052	0.038
0.5444	0.116	0.063	0.056	0.038
0.6222	0.116	0.072	0.060	0.038
0.7000	0.116	0.081	0.063	0.038
0.7778	0.116	0.090	0.067	0.038
0.8556	0.116	0.099	0.070	0.038
0.9333	0.116	0.108	0.073	0.038
1.0111	0.116	0.117	0.076	0.038
1.0889	0.116	0.126	0.079	0.038
1.1667	0.116	0.135	0.082	0.038
1.2444	0.116	0.144	0.085	0.038
1.3222	0.116	0.153	0.087	0.038
1.4000	0.116	0.162	0.090	0.038
1.4778	0.116	0.171	0.092	0.038
1.5556	0.116	0.180	0.095	0.038
1.6333	0.116	0.189	0.097	0.038
1.7111	0.116	0.198	0.099	0.038
1.7889	0.116	0.207	0.102	0.038
1.8667	0.116	0.216	0.104	0.038
1.9444	0.116	0.225	0.106	0.038
2.0222	0.116	0.234	0.108	0.038
2.1000	0.116	0.243	0.110	0.038
2.1778	0.116	0.252	0.112	0.038
2.2556	0.116	0.261	0.114	0.038

2.3333	0.116	0.270	0.116	0.038
2.4111	0.116	0.279	0.118	0.038
2.4889	0.116	0.289	0.120	0.038
2.5667	0.116	0.298	0.122	0.038
2.6444	0.116	0.307	0.124	0.038
2.7222	0.116	0.316	0.126	0.038
2.8000	0.116	0.325	0.127	0.038
2.8778	0.116	0.334	0.129	0.038
2.9556	0.116	0.343	0.131	0.038
3.0333	0.116	0.352	0.133	0.038
3.1111	0.116	0.361	0.134	0.038
3.1889	0.116	0.370	0.136	0.038
3.2667	0.116	0.379	0.138	0.038
3.3444	0.116	0.388	0.139	0.038
3.4222	0.116	0.397	0.141	0.038
3.5000	0.116	0.406	0.142	0.038
3.5778	0.116	0.415	0.144	0.038
3.6556	0.116	0.424	0.146	0.038
3.7333	0.116	0.433	0.147	0.038
3.8111	0.116	0.442	0.149	0.038
3.8889	0.116	0.451	0.150	0.038
3.9667	0.116	0.460	0.152	0.038
4.0444	0.116	0.469	0.153	0.038
4.1222	0.116	0.478	0.155	0.038
4.2000	0.116	0.487	0.156	0.038
4.2778	0.116	0.496	0.158	0.038
4.3556	0.116	0.505	0.159	0.038
4.4333	0.116	0.514	0.208	0.038
4.5111	0.116	0.523	0.296	0.038
4.5889	0.116	0.532	0.408	0.038
4.6667	0.116	0.541	0.537	0.038
4.7444	0.116	0.550	0.678	0.038
4.8222	0.116	0.559	0.830	0.038
4.9000	0.116	0.568	0.990	0.038
4.9778	0.116	0.577	1.157	0.038
5.0556	0.116	0.586	1.328	0.038
5.1333	0.116	0.596	1.504	0.038
5.2111	0.116	0.605	1.682	0.038
5.2889	0.116	0.614	1.861	0.038
5.3667	0.116	0.623	2.046	0.038
5.4444	0.116	0.632	2.268	0.038
5.5222	0.116	0.641	2.497	0.038
5.6000	0.116	0.650	2.734	0.038
5.6778	0.116	0.659	2.979	0.038
5.7556	0.116	0.668	3.231	0.038
5.8333	0.116	0.677	4.549	0.038
5.9111	0.116	0.686	4.900	0.038
5.9889	0.116	0.695	5.259	0.038
6.0667	0.116	0.704	6.135	0.038
6.1444	0.116	0.713	7.934	0.038
6.2222	0.116	0.722	10.31	0.038
6.3000	0.116	0.731	13.14	0.038
6.3778	0.116	0.740	16.36	0.038
6.4556	0.116	0.749	19.90	0.038
6.5333	0.116	0.758	23.73	0.038
6.6111	0.116	0.767	27.80	0.038
6.6889	0.116	0.776	32.07	0.038
6.7667	0.116	0.785	36.49	0.038

6.8444	0.116	0.794	41.03	0.038
6.9222	0.116	0.803	45.63	0.038
7.0000	0.116	0.812	50.26	0.038
7.0778	0.116	0.821	54.86	0.038
7.1556	0.000	0.000	59.40	0.108

Vault D1, D2

Width: 89.7553546985461 ft.
Length: 89.7553546985461 ft.
Depth: 7 ft.
Infiltration On
Infiltration rate: 2.5
Infiltration safety factor: 0.33
Total Volume Infiltrated (ac-ft.): 136.043
Total Volume Through Riser (ac-ft.): 130.335
Total Volume Through Facility (ac-ft.): 266.377
Percent Infiltrated: 51.07
Total Precip Applied to Facility: 0
Total Evap From Facility: 0
Discharge Structure
Riser Height: 6 ft.
Riser Diameter: 54 in.
Notch Type: Rectangular
Notch Width: 0.902 ft.
Notch Height: 1.840 ft.
Orifice 1 Diameter: 2.246 in. Elevation:0 ft.
Element Flows To:
Outlet 1 Outlet 2

Vault Hydraulic Table

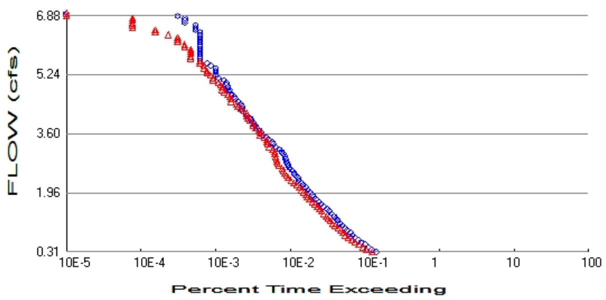
Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.184	0.000	0.000	0.000
0.0778	0.184	0.014	0.038	0.153
0.1556	0.184	0.028	0.054	0.153
0.2333	0.184	0.043	0.066	0.153
0.3111	0.184	0.057	0.076	0.153
0.3889	0.184	0.071	0.085	0.153
0.4667	0.184	0.086	0.093	0.153
0.5444	0.184	0.100	0.101	0.153
0.6222	0.184	0.115	0.108	0.153
0.7000	0.184	0.129	0.114	0.153
0.7778	0.184	0.143	0.120	0.153
0.8556	0.184	0.158	0.126	0.153
0.9333	0.184	0.172	0.132	0.153
1.0111	0.184	0.187	0.137	0.153
1.0889	0.184	0.201	0.142	0.153
1.1667	0.184	0.215	0.147	0.153
1.2444	0.184	0.230	0.152	0.153
1.3222	0.184	0.244	0.157	0.153
1.4000	0.184	0.258	0.162	0.153
1.4778	0.184	0.273	0.166	0.153
1.5556	0.184	0.287	0.170	0.153
1.6333	0.184	0.302	0.175	0.153
1.7111	0.184	0.316	0.179	0.153
1.7889	0.184	0.330	0.183	0.153
1.8667	0.184	0.345	0.187	0.153
1.9444	0.184	0.359	0.190	0.153
2.0222	0.184	0.374	0.194	0.153
2.1000	0.184	0.388	0.198	0.153
2.1778	0.184	0.402	0.202	0.153
2.2556	0.184	0.417	0.205	0.153

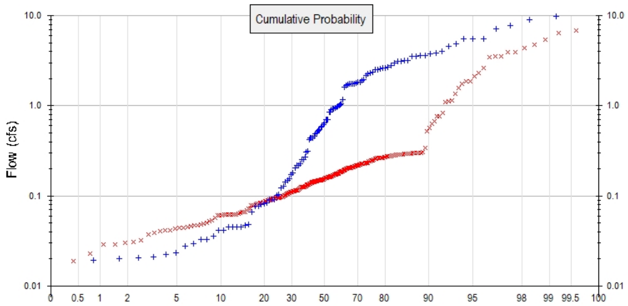
2.3333	0.184	0.431	0.209	0.153
2.4111	0.184	0.445	0.212	0.153
2.4889	0.184	0.460	0.216	0.153
2.5667	0.184	0.474	0.219	0.153
2.6444	0.184	0.489	0.222	0.153
2.7222	0.184	0.503	0.225	0.153
2.8000	0.184	0.517	0.229	0.153
2.8778	0.184	0.532	0.232	0.153
2.9556	0.184	0.546	0.235	0.153
3.0333	0.184	0.561	0.238	0.153
3.1111	0.184	0.575	0.241	0.153
3.1889	0.184	0.589	0.244	0.153
3.2667	0.184	0.604	0.247	0.153
3.3444	0.184	0.618	0.250	0.153
3.4222	0.184	0.632	0.253	0.153
3.5000	0.184	0.647	0.256	0.153
3.5778	0.184	0.661	0.258	0.153
3.6556	0.184	0.676	0.261	0.153
3.7333	0.184	0.690	0.264	0.153
3.8111	0.184	0.704	0.267	0.153
3.8889	0.184	0.719	0.270	0.153
3.9667	0.184	0.733	0.272	0.153
4.0444	0.184	0.748	0.275	0.153
4.1222	0.184	0.762	0.277	0.153
4.2000	0.184	0.776	0.304	0.153
4.2778	0.184	0.791	0.401	0.153
4.3556	0.184	0.805	0.534	0.153
4.4333	0.184	0.819	0.693	0.153
4.5111	0.184	0.834	0.871	0.153
4.5889	0.184	0.848	1.064	0.153
4.6667	0.184	0.863	1.268	0.153
4.7444	0.184	0.877	1.482	0.153
4.8222	0.184	0.891	1.704	0.153
4.9000	0.184	0.906	1.931	0.153
4.9778	0.184	0.920	2.162	0.153
5.0556	0.184	0.935	2.396	0.153
5.1333	0.184	0.949	2.632	0.153
5.2111	0.184	0.963	2.901	0.153
5.2889	0.184	0.978	3.196	0.153
5.3667	0.184	0.992	3.501	0.153
5.4444	0.184	1.006	3.816	0.153
5.5222	0.184	1.021	4.141	0.153
5.6000	0.184	1.035	5.804	0.153
5.6778	0.184	1.050	6.257	0.153
5.7556	0.184	1.064	6.721	0.153
5.8333	0.184	1.078	7.196	0.153
5.9111	0.184	1.093	7.682	0.153
5.9889	0.184	1.107	8.180	0.153
6.0667	0.184	1.122	9.076	0.153
6.1444	0.184	1.136	10.87	0.153
6.2222	0.184	1.150	13.25	0.153
6.3000	0.184	1.165	16.08	0.153
6.3778	0.184	1.179	19.30	0.153
6.4556	0.184	1.193	22.85	0.153
6.5333	0.184	1.208	26.68	0.153
6.6111	0.184	1.222	30.75	0.153
6.6889	0.184	1.237	35.02	0.153
6.7667	0.184	1.251	39.44	0.153

6.8444	0.184	1.265	43.98	0.153
6.9222	0.184	1.280	48.58	0.153
7.0000	0.184	1.294	53.21	0.153
7.0778	0.184	1.309	57.81	0.153
7.1556	0.000	0.000	62.35	0.486

Analysis Results

POC 1





+ Predeveloped   x Mitigated

Predeveloped Landuse Totals for POC #1

Total Pervious Area:	7.95
Total Impervious Area:	0

Mitigated Landuse Totals for POC #1

Total Pervious Area:	1.59
Total Impervious Area:	6.36

Flow Frequency Method: Cunnane

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	3.1476
5 year	4.932977
10 year	6.882232
25 year	9.056806

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	1.139873
5 year	3.614428
10 year	4.700231
25 year	6.41297

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.3148	1864	1635	87	Pass
0.3811	1593	1352	84	Pass
0.4474	1435	1225	85	Pass
0.5138	1291	1085	84	Pass
0.5801	1161	949	81	Pass
0.6465	1049	863	82	Pass
0.7128	965	773	80	Pass
0.7791	888	717	80	Pass
0.8455	825	667	80	Pass
0.9118	753	618	82	Pass
0.9781	701	569	81	Pass
1.0445	650	519	79	Pass
1.1108	600	476	79	Pass
1.1772	560	443	79	Pass
1.2435	529	417	78	Pass
1.3098	503	393	78	Pass
1.3762	465	362	77	Pass
1.4425	431	342	79	Pass
1.5088	399	317	79	Pass
1.5752	365	299	81	Pass
1.6415	339	282	83	Pass
1.7079	319	255	79	Pass
1.7742	286	236	82	Pass
1.8405	268	220	82	Pass
1.9069	258	210	81	Pass
1.9732	241	197	81	Pass
2.0396	223	183	82	Pass
2.1059	208	172	82	Pass
2.1722	192	157	81	Pass
2.2386	184	144	78	Pass
2.3049	172	133	77	Pass
2.3712	164	121	73	Pass
2.4376	153	116	75	Pass
2.5039	145	109	75	Pass
2.5703	137	106	77	Pass
2.6366	128	101	78	Pass
2.7029	122	91	74	Pass
2.7693	118	88	74	Pass
2.8356	114	86	75	Pass
2.9019	112	85	75	Pass
2.9683	110	83	75	Pass
3.0346	104	81	77	Pass
3.1010	99	80	80	Pass
3.1673	93	75	80	Pass
3.2336	82	68	82	Pass
3.3000	76	64	84	Pass
3.3663	74	63	85	Pass
3.4327	67	63	94	Pass
3.4990	62	58	93	Pass
3.5653	55	51	92	Pass
3.6317	52	51	98	Pass
3.6980	50	50	100	Pass
3.7643	46	45	97	Pass

3.8307	44	41	93	Pass
3.8970	42	41	97	Pass
3.9634	39	37	94	Pass
4.0297	38	35	92	Pass
4.0960	34	34	100	Pass
4.1624	33	34	103	Pass
4.2287	29	31	106	Pass
4.2950	29	28	96	Pass
4.3614	29	26	89	Pass
4.4277	28	25	89	Pass
4.4941	26	21	80	Pass
4.5604	24	21	87	Pass
4.6267	23	20	86	Pass
4.6931	21	19	90	Pass
4.7594	20	17	85	Pass
4.8258	20	16	80	Pass
4.8921	19	16	84	Pass
4.9584	18	15	83	Pass
5.0248	18	14	77	Pass
5.0911	17	12	70	Pass
5.1574	14	12	85	Pass
5.2238	13	11	84	Pass
5.2901	13	10	76	Pass
5.3565	13	10	76	Pass
5.4228	13	9	69	Pass
5.4891	11	9	81	Pass
5.5555	10	8	80	Pass
5.6218	8	8	100	Pass
5.6881	8	6	75	Pass
5.7545	8	6	75	Pass
5.8208	8	6	75	Pass
5.8872	8	6	75	Pass
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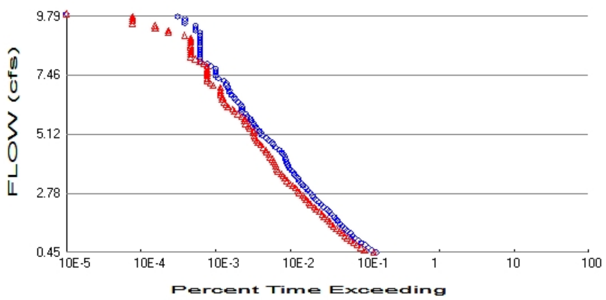
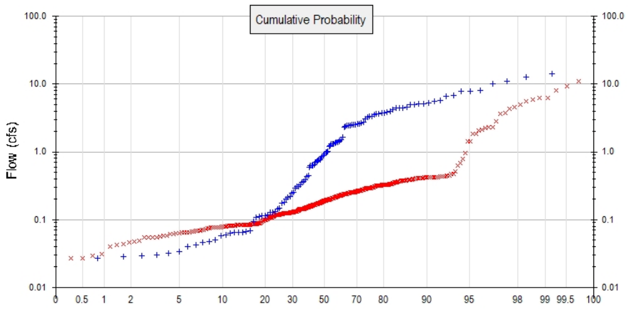
6.0198	8	5	62	Pass
6.0862	8	5	62	Pass
6.1525	8	4	50	Pass
6.2189	8	4	50	Pass
6.2852	8	4	50	Pass
6.3515	8	3	37	Pass
6.4179	8	2	25	Pass
6.4842	7	2	28	Pass
6.5505	7	1	14	Pass
6.6169	7	1	14	Pass
6.6832	5	1	20	Pass
6.7496	5	1	20	Pass
6.8159	5	1	20	Pass
6.8822	4	0	0	Pass

Water Quality

POC 2





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #2

Total Pervious Area:	11.31
Total Impervious Area:	0

Mitigated Landuse Totals for POC #2

Total Pervious Area:	2.26
Total Impervious Area:	9.05

Flow Frequency Method: Cunnane

Flow Frequency Return Periods for Predeveloped. POC #2

Return Period	**Flow(cfs)**
2 year	4.477907
5 year	7.017858
10 year	9.790951
25 year	12.884589

Flow Frequency Return Periods for Mitigated. POC #2

Return Period	**Flow(cfs)**
2 year	1.863307
5 year	5.007627
10 year	6.177143
25 year	9.359948

Duration Flows

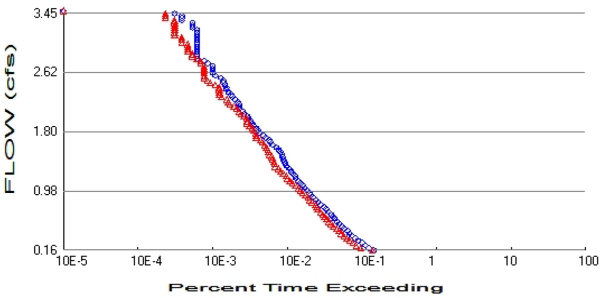
The Facility PASSED

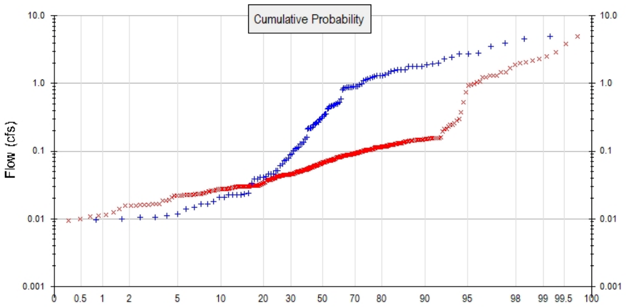
Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.4478	1864	1703	91	Pass
0.5422	1593	1277	80	Pass
0.6365	1434	1152	80	Pass
0.7309	1291	1016	78	Pass
0.8253	1161	914	78	Pass
0.9197	1049	837	79	Pass
1.0140	964	751	77	Pass
1.1084	888	693	78	Pass
1.2028	825	642	77	Pass
1.2972	753	596	79	Pass
1.3915	701	540	77	Pass
1.4859	650	494	76	Pass
1.5803	600	462	77	Pass
1.6747	560	433	77	Pass
1.7690	529	404	76	Pass
1.8634	502	372	74	Pass
1.9578	466	349	74	Pass
2.0522	431	317	73	Pass
2.1465	399	288	72	Pass
2.2409	365	273	74	Pass
2.3353	339	245	72	Pass
2.4297	319	232	72	Pass
2.5240	286	212	74	Pass
2.6184	268	200	74	Pass
2.7128	258	192	74	Pass
2.8072	241	173	71	Pass
2.9015	223	164	73	Pass
2.9959	208	153	73	Pass
3.0903	192	139	72	Pass
3.1847	184	127	69	Pass
3.2791	172	117	68	Pass
3.3734	164	109	66	Pass
3.4678	153	104	67	Pass
3.5622	145	98	67	Pass
3.6566	137	90	65	Pass
3.7509	128	86	67	Pass
3.8453	122	83	68	Pass
3.9397	118	82	69	Pass
4.0341	114	78	68	Pass
4.1284	112	75	66	Pass
4.2228	110	70	63	Pass
4.3172	104	67	64	Pass
4.4116	99	62	62	Pass
4.5059	93	61	65	Pass
4.6003	82	56	68	Pass
4.6947	76	52	68	Pass
4.7891	74	48	64	Pass
4.8834	67	46	68	Pass
4.9778	62	44	70	Pass
5.0722	55	43	78	Pass
5.1666	52	42	80	Pass
5.2609	50	42	84	Pass
5.3553	46	37	80	Pass

5.4497	44	36	81	Pass
5.5441	42	33	78	Pass
5.6384	39	32	82	Pass
5.7328	38	32	84	Pass
5.8272	34	29	85	Pass
5.9216	33	26	78	Pass
6.0159	29	23	79	Pass
6.1103	29	22	75	Pass
6.2047	29	19	65	Pass
6.2991	28	18	64	Pass
6.3934	26	17	65	Pass
6.4878	24	16	66	Pass
6.5822	23	16	69	Pass
6.6766	21	15	71	Pass
6.7709	20	15	75	Pass
6.8653	20	15	75	Pass
6.9597	19	15	78	Pass
7.0541	18	12	66	Pass
7.1484	18	11	61	Pass
7.2428	17	10	58	Pass
7.3372	14	10	71	Pass
7.4316	13	10	76	Pass
7.5259	13	10	76	Pass
7.6203	13	10	76	Pass
7.7147	13	10	76	Pass
7.8091	11	10	90	Pass
7.9034	10	9	90	Pass
7.9978	8	8	100	Pass
8.0922	8	7	87	Pass
8.1866	8	6	75	Pass
8.2809	8	6	75	Pass
8.3753	8	6	75	Pass
8.4697	8	6	75	Pass
8.5641	8	6	75	Pass
8.6584	8	6	75	Pass
8.7528	8	6	75	Pass
8.8472	8	6	75	Pass
8.9416	8	6	75	Pass
9.0359	8	5	62	Pass
9.1303	8	3	37	Pass
9.2247	7	3	42	Pass
9.3191	7	2	28	Pass
9.4134	7	2	28	Pass
9.5078	5	1	20	Pass
9.6022	5	1	20	Pass
9.6966	5	1	20	Pass
9.7910	4	1	25	Pass

Water Quality

POC 3





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #3

Total Pervious Area:	3.98
Total Impervious Area:	0

Mitigated Landuse Totals for POC #3

Total Pervious Area:	0.8
Total Impervious Area:	3.18

Flow Frequency Method: Cunnane

Flow Frequency Return Periods for Predeveloped. POC #3

Return Period	**Flow(cfs)**
2 year	1.57578
5 year	2.469591
10 year	3.445445
25 year	4.534099

Flow Frequency Return Periods for Mitigated. POC #3

Return Period	**Flow(cfs)**
2 year	1.048166
5 year	2.003933
10 year	2.488788
25 year	3.876127

Duration Flows

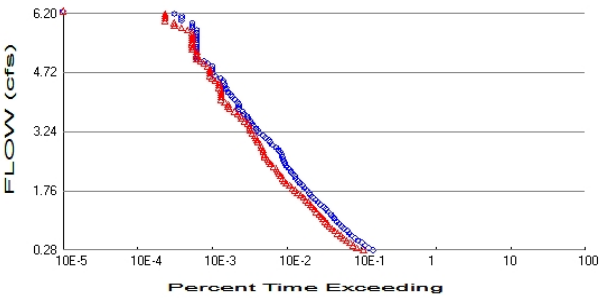
The Facility PASSED

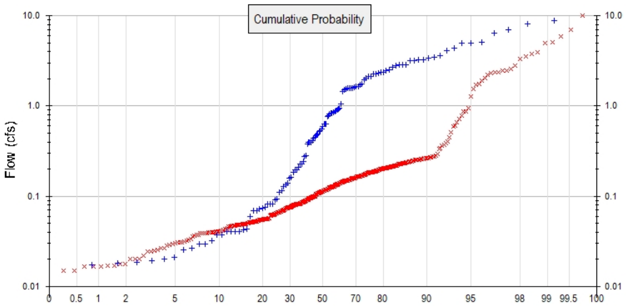
Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.1576	1867	1783	95	Pass
0.1908	1596	1247	78	Pass
0.2240	1431	1097	76	Pass
0.2572	1291	982	76	Pass
0.2904	1161	885	76	Pass
0.3236	1051	813	77	Pass
0.3568	967	745	77	Pass
0.3901	888	685	77	Pass
0.4233	825	641	77	Pass
0.4565	753	593	78	Pass
0.4897	701	535	76	Pass
0.5229	650	497	76	Pass
0.5561	600	465	77	Pass
0.5893	560	440	78	Pass
0.6225	529	412	77	Pass
0.6557	504	388	76	Pass
0.6890	467	362	77	Pass
0.7222	431	333	77	Pass
0.7554	399	319	79	Pass
0.7886	365	306	83	Pass
0.8218	339	278	82	Pass
0.8550	318	256	80	Pass
0.8882	286	246	86	Pass
0.9214	268	228	85	Pass
0.9546	258	208	80	Pass
0.9878	241	194	80	Pass
1.0211	222	183	82	Pass
1.0543	208	168	80	Pass
1.0875	193	152	78	Pass
1.1207	184	140	76	Pass
1.1539	172	131	76	Pass
1.1871	164	125	76	Pass
1.2203	153	114	74	Pass
1.2535	145	106	73	Pass
1.2867	139	99	71	Pass
1.3200	129	90	69	Pass
1.3532	122	88	72	Pass
1.3864	118	86	72	Pass
1.4196	114	82	71	Pass
1.4528	112	81	72	Pass
1.4860	110	75	68	Pass
1.5192	104	72	69	Pass
1.5524	99	71	71	Pass
1.5856	93	68	73	Pass
1.6189	82	64	78	Pass
1.6521	76	60	78	Pass
1.6853	74	57	77	Pass
1.7185	67	50	74	Pass
1.7517	62	50	80	Pass
1.7849	55	49	89	Pass
1.8181	52	46	88	Pass
1.8513	50	44	88	Pass
1.8845	46	40	86	Pass

1.9177	44	38	86	Pass
1.9510	42	38	90	Pass
1.9842	39	37	94	Pass
2.0174	38	34	89	Pass
2.0506	34	31	91	Pass
2.0838	33	29	87	Pass
2.1170	29	27	93	Pass
2.1502	29	25	86	Pass
2.1834	29	22	75	Pass
2.2166	28	21	75	Pass
2.2499	26	20	76	Pass
2.2831	24	17	70	Pass
2.3163	23	16	69	Pass
2.3495	21	16	76	Pass
2.3827	20	16	80	Pass
2.4159	20	16	80	Pass
2.4491	19	14	73	Pass
2.4823	18	12	66	Pass
2.5155	18	11	61	Pass
2.5488	17	10	58	Pass
2.5820	14	10	71	Pass
2.6152	13	10	76	Pass
2.6484	13	10	76	Pass
2.6816	13	10	76	Pass
2.7148	13	10	76	Pass
2.7480	11	9	81	Pass
2.7812	10	9	90	Pass
2.8144	8	8	100	Pass
2.8477	8	7	87	Pass
2.8809	8	7	87	Pass
2.9141	8	6	75	Pass
2.9473	8	6	75	Pass
2.9805	8	6	75	Pass
3.0137	8	6	75	Pass
3.0469	8	5	62	Pass
3.0801	8	5	62	Pass
3.1133	8	5	62	Pass
3.1465	8	4	50	Pass
3.1798	8	4	50	Pass
3.2130	8	4	50	Pass
3.2462	7	4	57	Pass
3.2794	7	4	57	Pass
3.3126	7	4	57	Pass
3.3458	5	4	80	Pass
3.3790	5	3	60	Pass
3.4122	5	3	60	Pass
3.4454	4	3	75	Pass

Water Quality

POC 4





+ Predeveloped   x Mitigated

Predeveloped Landuse Totals for POC #4

Total Pervious Area:	7.16
Total Impervious Area:	0

Mitigated Landuse Totals for POC #4

Total Pervious Area:	1.43
Total Impervious Area:	5.73

Flow Frequency Method: Cunnane

Flow Frequency Return Periods for Predeveloped. POC #4

Return Period	**Flow(cfs)**
2 year	2.83482
5 year	4.442782
10 year	6.198338
25 year	8.156821

Flow Frequency Return Periods for Mitigated. POC #4

Return Period	**Flow(cfs)**
2 year	1.906823
5 year	3.576627
10 year	5.040317
25 year	7.16087

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.2835	1864	1370	73	Pass
0.3432	1594	1121	70	Pass
0.4030	1437	998	69	Pass
0.4627	1291	909	70	Pass
0.5225	1161	810	69	Pass
0.5822	1049	741	70	Pass
0.6420	966	678	70	Pass
0.7017	889	623	70	Pass
0.7615	825	568	68	Pass
0.8212	753	516	68	Pass
0.8809	701	478	68	Pass
0.9407	650	452	69	Pass
1.0004	600	423	70	Pass
1.0602	560	398	71	Pass
1.1199	529	376	71	Pass
1.1797	503	350	69	Pass
1.2394	465	321	69	Pass
1.2992	431	305	70	Pass
1.3589	399	284	71	Pass
1.4187	365	269	73	Pass
1.4784	339	251	74	Pass
1.5381	319	232	72	Pass
1.5979	286	216	75	Pass
1.6576	268	197	73	Pass
1.7174	258	179	69	Pass
1.7771	241	166	68	Pass
1.8369	223	152	68	Pass
1.8966	208	141	67	Pass
1.9564	192	127	66	Pass
2.0161	184	119	64	Pass
2.0759	172	114	66	Pass
2.1356	164	107	65	Pass
2.1954	153	101	66	Pass
2.2551	145	97	66	Pass
2.3148	139	94	67	Pass
2.3746	128	85	66	Pass
2.4343	122	78	63	Pass
2.4941	118	74	62	Pass
2.5538	114	71	62	Pass
2.6136	112	64	57	Pass
2.6733	110	64	58	Pass
2.7331	104	62	59	Pass
2.7928	99	62	62	Pass
2.8526	93	59	63	Pass
2.9123	82	58	70	Pass
2.9721	76	52	68	Pass
3.0318	74	51	68	Pass
3.0915	67	50	74	Pass
3.1513	62	48	77	Pass
3.2110	55	44	80	Pass
3.2708	52	42	80	Pass
3.3305	50	41	82	Pass
3.3903	46	41	89	Pass

3.4500	44	39	88	Pass
3.5098	42	35	83	Pass
3.5695	39	32	82	Pass
3.6293	38	31	81	Pass
3.6890	34	28	82	Pass
3.7488	33	26	78	Pass
3.8085	29	22	75	Pass
3.8682	29	21	72	Pass
3.9280	29	21	72	Pass
3.9877	28	19	67	Pass
4.0475	26	17	65	Pass
4.1072	24	17	70	Pass
4.1670	23	17	73	Pass
4.2267	21	17	80	Pass
4.2865	20	17	85	Pass
4.3462	20	16	80	Pass
4.4060	19	16	84	Pass
4.4657	18	16	88	Pass
4.5254	18	14	77	Pass
4.5852	17	13	76	Pass
4.6449	14	12	85	Pass
4.7047	13	12	92	Pass
4.7644	13	12	92	Pass
4.8242	13	12	92	Pass
4.8839	13	11	84	Pass
4.9437	11	10	90	Pass
5.0034	10	9	90	Pass
5.0632	8	8	100	Pass
5.1229	8	8	100	Pass
5.1827	8	8	100	Pass
5.2424	8	8	100	Pass
5.3021	8	7	87	Pass
5.3619	8	7	87	Pass
5.4216	8	7	87	Pass
5.4814	8	7	87	Pass
5.5411	8	7	87	Pass
5.6009	8	7	87	Pass
5.6606	8	7	87	Pass
5.7204	8	7	87	Pass
5.7801	8	6	75	Pass
5.8399	7	5	71	Pass
5.8996	7	4	57	Pass
5.9594	7	4	57	Pass
6.0191	5	3	60	Pass
6.0788	5	3	60	Pass
6.1386	5	3	60	Pass
6.1983	4	3	75	Pass

Water Quality

Rational Method

Data for Rational Method is not available.

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

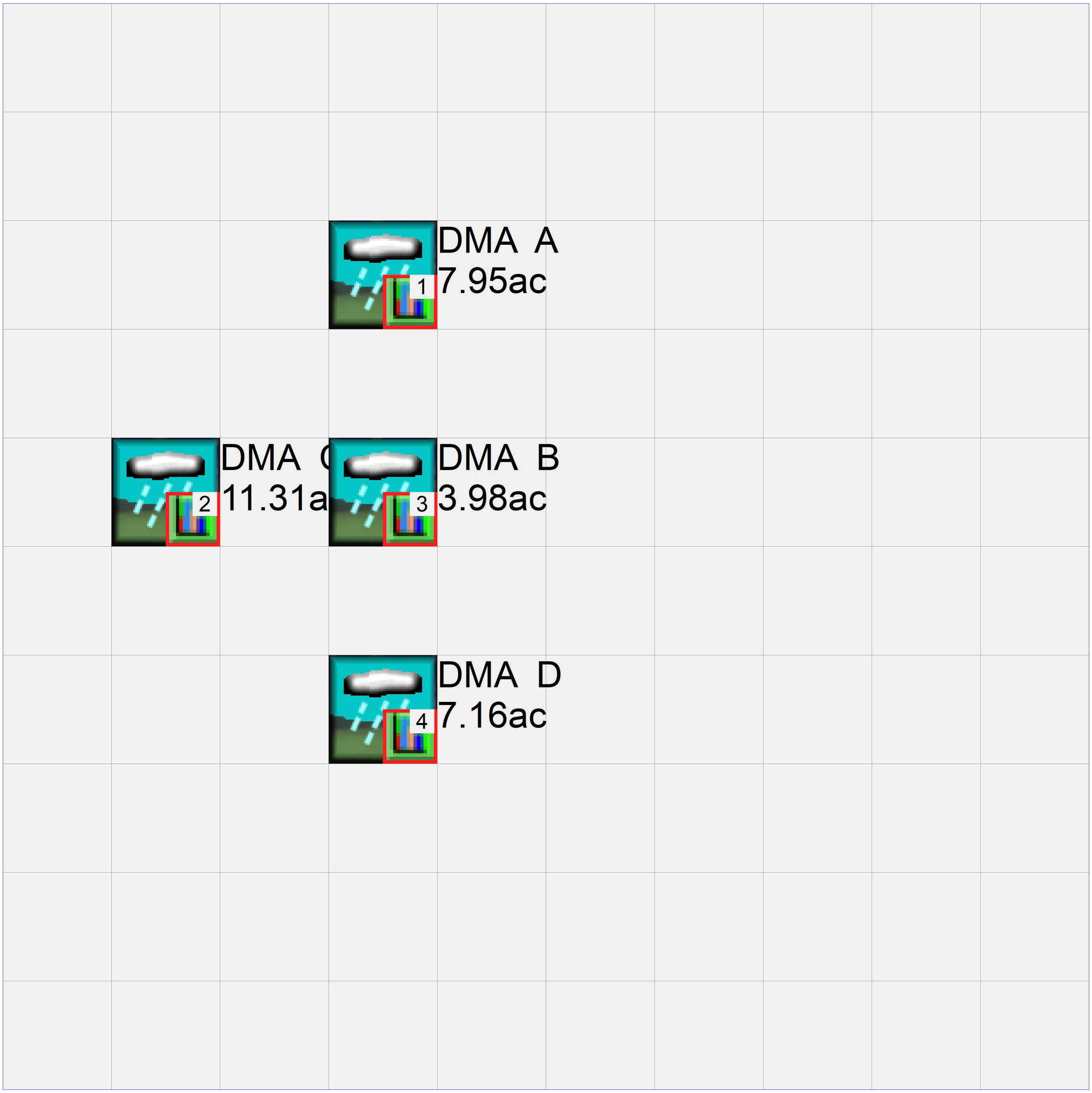
No PERLND changes have been made.

IMPLND Changes

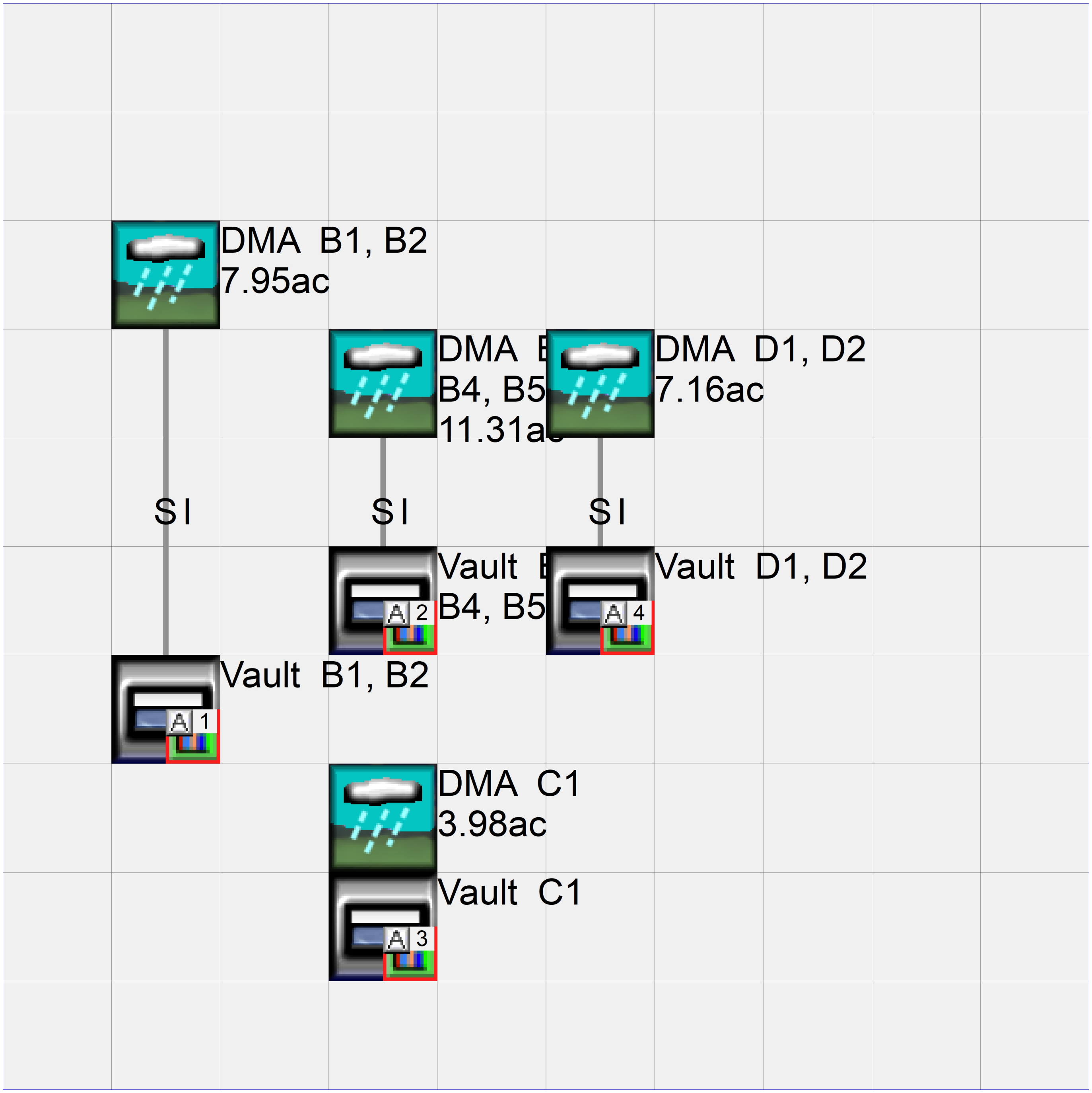
No IMPLND changes have been made.

Appendix

Predeveloped Schematic



Mitigated Schematic



Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1974 10 01        END    2011 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM        26   The Terraces - Murrieta.wdm
MESSU      25   PreThe Terraces - Murrieta.MES
           27   PreThe Terraces - Murrieta.L61
           28   PreThe Terraces - Murrieta.L62
           30   POCThe Terraces - Murrieta1.dat
           31   POCThe Terraces - Murrieta2.dat
           32   POCThe Terraces - Murrieta3.dat
           33   POCThe Terraces - Murrieta4.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      42
      COPY       501
      COPY       502
      COPY       503
      COPY       504
      DISPLY       1
      DISPLY       2
      DISPLY       3
      DISPLY       4
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        DMA  A                      MAX                      1    2   30    9
    2        DMA  C                      MAX                      1    2   31    9
    3        DMA  B                      MAX                      1    2   32    9
    4        DMA  D                      MAX                      1    2   33    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  502         1    1
  503         1    1
  504         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                           in  out           ***
   42     C/D,Grass,Mod(5-10%)    1    1    1    1   27    0
```

```
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   42         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   42         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   42         0    0    0    1    0    0    0    0    1    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   42              0       4.5      0.04       350       0.1         2      0.95
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   42             40        35         3         2      0.15      0.15         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   42              0       0.7      0.25       1.2      0.45         0
  END PWAT-PARM4
  MON-LZETPARM
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
   42       0.4  0.4  0.4 0.45  0.5 0.55 0.55 0.55 0.55 0.55 0.45  0.4
  END MON-LZETPARM
  MON-INTERCEP
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
   42      0.12 0.12 0.12 0.11  0.1  0.1  0.1  0.1  0.1  0.1 0.11 0.12
  END MON-INTERCEP

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   42              0         0      0.01         0       0.5       0.3      0.01
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                     in  out            ***
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
  END ACTIVITY
```

```
  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK    ***
<Name>   #                  <-factor->     <Name>   #   Tbl#    ***
DMA  A***
PERLND  42                        7.95     COPY   501     12
PERLND  42                        7.95     COPY   501     13
DMA  C***
PERLND  42                       11.31     COPY   502     12
PERLND  42                       11.31     COPY   502     13
DMA  B***
PERLND  42                        3.98     COPY   503     12
PERLND  42                        3.98     COPY   503     13
DMA  D***
PERLND  42                        7.16     COPY   504     12
PERLND  42                        7.16     COPY   504     13

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1
COPY   502 OUTPUT MEAN   1 1   48.4        DISPLY   2     INPUT  TIMSER 1
COPY   503 OUTPUT MEAN   1 1   48.4        DISPLY   3     INPUT  TIMSER 1
COPY   504 OUTPUT MEAN   1 1   48.4        DISPLY   4     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG             ***
                                           in  out                           ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
```

```
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible   exit *** possible   exit     possible   exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *        ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                       ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #   ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    1              PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    1              IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    501 FLOW     ENGL      REPL
COPY   502 OUTPUT MEAN   1 1     48.4      WDM    502 FLOW     ENGL      REPL
COPY   503 OUTPUT MEAN   1 1     48.4      WDM    503 FLOW     ENGL      REPL
COPY   504 OUTPUT MEAN   1 1     48.4      WDM    504 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>      <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>               <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY          INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY          INPUT  MEAN
  END MASS-LINK   13


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1974 10 01        END    2011 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM        26   The Terraces - Murrieta.wdm
MESSU      25   MitThe Terraces - Murrieta.MES
           27   MitThe Terraces - Murrieta.L61
           28   MitThe Terraces - Murrieta.L62
           31   POCThe Terraces - Murrieta2.dat
           32   POCThe Terraces - Murrieta3.dat
           33   POCThe Terraces - Murrieta4.dat
           30   POCThe Terraces - Murrieta1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      46
      IMPLND       1
      RCHRES       1
      RCHRES       2
      RCHRES       3
      GENER        5
      RCHRES       4
      RCHRES       5
      RCHRES       6
      COPY         2
      COPY       502
      COPY         3
      COPY       503
      COPY         4
      COPY       504
      COPY         1
      COPY       501
      DISPLY       2
      DISPLY       3
      DISPLY       4
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    2        Vault  C                    MAX                    1    2   31    9
    3        Vault  B                    MAX                    1    2   32    9
    4        Vault  D                    MAX                    1    2   33    9
    1        Vault  A                    MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
    2         1    1
  502         1    1
    3         1    1
  503         1    1
    4         1    1
  504         1    1
  501         1    1
  END TIMESERIES
```

```
END COPY
GENER
  OPCODE
    #    # OPCD ***
    5        24
  END OPCODE
  PARM
    #    #         K ***
    5             0.
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out           ***
   46      C/D,Urban,Mod(5-10%)    1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   46         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   46         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   46         0    0    0    1    0    0    0    0    1    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   46              0       4.2      0.03       350       0.1         3     0.995
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   46             40        35         3         2      0.45      0.15         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   46              0       0.5      0.25       0.7      0.35         0
  END PWAT-PARM4
  MON-LZETPARM
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
   46       0.5  0.5  0.5  0.6 0.65 0.65 0.65 0.65 0.65 0.65 0.55  0.5
  END MON-LZETPARM
  MON-INTERCEP
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
   46      0.11 0.11 0.11 0.11 0.11 0.11 0.11 0.11 0.11 0.11 0.11 0.11
  END MON-INTERCEP

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   46              0         0      0.01         0       3.5       1.7       0.1
```

```
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                      in  out           ***
    1     Roads,Flat(0-5%)        1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    1         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    1         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI    ***
    1         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1            100      0.05       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
DMA  A***
PERLND  46                        1.59     RCHRES   4      2
PERLND  46                        1.59     RCHRES   4      3
IMPLND   1                        6.36     RCHRES   4      5
DMA  C***
PERLND  46                        2.26     RCHRES   1      2
PERLND  46                        2.26     RCHRES   1      3
IMPLND   1                        9.05     RCHRES   1      5
DMA  B***
PERLND  46                         0.8     RCHRES   2      2
PERLND  46                         0.8     RCHRES   2      3
IMPLND   1                        3.18     RCHRES   2      5
DMA  D***
PERLND  46                        1.43     RCHRES   3      2
PERLND  46                        1.43     RCHRES   3      3
IMPLND   1                        5.73     RCHRES   3      5
```

```
******Routing******
RCHRES   5                           1     RCHRES   6      7
RCHRES   5                                 COPY     1     17
RCHRES   4                           1     RCHRES   6      7
RCHRES   4                                 COPY     1     17
RCHRES   4                           1     RCHRES   5      8
RCHRES   6                           1     COPY   501     17
RCHRES   1                           1     COPY   502     17
RCHRES   1                           1     COPY   602     17
RCHRES   2                           1     COPY   503     17
RCHRES   2                           1     COPY   603     17
RCHRES   3                           1     COPY   504     17
RCHRES   3                           1     COPY   604     17
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   502 OUTPUT MEAN   1 1   48.4        DISPLY   2     INPUT  TIMSER 1
COPY   503 OUTPUT MEAN   1 1   48.4        DISPLY   3     INPUT  TIMSER 1
COPY   504 OUTPUT MEAN   1 1   48.4        DISPLY   4     INPUT  TIMSER 1
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1
GENER    5 OUTPUT TIMSER      .0011111     RCHRES   4     EXTNL  OUTDGT 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                   ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG              ***
                                           in  out                             ***
    1     Vault  C                2    1    1    1    28    0    1
    2     Vault  B                2    1    1    1    28    0    1
    3     Vault  D                2    1    1    1    28    0    1
    4     Surface Bio Swal-018    2    1    1    1    28    0    1
    5     Bio Swale  1            2    1    1    1    28    0    1
    6     Vault  A                2    1    1    1    28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
    2         1    0    0    0    0    0    0    0    0    0
    3         1    0    0    0    0    0    0    0    0    0
    4         1    0    0    0    0    0    0    0    0    0
    5         1    0    0    0    0    0    0    0    0    0
    6         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
    1         4    0    0    0    0    0    0    0    0    0    1    9
    2         4    0    0    0    0    0    0    0    0    0    1    9
    3         4    0    0    0    0    0    0    0    0    0    1    9
    4         4    0    0    0    0    0    0    0    0    0    1    9
    5         4    0    0    0    0    0    0    0    0    0    1    9
    6         4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                     ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
```

```
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
    1        0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
    2        0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
    3        0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
    4        0  1  0  0    4  5  0  0  0       0  1  0  0  0       2  1  2  2  2
    5        0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
    6        0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
    1              1      0.02       0.0       0.0       0.5       0.0
    2              2      0.01       0.0       0.0       0.5       0.0
    3              3      0.02       0.0       0.0       0.5       0.0
    4              4      0.01       0.0       0.0       0.0       0.0
    5              5      0.03       0.0       0.0       0.0       0.0
    6              6      0.02       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                         ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1           0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    2           0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    3           0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    4           0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    5           0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    6           0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
*** User-Defined Variable Quantity Lines
***                          addr
***                        <------>
*** kwd  varnam optyp  opn  vari  s1 s2 s3 tp multiply  lc ls ac as agfn ***
  <****> <----> <----> <-> <----><-><-><-><-><--------> <><-> <><-> <--> ***
  UVQUAN vol5   RCHRES   5 VOL              4
  UVQUAN v2m5   GLOBAL     WORKSP  4        3
  UVQUAN vpo5   GLOBAL     WORKSP  5        3
  UVQUAN v2d5   GENER    5 K       1        3
*** User-Defined Target Variable Names
***                  addr or                       addr or
***                 <------->                     <------->
*** kwd   varnam ct  vari  s1 s2 s3  frac oper     vari  s1 s2 s3  frac oper
  <****>  <----><-> <----><-><-><-> <---> <-->    <----><-><-><-> <---> <-->
  UVNAME  v2m5    1 WORKSP  4         1.0 QUAN
  UVNAME  vpo5    1 WORKSP  5         1.0 QUAN
  UVNAME  v2d5    1 K       1         1.0 QUAN
*** opt foplop dcdts  yr mo dy hr mn d t   vnam  s1 s2 s3 ac quantity  tc  ts rp
  <****><-><--><><-><--> <> <> <> <><><>  <----><-><-><-><-><--------> <> <-><->
  GENER    5                               v2m5            =  6594.2
*** Compute remaining available pore space
  GENER    5                               vpo5            =  v2m5
  GENER    5                               vpo5           -=  vol5
*** Check to see if VPORA goes negative; if so set VPORA = 0.0
IF (vpo5 < 0.0) THEN
  GENER    5                               vpo5            =  0.0
END IF
*** Infiltration volume
  GENER    5                               v2d5            =  vpo5
END SPEC-ACTIONS
FTABLES
  FTABLE      6
   92    5
     Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
      (ft)   (acres) (acre-ft)    (cfs)      (cfs)    (ft/sec)    (Minutes)***
```

```
0.000000  0.232320  0.000000  0.000000  0.000000
0.077778  0.232320  0.018069  0.040875  0.038652
0.155556  0.232320  0.036139  0.057806  0.038652
0.233333  0.232320  0.054208  0.070798  0.038652
0.311111  0.232320  0.072277  0.081750  0.038652
0.388889  0.232320  0.090347  0.091399  0.038652
0.466667  0.232320  0.108416  0.100123  0.038652
0.544444  0.232320  0.126485  0.108145  0.038652
0.622222  0.232320  0.144555  0.115612  0.038652
0.700000  0.232320  0.162624  0.122625  0.038652
0.777778  0.232320  0.180693  0.129258  0.038652
0.855556  0.232320  0.198763  0.135567  0.038652
0.933333  0.232320  0.216832  0.141595  0.038652
1.011111  0.232320  0.234901  0.147377  0.038652
1.088889  0.232320  0.252971  0.152941  0.038652
1.166667  0.232320  0.271040  0.158309  0.038652
1.244444  0.232320  0.289109  0.163500  0.038652
1.322222  0.232320  0.307179  0.168532  0.038652
1.400000  0.232320  0.325248  0.173418  0.038652
1.477778  0.232320  0.343317  0.178170  0.038652
1.555556  0.232320  0.361386  0.182799  0.038652
1.633333  0.232320  0.379456  0.187313  0.038652
1.711111  0.232320  0.397525  0.191721  0.038652
1.788889  0.232320  0.415594  0.196030  0.038652
1.866667  0.232320  0.433664  0.200246  0.038652
1.944444  0.232320  0.451733  0.204375  0.038652
2.022222  0.232320  0.469802  0.208423  0.038652
2.100000  0.232320  0.487872  0.212393  0.038652
2.177778  0.232320  0.505941  0.216291  0.038652
2.255556  0.232320  0.524010  0.220119  0.038652
2.333333  0.232320  0.542080  0.223882  0.038652
2.411111  0.232320  0.560149  0.227583  0.038652
2.488889  0.232320  0.578218  0.231224  0.038652
2.566667  0.232320  0.596288  0.234810  0.038652
2.644444  0.232320  0.614357  0.238341  0.038652
2.722222  0.232320  0.632426  0.241820  0.038652
2.800000  0.232320  0.650496  0.245251  0.038652
2.877778  0.232320  0.668565  0.248633  0.038652
2.955556  0.232320  0.686634  0.251971  0.038652
3.033333  0.232320  0.704704  0.255265  0.038652
3.111111  0.232320  0.722773  0.258517  0.038652
3.188889  0.232320  0.740842  0.261728  0.038652
3.266667  0.232320  0.758912  0.264901  0.038652
3.344444  0.232320  0.776981  0.268036  0.038652
3.422222  0.232320  0.795050  0.271135  0.038652
3.500000  0.232320  0.813120  0.274198  0.038652
3.577778  0.232320  0.831189  0.277228  0.038652
3.655556  0.232320  0.849258  0.280226  0.038652
3.733333  0.232320  0.867328  0.283191  0.038652
3.811111  0.232320  0.885397  0.286126  0.038652
3.888889  0.232320  0.903466  0.289031  0.038652
3.966667  0.232320  0.921536  0.291907  0.038652
4.044444  0.232320  0.939605  0.294754  0.038652
4.122222  0.232320  0.957674  0.297575  0.038652
4.200000  0.232320  0.975743  0.300369  0.038652
4.277778  0.232320  0.993813  0.303138  0.038652
4.355556  0.232320  1.011882  0.305881  0.038652
4.433333  0.232320  1.029951  0.308600  0.038652
4.511111  0.232320  1.048021  0.311295  0.038652
4.588889  0.232320  1.066090  0.366956  0.038652
4.666667  0.232320  1.084159  0.513632  0.038652
4.744444  0.232320  1.102229  0.711762  0.038652
4.822222  0.232320  1.120298  0.950181  0.038652
4.900000  0.232320  1.138367  1.222896  0.038652
4.977778  0.232320  1.156437  1.525998  0.038652
5.055556  0.232320  1.174506  1.856671  0.038652
5.133333  0.232320  1.192575  2.212767  0.038652
5.211111  0.232320  1.210645  2.592571  0.038652
5.288889  0.232320  1.228714  2.994676  0.038652
5.366667  0.232320  1.246783  3.417898  0.038652
```

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5.444444  0.232320  1.264853  3.861225  0.038652
5.522222  0.232320  1.282922  4.323778  0.038652
5.600000  0.232320  1.300991  4.804784  0.038652
5.677778  0.232320  1.319061  5.303555  0.038652
5.755556  0.232320  1.337130  5.819477  0.038652
5.833333  0.232320  1.355199  6.351994  0.038652
5.911111  0.232320  1.373269  6.900601  0.038652
5.988889  0.232320  1.391338  7.464837  0.038652
6.066667  0.232320  1.409407  8.370771  0.038652
6.144444  0.232320  1.427477  10.17095  0.038652
6.222222  0.232320  1.445546  12.54912  0.038652
6.300000  0.232320  1.463615  15.38374  0.038652
6.377778  0.232320  1.481685  18.60220  0.038652
6.455556  0.232320  1.499754  22.15021  0.038652
6.533333  0.232320  1.517823  25.98131  0.038652
6.611111  0.232320  1.535893  30.05229  0.038652
6.688889  0.232320  1.553962  34.32084  0.038652
6.766667  0.232320  1.572031  38.74441  0.038652
6.844444  0.232320  1.590101  43.27981  0.038652
6.922222  0.232320  1.608170  47.88302  0.038652
7.000000  0.232320  1.626239  52.50949  0.038652
7.077778  0.232320  1.644308  57.11450  0.038652
END FTABLE  6
FTABLE      1
 92    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)     (cfs)    (ft/sec)    (Minutes)***
0.000000  0.357737  0.000000  0.000000  0.000000
0.077778  0.357737  0.027824  0.059038  0.059519
0.155556  0.357737  0.055648  0.083492  0.059519
0.233333  0.357737  0.083472  0.102256  0.059519
0.311111  0.357737  0.111296  0.118075  0.059519
0.388889  0.357737  0.139120  0.132012  0.059519
0.466667  0.357737  0.166944  0.144612  0.059519
0.544444  0.357737  0.194768  0.156199  0.059519
0.622222  0.357737  0.222592  0.166983  0.059519
0.700000  0.357737  0.250416  0.177113  0.059519
0.777778  0.357737  0.278240  0.186693  0.059519
0.855556  0.357737  0.306064  0.195805  0.059519
0.933333  0.357737  0.333888  0.204512  0.059519
1.011111  0.357737  0.361712  0.212863  0.059519
1.088889  0.357737  0.389536  0.220898  0.059519
1.166667  0.357737  0.417360  0.228651  0.059519
1.244444  0.357737  0.445184  0.236150  0.059519
1.322222  0.357737  0.473008  0.243418  0.059519
1.400000  0.357737  0.500832  0.250475  0.059519
1.477778  0.357737  0.528656  0.257339  0.059519
1.555556  0.357737  0.556480  0.264024  0.059519
1.633333  0.357737  0.584304  0.270544  0.059519
1.711111  0.357737  0.612128  0.276911  0.059519
1.788889  0.357737  0.639952  0.283134  0.059519
1.866667  0.357737  0.667776  0.289224  0.059519
1.944444  0.357737  0.695600  0.295188  0.059519
2.022222  0.357737  0.723424  0.301034  0.059519
2.100000  0.357737  0.751248  0.306768  0.059519
2.177778  0.357737  0.779072  0.312397  0.059519
2.255556  0.357737  0.806896  0.317927  0.059519
2.333333  0.357737  0.834721  0.323362  0.059519
2.411111  0.357737  0.862545  0.328707  0.059519
2.488889  0.357737  0.890369  0.333967  0.059519
2.566667  0.357737  0.918193  0.339145  0.059519
2.644444  0.357737  0.946017  0.344245  0.059519
2.722222  0.357737  0.973841  0.349271  0.059519
2.800000  0.357737  1.001665  0.354225  0.059519
2.877778  0.357737  1.029489  0.359111  0.059519
2.955556  0.357737  1.057313  0.363932  0.059519
3.033333  0.357737  1.085137  0.368689  0.059519
3.111111  0.357737  1.112961  0.373386  0.059519
3.188889  0.357737  1.140785  0.378025  0.059519
3.266667  0.357737  1.168609  0.382607  0.059519
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3.344444  0.357737  1.196433  0.387135  0.059519
3.422222  0.357737  1.224257  0.391611  0.059519
3.500000  0.357737  1.252081  0.396036  0.059519
3.577778  0.357737  1.279905  0.400412  0.059519
3.655556  0.357737  1.307729  0.404741  0.059519
3.733333  0.357737  1.335553  0.409024  0.059519
3.811111  0.357737  1.363377  0.413263  0.059519
3.888889  0.357737  1.391201  0.417459  0.059519
3.966667  0.357737  1.419025  0.421612  0.059519
4.044444  0.357737  1.446849  0.425726  0.059519
4.122222  0.357737  1.474673  0.429800  0.059519
4.200000  0.357737  1.502497  0.433836  0.059519
4.277778  0.357737  1.530321  0.437834  0.059519
4.355556  0.357737  1.558145  0.441797  0.059519
4.433333  0.357737  1.585969  0.445724  0.059519
4.511111  0.357737  1.613793  0.449617  0.059519
4.588889  0.357737  1.641617  0.518263  0.059519
4.666667  0.357737  1.669441  0.698160  0.059519
4.744444  0.357737  1.697265  0.940948  0.059519
4.822222  0.357737  1.725089  1.232984  0.059519
4.900000  0.357737  1.752913  1.566938  0.059519
4.977778  0.357737  1.780737  1.938033  0.059519
5.055556  0.357737  1.808561  2.342829  0.059519
5.133333  0.357737  1.836385  2.778697  0.059519
5.211111  0.357737  1.864209  3.243543  0.059519
5.288889  0.357737  1.892033  3.735645  0.059519
5.366667  0.357737  1.919857  4.253559  0.059519
5.444444  0.357737  1.947681  4.796045  0.059519
5.522222  0.357737  1.975505  5.362030  0.059519
5.600000  0.357737  2.003329  5.950568  0.059519
5.677778  0.357737  2.031153  6.560820  0.059519
5.755556  0.357737  2.058977  7.192034  0.059519
5.833333  0.357737  2.086801  7.843530  0.059519
5.911111  0.357737  2.114625  8.514693  0.059519
5.988889  0.357737  2.142449  9.204957  0.059519
6.066667  0.357737  2.170273  10.13006  0.059519
6.144444  0.357737  2.198097  11.93126  0.059519
6.222222  0.357737  2.225921  14.31045  0.059519
6.300000  0.357737  2.253745  17.14608  0.059519
6.377778  0.357737  2.281569  20.36555  0.059519
6.455556  0.357737  2.309393  23.91455  0.059519
6.533333  0.357737  2.337217  27.74666  0.059519
6.611111  0.357737  2.365041  31.81862  0.059519
6.688889  0.357737  2.392865  36.08815  0.059519
6.766667  0.357737  2.420689  40.51270  0.059519
6.844444  0.357737  2.448513  45.04906  0.059519
6.922222  0.357737  2.476338  49.65324  0.059519
7.000000  0.357737  2.504162  54.28067  0.059519
7.077778  0.357737  2.531986  58.88663  0.059519
END FTABLE  1
FTABLE      2
 92    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)    (cfs)     (cfs)   (ft/sec)    (Minutes)***
0.000000  0.116100  0.000000  0.000000  0.000000
0.077778  0.116100  0.009030  0.021309  0.038632
0.155556  0.116100  0.018060  0.030136  0.038632
0.233333  0.116100  0.027090  0.036909  0.038632
0.311111  0.116100  0.036120  0.042619  0.038632
0.388889  0.116100  0.045150  0.047649  0.038632
0.466667  0.116100  0.054180  0.052197  0.038632
0.544444  0.116100  0.063210  0.056379  0.038632
0.622222  0.116100  0.072240  0.060272  0.038632
0.700000  0.116100  0.081270  0.063928  0.038632
0.777778  0.116100  0.090300  0.067386  0.038632
0.855556  0.116100  0.099330  0.070675  0.038632
0.933333  0.116100  0.108360  0.073818  0.038632
1.011111  0.116100  0.117390  0.076832  0.038632
1.088889  0.116100  0.126420  0.079732  0.038632
1.166667  0.116100  0.135450  0.082531  0.038632
```

1.244444	0.116100	0.144480	0.085237	0.038632
1.322222	0.116100	0.153510	0.087861	0.038632
1.400000	0.116100	0.162540	0.090408	0.038632
1.477778	0.116100	0.171570	0.092885	0.038632
1.555556	0.116100	0.180599	0.095298	0.038632
1.633333	0.116100	0.189629	0.097652	0.038632
1.711111	0.116100	0.198659	0.099950	0.038632
1.788889	0.116100	0.207689	0.102196	0.038632
1.866667	0.116100	0.216719	0.104394	0.038632
1.944444	0.116100	0.225749	0.106547	0.038632
2.022222	0.116100	0.234779	0.108657	0.038632
2.100000	0.116100	0.243809	0.110727	0.038632
2.177778	0.116100	0.252839	0.112759	0.038632
2.255556	0.116100	0.261869	0.114754	0.038632
2.333333	0.116100	0.270899	0.116716	0.038632
2.411111	0.116100	0.279929	0.118645	0.038632
2.488889	0.116100	0.288959	0.120544	0.038632
2.566667	0.116100	0.297989	0.122413	0.038632
2.644444	0.116100	0.307019	0.124254	0.038632
2.722222	0.116100	0.316049	0.126068	0.038632
2.800000	0.116100	0.325079	0.127856	0.038632
2.877778	0.116100	0.334109	0.129620	0.038632
2.955556	0.116100	0.343139	0.131360	0.038632
3.033333	0.116100	0.352169	0.133077	0.038632
3.111111	0.116100	0.361199	0.134772	0.038632
3.188889	0.116100	0.370229	0.136446	0.038632
3.266667	0.116100	0.379259	0.138100	0.038632
3.344444	0.116100	0.388289	0.139735	0.038632
3.422222	0.116100	0.397319	0.141350	0.038632
3.500000	0.116100	0.406349	0.142948	0.038632
3.577778	0.116100	0.415379	0.144527	0.038632
3.655556	0.116100	0.424409	0.146090	0.038632
3.733333	0.116100	0.433439	0.147636	0.038632
3.811111	0.116100	0.442469	0.149166	0.038632
3.888889	0.116100	0.451499	0.150680	0.038632
3.966667	0.116100	0.460529	0.152179	0.038632
4.044444	0.116100	0.469559	0.153664	0.038632
4.122222	0.116100	0.478589	0.155134	0.038632
4.200000	0.116100	0.487619	0.156591	0.038632
4.277778	0.116100	0.496649	0.158034	0.038632
4.355556	0.116100	0.505679	0.159465	0.038632
4.433333	0.116100	0.514709	0.208398	0.038632
4.511111	0.116100	0.523739	0.296943	0.038632
4.588889	0.116100	0.532769	0.408531	0.038632
4.666667	0.116100	0.541798	0.536979	0.038632
4.744444	0.116100	0.550828	0.678485	0.038632
4.822222	0.116100	0.559858	0.830331	0.038632
4.900000	0.116100	0.568888	0.990405	0.038632
4.977778	0.116100	0.577918	1.156982	0.038632
5.055556	0.116100	0.586948	1.328604	0.038632
5.133333	0.116100	0.595978	1.504006	0.038632
5.211111	0.116100	0.605008	1.682066	0.038632
5.288889	0.116100	0.614038	1.861779	0.038632
5.366667	0.116100	0.623068	2.046574	0.038632
5.444444	0.116100	0.632098	2.268071	0.038632
5.522222	0.116100	0.641128	2.497586	0.038632
5.600000	0.116100	0.650158	2.734844	0.038632
5.677778	0.116100	0.659188	2.979600	0.038632
5.755556	0.116100	0.668218	3.231629	0.038632
5.833333	0.116100	0.677248	4.549474	0.038632
5.911111	0.116100	0.686278	4.900231	0.038632
5.988889	0.116100	0.695308	5.259841	0.038632
6.066667	0.116100	0.704338	6.135050	0.038632
6.144444	0.116100	0.713368	7.934128	0.038632
6.222222	0.116100	0.722398	10.31119	0.038632
6.300000	0.116100	0.731428	13.14473	0.038632
6.377778	0.116100	0.740458	16.36211	0.038632
6.455556	0.116100	0.749488	19.90903	0.038632
6.533333	0.116100	0.758518	23.73907	0.038632
6.611111	0.116100	0.767548	27.80899	0.038632

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6.688889  0.116100  0.776578  32.07647  0.038632
6.766667  0.116100  0.785608  36.49900  0.038632
6.844444  0.116100  0.794638  41.03334  0.038632
6.922222  0.116100  0.803668  45.63552  0.038632
7.000000  0.116100  0.812698  50.26095  0.038632
7.077778  0.116100  0.821728  54.86493  0.038632
END FTABLE  2
FTABLE      3
 92    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)    (cfs)     (cfs)   (ft/sec)    (Minutes)***
0.000000  0.184941  0.000000  0.000000  0.000000
0.077778  0.184941  0.014384  0.038177  0.153848
0.155556  0.184941  0.028769  0.053991  0.153848
0.233333  0.184941  0.043153  0.066125  0.153848
0.311111  0.184941  0.057537  0.076355  0.153848
0.388889  0.184941  0.071921  0.085367  0.153848
0.466667  0.184941  0.086306  0.093515  0.153848
0.544444  0.184941  0.100690  0.101008  0.153848
0.622222  0.184941  0.115074  0.107982  0.153848
0.700000  0.184941  0.129459  0.114532  0.153848
0.777778  0.184941  0.143843  0.120727  0.153848
0.855556  0.184941  0.158227  0.126620  0.153848
0.933333  0.184941  0.172611  0.132250  0.153848
1.011111  0.184941  0.186996  0.137650  0.153848
1.088889  0.184941  0.201380  0.142847  0.153848
1.166667  0.184941  0.215764  0.147860  0.153848
1.244444  0.184941  0.230149  0.152709  0.153848
1.322222  0.184941  0.244533  0.157409  0.153848
1.400000  0.184941  0.258917  0.161973  0.153848
1.477778  0.184941  0.273301  0.166411  0.153848
1.555556  0.184941  0.287686  0.170734  0.153848
1.633333  0.184941  0.302070  0.174951  0.153848
1.711111  0.184941  0.316454  0.179068  0.153848
1.788889  0.184941  0.330839  0.183092  0.153848
1.866667  0.184941  0.345223  0.187030  0.153848
1.944444  0.184941  0.359607  0.190887  0.153848
2.022222  0.184941  0.373992  0.194667  0.153848
2.100000  0.184941  0.388376  0.198375  0.153848
2.177778  0.184941  0.402760  0.202016  0.153848
2.255556  0.184941  0.417144  0.205591  0.153848
2.333333  0.184941  0.431529  0.209106  0.153848
2.411111  0.184941  0.445913  0.212563  0.153848
2.488889  0.184941  0.460297  0.215964  0.153848
2.566667  0.184941  0.474682  0.219312  0.153848
2.644444  0.184941  0.489066  0.222610  0.153848
2.722222  0.184941  0.503450  0.225860  0.153848
2.800000  0.184941  0.517834  0.229064  0.153848
2.877778  0.184941  0.532219  0.232224  0.153848
2.955556  0.184941  0.546603  0.235341  0.153848
3.033333  0.184941  0.560987  0.238418  0.153848
3.111111  0.184941  0.575372  0.241455  0.153848
3.188889  0.184941  0.589756  0.244454  0.153848
3.266667  0.184941  0.604140  0.247418  0.153848
3.344444  0.184941  0.618524  0.250346  0.153848
3.422222  0.184941  0.632909  0.253240  0.153848
3.500000  0.184941  0.647293  0.256102  0.153848
3.577778  0.184941  0.661677  0.258932  0.153848
3.655556  0.184941  0.676062  0.261731  0.153848
3.733333  0.184941  0.690446  0.264501  0.153848
3.811111  0.184941  0.704830  0.267242  0.153848
3.888889  0.184941  0.719214  0.269955  0.153848
3.966667  0.184941  0.733599  0.272641  0.153848
4.044444  0.184941  0.747983  0.275301  0.153848
4.122222  0.184941  0.762367  0.277935  0.153848
4.200000  0.184941  0.776752  0.304204  0.153848
4.277778  0.184941  0.791136  0.401381  0.153848
4.355556  0.184941  0.805520  0.534911  0.153848
4.433333  0.184941  0.819904  0.693569  0.153848
4.511111  0.184941  0.834289  0.871306  0.153848
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4.588889  0.184941  0.848673  1.064033  0.153848
4.666667  0.184941  0.863057  1.268680  0.153848
4.744444  0.184941  0.877442  1.482790  0.153848
4.822222  0.184941  0.891826  1.704316  0.153848
4.900000  0.184941  0.906210  1.931502  0.153848
4.977778  0.184941  0.920594  2.162804  0.153848
5.055556  0.184941  0.934979  2.396848  0.153848
5.133333  0.184941  0.949363  2.632390  0.153848
5.211111  0.184941  0.963747  2.901242  0.153848
5.288889  0.184941  0.978132  3.196208  0.153848
5.366667  0.184941  0.992516  3.501422  0.153848
5.444444  0.184941  1.006900  3.816548  0.153848
5.522222  0.184941  1.021285  4.141279  0.153848
5.600000  0.184941  1.035669  5.804751  0.153848
5.677778  0.184941  1.050053  6.257046  0.153848
5.755556  0.184941  1.064437  6.721011  0.153848
5.833333  0.184941  1.078822  7.196359  0.153848
5.911111  0.184941  1.093206  7.682821  0.153848
5.988889  0.184941  1.107590  8.180148  0.153848
6.066667  0.184941  1.121975  9.076014  0.153848
6.144444  0.184941  1.136359  10.87604  0.153848
6.222222  0.184941  1.150743  13.25406  0.153848
6.300000  0.184941  1.165127  16.08853  0.153848
6.377778  0.184941  1.179512  19.30684  0.153848
6.455556  0.184941  1.193896  22.85470  0.153848
6.533333  0.184941  1.208280  26.68566  0.153848
6.611111  0.184941  1.222665  30.75649  0.153848
6.688889  0.184941  1.237049  35.02489  0.153848
6.766667  0.184941  1.251433  39.44832  0.153848
6.844444  0.184941  1.265817  43.98357  0.153848
6.922222  0.184941  1.280202  48.58664  0.153848
7.000000  0.184941  1.294586  53.21296  0.153848
7.077778  0.184941  1.308970  57.81783  0.153848
END FTABLE  3
FTABLE      5
 60    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
0.000000  0.162414  0.000000  0.000000  0.000000
0.062308  0.160583  0.000714  0.000000  0.000000
0.124615  0.158558  0.001449  0.000000  0.000000
0.186923  0.156539  0.002207  0.000000  0.000000
0.249231  0.154526  0.002986  0.000000  0.000000
0.311538  0.152520  0.003787  0.000000  0.000000
0.373846  0.150520  0.004611  0.000000  0.001628
0.436154  0.148527  0.005456  0.000000  0.002269
0.498462  0.146540  0.006324  0.000000  0.003061
0.560769  0.144560  0.007214  0.000000  0.004020
0.623077  0.142586  0.008127  0.000000  0.005158
0.685385  0.140618  0.009062  0.000000  0.006486
0.747692  0.138657  0.010019  0.000000  0.008014
0.810000  0.136702  0.011000  0.000000  0.008938
0.872308  0.134754  0.012003  0.000000  0.008938
0.934615  0.132812  0.014055  0.000000  0.008938
0.996923  0.130876  0.016153  0.000000  0.008938
1.059231  0.128947  0.018297  0.000000  0.008938
1.121538  0.127024  0.020487  0.000000  0.008938
1.183846  0.125108  0.022723  0.000000  0.008938
1.246154  0.123198  0.025006  0.000000  0.008938
1.308462  0.121295  0.027336  0.000000  0.008938
1.370769  0.119398  0.029712  0.000000  0.008938
1.433077  0.117507  0.032136  0.000000  0.008938
1.495385  0.115623  0.034607  0.000000  0.008938
1.557692  0.113745  0.037125  0.000000  0.008938
1.620000  0.111874  0.039691  0.000000  0.008938
1.682308  0.110009  0.042304  0.000000  0.008938
1.744615  0.108150  0.044966  0.000000  0.008938
1.806923  0.106298  0.047675  0.000000  0.008938
1.869231  0.104453  0.050433  0.000000  0.008938
1.931538  0.102613  0.053239  0.000000  0.008938
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  1.993846  0.100780  0.056093  0.000000  0.008938
  2.056154  0.098954  0.058996  0.000000  0.008938
  2.118462  0.097134  0.061948  0.000000  0.008938
  2.180769  0.095320  0.064950  0.000000  0.008938
  2.243077  0.093513  0.068000  0.000000  0.008938
  2.305385  0.091712  0.071100  0.000000  0.008938
  2.367692  0.089918  0.074249  0.000000  0.008938
  2.430000  0.088130  0.077448  0.000000  0.008938
  2.492308  0.086349  0.080697  0.000000  0.008938
  2.554615  0.084574  0.083996  0.000000  0.008938
  2.616923  0.082805  0.087346  0.000000  0.008938
  2.679231  0.081043  0.090745  0.000000  0.008938
  2.741538  0.079287  0.094196  0.000000  0.008938
  2.803846  0.077537  0.097697  0.000000  0.008938
  2.866154  0.075794  0.101249  0.000000  0.008938
  2.928462  0.074058  0.104851  0.000000  0.008938
  2.990769  0.072328  0.108506  0.000000  0.008938
  3.053077  0.070604  0.112167  0.000000  0.008938
  3.115385  0.068886  0.115880  0.000000  0.008938
  3.177692  0.067175  0.119643  0.000000  0.008938
  3.240000  0.065471  0.123458  0.000000  0.008938
  3.302308  0.063773  0.127324  0.000000  0.008938
  3.364615  0.062081  0.131242  0.000000  0.008938
  3.426923  0.060396  0.135212  0.000000  0.008938
  3.489231  0.058717  0.139234  0.000000  0.008938
  3.551538  0.057045  0.143308  0.000000  0.008938
  3.613846  0.055379  0.147434  0.000000  0.008938
  3.670000  0.053719  0.151382  0.000000  0.008938
  END FTABLE  5
  FTABLE      4
   34    5
     Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.053719  0.000000  0.000000  0.000000
  0.062308  0.164451  0.010183  0.000000  0.277231
  0.124615  0.166495  0.020493  0.000000  0.288747
  0.186923  0.168546  0.030931  0.000000  0.294505
  0.249231  0.170602  0.041497  0.000000  0.300263
  0.311538  0.172666  0.052191  0.000000  0.306021
  0.373846  0.174735  0.063014  0.000000  0.311778
  0.436154  0.176811  0.073966  0.000000  0.317536
  0.498462  0.178894  0.085048  0.000000  0.323294
  0.560769  0.180983  0.096259  0.000000  0.329052
  0.623077  0.183078  0.107601  0.000000  0.334810
  0.685385  0.185180  0.119074  0.000000  0.340568
  0.747692  0.187288  0.130677  0.000000  0.346326
  0.810000  0.189403  0.142413  0.000000  0.352084
  0.872308  0.191524  0.154280  0.000000  0.357841
  0.934615  0.193651  0.166280  0.000000  0.363599
  0.996923  0.195785  0.178412  0.000000  0.369357
  1.059231  0.197925  0.190678  0.229254  0.375115
  1.121538  0.200072  0.203077  0.672009  0.380873
  1.183846  0.202225  0.215610  1.241394  0.386631
  1.246154  0.204384  0.228277  1.896076  0.392389
  1.308462  0.206550  0.241080  2.597922  0.398147
  1.370769  0.208722  0.254017  3.307696  0.403905
  1.433077  0.210901  0.267090  3.986151  0.409662
  1.495385  0.213086  0.280299  4.597336  0.415420
  1.557692  0.215278  0.293644  5.113265  0.421178
  1.620000  0.217476  0.307126  5.519554  0.426936
  1.682308  0.219680  0.320745  5.821877  0.431557
  1.744615  0.221891  0.334502  6.053114  0.431557
  1.806923  0.224108  0.348396  6.365875  0.431557
  1.869231  0.226332  0.362429  6.607081  0.431557
  1.931538  0.228562  0.376601  6.839785  0.431557
  1.993846  0.230799  0.390912  7.064829  0.431557
  2.000000  0.231020  0.392333  7.282922  0.431557
  END FTABLE  4
END FTABLES
```

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EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    1              PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    1              IMPLND   1 999 EXTNL  PETINP
WDM     22 IRRG     ENGL    0.7       SAME PERLND  46     EXTNL  SURLI
WDM      2 PREC     ENGL    1              RCHRES   4     EXTNL  PREC
WDM      1 EVAP     ENGL    0.5            RCHRES   4     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.7            RCHRES   5     EXTNL  POTEV

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
RCHRES   6 HYDR   RO      1 1        1      WDM   1000 FLOW     ENGL      REPL
RCHRES   6 HYDR   O       1 1        1      WDM   1008 FLOW     ENGL      REPL
RCHRES   6 HYDR   O       2 1        1      WDM   1009 FLOW     ENGL      REPL
RCHRES   6 HYDR   STAGE   1 1        1      WDM   1001 STAG     ENGL      REPL
COPY     1 OUTPUT MEAN    1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN    1 1     48.4      WDM    801 FLOW     ENGL      REPL
RCHRES   1 HYDR   RO      1 1        1      WDM   1002 FLOW     ENGL      REPL
RCHRES   1 HYDR   O       1 1        1      WDM   1010 FLOW     ENGL      REPL
RCHRES   1 HYDR   O       2 1        1      WDM   1011 FLOW     ENGL      REPL
RCHRES   1 HYDR   STAGE   1 1        1      WDM   1003 STAG     ENGL      REPL
COPY     2 OUTPUT MEAN    1 1     48.4      WDM    702 FLOW     ENGL      REPL
COPY   502 OUTPUT MEAN    1 1     48.4      WDM    802 FLOW     ENGL      REPL
RCHRES   2 HYDR   RO      1 1        1      WDM   1004 FLOW     ENGL      REPL
RCHRES   2 HYDR   O       1 1        1      WDM   1012 FLOW     ENGL      REPL
RCHRES   2 HYDR   O       2 1        1      WDM   1013 FLOW     ENGL      REPL
RCHRES   2 HYDR   STAGE   1 1        1      WDM   1005 STAG     ENGL      REPL
COPY     3 OUTPUT MEAN    1 1     48.4      WDM    703 FLOW     ENGL      REPL
COPY   503 OUTPUT MEAN    1 1     48.4      WDM    803 FLOW     ENGL      REPL
RCHRES   3 HYDR   RO      1 1        1      WDM   1006 FLOW     ENGL      REPL
RCHRES   3 HYDR   O       1 1        1      WDM   1014 FLOW     ENGL      REPL
RCHRES   3 HYDR   O       2 1        1      WDM   1015 FLOW     ENGL      REPL
RCHRES   3 HYDR   STAGE   1 1        1      WDM   1007 STAG     ENGL      REPL
COPY     4 OUTPUT MEAN    1 1     48.4      WDM    704 FLOW     ENGL      REPL
COPY   504 OUTPUT MEAN    1 1     48.4      WDM    804 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK        2
PERLND     PWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    2

  MASS-LINK        3
PERLND     PWATER IFWO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    3

  MASS-LINK        5
IMPLND     IWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK        7
RCHRES     OFLOW  OVOL   1                 RCHRES         INFLOW IVOL
  END MASS-LINK    7

  MASS-LINK        8
RCHRES     OFLOW  OVOL   2                 RCHRES         INFLOW IVOL
  END MASS-LINK    8

  MASS-LINK       17
RCHRES     OFLOW  OVOL   1                 COPY           INPUT  MEAN
  END MASS-LINK   17
```

```
END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

```
ERROR/WARNING ID:   341   6

DATE/TIME: 1978/ 1/ 4 21:45

RCHRES:     4

The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB().  To continue the
simulation the table has been extrapolated, based on information contained
in the last two rows.  This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:

NROWS         V1         V2        VOL
34 1.7028E+04 1.7090E+04 1.7976E+04
```

```
ERROR/WARNING ID:   341   5

DATE/TIME: 1978/ 1/ 4 21:45

RCHRES:     4

Calculation of relative depth, using Newton's method of successive
approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated.  If extrapolation was small, no problem.
Remedy; extend ftable.  Relevant data are:

A          B          C      RDEP1      RDEP2  COUNT
9.6270E+00 2.0107E+04 -3.079E+05   15.202   1.5202E+01      3
```

```
ERROR/WARNING ID:   341   6

DATE/TIME: 1978/ 1/ 4 22: 0

RCHRES:     4

The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB().  To continue the
simulation the table has been extrapolated, based on information contained
in the last two rows.  This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:

NROWS         V1         V2        VOL
34 1.7028E+04 1.7090E+04 1.9213E+04
```

```
ERROR/WARNING ID:   341   5

DATE/TIME: 1978/ 1/ 4 22: 0

RCHRES:     4

Calculation of relative depth, using Newton's method of successive
approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated.  If extrapolation was small, no problem.
Remedy; extend ftable.  Relevant data are:

A          B          C      RDEP1      RDEP2  COUNT
9.6270E+00 2.0107E+04 -7.101E+05   34.736   3.4736E+01      3
```

```
ERROR/WARNING ID:   341   6

DATE/TIME: 1980/ 1/29  4: 0

RCHRES:     4
```

```
The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB().  To continue the
simulation the table has been extrapolated, based on information contained
in the last two rows.  This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:

NROWS         V1         V2         VOL
34 1.7028E+04 1.7090E+04 1.7271E+04
```

```
ERROR/WARNING ID:   341   5

DATE/TIME: 1980/ 1/29  4: 0

RCHRES:     4

Calculation of relative depth, using Newton's method of successive
approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated.  If extrapolation was small, no problem.
Remedy; extend ftable.  Relevant data are:

A          B          C      RDEP1      RDEP2  COUNT
9.6270E+00 2.0107E+04 -7.882E+04    3.9124  3.9124E+00      3
```

```
ERROR/WARNING ID:   341   6

DATE/TIME: 1993/ 2/ 8  1:30

RCHRES:     4

The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB().  To continue the
simulation the table has been extrapolated, based on information contained
in the last two rows.  This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:

NROWS         V1         V2         VOL
34 1.7028E+04 1.7090E+04 1.7879E+04
```

```
ERROR/WARNING ID:   341   5

DATE/TIME: 1993/ 2/ 8  1:30

RCHRES:     4

Calculation of relative depth, using Newton's method of successive
approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated.  If extrapolation was small, no problem.
Remedy; extend ftable.  Relevant data are:

A          B          C      RDEP1      RDEP2  COUNT
9.6270E+00 2.0107E+04 -2.766E+05   13.664     13.664        3
```

Disclaimer

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Appendix 8: Source Control

Pollutant Sources/Source Control Checklist

Include a copy of the completed Pollutant Sources/Source Control Checklist used to document Source Control BMPs in Section H of this Template.

Appendix 8
STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

How to use this worksheet (also see instructions in Section **H** of the 20**18** SMR 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 H.1 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.**	**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://www.rcwatershed.org/about/materials-library/#1450469138395-bb76dd39-d810** ☑ **Provide IPM information to new owners, lessees and operators.**

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE …	… THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
☐ 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://www.rcwatershed.org/about/materials-library/#1450469201433-f5f358c9-6008
☐ 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://www.rcwatershed.org/about/materials-library/#1450389926766-61e8af0b-53a9 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://www.rcwatershed.org/about/materials-library/#1450389926766-61e8af0b-53a9**
☐ 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://www.rcwatershed.org/about/materials-library/#1450389926766-61e8af0b-53a9** ☐ **Car dealerships and similar may rinse cars with water only.**

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
☐ K. **Vehicle/Equipment Repair and Maintenance**	☐ **Accommodate all vehicle equipment repair and maintenance indoors. Or designate an outdoor work area and design the area to prevent run-on and runoff of stormwater.** ☐ **Show secondary containment for exterior work areas where motor oil, brake fluid, gasoline, diesel fuel, radiator fluid, acid-containing batteries or other hazardous materials or hazardous wastes are used or stored. Drains shall not be installed within the secondary containment areas.** ☐ **Add a note on the plans that states either (1) there are no floor drains, or (2) floor drains are connected to wastewater pretreatment systems prior to discharge to the sanitary sewer and an industrial waste discharge permit will be obtained.**	☐ **State that no vehicle repair or maintenance will be done outdoors, or else describe the required features of the outdoor work area.** ☐ **State that there are no floor drains or if there are floor drains, note the agency from which an industrial waste discharge permit will be obtained and that the design meets that agency's requirements.** ☐ **State that there are no tanks, containers or sinks to be used for parts cleaning or rinsing or, if there are, note the agency from which an industrial waste discharge permit will be obtained and that the design meets that agency's requirements.**	**In the Stormwater Control Plan, note that all of the following restrictions apply to use the site:** ☐ **No person shall dispose of, nor permit the disposal, directly or indirectly of vehicle fluids, hazardous materials, or rinsewater from parts cleaning into storm drains.** ☐ **No vehicle fluid removal shall be performed outside a building, nor on asphalt or ground surfaces, whether inside or outside a building, except in such a manner as to ensure that any spilled fluid will be in an area of secondary containment. Leaking vehicle fluids shall be contained or drained from the vehicle immediately.** ☐ **No person shall leave unattended drip parts or other open containers containing vehicle fluid, unless such containers are in use or in an area of secondary containment.** **Refer to "Automotive Maintenance & Car Care Best Management Practices for Auto Body Shops, Auto Repair Shops, Car Dealerships, Gas Stations and Fleet Service Operations; "Outdoor Cleaning Activities;" and "Professional Mobile Service Providers" for many of the Potential Sources of Runoff Pollutants. Brochures can be found at: http://www.rcwatershed.org/about/materials-library/#1450389926766-61e8af0b-53a9**

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

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

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

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

Appendix 8
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

Include the completed Operation and Maintenance Plan in this Appendix along with additional documentation of Finance and Maintenance Recording Mechanisms for the site. Refer to Sections 3.10 and 5 of the SMR WQMP and Section J of this Template.

Operations, Maintenance, Inspection and Funding Plan

I. Introduction

The proposed project would construct 900 apartment units on a 37.8 acre site (30 units/acre) located north of Murrieta Hot Springs Road, west of Interstate 15, east of the existing Sparkman Court corridor and south of Vista Murrieta Road in the City of Murrieta. The site is bordered to the south by Murrieta Hot Springs Road and undeveloped land, to the west by the Interstate 15 corridor, to the north by Vista Murrieta Road and single-family residences and to the east by Sparkman Court and office research park uses.

The LID principles incorporated in the site design are Bioclean Modular Wetland Systems, underground vault system, and dry wells.

II. Responsibility for Maintenance

A. General

The owner is responsible for the operation, maintenance, inspection and funding of the source control BMPs, LID BMPs and drainage structures designed for the purposes of the Final Water Quality Management Plan and development of the project.

Responsible Parties

24-Hour Contact Information
[TBD]

B. Funding

The owner is responsible for funding source control, LID, and hydromodification BMP operations and maintenance, including storm drain catch basins, Bioclean Modular Wetland System, underground vault detention system, and storm drainpipe appurtenances and conveyances within the project's limits.

C. Training

Proper training for the inspection and maintenance of installed BMPs will be provided to employees by the owner at the time of hiring and reviewed on an annual basis. Proper training for the inspection and maintenance of General Housekeeping BMPs, and any other applicable responsibilities needed will be provided to the appropriate staff by the owner at the time of hiring and reviewed on an annual basis. The owner will be responsible for providing this information to their respective employees. A training log will be developed and retained for records.

D. Bioclean Modular Wetland System

The Bioclean Modular Wetland System will be inspected and maintained by the project site owner following the manufacturer standards and recommendations. Maintenance and regular inspections are important for proper function of the system. Plants, soil, and pretreatment filter shall be maintained yearly. Maintenance should be completed when an inspection reveals the system has overgrown vegetation, has invasive vegetation/weeds, trash and debris, pre-treatment filter are clogged, presence of erosion/sediment accumulation, any evidence of pollutants/contaminants, and standing water. Annual maintenance should take place in the summer/early fall seasons prior to the start of a rainy season. Maintenance cost will be dependent on maintenance frequency, requirement, and provider and shall be determined by owner at time of maintenance. Refer to manufacturer guidelines for inspection and maintenance in Attachment 2.

E. Underground vault detention system

The underground vault detention system will be inspected and maintained by the project site owner following the manufacturer’s standards and specifications. Maintenance and regular inspections are important for proper function of the system. Inspection must be inspected at a minimum of two times per year. Annual maintenance should take place in the summer/early fall seasons prior to the start of a rainy season. Maintenance cost will be dependent on maintenance frequency, requirement, and provider and shall be determined by owner at time of maintenance. The manufacturer’s manual can be found in Attachment 3.

III. Inspection Forms

Inspection forms for the Project are included in Attachment 1. Inspection forms are to be filled out during the annual maintenance and inspection. All inspection forms are to be retained for records for a minimum of 5 years for the bioretention basin.

Attachment 1: Inspection Sheets

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Inspection & Maintenance Log

BMP#			**Location:**		
Date	**Depth of Sediment**	**Accumulated Trash**	**Maintenance Performed**	**Maintenance Personnel**	**Comments**

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Attachment 2: Bioclean Modular Wetland System Manufacturer Instructions

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Attachment 3: Underground Vault Detention System Manufacturer Instructions

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Attachment 4: Flogard+Plus Catch Basin Insert Filters

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Attachment 5: Operations & Maintenance Agreement

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Attachment 6: WQMP Exhibit

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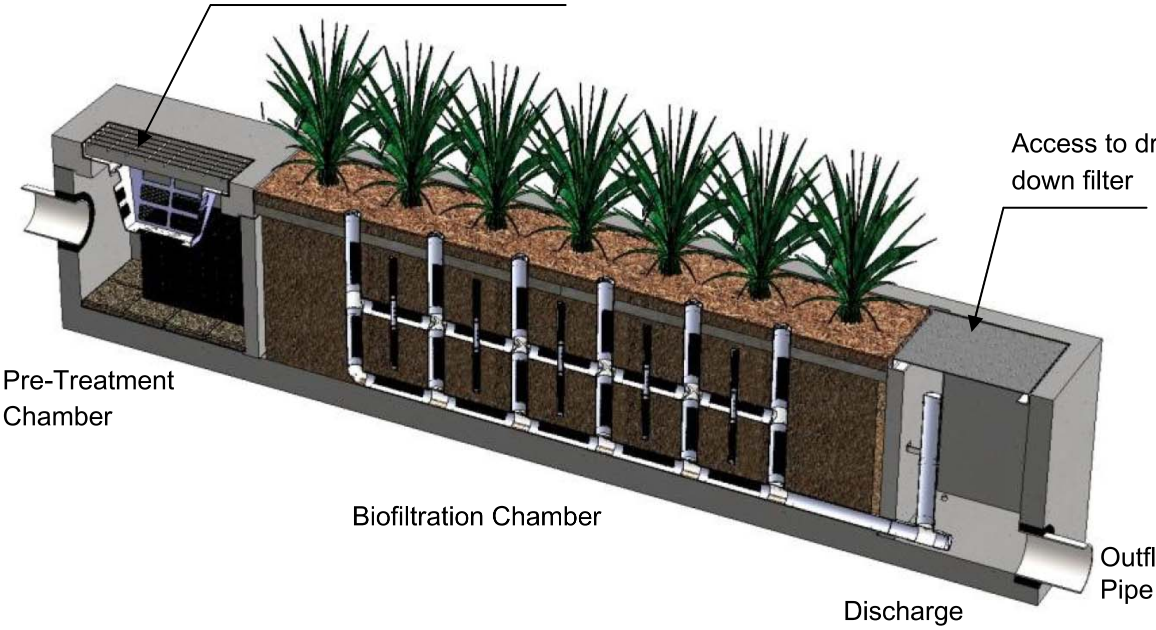
Maintenance Guidelines for
Modular Wetland System - Linear

Maintenance Summary

- Remove Trash from Screening Device – average maintenance interval is 6 to 12 months.
    - (*5 minute average service time*).
- Remove Sediment from Separation Chamber – average maintenance interval is 12 to 24 months.
    - (*10 minute average service time*).
- Replace Cartridge Filter Media – average maintenance interval 12 to 24 months.
    - (*10-15 minute per cartridge average service time*).
- Replace Drain Down Filter Media – average maintenance interval is 12 to 24 months.
    - (*5 minute average service time*).
- Trim Vegetation – average maintenance interval is 6 to 12 months.
    - (*Service time varies*).

System Diagram



Maintenance Procedures

Screening Device

1. Remove grate or manhole cover to gain access to the screening device in the Pre-Treatment Chamber. Vault type units do not have screening device. Maintenance can be performed without entry.
2. Remove all pollutants collected by the screening device. Removal can be done manually or with the use of a vacuum truck. The hose of the vacuum truck will not damage the screening device.
3. Screening device can easily be removed from the Pre-Treatment Chamber to gain access to separation chamber and media filters below. Replace grate or manhole cover when completed.

Separation Chamber

1. Perform maintenance procedures of screening device listed above before maintaining the separation chamber.
2. With a pressure washer spray down pollutants accumulated on walls and cartridge filters.
3. Vacuum out Separation Chamber and remove all accumulated pollutants. Replace screening device, grate or manhole cover when completed.

Cartridge Filters

1. Perform maintenance procedures on screening device and separation chamber before maintaining cartridge filters.
2. Enter separation chamber.
3. Unscrew the two bolts holding the lid on each cartridge filter and remove lid.
4. Remove each of 4 to 8 media cages holding the media in place.
5. Spray down the cartridge filter to remove any accumulated pollutants.
6. Vacuum out old media and accumulated pollutants.
7. Reinstall media cages and fill with new media from manufacturer or outside supplier. Manufacturer will provide specification of media and sources to purchase.
8. Replace the lid and tighten down bolts. Replace screening device, grate or manhole cover when completed.

Drain Down Filter

1. Remove hatch or manhole cover over discharge chamber and enter chamber.
2. Unlock and lift drain down filter housing and remove old media block. Replace with new media block. Lower drain down filter housing and lock into place.
3. Exit chamber and replace hatch or manhole cover.

Maintenance Notes

1. Following maintenance and/or inspection, it is recommended the maintenance operator prepare a maintenance/inspection record. The record should include any maintenance activities performed, amount and description of debris collected, and condition of the system and its various filter mechanisms.

2. The owner should keep maintenance/inspection record(s) for a minimum of five years from the date of maintenance. These records should be made available to the governing municipality for inspection upon request at any time.

3. Transport all debris, trash, organics and sediments to approved facility for disposal in accordance with local and state requirements.

4. Entry into chambers may require confined space training based on state and local regulations.

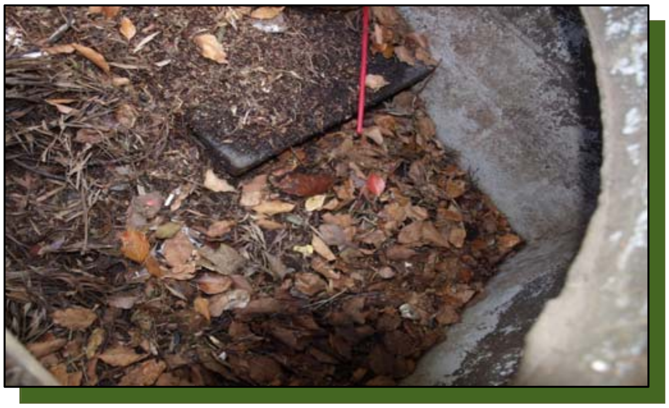
5. No fertilizer shall be used in the Biofiltration Chamber.

6. Irrigation should be provided as recommended by manufacturer and/or landscape architect. Amount of irrigation required is dependent on plant species. Some plants may require irrigation.

Maintenance Procedure Illustration

Screening Device

The screening device is located directly under the manhole or grate over the Pre-Treatment Chamber. It's mounted directly underneath for easy access and cleaning. Device can be cleaned by hand or with a vacuum truck.

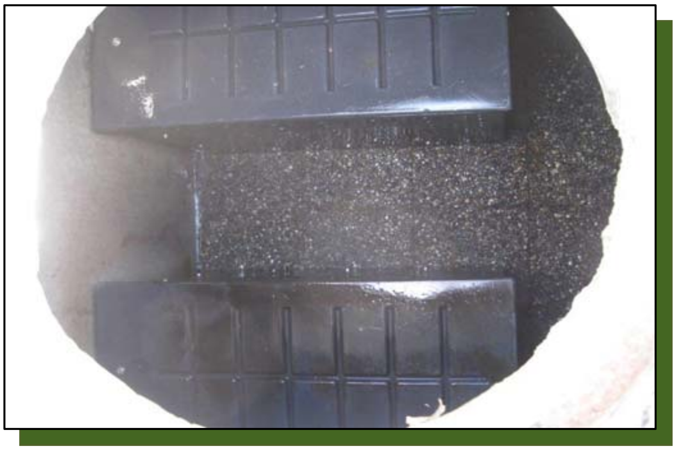


Separation Chamber

The separation chamber is located directly beneath the screening device. It can be quickly cleaned using a vacuum truck or by hand. A pressure washer is useful to assist in the cleaning process.

Cartridge Filters

The cartridge filters are located in the Pre-Treatment chamber connected to the wall adjacent to the biofiltration chamber. The cartridges have removable tops to access the individual media filters. Once the cartridge is open media can be easily removed and replaced by hand or a vacuum truck.



Drain Down Filter

The drain down filter is located in the Discharge Chamber. The drain filter unlocks from the wall mount and hinges up. Remove filter block and replace with new block.

Trim Vegetation

Vegetation should be maintained in the same manner as surrounding vegetation and trimmed as needed. No fertilizer shall be used on the plants. Irrigation per the recommendation of the manufacturer and or landscape architect. Different types of vegetation requires different amounts of irrigation.

Inspection Form

Modular Wetland System, Inc.
P. 760.433-7640
F. 760-433-3176
E. Info@modularwetlands.com

www.modularwetlands.com

Inspection Report
Modular Wetlands System

For Office Use Only
(Reviewed By)
(Date) Office personnel to complete section to the left.

Project Name ____________________

Project Address ____________________ (city) (Zip Code)

Owner / Management Company ____________________

Contact ____________________ Phone (   )   –

Inspector Name ____________________ Date ____/____/______ Time __________ AM / PM

Type of Inspection ☐ Routine ☐ Follow Up ☐ Complaint ☐ Storm   Storm Event in Last 72-hours? ☐ No ☐ Yes

Weather Condition ____________________ Additional Notes ____________________

Inspection Checklist

Modular Wetland System Type (Curb, Grate or UG Vault): ____________ Size (22', 14' or etc.): ____________

Structural Integrity:	**Yes**	**No**	**Comments**
Damage to pre-treatment access cover (manhole cover/grate) or cannot be opened using normal lifting pressure?			
Damage to discharge chamber access cover (manhole cover/grate) or cannot be opened using normal lifting pressure?			
Does the MWS unit show signs of structural deterioration (cracks in the wall, damage to frame)?			
Is the inlet/outlet pipe or drain down pipe damaged or otherwise not functioning properly?			
Working Condition:			
Is there evidence of illicit discharge or excessive oil, grease, or other automobile fluids entering and clogging the unit?			
Is there standing water in inappropriate areas after a dry period?			
Is the filter insert (if applicable) at capacity and/or is there an accumulation of debris/trash on the shelf system?			
Does the depth of sediment/trash/debris suggest a blockage of the inflow pipe, bypass or cartridge filter? If yes specify which one in the comments section. Note depth of accumulation in in pre-treatment chamber.			Depth:
Does the cartridge filter media need replacement in pre-treatment chamber and/or discharge chamber?			Chamber:
Any signs of improper functioning in the discharge chamber? Note issues in comments section.			
Other Inspection Items:			
Is there an accumulation of sediment/trash/debris in the wetland media (if applicable)?			
Is it evident that the plants are alive and healthy (if applicable)? Please note Plant Information below.			
Is there a septic or foul odor coming from inside the system?			

Waste:	**Yes**	**No**
Sediment / Silt / Clay		
Trash / Bags / Bottles		
Green Waste / Leaves / Foliage		

Recommended Maintenance	
No Cleaning Needed	
Schedule Maintenance as Planned	
Needs Immediate Maintenance	

Plant Information	
Damage to Plants	
Plant Replacement	
Plant Trimming	

Additional Notes: ____________________

Maintenance Report

Modular Wetland System, Inc.
P. 760.433-7640
F. 760-433-3176
E. Info@modularwetlands.com

www.modularwetlands.com

Cleaning and Maintenance Report
Modular Wetlands System

For Office Use Only

(Reviewed By)

(Date)

Office personnel to complete section to the left.

Project Name ______________________________

Project Address ______________________________ (city) (Zip Code)

Owner / Management Company ______________________________

Contact ______________________________ Phone (   )   –

Inspector Name ______________________________ Date ____/____/______ Time __________ AM / PM

Type of Inspection ☐ Routine ☐ Follow Up ☐ Complaint ☐ Storm Storm Event in Last 72-hours? ☐ No ☐ Yes

Weather Condition ______________________________ Additional Notes ______________________________

Site Map #	GPS Coordinates of Insert	Manufacturer / Description / Sizing	Trash Accumulation	Foliage Accumulation	Sediment Accumulation	Total Debris Accumulation	Condition of Media 25/50/75/100 (will be changed @ 75%)	Operational Per Manufactures' Specifications (If not, why?)
	Lat: Long:	MWS Catch Basins						
		MWS Sedimentation Basin						
		Media Filter Condition						
		Plant Condition						
		Drain Down Media Condition						
		Discharge Chamber Condition						
		Drain Down Pipe Condition						
		Inlet and Outlet Pipe Condition						

Comments:

Appendix 10: Educational Materials

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

Examples of material to provide in Appendix 10 may include but are not limited to the following:

- BMP Fact Sheets for proposed BMPs form Exhibit C: LID BMP Design Handbook of the SMR WQMP,
- Source control information and training material for site owners and operators,
- O&M training material,
- Other educational/training material related to site drainage and BMPs.

Outdoor Loading/Unloading SC-30

Description

The loading/unloading of materials usually takes place outside on docks or terminals; therefore, materials spilled, leaked, or lost during loading/unloading may collect in the soil or on other surfaces and have the potential to be carried away by wind, stormwater runoff or when the area is cleaned. Additionally, rainfall may wash pollutants from machinery used to unload or move materials. Implementation of the following protocols will prevent or reduce the discharge of pollutants to stormwater from outdoor loading/unloading of materials.

Approach

Reduce potential for pollutant discharge through source control pollution prevention and BMP implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

General Pollution Prevention Protocols

- ☐ Park tank trucks or delivery vehicles in designated areas so that spills or leaks can be contained.
- ☐ Limit exposure of material to rainfall whenever possible.
- ☐ Prevent stormwater run-on.
- ☐ Check equipment regularly for leaks.

Good Housekeeping

- ☐ Develop an operations plan that describes procedures for loading and/or unloading.
- ☐ Conduct loading and unloading in dry weather if possible.

Objectives

- ■ *Cover*
- ■ *Contain*
- ■ *Educate*
- ■ *Reduce/Minimize*
- ■ *Product Substitution*

Targeted Constituents	
Sediment	✓
Nutrients	✓
Trash	
Metals	✓
Bacteria	
Oil and Grease	✓
Organics	✓

Minimum BMPs Covered	
Good Housekeeping	✓
Preventative Maintenance	
Spill and Leak Prevention and Response	✓
Material Handling & Waste Management	✓
Erosion and Sediment Controls	
Employee Training Program	✓
Quality Assurance Record Keeping	✓

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☐ Cover designated loading/unloading areas to reduce exposure of materials to rain.

☐ Consider placing a seal or door skirt between delivery vehicles and building to prevent exposure to rain.

☐ Design loading/unloading area to prevent stormwater run-on, which would include grading or berming the area, and position roof downspouts so they direct stormwater away from the loading/unloading areas.

☐ Have employees load and unload all materials and equipment in covered areas such as building overhangs at loading docks if feasible.

☐ Load/unload only at designated loading areas.

☐ Use drip pans underneath hose and pipe connections and other leak-prone spots during liquid transfer operations, and when making and breaking connections. Several drip pans should be stored in a covered location near the liquid transfer area so that they are always available, yet protected from precipitation when not in use. Drip pans can be made specifically for railroad tracks. Drip pans must be cleaned periodically, and drip collected materials must be disposed of properly.

☐ Pave loading areas with concrete instead of asphalt.

☐ Avoid placing storm drains inlets in the area.

☐ Grade and/or berm the loading/unloading area with drainage to sump; regularly remove materials accumulated in sump.

Spill Response and Prevention Procedures

☐ Keep your spill prevention and control plan up-to-date or have an emergency spill cleanup plan readily available, as applicable.

☐ Contain leaks during transfer.

☐ Store and maintain appropriate spill cleanup materials in a location that is readily accessible and known to all employees.

☐ Ensure that employees are familiar with the site's spill control plan and proper spill cleanup procedures.

☐ Use drip pans or comparable devices when transferring oils, solvents, and paints.

Material Handling and Waste Management

☐ Spot clean leaks and drips routinely to prevent runoff of spillage.

☐ Do not pour liquid wastes into floor drains, sinks, outdoor storm drain inlets, or other storm drains or sewer connections.

- ☐ Do not put used or leftover cleaning solutions, solvents, and automotive fluids in the storm drain or sanitary sewer.
- ☐ Collect leaking or dripping fluids in drip pans or containers. Fluids are easier to recycle if kept separate.
- ☐ Promptly transfer used fluids to the proper waste or recycling drums. Do not leave drip pans or other open containers lying around.
- ☐ Minimize the possibility of stormwater pollution from outside waste receptacles by doing at least one of the following:
  - ✓ Use only watertight waste receptacle(s) and keep the lid(s) closed.
  - ✓ Grade and pave the waste receptacle area to prevent run-on of stormwater.
  - ✓ Install a roof over the waste receptacle area.
  - ✓ Install a low containment berm around the waste receptacle area.
  - ✓ Use and maintain drip pans under waste receptacles.
- ☐ Post "no littering" signs.
- ☐ Perform work area clean-up and dry sweep after daily operations.

Employee Training Program

- ☐ Train employees (e.g., fork lift operators) and contractors on proper spill containment and cleanup.
- ☐ Have employees trained in spill containment and cleanup present during loading/unloading.
- ☐ Train employees in proper handling techniques during liquid transfers to avoid spills.
- ☐ Make sure forklift operators are properly trained on loading and unloading procedures.

Quality Assurance and Record Keeping

- ☐ Keep accurate maintenance logs that document activities performed, quantities of materials removed, and improvement actions.
- ☐ Keep accurate logs of spill response actions that document what was spilled, how it was cleaned up, and how the waste was disposed.
- ☐ Establish procedures to complete logs and file them in the central office.
- ☐ Keep accurate logs of daily clean-up operations.

Potential Limitations and Work-Arounds

Some facilities may have space constraints, limited staffing and time limitations that may preclude implementation of BMPs. Provided below are typical limitations and recommended "work-arounds."

- ☐ Space and time limitations may preclude all transfers from being performed indoors or under cover.
  - ✓ Designate specific areas for outdoor loading and unloading.
  - ✓ Require employees to understand and follow spill and leak prevention BMPs.
- ☐ It may not be possible to conduct transfers only during dry weather.
  - ✓ Limit materials and equipment rainfall exposure to all extents practicable.
  - ✓ Require employees to understand and follow spill and leak prevention BMPs.

Potential Capital Facility Costs and Operation & Maintenance Requirements

Facilities

Many facilities will already have indoor or covered areas where loading/unloading takes place and will require no additional capital expenditures.

If outdoor activities are required, construction of berms or other means to retain spills and leaks may require appropriate constructed systems for containment. These containment areas may require significant new capital investment.

Capital investments will likely be required at some sites if adequate cover and containment facilities do not exist and can vary significantly depending upon site conditions.

Maintenance

Most of the operations and maintenance activities associated with implementing this BMP are integrally linked to routine operations as previously described. Therefore additional O&M is not required.

- ☐ Conduct regular inspections and make repairs and improvements as necessary.
- ☐ Check loading and unloading equipment regularly for leaks.
- ☐ Conduct regular broom dry-sweeping of area. Do not wash with water.

Supplemental Information

Loading and Unloading of Liquids

- ☐ Loading or unloading of liquids should occur in the manufacturing building so that any spills that are not completely retained can be discharged to the sanitary sewer, treatment plant, or treated in a manner consistent with local sewer authorities and permit requirements.

- ☐ For loading and unloading tank trucks to above and below ground storage tanks, the following procedures should be used:
  - ✓ The area where the transfer takes place should be paved. If the liquid is reactive with the asphalt, Portland cement should be used to pave the area.
  - ✓ The transfer area should be designed to prevent run-on of stormwater from adjacent areas. Sloping the pad and using a curb, like a speed bump, around the uphill side of the transfer area should reduce run-on.
  - ✓ The transfer area should be designed to prevent runoff of spilled liquids from the area. Sloping the area to a drain should prevent runoff. The drain should be connected to a dead-end sump or to the sanitary sewer. A positive control valve should be installed on the drain.
- ☐ For transfer from rail cars to storage tanks that must occur outside, use the following procedures:
  - ✓ Drip pans should be placed at locations where spillage may occur, such as hose connections, hose reels, and filler nozzles. Use drip pans when making and breaking connections.
  - ✓ Drip pan systems should be installed between the rails to collect spillage from tank cars.

References and Resources

Minnesota Pollution Control Agency, *Industrial Stormwater Best Management Practices Guidebook BMP 26 Fueling and Liquid Loading/Unloading Operations*. Available online at: http://www.pca.state.mn.us/index.php/view-document.html?gid=10557.

New Jersey Department of Environmental Protection, 2013. *Basic Industrial Stormwater General Permit Guidance Document NJPDES General Permit No NJ0088315*. Available online at: http://www.nj.gov/dep/dwq/pdf/5G2_guidance_color.pdf.

Orange County Stormwater Program, Best Management Practices for Industrial/Commercial Business Activities. Available online at: http://ocwatersheds.com/documents/bmp/industrialcommercialbusinessesactivities.

Oregon Department of Environmental Quality, 2013. *Industrial Stormwater Best Management Practices Manual- BMP 26 Fueling and Liquid Loading/Unloading Operations*. Available online at: http://www.deq.state.or.us/wq/wqpermit/docs/IndBMP021413.pdf.

Sacramento Stormwater Management Program, *Best Management Practices for Industrial Storm Water Pollution Control*. Available online at: http://www.msa.saccounty.net/sactostormwater/documents/guides/industrial-BMP-manual.pdf.

Sacramento County Environmental Management Stormwater Program: *Best Management Practices*. Available online at: http://www.emd.saccounty.net/EnvHealth/Stormwater/Stormwater-BMPs.html.

Santa Clara Valley Urban Runoff Pollution Prevention Program. http://www.scvurppp-w2k.com/.

US EPA. National Pollutant Discharge Elimination System – Industrial Fact Sheet Series for Activities Covered by EPA's Multi Sector General Permit. Available online at: http://cfpub.epa.gov/npdes/stormwater/swsectors.cfm.

Waste Handling & Disposal

SC-34

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	
Nutrients	
Trash	
Metals	✓
Bacteria	✓
Oil and Grease	✓
Organics	✓

Description

Improper storage and handling of solid wastes can allow toxic compounds, oils and greases, heavy metals, nutrients, suspended solids, and other pollutants to enter stormwater runoff. The discharge of pollutants to stormwater from waste handling and disposal can be prevented and reduced by tracking waste generation, storage, and disposal; reducing waste generation and disposal through source reduction, reuse, and recycling; and preventing run-on and runoff.

Approach

Pollution Prevention

- Accomplish reduction in the amount of waste generated using the following source controls:
    - Production planning and sequencing
    - Process or equipment modification
    - Raw material substitution or elimination
    - Loss prevention and housekeeping
    - Waste segregation and separation
    - Close loop recycling
- Establish a material tracking system to increase awareness about material usage. This may reduce spills and minimize contamination, thus reducing the amount of waste produced.
- Recycle materials whenever possible.

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Suggested Protocols

General

- Cover storage containers with leak proof lids or some other means. If waste is not in containers, cover all waste piles (plastic tarps are acceptable coverage) and prevent stormwater run-on and runoff with a berm. The waste containers or piles must be covered except when in use.
- Use drip pans or absorbent materials whenever grease containers are emptied by vacuum trucks or other means. Grease cannot be left on the ground. Collected grease must be properly disposed of as garbage.
- Check storage containers weekly for leaks and to ensure that lids are on tightly. Replace any that are leaking, corroded, or otherwise deteriorating.
- Sweep and clean the storage area regularly. If it is paved, do not hose down the area to a storm drain.
- Dispose of rinse and wash water from cleaning waste containers into a sanitary sewer if allowed by the local sewer authority. Do not discharge wash water to the street or storm drain.
- Transfer waste from damaged containers into safe containers.
- Take special care when loading or unloading wastes to minimize losses. Loading systems can be used to minimize spills and fugitive emission losses such as dust or mist. Vacuum transfer systems can minimize waste loss.

Controlling Litter

- Post “No Littering” signs and enforce anti-litter laws.
- Provide a sufficient number of litter receptacles for the facility.
- Clean out and cover litter receptacles frequently to prevent spillage.

Waste Collection

- Keep waste collection areas clean.
- Inspect solid waste containers for structural damage regularly. Repair or replace damaged containers as necessary.
- Secure solid waste containers; containers must be closed tightly when not in use.
- Do not fill waste containers with washout water or any other liquid.
- Ensure that only appropriate solid wastes are added to the solid waste container. Certain wastes such as hazardous wastes, appliances, fluorescent lamps, pesticides, etc., may not be disposed of in solid waste containers (see chemical/ hazardous waste collection section below).

- Do not mix wastes; this can cause chemical reactions, make recycling impossible, and complicate disposal.

Good Housekeeping

- Use all of the product before disposing of the container.
- Keep the waste management area clean at all times by sweeping and cleaning up spills immediately.
- Use dry methods when possible (e.g., sweeping, use of absorbents) when cleaning around restaurant/food handling dumpster areas. If water must be used after sweeping/using absorbents, collect water and discharge through grease interceptor to the sewer.

Chemical/Hazardous Wastes

- Select designated hazardous waste collection areas on-site.
- Store hazardous materials and wastes in covered containers and protect them from vandalism.
- Place hazardous waste containers in secondary containment.
- Make sure that hazardous waste is collected, removed, and disposed of only at authorized disposal areas.
- Stencil or demarcate storm drains on the facility's property with prohibitive message regarding waste disposal.

Run-on/Runoff Prevention

- Prevent stormwater run-on from entering the waste management area by enclosing the area or building a berm around the area.
- Prevent waste materials from directly contacting rain.
- Cover waste piles with temporary covering material such as reinforced tarpaulin, polyethylene, polyurethane, polypropyleneor hypalon.
- Cover the area with a permanent roof if feasible.
- Cover dumpsters to prevent rain from washing waste out of holes or cracks in the bottom of the dumpster.
- Move the activity indoor after ensuring all safety concerns such as fire hazard and ventilation are addressed.

Inspection

- Inspect and replace faulty pumps or hoses regularly to minimize the potential of releases and spills.
- Check waste management areas for leaking containers or spills.

- Repair leaking equipment including valves, lines, seals, or pumps promptly.

Training

- Train staff in pollution prevention measures and proper disposal methods.
- Train employees and contractors in proper spill containment and cleanup. The employee should have the tools and knowledge to immediately begin cleaning up a spill should one occur.
- Train employees and subcontractors in proper hazardous waste management.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Have an emergency plan, equipment and trained personnel ready at all times to deal immediately with major spills
- Collect all spilled liquids and properly dispose of them.
- Store and maintain appropriate spill cleanup materials in a location known to all near the designated wash area.
- Ensure that vehicles transporting waste have spill prevention equipment that can prevent spills during transport. Spill prevention equipment includes:
    - Vehicles equipped with baffles for liquid waste
    - Trucks with sealed gates and spill guards for solid waste

Other Considerations (Limitations and Regulations)

Hazardous waste cannot be reused or recycled; it must be disposed of by a licensed hazardous waste hauler.

Requirements

Costs

Capital and O&M costs for these programs will vary substantially depending on the size of the facility and the types of waste handled. Costs should be low if there is an inventory program in place.

Maintenance

- None except for maintaining equipment for material tracking program.

Supplemental Information

Further Detail of the BMP

Land Treatment System

Minimize runoff of polluted stormwater from land application by:

- Choosing a site where slopes are under 6%, the soil is permeable, there is a low water table, it is located away from wetlands or marshes, and there is a closed drainage system

- Avoiding application of waste to the site when it is raining or when the ground is saturated with water
- Growing vegetation on land disposal areas to stabilize soils and reduce the volume of surface water runoff from the site
- Maintaining adequate barriers between the land application site and the receiving waters (planted strips are particularly good)
- Using erosion control techniques such as mulching and matting, filter fences, straw bales, diversion terracing, and sediment basins
- Performing routine maintenance to ensure the erosion control or site stabilization measures are working

Examples

The port of Long Beach has a state-of-the-art database for identifying potential pollutant sources, documenting facility management practices, and tracking pollutants.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

Solid Waste Container Best Management Practices – Fact Sheet On-Line Resources – Environmental Health and Safety. Harvard University. 2002.

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA). http://www.basmaa.org

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

Building & Grounds Maintenance SC-41

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	✓
Nutrients	✓
Trash	
Metals	✓
Bacteria	✓
Oil and Grease	
Organics	

Description

Stormwater runoff from building and grounds maintenance activities can be contaminated with toxic hydrocarbons in solvents, fertilizers and pesticides, suspended solids, heavy metals, abnormal pH, and oils and greases. Utilizing the protocols in this fact sheet will prevent or reduce the discharge of pollutants to stormwater from building and grounds maintenance activities by washing and cleaning up with as little water as possible, following good landscape management practices, preventing and cleaning up spills immediately, keeping debris from entering the storm drains, and maintaining the stormwater collection system.

Approach

Reduce potential for pollutant discharge through source control pollution prevention and BMP implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

Pollution Prevention

- Switch to non-toxic chemicals for maintenance when possible.
- Choose cleaning agents that can be recycled.
- Encourage proper lawn management and landscaping, including use of native vegetation.

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Quality
Association

- Encourage use of Integrated Pest Management techniques for pest control.

- Encourage proper onsite recycling of yard trimmings.

- Recycle residual paints, solvents, lumber, and other material as much as possible.

Suggested Protocols

Pressure Washing of Buildings, Rooftops, and Other Large Objects

- In situations where soaps or detergents are used and the surrounding area is paved, pressure washers must use a water collection device that enables collection of wash water and associated solids. A sump pump, wet vacuum or similarly effective device must be used to collect the runoff and loose materials. The collected runoff and solids must be disposed of properly.

- If soaps or detergents are not used, and the surrounding area is paved, wash runoff does not have to be collected but must be screened. Pressure washers must use filter fabric or some other type of screen on the ground and/or in the catch basin to trap the particles in wash water runoff.

- If you are pressure washing on a grassed area (with or without soap), runoff must be dispersed as sheet flow as much as possible, rather than as a concentrated stream. The wash runoff must remain on the grass and not drain to pavement.

Landscaping Activities

- Dispose of grass clippings, leaves, sticks, or other collected vegetation as garbage, or by composting. Do not dispose of collected vegetation into waterways or storm drainage systems.

- Use mulch or other erosion control measures on exposed soils.

Building Repair, Remodeling, and Construction

- Do not dump any toxic substance or liquid waste on the pavement, the ground, or toward a storm drain.

- Use ground or drop cloths underneath outdoor painting, scraping, and sandblasting work, and properly dispose of collected material daily.

- Use a ground cloth or oversized tub for activities such as paint mixing and tool cleaning.

- Clean paintbrushes and tools covered with water-based paints in sinks connected to sanitary sewers or in portable containers that can be dumped into a sanitary sewer drain. Brushes and tools covered with non-water-based paints, finishes, or other materials must be cleaned in a manner that enables collection of used solvents (e.g., paint thinner, turpentine, etc.) for recycling or proper disposal.

- Use a storm drain cover, filter fabric, or similarly effective runoff control mechanism if dust, grit, wash water, or other pollutants may escape the work area and enter a catch basin. This is particularly necessary on rainy days. The containment device(s) must be in place at the beginning of the work day, and accumulated dirty runoff and solids must be collected and disposed of before removing the containment device(s) at the end of the work day.

- If you need to de-water an excavation site, you may need to filter the water before discharging to a catch basin or off-site. If directed off-site, you should direct the water through hay bales and filter fabric or use other sediment filters or traps.

- Store toxic material under cover during precipitation events and when not in use. A cover would include tarps or other temporary cover material.

Mowing, Trimming, and Planting

- Dispose of leaves, sticks, or other collected vegetation as garbage, by composting or at a permitted landfill. Do not dispose of collected vegetation into waterways or storm drainage systems.

- Use mulch or other erosion control measures when soils are exposed.

- Place temporarily stockpiled material away from watercourses and drain inlets, and berm or cover stockpiles to prevent material releases to the storm drain system.

- Consider an alternative approach when bailing out muddy water: do not put it in the storm drain; pour over landscaped areas.

- Use hand weeding where practical.

Fertilizer and Pesticide Management

- Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of fertilizers and pesticides and training of applicators and pest control advisors.

- Use less toxic pesticides that will do the job when applicable. Avoid use of copper-based pesticides if possible.

- Do not use pesticides if rain is expected.

- Do not mix or prepare pesticides for application near storm drains.

- Use the minimum amount needed for the job.

- Calibrate fertilizer distributors to avoid excessive application.

- Employ techniques to minimize off-target application (e.g., spray drift) of pesticides, including consideration of alternative application techniques.

- Apply pesticides only when wind speeds are low.

- Fertilizers should be worked into the soil rather than dumped or broadcast onto the surface.

- Irrigate slowly to prevent runoff and then only as much as is needed.

- Clean pavement and sidewalk if fertilizer is spilled on these surfaces before applying irrigation water.

- Dispose of empty pesticide containers according to the instructions on the container label.

- Use up the pesticides. Rinse containers, and use rinse water as product. Dispose of unused pesticide as hazardous waste.
- Implement storage requirements for pesticide products with guidance from the local fire department and County Agricultural Commissioner. Provide secondary containment for pesticides.

Inspection

- Inspect irrigation system periodically to ensure that the right amount of water is being applied and that excessive runoff is not occurring. Minimize excess watering and repair leaks in the irrigation system as soon as they are observed.

Training

- Educate and train employees on pesticide use and in pesticide application techniques to prevent pollution.
- Train employees and contractors in proper techniques for spill containment and cleanup.
- Be sure the frequency of training takes into account the complexity of the operations and the nature of the staff.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Place a stockpile of spill cleanup materials, such as brooms, dustpans, and vacuum sweepers (if desired) near the storage area where it will be readily accessible.
- Have employees trained in spill containment and cleanup present during the loading/unloading of dangerous wastes, liquid chemicals, or other materials.
- Familiarize employees with the Spill Prevention Control and Countermeasure Plan.
- Clean up spills immediately.

Other Considerations

Alternative pest/weed controls may not be available, suitable, or effective in many cases.

Requirements

Costs

- Cost will vary depending on the type and size of facility.
- Overall costs should be low in comparison to other BMPs.

Maintenance

Sweep paved areas regularly to collect loose particles. Wipe up spills with rags and other absorbent material immediately, do not hose down the area to a storm drain.

Supplemental Information

Further Detail of the BMP

Fire Sprinkler Line Flushing

Building fire sprinkler line flushing may be a source of non-stormwater runoff pollution. The water entering the system is usually potable water, though in some areas it may be non-potable reclaimed wastewater. There are subsequent factors that may drastically reduce the quality of the water in such systems. Black iron pipe is usually used since it is cheaper than potable piping, but it is subject to rusting and results in lower quality water. Initially, the black iron pipe has an oil coating to protect it from rusting between manufacture and installation; this will contaminate the water from the first flush but not from subsequent flushes. Nitrates, poly-phosphates and other corrosion inhibitors, as well as fire suppressants and antifreeze may be added to the sprinkler water system. Water generally remains in the sprinkler system a long time (typically a year) and between flushes may accumulate iron, manganese, lead, copper, nickel, and zinc. The water generally becomes anoxic and contains living and dead bacteria and breakdown products from chlorination. This may result in a significant BOD problem and the water often smells. Consequently dispose fire sprinkler line flush water into the sanitary sewer. Do not allow discharge to storm drain or infiltration due to potential high levels of pollutants in fire sprinkler line water.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Mobile Cleaners Pilot Program: Final Report. 1997. Bay Area Stormwater Management Agencies Association (BASMAA). http://www.basmaa.org/

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA). http://www.basmaa.org/

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

Parking/Storage Area Maintenance SC-43

Description

Parking lots and storage areas can contribute a number of substances, such as trash, suspended solids, hydrocarbons, oil and grease, and heavy metals that can enter receiving waters through stormwater runoff or non-stormwater discharges. The protocols in this fact sheet are intended to prevent or reduce the discharge of pollutants from parking/storage areas and include using good housekeeping practices, following appropriate cleaning BMPs, and training employees.

Approach

The goal of this program is to ensure stormwater pollution prevention practices are considered when conducting activities on or around parking areas and storage areas to reduce potential for pollutant discharge to receiving waters. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

Pollution Prevention

- Encourage alternative designs and maintenance strategies for impervious parking lots. (See New Development and Redevelopment BMP Handbook)
- Keep accurate maintenance logs to evaluate BMP implementation.

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	✓
Nutrients	
Trash	✓
Metals	✓
Bacteria	
Oil and Grease	✓
Organics	✓

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Suggested Protocols

General

- Keep the parking and storage areas clean and orderly. Remove debris in a timely fashion.
- Allow sheet runoff to flow into biofilters (vegetated strip and swale) and/or infiltration devices.
- Utilize sand filters or oleophilic collectors for oily waste in low quantities.
- Arrange rooftop drains to prevent drainage directly onto paved surfaces.
- Design lot to include semi-permeable hardscape.
- Discharge soapy water remaining in mop or wash buckets to the sanitary sewer through a sink, toilet, clean-out, or wash area with drain.

Controlling Litter

- Post "No Littering" signs and enforce anti-litter laws.
- Provide an adequate number of litter receptacles.
- Clean out and cover litter receptacles frequently to prevent spillage.
- Provide trash receptacles in parking lots to discourage litter.
- Routinely sweep, shovel, and dispose of litter in the trash.

Surface Cleaning

- Use dry cleaning methods (e.g., sweeping, vacuuming) to prevent the discharge of pollutants into the stormwater conveyance system if possible.
- Establish frequency of public parking lot sweeping based on usage and field observations of waste accumulation.
- Sweep all parking lots at least once before the onset of the wet season.
- Follow the procedures below if water is used to clean surfaces:
    - Block the storm drain or contain runoff.
    - Collect and pump wash water to the sanitary sewer or discharge to a pervious surface. Do not allow wash water to enter storm drains.
    - Dispose of parking lot sweeping debris and dirt at a landfill.
- Follow the procedures below when cleaning heavy oily deposits:
    - Clean oily spots with absorbent materials.
    - Use a screen or filter fabric over inlet, then wash surfaces.

  - Do not allow discharges to the storm drain.
  - Vacuum/pump discharges to a tank or discharge to sanitary sewer.
  - Appropriately dispose of spilled materials and absorbents.

Surface Repair

- Preheat, transfer or load hot bituminous material away from storm drain inlets.
- Apply concrete, asphalt, and seal coat during dry weather to prevent contamination from contacting stormwater runoff.
- Cover and seal nearby storm drain inlets where applicable (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc. Leave covers in place until job is complete and all water from emulsified oil sealants has drained or evaporated. Clean any debris from these covered manholes and drains for proper disposal.
- Use only as much water as necessary for dust control, to avoid runoff.
- Catch drips from paving equipment that is not in use with pans or absorbent material placed under the machines. Dispose of collected material and absorbents properly.

Inspection

- Have designated personnel conduct inspections of parking facilities and stormwater conveyance systems associated with parking facilities on a regular basis.
- Inspect cleaning equipment/sweepers for leaks on a regular basis.

Training

- Provide regular training to field employees and/or contractors regarding cleaning of paved areas and proper operation of equipment.
- Train employees and contractors in proper techniques for spill containment and cleanup.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Place a stockpile of spill cleanup materials where it will be readily accessible or at a central location.
- Clean up fluid spills immediately with absorbent rags or material.
- Dispose of spilled material and absorbents properly.

Other Considerations

Limitations related to sweeping activities at large parking facilities may include high equipment costs, the need for sweeper operator training, and the inability of current sweeper technology to remove oil and grease.

Requirements

Costs

Cleaning/sweeping costs can be quite large. Construction and maintenance of stormwater structural controls can be quite expensive as well.

Maintenance

- Sweep parking lot regularly to minimize cleaning with water.
- Clean out oil/water/sand separators regularly, especially after heavy storms.
- Clean parking facilities regularly to prevent accumulated wastes and pollutants from being discharged into conveyance systems during rainy conditions.

Supplemental Information

Further Detail of the BMP

Surface Repair

Apply concrete, asphalt, and seal coat during dry weather to prevent contamination from contacting stormwater runoff. Where applicable, cover and seal nearby storm drain inlets (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc. Leave covers in place until job is complete and all water from emulsified oil sealants has drained or evaporated. Clean any debris from these covered manholes and drains for proper disposal. Only use only as much water as is necessary for dust control to avoid runoff.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA). http://www.basmaa.org/

Oregon Association of Clean Water Agencies. Oregon Municipal Stormwater Toolbox for Maintenance Practices. June 1998.

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

Drainage System Maintenance SC-44

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize

Targeted Constituents

Sediment	✓
Nutrients	
Trash	✓
Metals	
Bacteria	✓
Oil and Grease	
Organics	

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Description

As a consequence of its function, the stormwater conveyance system collects and transports urban runoff and stormwater that may contain certain pollutants. The protocols in this fact sheet are intended to reduce pollutants reaching receiving waters through proper conveyance system operation and maintenance.

Approach

Pollution Prevention

Maintain catch basins, stormwater inlets, and other stormwater conveyance structures on a regular basis to remove pollutants, reduce high pollutant concentrations during the first flush of storms, prevent clogging of the downstream conveyance system, restore catch basins' sediment trapping capacity, and ensure the system functions properly hydraulically to avoid flooding.

Suggested Protocols

Catch Basins/Inlet Structures

- Staff should regularly inspect facilities to ensure compliance with the following:
  - Immediate repair of any deterioration threatening structural integrity.
  - Cleaning before the sump is 40% full. Catch basins should be cleaned as frequently as needed to meet this standard.
  - Stenciling of catch basins and inlets (see SC34 Waste Handling and Disposal).

- Clean catch basins, storm drain inlets, and other conveyance structures before the wet season to remove sediments and debris accumulated during the summer.

- Conduct inspections more frequently during the wet season for problem areas where sediment or trash accumulates more often. Clean and repair as needed.

- Keep accurate logs of the number of catch basins cleaned.

- Store wastes collected from cleaning activities of the drainage system in appropriate containers or temporary storage sites in a manner that prevents discharge to the storm drain.

- Dewater the wastes if necessary with outflow into the sanitary sewer if permitted. Water should be treated with an appropriate filtering device prior to discharge to the sanitary sewer. If discharge to the sanitary sewer is not allowed, water should be pumped or vacuumed to a tank and properly disposed. Do not dewater near a storm drain or stream.

Storm Drain Conveyance System

- Locate reaches of storm drain with deposit problems and develop a flushing schedule that keeps the pipe clear of excessive buildup.

- Collect and pump flushed effluent to the sanitary sewer for treatment whenever possible.

Pump Stations

- Clean all storm drain pump stations prior to the wet season to remove silt and trash.

- Do not allow discharge to reach the storm drain system when cleaning a storm drain pump station or other facility.

- Conduct routine maintenance at each pump station.

- Inspect, clean, and repair as necessary all outlet structures prior to the wet season.

Open Channel

- Modify storm channel characteristics to improve channel hydraulics, increase pollutant removals, and enhance channel/creek aesthetic and habitat value.

- Conduct channel modification/improvement in accordance with existing laws. Any person, government agency, or public utility proposing an activity that will change the natural (emphasis added) state of any river, stream, or lake in California, must enter into a Steam or Lake Alteration Agreement with the Department of Fish and Game. The developer-applicant should also contact local governments (city, county, special districts), other state agencies (SWRCB, RWQCB, Department of Forestry, Department of Water Resources), and Federal Corps of Engineers and USFWS.

Illicit Connections and Discharges

- Look for evidence of illegal discharges or illicit connections during routine maintenance of conveyance system and drainage structures:

  - Is there evidence of spills such as paints, discoloring, etc?

  - Are there any odors associated with the drainage system?

  - Record locations of apparent illegal discharges/illicit connections?

  - Track flows back to potential dischargers and conduct aboveground inspections. This can be done through visual inspection of upgradient manholes or alternate techniques including zinc chloride smoke testing, fluorometric dye testing, physical inspection testing, or television camera inspection.

  - Eliminate the discharge once the origin of flow is established.

- Stencil or demarcate storm drains, where applicable, to prevent illegal disposal of pollutants. Storm drain inlets should have messages such as "Dump No Waste Drains to Stream" stenciled next to them to warn against ignorant or intentional dumping of pollutants into the storm drainage system.

- Refer to fact sheet SC-10 Non-Stormwater Discharges.

Illegal Dumping

- Inspect and clean up hot spots and other storm drainage areas regularly where illegal dumping and disposal occurs.

- Establish a system for tracking incidents. The system should be designed to identify the following:

  - Illegal dumping hot spots

  - Types and quantities (in some cases) of wastes

  - Patterns in time of occurrence (time of day/night, month, or year)

  - Mode of dumping (abandoned containers, "midnight dumping" from moving vehicles, direct dumping of materials, accidents/spills)

  - Responsible parties

- Post "No Dumping" signs in problem areas with a phone number for reporting dumping and disposal. Signs should also indicate fines and penalties for illegal dumping.

- Refer to fact sheet SC-10 Non-Stormwater Discharges.

Training

- Train crews in proper maintenance activities, including record keeping and disposal.

- Allow only properly trained individuals to handle hazardous materials/wastes.

- Have staff involved in detection and removal of illicit connections trained in the following:

  - OSHA-required Health and Safety Training (29 CFR 1910.120) plus annual refresher training (as needed).

  - OSHA Confined Space Entry training (Cal-OSHA Confined Space, Title 8 and Federal OSHA 29 CFR 1910.146).
  - Procedural training (field screening, sampling, smoke/dye testing, TV inspection).

Spill Response and Prevention

- Investigate all reports of spills, leaks, and/or illegal dumping promptly.
- Clean up all spills and leaks using "dry" methods (with absorbent materials and/or rags) or dig up, remove, and properly dispose of contaminated soil.
- Refer to fact sheet SC-11 Spill Prevention, Control, and Cleanup.

Other Considerations (Limitations and Regulations)

- Clean-up activities may create a slight disturbance for local aquatic species. Access to items and material on private property may be limited. Trade-offs may exist between channel hydraulics and water quality/riparian habitat. If storm channels or basins are recognized as wetlands, many activities, including maintenance, may be subject to regulation and permitting.
- Storm drain flushing is most effective in small diameter pipes (36-inch diameter pipe or less, depending on water supply and sediment collection capacity). Other considerations associated with storm drain flushing may include the availability of a water source, finding a downstream area to collect sediments, liquid/sediment disposal, and prohibition against disposal of flushed effluent to sanitary sewer in some areas.
- Regulations may include adoption of substantial penalties for illegal dumping and disposal.
- Local municipal codes may include sections prohibiting discharge of soil, debris, refuse, hazardous wastes, and other pollutants into the storm drain system.

Requirements

Costs

- An aggressive catch basin cleaning program could require a significant capital and O&M budget.
- The elimination of illegal dumping is dependent on the availability, convenience, and cost of alternative means of disposal. The primary cost is for staff time. Cost depends on how aggressively a program is implemented. Other cost considerations for an illegal dumping program include:
  - Purchase and installation of signs.
  - Rental of vehicle(s) to haul illegally-disposed items and material to landfills.
  - Rental of heavy equipment to remove larger items (e.g., car bodies) from channels.
  - Purchase of landfill space to dispose of illegally-dumped items and material.

- Methods used for illicit connection detection (smoke testing, dye testing, visual inspection, and flow monitoring) can be costly and time-consuming. Site-specific factors, such as the level of impervious area, the density and ages of buildings, and type of land use will determine the level of investigation necessary.

Maintenance

- Two-person teams may be required to clean catch basins with vactor trucks.
- Teams of at least two people plus administrative personnel are required to identify illicit discharges, depending on the complexity of the storm sewer system.
- Arrangements must be made for proper disposal of collected wastes.
- Technical staff are required to detect and investigate illegal dumping violations.

Supplemental Information

Further Detail of the BMP

Storm Drain Flushing

Flushing is a common maintenance activity used to improve pipe hydraulics and to remove pollutants in storm drainage systems. Flushing may be designed to hydraulically convey accumulated material to strategic locations, such as an open channel, another point where flushing will be initiated, or the sanitary sewer and the treatment facilities, thus preventing resuspension and overflow of a portion of the solids during storm events. Flushing prevents "plug flow" discharges of concentrated pollutant loadings and sediments. Deposits can hinder the designed conveyance capacity of the storm drain system and potentially cause backwater conditions in severe cases of clogging.

Storm drain flushing usually takes place along segments of pipe with grades that are too flat to maintain adequate velocity to keep particles in suspension. An upstream manhole is selected to place an inflatable device that temporarily plugs the pipe. Further upstream, water is pumped into the line to create a flushing wave. When the upstream reach of pipe is sufficiently full to cause a flushing wave, the inflated device is rapidly deflated with the assistance of a vacuum pump, thereby releasing the backed up water and resulting in the cleaning of the storm drain segment.

To further reduce impacts of stormwater pollution, a second inflatable device placed well downstream may be used to recollect the water after the force of the flushing wave has dissipated. A pump may then be used to transfer the water and accumulated material to the sanitary sewer for treatment. In some cases, an interceptor structure may be more practical or required to recollect the flushed waters.

It has been found that cleansing efficiency of periodic flush waves is dependent upon flush volume, flush discharge rate, sewer slope, sewer length, sewer flow rate, sewer diameter, and population density. As a rule of thumb, the length of line to be flushed should not exceed 700 feet. At this maximum recommended length, the percent removal efficiency ranges between 65-75% for organics and 55-65% for dry weather grit/inorganic material. The percent removal efficiency drops rapidly beyond that. Water is commonly supplied by a water truck, but fire hydrants can also supply water. To make the best use of water, it is recommended that reclaimed water be used or that fire hydrant line flushing coincide with storm sewer flushing.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

Ferguson, B.K. 1991. Urban Stream Reclamation, p. 324-322, Journal of Soil and Water Conservation.

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Oregon Association of Clean Water Agencies. Oregon Municipal Stormwater Toolbox for Maintenance Practices. June 1998.

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net

United States Environmental Protection Agency (USEPA). 2002. Pollution Prevention/Good Housekeeping for Municipal Operations Storm Drain System Cleaning. On line:
http://www.epa.gov/npdes/menuofbmps/poll_16.htm

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.

Outdoor Material Storage Areas SD-34


2 15 '96

Design Objectives

Maximize Infiltration

Provide Retention

Slow Runoff

Minimize Impervious Land Coverage

Prohibit Dumping of Improper Materials

☑ Contain Pollutant

Collect and Convey

Description

Proper design of outdoor storage areas for materials reduces opportunity for toxic compounds, oil and grease, heavy metals, nutrients, suspended solids, and other pollutants to enter the stormwater conveyance system. Materials may be in the form of raw products, by-products, finished products, and waste products. The type of pollutants associated with the materials will vary depending on the type of commercial or industrial activity.

Approach

Outdoor storage areas require a drainage approach different from the typical infiltration/detention strategy. In outdoor storage areas, infiltration is discouraged. Containment is encouraged. Preventative measures include enclosures, secondary containment structures and impervious surfaces.

Suitable Applications

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

Design Considerations

Some materials are more of a concern than others. Toxic and hazardous materials must be prevented from coming in contact with stormwater. Non-toxic or non-hazardous materials do not have to be prevented from stormwater contact. However, these materials may have toxic effects on receiving waters if allowed to be discharged with stormwater in significant quantities. Accumulated material on an impervious surface could result in significant impact on the rivers or streams that receive the runoff.

Material may be stored in a variety of ways, including bulk piles, containers, shelving, stacking, and tanks. Stormwater contamination may be prevented by eliminating the possibility of stormwater contact with the material storage areas either through diversion, cover, or capture of the stormwater. Control measures may also include minimizing the storage area. Design

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requirements for material storage areas are governed by Building and Fire Codes, and by current City or County ordinances and zoning requirements. Control measures are site specific, and must meet local agency requirements.

Designing New Installations

Where proposed project plans include outdoor areas for storage of materials that may contribute pollutants to the stormwater conveyance system, the following structural or treatment BMPS should be considered:

- Materials with the potential to contaminate stormwater should be: (1) placed in an enclosure such as, but not limited to, a cabinet, shed, or similar structure that prevents contact with runoff or spillage to the stormwater conveyance system, or (2) protected by secondary containment structures such as berms, dikes, or curbs.

- The storage area should be paved and sufficiently impervious to contain leaks and spills.

- The storage area should slope towards a dead-end sump to contain spills and direct runoff from downspouts/roofs should be directed away from storage areas.

- The storage area should have a roof or awning that extends beyond the storage area to minimize collection of stormwater within the secondary containment area. A manufactured storage shed may be used for small containers.

Note that the location(s) of installations of where these preventative measures will be employed must be included on the map or plans identifying BMPs.

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.

Additional Information

Stormwater and non-stormwater will accumulate in containment areas and sumps with impervious surfaces. Contaminated accumulated water must be disposed of in accordance with applicable laws and cannot be discharged directly to the storm drain or sanitary sewer system without the appropriate permits.

Other Resources

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

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

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

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