Project Specific Water Quality Management Plan

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

DATE May 7, 2024

ERSC
Engineering Resources of Southern California

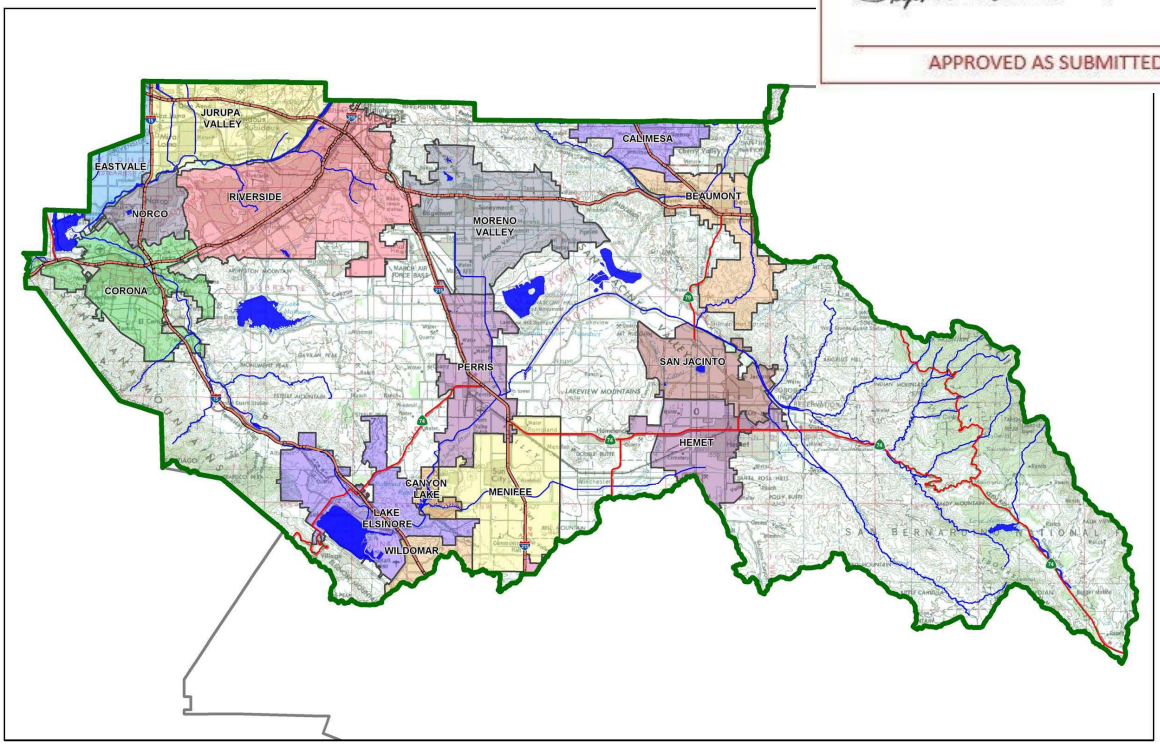
Stephen Wilson

APPROVED AS SUBMITTED

Project Title: Lake Elsinore Ortega Plaza

Development No: PWQMP 2023-0003

Design Review/Case No: TBD



☒ **Preliminary**
☐ **Final**

Original Date Prepared: 09/11/2020

Revision Date(s): 11-09-2023, 03-05-2024, 05/03/2024

Prepared for Compliance with
Regional Board Order No. **R8-2010-0033**
Template revised June 30, 2016
Spring 2019 WQMP Training Update

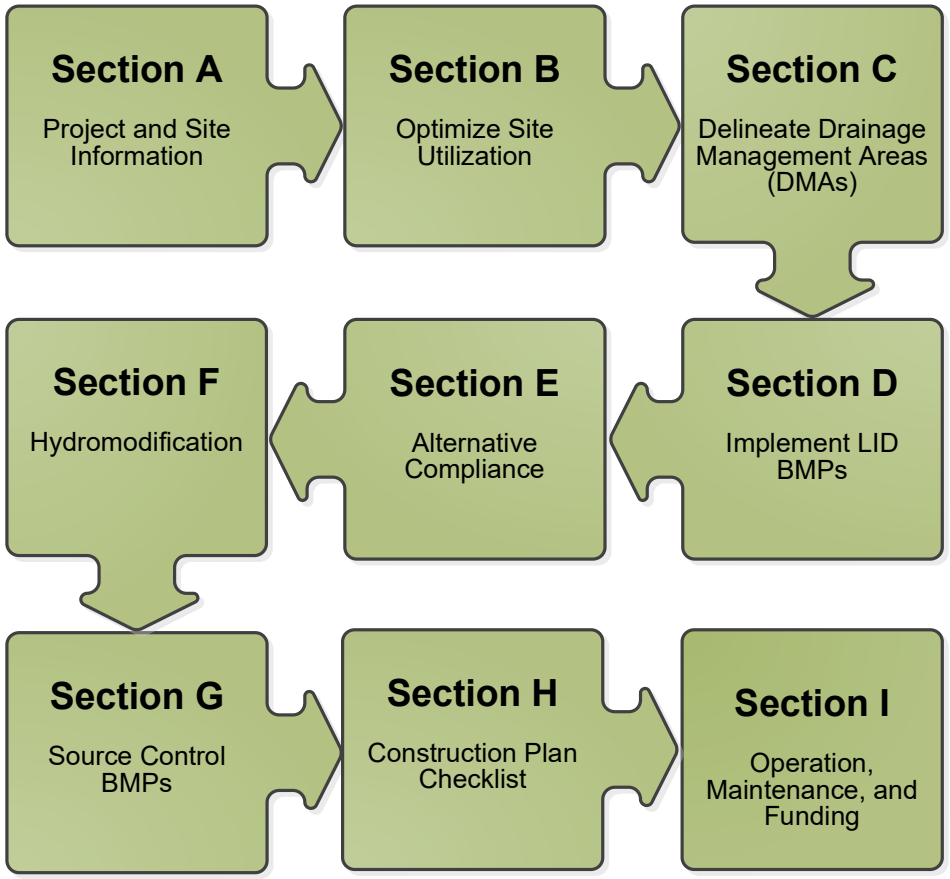
Contact Information:

Prepared for:
Empire Design Group, Inc.
24861 Washington Avenue
Murrieta, CA 92562
Gregory Hann , President
(951) 696-1490

Prepared by:
Plump Engineering, Inc.,
914 E. Katella Avenue,
Anaheim, CA 92805,
Troy Tryfonopoulos PE,
Director of Civil Engineering
(714) 385-1835

A Brief Introduction

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



OWNER'S CERTIFICATION

This Project-Specific Water Quality Management Plan (WQMP) has been prepared for Empire Design Group by Plump Engineering Inc. for the Lake Elsinore Ortega Plaza project.

This WQMP is intended to comply with the requirements of City of Lake Elsinore for Ordinance No.754 which includes the requirement for the preparation and implementation of a Project-Specific WQMP.

The undersigned, while owning the property/project described in the preceding paragraph, shall be responsible for the implementation and funding of this WQMP and will ensure that this WQMP is amended as appropriate to reflect up-to-date conditions on the site. In addition, the property owner accepts responsibility for interim operation and maintenance of Stormwater BMPs until such time as this responsibility is formally transferred to a subsequent owner. This WQMP will be reviewed with the facility operator, facility supervisors, employees, tenants, maintenance and service contractors, or any other party (or parties) having responsibility for implementing portions of this WQMP. At least one copy of this WQMP will be maintained at the project site or project office in perpetuity. The undersigned is authorized to certify and to approve implementation of this WQMP. The undersigned is aware that implementation of this WQMP is enforceable under Riverside County Water Quality Ordinance (Municipal Code Section754.2).

"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

05/22/2024
Date

Kazak Gorou
Owner's Printed Name

Owner Representative
Owner's Title/Position

PREPARER'S CERTIFICATION

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

Preparer's Signature

5/21/2024
Date

Troy Tryfonopoulos, PE
Preparer's Printed Name

Director of Civil Engineering
Preparer's Title/Position

Preparer's Licensure: 65859

Table of Contents

Section A: Project and Site Information 6

A.1 Project Description 6
A.2 Maps and Site Plans 7
A.3 Identify Receiving Waters 7
A.4 Additional Permits/Approvals required for the Project: 7

Section B: Optimize Site Utilization (LID Principles) 9

Section C: Delineate Drainage Management Areas (DMAs) 11

Section D: Implement LID BMPs 13

D.1 Infiltration Applicability 13
D.2 Harvest and Use Assessment 14
D.3 Bioretention and Biotreatment Assessment 16
D.4 Feasibility Assessment Summaries 17
D.5 LID BMP Sizing 18

Section E: Alternative Compliance (LID Waiver Program) 21

E.1 Identify Pollutants of Concern 22
E.2 Stormwater Credits 23
E.3 Sizing Criteria 23
E.4 Treatment Control BMP Selection 24

Section F: Hydromodification 25

F.1 Hydrologic Conditions of Concern (HCOC) Analysis 25
F.2 HCOC Mitigation 26

Section G: Source Control BMPs 27

Section H: Construction Plan Checklist 31

Section I: Operation, Maintenance and Funding 32

List of Tables

Table A.1 Identification of Receiving Waters 7
Table A.2 Other Applicable Permits 7
Table C.1 DMA Classifications 11
Table C.2 Type 'A', Self-Treating Areas 11
Table C.3 Type 'B', Self-Retaining Areas 11
Table C.4 Type 'C', Areas that Drain to Self-Retaining Areas 12
Table C.5 Type 'D', Areas Draining to BMPs 12
Table D.1 Infiltration Feasibility 13
Table D.2 LID Prioritization Summary Matrix 17
Table D.3 DCV Calculations for LID BMPs 18
Table E.1 Potential Pollutants by Land Use Type 22
Table E.2 Water Quality Credits 23
Table E.3 Treatment Control BMP Sizing 23
Table E.4 Treatment Control BMP Selection 24
Table F.1 Hydrologic Conditions of Concern Summary 25
Table G.1 Permanent and Operational Source Control Measures 28
Table H.1 Construction Plan Cross-reference 31

List of Appendices

Appendix 1: Maps and Site Plans 33
Appendix 2: Construction Plans 34
Appendix 3: Soils Information 35
Appendix 4: Historical Site Conditions 36
Appendix 5: LID Infeasibility 37
Appendix 6: BMP Design Details 38
Appendix 7: Hydromodification 39
Appendix 8: Source Control 40
Appendix 9: O&M 41
Appendix 10: Educational Materials 42

Section A: Project and Site Information

PROJECT INFORMATION	
Type of Project:	Commercial
Planning Area:	General Commercial (C-2)
Community Name:	Lake Elsinore
Development Name:	General Commercial
PROJECT LOCATION	
Latitude & Longitude (DMS): 33.657886, -117.375525	
Project Watershed and Sub-Watershed: Santa Ana River Watershed/San Jacinto River Subwatershed	
Gross Acres: 5.67 ac (246,827 sf) - among which the total disturbed area is 3.57 ac. APN(s): 381-320-025-6	
Map Book and Page No.: Book 8, Page 377 of Maps, Records of San Diego County, California	
PROJECT CHARACTERISTICS	
Proposed or Potential Land Use(s)	General Commercial
Proposed or Potential SIC Code(s)	5311, 5541, 5812
Area of Impervious Project Footprint (SF)	144,205
Total Area of proposed Impervious Surfaces within the Project Footprint (SF)/or Replacement	144,205
Does the project consist of offsite road improvements?	☒ Y ☐ N
Does the project propose to construct unpaved roads?	☒ Y ☐ N
Is the project part of a larger common plan of development (phased project)?	☐ Y ☒ N
EXISTING SITE CHARACTERISTICS	
Total area of existing Impervious Surfaces within the Project limits Footprint (SF)	115,554
Is the project located within any MSHCP Criteria Cell?	☐ Y ☒ N
If so, identify the Cell number:	N/A
Are there any natural hydrologic features on the project site?	☐ Y ☒ N
Is a Geotechnical Report attached?	☒ Y ☐ N
If no Geotech. Report, list the NRCS soils type(s) present on the site (A, B, C and/or D)	D
What is the Water Quality Design Storm Depth for the project?	0.92 inches

A.1 Project Description

The existing site is partially developed with some vegetation. Landscaping lines the front of the property along Ortega Highway. The project proposes to develop the site for more commercial use. The new development will primarily consist of a C-store (3,375 SF) and adjacent QSR (1,400 SF) with drive-thru (7,865 SF), one (1) gas station canopy (3,427 SF) and offsite improvement including curb & gutter, sidewalk, and ac pavement. The two existing buildings (Retail Building – 8,634 SF and 2-story office 6,478 SF) on the south side of the property will remain in place. And a vacant building pad (78,636 SF) in the southern site will remain undisturbed with no future development plan at this time. If this vacant parcel property is to be developed in the future, the currently programed treatment facility to receive its runoff shall be expanded or a separate facility shall be added to accommodate future increased stormwater volume from the drainage area (designated as DMA 1 in this WQMP). And this WQMP shall be formally amended to include the development of this vacant land.

In drainage design, the proposed drainage pattern of the site will sheet flow stormwater runoff to the landscape areas fronting the property along Ortega Highway and Grand Avenue. Stormwater from the site (designated as

DMA 1 and DMA-2) will be treated by the bioretention systems located within the landscape areas. Stormwater treated by the bioretention systems will flow into the underdrains connected to the pump station before being discharged to the curb and gutter on Ortega Highway. Storm events exceeding the capacity of the bioretention system will discharge through the primary overflow system to the pump structure. Secondary overflow structures have been included on each basin fronting the property and will discharge directly to the curb and gutter on Ortega Highway. In addition, there will be a dedication of approximately 0.74 acres of land (designated as DMA 3) for street improvement along Ortega Highway and Grand Ave. This area (DMA-3) will be alternatively included in sizing of the proposed basin (BMP-1) in DMA-1, although its runoff will not be possibly captured by the basin due to elevation constraints. Lastly, Runoff from the Ortega Highway gutter will flow into the curb and gutter on Grand Avenue before discharging to an engineered swale and proceeding to Lake Elsinore.

A.2 Maps and Site Plans

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

- Drainage Management Areas
- List of Symbols
- Proposed Structural BMPs
- Drainage Path, Arrows
- Drainage Infrastructure, Inlets, Overflows
- Source Control BMPs
- Buildings, Roof Lines, Downspouts
- Impervious Surfaces/Pervious table
- Standard Labeling
- BMP Locations (Lat/Long)

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

A.3 Identify Receiving Waters

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

Table A.1 Identification of Receiving Waters

Receiving Waters	EPA Approved 303(d) List Impairments	Designated Beneficial Uses	Proximity to RARE Beneficial Use
RCFC&WCD MS4 Facility - Ortega Channel	N/A	N/A	N/A
Lake Elsinore	Nutrients, Organic Enrichment/Low Dissolved Oxygen, PCBs (Polychrinated biphenyls), DDT. Unknown Toxicity	All	REC1, REC2, WARM, WILD, COMM & RARE

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

Table A.2 Other Applicable Permits

Agency	Permit Required	
State Department of Fish and Game, 1602 Streambed Alteration Agreement	☐ Y	☒ N
State Water Resources Control Board, Clean Water Act (CWA) Section 401 Water Quality Cert.	☐ Y	☒ N
US Army Corps of Engineers, CWA Section 404 Permit	☐ Y	☒ N

US Fish and Wildlife, Endangered Species Act Section 7 Biological Opinion	☐ Y	☒ N
Statewide Construction General Permit Coverage	☒ Y	☐ N
Statewide Industrial General Permit Coverage	☐ Y	☒ N
Western Riverside MSHCP Consistency Approval (e.g., JPR, DBESP)	☐ Y	☒ N
Other *(please list in the space below as required)* Grading Permit, Building Permit from the City of Lake Elsinore	☒ Y	☐ N

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

Section B: Optimize Site Utilization (LID Principles)

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

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

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

Site Optimization

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

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

The existing condition is developed on the east half of the site with some landscaping and the west half of the site is undeveloped with vegetation ground cover. The proposed site will be fully developed for commercial use. The new development will consist of one (1) retail buildings with drive-thru (5,499 SF), one (1) gas station canopy (6,324 SF), and offsite improvement including curb & gutter, sidewalk, and ac pavement. The two existing buildings on the south side of the property will remain in place. The proposed drainage pattern of the site will remain similar to the existing condition, draining towards the north east corner of the site. Run-off from the site will be treated by the bioretention basin with underdrain and impermeable liner located within the landscape areas along Ortega Highway and Grand Avenue. Treated and pumped runoff water from Biofiltration basin along with overflow from the bioretention system will discharge to the curb and gutter on Ortega Highway and flow to the existing curb and gutter on Grand Avenue before reaching the lake.

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

Majority of the existing site is developed. There are several landscape planters throughout the property. Landscaping lines the front of the property along Ortega Highway. The south west corner of the site is undeveloped with some ground cover. The redevelopment will remove the existing landscaping and add new landscaping to the developed and undeveloped portion of the site. The new landscaping will front the property along Grand Avenue and Ortega Highway. Vegetation on the south west corner of the site will be protected in place. The proposed project shall include drought tolerant landscaping.

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

The existing infiltration rate of the site is measured at 0.27 in/hr per the soils report (Appendix 3). The proposed bioretention basin with underdrain and impermeable liner will be utilized to treat the stormwater runoff.

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

Roughly 39% of the project site will be developed for landscaping and the bioretention basin with underdrain and impermeable liner. The bioretention system shall be designed to retain and treat a the Design Capture Volume (DCV) of stormwater runoff.

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

The proposed grading and drainage are designed to maintain a similar flow pattern to the existing conditions. Landscaping along the west and south side of the property will flow north east towards Ortega Highway and Grand Avenue. Based on the elevation on the west and south side of the site, runoff will flow away from the adjacent properties. The proposed drainage pattern will direct runoff to the bioretention basins located along the landscaping on the north and east side of the property for treatment. Overflow from the bioretention basin will be directed to the curb and gutter on Ortega Highway.

Section C: Delineate Drainage Management Areas (DMAs)

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

Table C.1 DMA Classifications

DMA Name or ID	Surface Type(s)[1][2]	Area (Sq. Ft.)	DMA Type
DMA 1	Mixed surface (Commercial Development)	124,872	Type "D"
DMA 2	Mixed surface (Commercial Development)	121,153	Type "D"
DMA 3	Mixed surface (Commercial Development)	33,144	Type "D"

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

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

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

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

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

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

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

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

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

DMA Name or ID	BMP Name or ID
DMA-1	BMP 1, TC-32, Bioretention Basin with Underdrain and Impermeable Liner
DMA-2	BMP 2, TC-32, Bioretention Basin with Underdrain and Impermeable Liner
DMA-3	BMP 1, TC-32, Bioretention Basin with Underdrain and Impermeable Liner (**note: only for sizing**)

Note: More than one drainage management area can drain to a single LID BMP, however, one drainage management area may not drain to more than one BMP.

Section D: Implement LID BMPs

D.1 Infiltration Applicability

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

If yes has been checked, Infiltration BMPs shall not be used for the site; proceed to section D.3

If no, continue working through this section to implement your LID BMPs. It is recommended that you contact your Co-Permittee to verify whether or not your project discharges to an approved downstream 'Highest and Best Use' feature.

Geotechnical Report

A Geotechnical Report or Phase I Environmental Site Assessment may be required by the Copermittee to confirm present and past site characteristics that may affect the use of Infiltration BMPs. In addition, the Co-Permittee, at their discretion, may not require a geotechnical report for small projects as described in Chapter 2 of the WQMP Guidance Document. If a geotechnical report has been prepared, include it in Appendix 3. In addition, if a Phase I Environmental Site Assessment has been prepared, include it in Appendix 4.

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

Infiltration Feasibility

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

Table D.1 Infiltration Feasibility

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

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

D.2 Harvest and Use Assessment

Please check what applies*:*

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

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

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

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

Irrigation Use Feasibility

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

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

Total Area of Irrigated Landscape: N/A

Type of Landscaping (Conservation Design or Active Turf): Conservative Design with native plants

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

Total Area of Impervious Surfaces: N/A

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

Enter your EIATIA factor: N/A

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

Minimum required irrigated area: N/A

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

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

Toilet Use Feasibility

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

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

Projected Number of Daily Toilet Users: N/A

Project Type: Commercial

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

Total Area of Impervious Surfaces: N/A

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

Enter your TUTIA factor: N/A

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

Minimum number of toilet users: N/A

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

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

Other Non-Potable Use Feasibility

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

None

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

Average Daily Demand: N/A

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

Total Area of Impervious Surfaces: N/A

Step 3: Enter the Design Storm depth for the project site (see Exhibit A) into the left column of Table 2-4 in Chapter 2 to determine the minimum demand for non-potable uses per tributary impervious acre.

Enter the factor from Table 2-4: N/A

Step 4: Multiply the unit value obtained from Step 3 by the total of impervious areas from Step 2 to develop the minimum number of gallons per day of non-potable use that would be required.

Minimum required use: N/A

Step 5: Determine if harvesting stormwater runoff for other non-potable use is feasible for the project by comparing the projected average daily use (Step 1) to the minimum required non-potable use (Step 4).

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

If Irrigation, Toilet and Other Use feasibility anticipated demands are less than the applicable minimum values, Harvest and Use BMPs are not required and you should proceed to utilize LID Bioretention and Biotreatment per Section 3.4.2 of the WQMP Guidance Document.

D.3 Bioretention and Biotreatment Assessment

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

Select one of the following:

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

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

D.4 Feasibility Assessment Summaries

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

Table D.2 LID Prioritization Summary Matrix

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

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

D.5 LID BMP Sizing

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

Due to offsite drainage condition, DCV of DMA 3 will be included in the DMA 1 for treatment.

Table D.3 DCV Calculations for LID BMPs

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Impervious Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Capture Volume, V_{BMP} (cubic feet)*	*Bioretention with underdrain and impermeable liner*	
	[A]		[B]	[C]	[A] x [C]	[F] = [D]x[E] / 12		
DMA-1	124,872	Mixed surface types	0.242	0.19	24,199	1,855		
DMA-3	32,341	Mixed surface types	0.861	0.68	21,857	1,686		
							Design Storm Depth (in)	*Proposed Volume on Plans (cubic feet)*
	A_T = Σ[A] 157,213				Σ= [D] 46,056	Σ= [F] 3,531	[E] 0.92	***3,751***

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Impervious Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Capture Volume, V_{BMP} (cubic feet)*	*Bioretention with underdrain and impermeable liner*	
	[A]		[B]	[C]	[A] x [C]	[F] = [D]x[E] / 12		
DMA-2	121,153	Mixed surface types	0.74	0.53	64,208	4,923	*Design Storm Depth (in)*	*Proposed Volume on Plans (cubic feet)*
	A_T = Σ[A] 121,147				Σ= [D] 64,636	Σ= [F] 4,955	[E] 0.92	***4,922***

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

Effective Impervious Fraction, I_f:
(Impervious Fraction values per the Water Quality Management Plan Guidance Document for the Santa Ana Region of Riverside County Table 2-1, pg.22. Values selected for impervious surface I_f=1 and for pervious surface soil type D I_f=0.03)

DMA-1
Impervious Area (A_{Imp1}) = 27,283 sf , I_f = 1
Pervious Area (A_{per1}) = 97,588 sf , I_f = 0.03
Total Area (A_{T1})= 124,872 sf

$I_{f\text{-}ave1}$ = (27,283*1 + 97,588*0.03)/124,872
$I_{f\text{-}ave1}$= 0.242

DMA-2
Impervious Area (A_{Imp2}) = 89,212 sf , I_f = 1
Pervious Area (A_{per2}) = 32,743 sf , I_f = 0.03
Total Area (A_{T2})= 121,955 sf

$I_{f\text{-}ave2}$ = (89,212*1 + 32,743*0.03)/121,955
$I_{f\text{-}ave2}$ = 0.740

DMA-3
Impervious Area (A_{Imp1}) = 27,710 sf , I_f = 1
Pervious Area (A_{per1}) = 4,631 sf , I_f = 0.03
Total Area (A_{T1})= 32,341 sf

$I_{f\text{-}ave1}$ = (27,710*1 + 4,631*0.03)/32,341
$I_{f\text{-}ave3}$= 0.86

Runoff Factor, C:
(Runoff Factor per the Water Quality Management Plan Guidance Document for the Santa Ana Region of Riverside County pg.22)

$C = 0.858 * I_f^3 - 0.78 * I_f^2 + 0.774 * I_f + 0.04$

DMA-1
$I_{f\text{-}ave1} = 0.242$

$C = 0.858*(0.242)^3 - 0.78*(0.242)^2 + 0.774*(0.242)+0.04$
$C_1 = 0.194$

DMA-2
$I_{f\text{-}ave2} = 0.740$

$C = 0.858*(0.740)^3 - 0.78*(0.740)^2 + 0.774*(0.740)+0.04$
$C_2 = 0.533$

DMA-3
$I_{f\text{-}ave1} = 0.86$

$C = 0.858*(0.86)^3 - 0.78*(0.86)^2 + 0.774*(0.86)+0.04$
$C_3 = 0.68$

Section E: Alternative Compliance (LID Waiver Program)

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

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

- *Or* -

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

E.1 Identify Pollutants of Concern

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

Table E.1 Potential Pollutants by Land Use Type

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

P = Potential

N = Not Potential

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

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

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

(4) Specifically petroleum hydrocarbons

(5) Specifically solvents

(6) Bacterial indicators are routinely detected in pavement runoff

E.2 Stormwater Credits

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

Table E.2 Water Quality Credits

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

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

E.3 Sizing Criteria

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

Table E.3 Treatment Control BMP Sizing

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

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

E.4 Treatment Control BMP Selection

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

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

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

Table E.4 Treatment Control BMP Selection

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

[1] Treatment Control BMPs must not be constructed within Receiving Waters. In addition, a proposed Treatment Control BMP may be listed more than once if they possess more than one qualifying pollutant removal efficiency.

[2] Cross Reference Table E.1 above to populate this column.

[3] As documented in a Co-Permittee Approved Study and provided in Appendix 6.

Section F: Hydromodification

F.1 Hydrologic Conditions of Concern (HCOC) Analysis

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

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

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

If Yes, HCOC criteria do not apply.

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

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

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

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

Table F.1 Hydrologic Conditions of Concern Summary

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

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

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

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

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

Runoff from the site will be treated by the bioretention basins with underdrain and impermeable liner and pump system. Overflow during high storm events will flow offsite to the curb and gutter on Ortega Hwy. Flow from the site will sheet flow along the curb and gutter on Grand Avenue and drain to a engineered channel before proceeding to Lake Elsinore.

F.2 HCOC Mitigation

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

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

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

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

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

Section G: Source Control BMPs

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

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

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

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

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

Table G.1 Permanent and Operational Source Control Measures

Potential Sources of Runoff pollutants	Permanent Structural Source Control BMPs	Operational Source Control BMPs
On-Site Storm Drain Inlets	Storm Drain Inlet Messaging	Owners shall annually inspect and maintain all stenciled or placarded messaging on storm drain inlets, for legibility. Owners shall also regularly inspect/maintain all storm drain inlets free of debris and/or trash accumulations, including inspection for evidence of illegal/illicit discharges into inlets. See applicable operational BMPs in Fact Sheet SC-44, "Drainage System Maintenance," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com Owners shall include the following in lease agreements: "Tenant shall not allow anyone to discharge anything to storm drains or to store or deposit materials so as to create a potential discharge to storm drains."
Landscape/ Outdoor Pest	Designing 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. Providing plants that are tolerant of saturated soil conditions where landscaped areas are used to retain or detain stormwater. Providing pest-resistant plants, especially adjacent to hardscape.	Owners shall be responsible for landscape maintenance practices and proper collection/disposal of landscape cuttings & waste, to keep it out of storm drain inlets. Owners shall be responsible for irrigation system maintenance and repair of broken pipes, sprinkler heads, etc., to conserve water and prevent erosion of soil. See applicable operational BMPs in "What you should know for.....Landscape and Gardening" at http://rcflood.org/stormwater

Fuel Dispensing Areas	Fueling areas will 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 (V-gutters) that prevents run-on of stormwater to the maximum extent practicable. Fueling areas will be covered by a canopy that extends a minimum of ten feet in each direction from each pump. The canopy [or cover] will not drain onto the fueling area.	Owners shall inspect/maintain fueling areas' floors, canopy routinely. Owners 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
Miscellaneous Drain or Wash Water or Other Sources - Roofing, gutters, and trim.		Owners shall inspect/maintain roofing, gutter, and trim routinely to avoid these made of copper or other unprotected metals that may leach into runoff. Owners shall collect all wastewater from pressure washing to prevent entry into the storm drain system. Owners shall collect wash water containing any cleaning agent or degreaser and discharge it to the sanitary sewer not to a storm drain.
Plazas, sidewalks, and parking lots.		Owners shall vacuum sweep plazas, sidewalks, and parking lots at least monthly to prevent accumulation of litter and debris.

Food Service	Grease interceptors will be installed on-site to connect the drain from a floor sink or other area for cleaning floor mats and containers in food preparation places, and equipment will also be connected to a grease interceptor before discharging to the sanitary sewer.	Owners shall inspect/maintain the grease interceptor routinely. Owners shall maintain all cleaning areas and cooling equipment routinely to avoid discharge to the street or storm drain. See the brochure, "The Food Service Industry Best Management Practices for: Restaurants, Grocery Stores, Delicatessens and Bakeries" at http://rcflood.org/stormwater/ Provide this brochure to new site owners, lessees, and operators.
Refuse Area (Trash Enclosure)	A trash enclosure will be installed on-site. The designated dumpster area will be covered with a solid roof, graded, and paved to prevent run-on. No drains from dumpsters, compactors, and tallow bin areas are proposed.	Owners shall provide an adequate number of receptacles. Owners shall inspect receptacles regularly; repair or replace leaky receptacles. Owners shall keep receptacles covered and prohibit/ prevent dumping of liquid or hazardous wastes. Owners shall post "no hazardous materials" signs. Owners shall inspect and pick up litter daily and clean up spills immediately and 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
Education of Site Owners, Tenants, Site Employees, Occupants, and Contractors		Owners shall familiarize himself and/or herself with the contents of this WQMP and shall utilize BMP Educational Materials in Appendix 10 to provide stormwater pollution prevention information to new site owners, lessees, site employees, and operators/contractors. Owners shall provide education training program as it would apply to future employees of individual business on-site.

Section H: Construction Plan Checklist

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

Table H.1 Construction Plan Cross-reference

BMP No. or ID	BMP Identifier and Description	Corresponding Plan Sheet(s)	BMP Location (Lat/Long)
BMP-1	Bioretention Basin with Underdrain and Impermeable liner	WQMP, Sheet C02 Grading Plan, Sheet C01	33.65694, -117.376673
BMP-2	Bioretention Basin with Underdrain and Impermeable liner	WQMP, Sheet C02 Grading Plan, Sheet C01	33.658013, -117.375750

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

Section I: Operation, Maintenance and Funding

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

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

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

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

Maintenance Mechanism: Refer to Appendix 9 for BMP Operation and Maintance Plan Requirements.

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

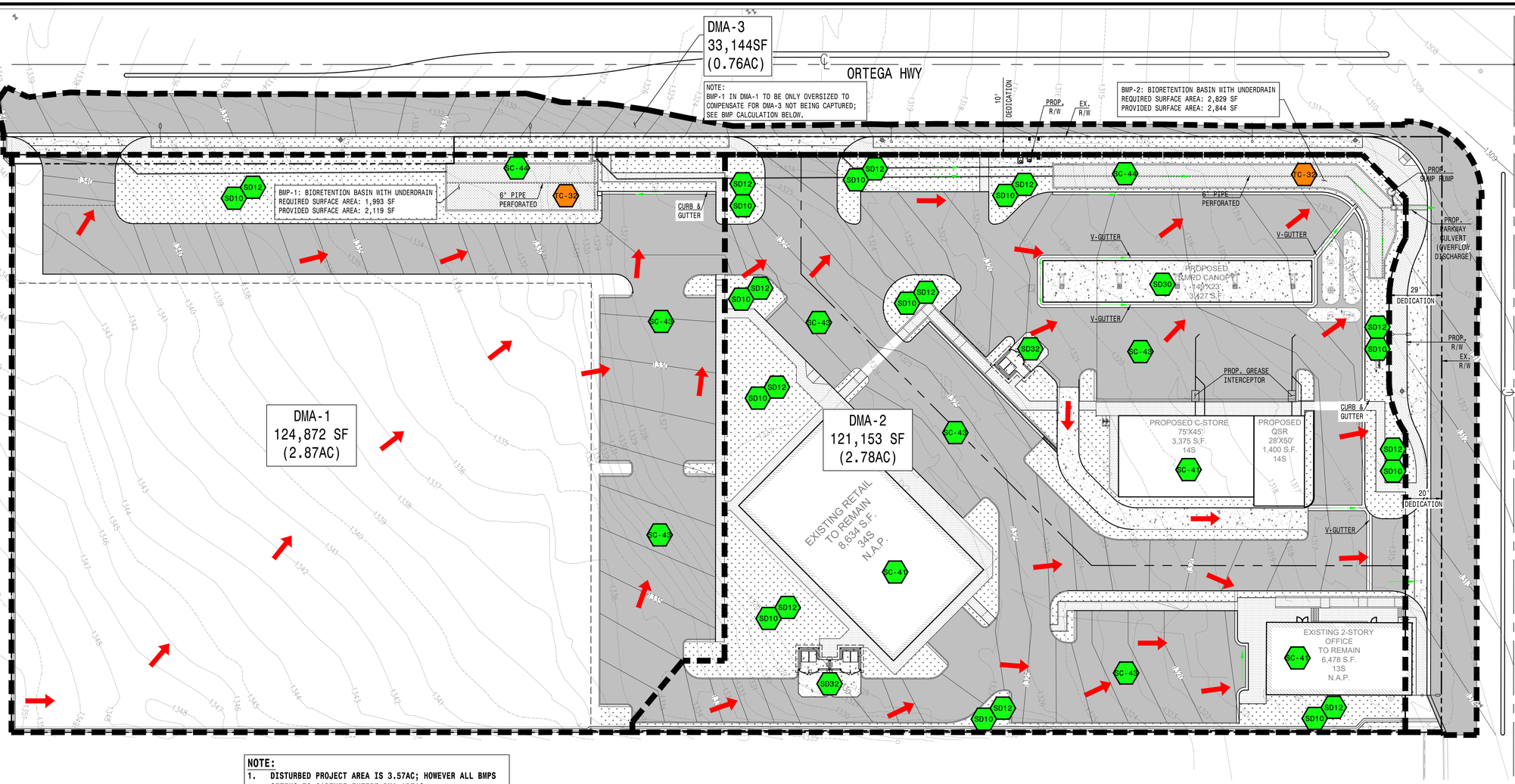
☐ Y ☒ N

The on-site BMPs will be maintained by the property owner. Refer to Appendix 10 for the property owner information.

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

Appendix 1: Maps and Site Plans

Location Map, WQMP Site Plan and Receiving Waters Map



LEGEND:

- PROPOSED LANDSCAPE AREA
- SHEET FLOW
- CONCENTRATED FLOW
- DMA BOUNDARY
- DMA-X XX,XXX SF X.XX ac — DMA INFORMATION

SOURCE CONTROL BMP'S:

- SD10 — SITE DESIGN & LANDSCAPE PLANNING
- SD12 — EFFICIENT IRRIGATION
- SD30 — FUELING AREAS
- SD32 — ROOFED TRASH STORAGE AREAS

NON STRUCTURAL CONTROL BMP'S:

- N4 — EDUCATION FOR PROPERTY OWNERS, TENANTS AND OCCUPANTS (ENTIRE SITE)

TREATMENT CONTROL BMP'S:

- TC32 — BIORETENTION BASIN WITH UNDERDRAIN AND IMPERMEABLE LINER

CASQA BMPS:

- SC-41 — BUILDING & GROUND MAINTENANCE
- SC-43 — PARKING LOT MAINTENANCE
- SC-44 — DRAINAGE SYSTEM MAINTENANCE

NOTE:

1. DISTURBED PROJECT AREA IS 3.57AC; HOWEVER ALL BMPS SIZING TO CAPTURE ENTIRE DMA AREAS
2. ONCE UNDISTURBED LAND AREA IN DMA 1 FULLY DEVELOPED, BMP SIZING SHALL BE UPDATED TO ULTIMATE CONDITION

SITE DATA:

IMPROVEMENT AREA:

BUILDING:	20,603 S.F.
LANDSCAPING:	43,605 S.F.
IMPERVIOUS:	91,332 S.F.
UNDISTRUBED LAND:	90,509 S.F.
PUBLIC R/W:	61,890 S.F.
GROSS TOTAL:	307,939 S.F.

DISTRUBED AREA: 3.57 ACRES (155,540 S.F.)

DCV CALCULATIONS

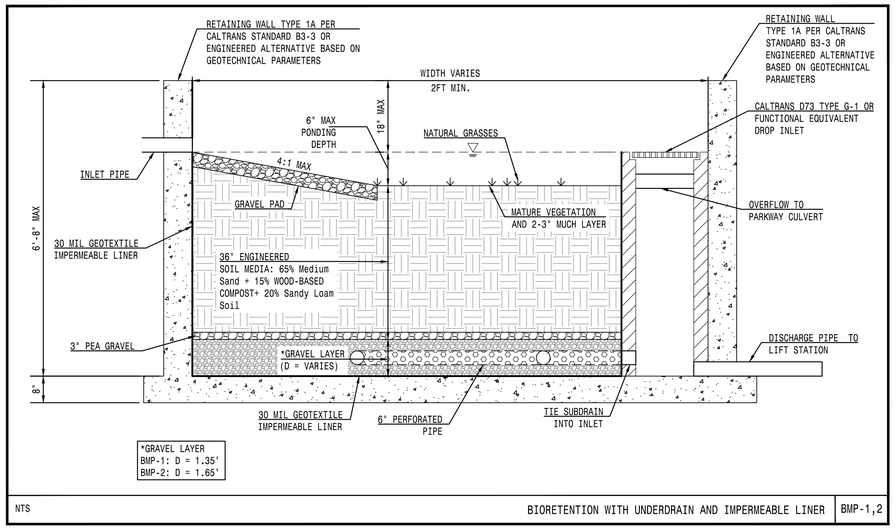
PERVIOUS AND IMPERVIOUS AREA

DMA	PERVIOUS AREA (SF)	IMPERVIOUS AREA (SF)	TOTAL AREA (SF)	DCV (CF)
1	97,344	27,528	124,872	1,855
2	29,292	91,861	121,153	4,986
3	3,776	29,369	33,144	1,686
TOTAL	130,411.25	148,757	279,168	8,527

BMP CALCULATION

BIORETENTION FACILITY DESIGN (PER RIVERSIDE COUNTY LID DESIGN MANUAL)

BMP	VBMP	SOIL DEPTH	TOP WIDTH	EFFECTIVE DEPTH	REQUIRED SURFACE AREA	PROVIDED SURFACE AREA
	CF	FT	FT	FT	SF	SF
1	1,855+1,676= 3,531	3.0	25.3	1.77	1,993	2,119
2	4,922	3.0	12.6	1.74	2,829	2,861



NTS — BIORETENTION WITH UNDERDRAIN AND IMPERMEABLE LINER — BMP-1,2

30' 0 30' 60' 90'

SCALE: 1" = 30'

P:\ACAD\PBD.bmp

CONSULTING ENGINEERS IN CIVIL, SURVEYING, AND STRUCTURAL ENGINEERING
914 E. KATELLA AVENUE
ANAHEIM, CALIFORNIA 92805
(714) 385-1835, FAX (714) 385-1834

ARCHITECT:
EMPIRE DESIGN GROUP Inc.
24861 Washington Ave.
Murrieta, Calif. 92562
Tel 951-696-1400 Fax 951-696-1443

CLIENT:
ORTEGA PLAZA, LLC

COMMERCIAL RETAIL
APN: 381-320-025-6
15890 GRAND AVE.
LAKE ELSINORE, CA 92530

ENGINEER OF RECORD:
TRYFON TRYFONOPOULOS, PE
914 E KATELLA AVE.
ANAHEIM, CA 92805
(714)385-1835

SEAL:
REGISTERED PROFESSIONAL ENGINEER TRYFON P. TRYFONOPOULOS NO. 65859 EXP.12/31/21 CIVIL STATE OF CALIFORNIA

Date: 5-3-2024
Project Number: 2006012

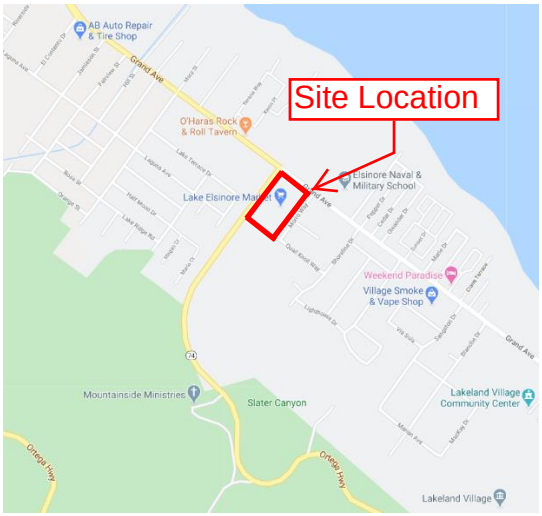
NO.	DATE	REVISION DESCRIPTION

DESIGNED BY: TT
CHECKED BY: TT
DRAWN BY: AL

DRAWING TITLE:
WQMP SITE PLAN

SHEET NO:
C02

Local Vicinity and Existing Site Map



Vicinity Map

Existing Site

Project Narrative:

The existing site of 5.93 acres is partially developed with some vegetation. Landscaping line the front of the property along Ortega Highway. The project proposes to develop the site for commercial use. The proposed site will be fully developed for commercial use. The new development will consist of one (1) retail buildings with drive-thru (5,499 SF), and one (1) gas station canopy (6,324 SF). The two existing buildings on the south side of the property will remain in place. The proposed drainage pattern of the site will sheet flow stormwater runoff to the landscape areas fronting the property along Ortega Highway and Grand Avenue. Stormwater from the site will be treated by the bioretention systems located within the landscape areas. Stormwater treated by the bioretention systems will flow to the pump station before being discharged to the curb and gutter on Ortega Highway. Storm events exceeding the capacity of the bioretention system will discharge through the primary overflow system to the pump structure. Secondary overflow structures have been included on each basin fronting the property and will discharge directly to the curb and gutter on Ortega Highway. Runoff discharged from the site will flow the curb and gutter on Grand Avenue before discharging to an engineered swale and proceeding to Lake Elsinore.

R 07 W | R 06 W | R 05 W | R 04 W | R 03 W | R 02 W | R 01 W | R 01 E | R 02 E | R 03 E | R 04 E | R 05 E

T 01 S
T 02 S
T 03 S
T 04 S
T 05 S
T 06 S
T 07 S
T 08 S

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

0.85 MiraLoma
0.61 Riverside North
0.54 Riverside South
0.68 PigeonPass
0.66 MorenoEast
0.85 Beaumont
0.88 PradoDam
0.51 Woodcrest
0.50 LakeMathews
0.68 PerrisReservoir
0.87 VistaGrandeGS
0.70 SanJacintoNWS
1.18 Idyllwild
0.58 SunCity
0.68 Winchester
0.90 HurkeyCreek
0.70 ElsinoreNWS
1.11 ElCarisoStation
0.77 WildomarLaCresta
0.52 SkinnerLake
0.65 Anza
0.77 SantaRosaPlateau
1.00 TemeculaNWS
0.64 AguangaValley

Santa Ana River Watershed
Santa Margarita Watershed

JURUPA VALLEY | EASTVALE | NORCO | CORONA | RIVERSIDE | MORENO VALLEY | CALIMESA | BEAUMONT | SAN JACINTO | PERRIS | CANYON LAKE | LAKE ELSINORE | WILDOMAR | MENIFEE | HEMET | MURRIETA | TEMECULA

N

Rain Gage Locations

RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT

Isohyetal Map for the 85th Percentile 24 hour Storm Event

July 2011

Impaired Water Bodies

Listing a water body as impaired in California is governed by the Water Quality Control Policy for developing California's Clean Water Act Section 303(d) Listing Policy. The State and Regional Water Boards assess water quality data for California's waters every two years to determine if they contain pollutants at levels that exceed protective water quality criteria and standards. This biennial assessment is required under Section 303(d) of the Federal Clean Water Act.

⋙ Fact Sheet - "2010 Integrated Report on Water Quality with Web-Based Interactive Map," April 2010

Please allow time for the information below to appear. Tabs will be available to navigate to various topics.

2010 Integrated Report (Clean Water Act Section 303(d) List / 305(b) Report) — Statewide

2010 Integrated Report | Map | 303(d) List | References | Data Download | Draft Reports | Contact Us

2010 INTEGRATED REPORT — ALL ASSESSED WATERS

Zoom to county: All

Show county

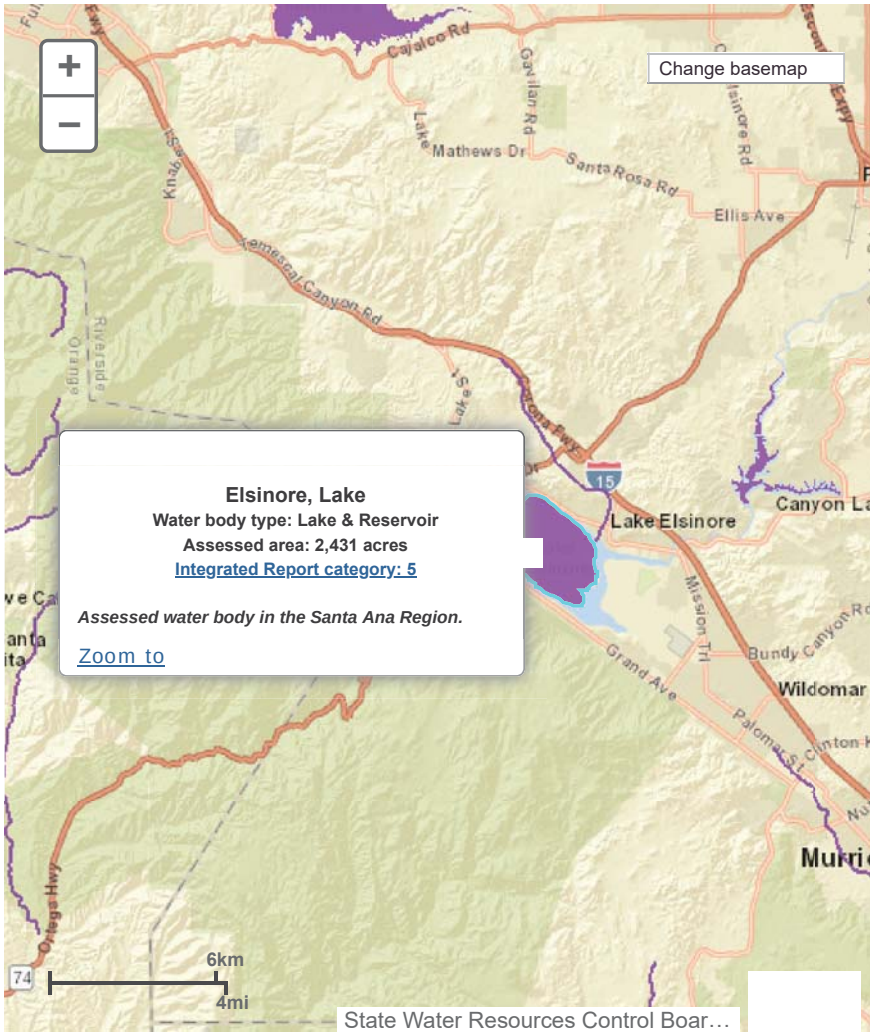
Zoom to Regional Board: All

Show Regional Board

Map Help

Zoom to water body: *(Filter: All)*

Filter list by: Reset list



Elsinore, Lake
Water body type: Lake & Reservoir
Assessed area: 2,431 acres
Integrated Report category: 5

Assessed water body in the Santa Ana Region.

Zoom to

Elsinore, Lake Close
Pollutant assessments

Pollutants	Listing Decision / Report Link / Potential Sources / Schedule / *Comments*
Mercury	Do Not List on 303(d) list (TMDL required list) / 28442 / n/a /
Nutrients	List on 303(d) list (being addressed by USEPA approved TMDL) / 20368 / n/a / USEPA TMDL approval: 2005
Organic Enrichment/Low Dissolved Oxygen	List on 303(d) list (being addressed by USEPA approved TMDL) / 20369 / n/a / USEPA TMDL approval: 2005
PCBs (Polychlorinated biphenyls)	List on 303(d) list (TMDL required list) / 19173 / n/a / Est. TMDL

REGION	WATER BODY NAME	WATER TYPE	WATERSHED CALWATER/ USGS HUC	POLLUTANT POTENTIAL SOURCES	ESTIMATED AREA ASSESSED	FIRST YEAR LISTED	TMDL REQUIREMENT STATUS	DATE
				• Copper Source Unknown	9.6 Miles	2010	5A	2021
				• Lead Source Unknown	9.6 Miles	2010	5A	2021
				• Zinc Source Unknown	9.6 Miles	2010	5A	2021
8	Cucamonga Creek Reach 2 (Mountain Reach)	River & Stream	80124020 / 18070203	• pH Source Unknown	13 Miles	2010	5A	2021
8	East Garden Grove Wintersburg Channel	River & Stream	80111000 / 18070201	• Ammonia (Unionized) Source Unknown	2.9 Miles	2010	5A	2021
8	Elsinore, Lake	Lake & Reservoir	80231000 / 18070202	• Nutrients Unknown Nonpoint Source	2431 Acres	1994	5B	2005
				• Organic Enrichment/Low Dissolved Oxygen Unknown Nonpoint Source	2431 Acres	1994	5B	2005
				• PCBs (Polychlorinated biphenyls) Source Unknown	2431 Acres	2006	5A	2019
				• Sediment Toxicity Source Unknown	2431 Acres	2010	5A	2021
				• Unknown Toxicity Source Unknown	2431 Acres	1994	5A	2007
8	Fulmor, Lake	Lake & Reservoir	80221000 / 18070202	• Pathogens Unknown Nonpoint Source	4.2 Acres	1998	5A	2019

PLUMP ENGINEERING INC.
CONSULTING ENGINEERS IN
CIVIL / STRUCTURAL
ENGINEERING & SURVEYING
914 E. KATELLA AVENUE
ANAHEIM, CALIFORNIA 92805
(714) 385-1835, FAX (714) 385-1834

RECEIVING WATERS MAP
ORTEGA PLAZA LAKE ELSINORE
15890 GRAND AVE LAKE ELSINORE, CA 92530

Appendix 2: Construction Plans

Grading and Drainage Plans, Landscape/Irrigation Plans, Street Plans

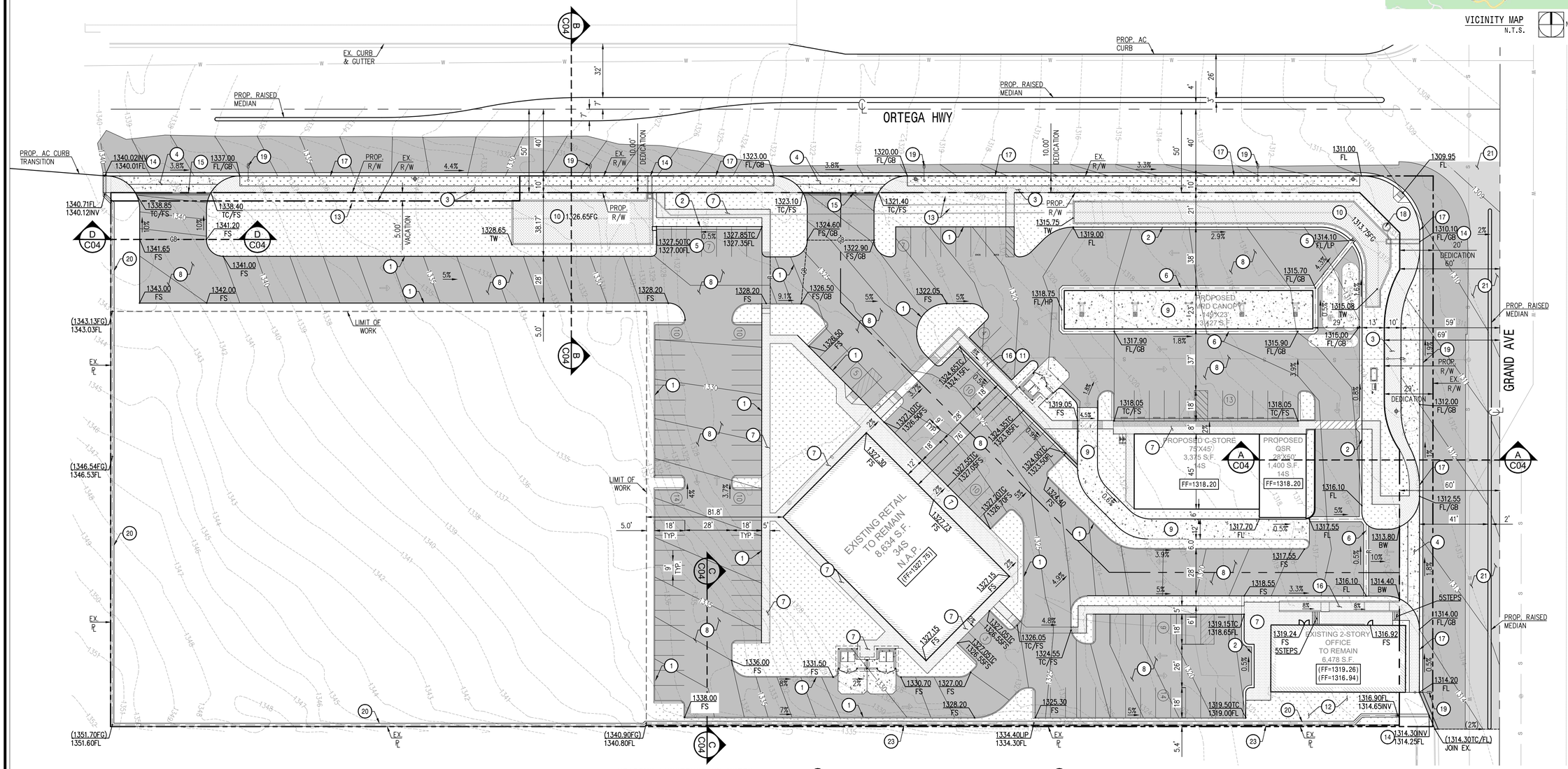
CONCEPTUAL GRADING PLANS
FOR
COMMERCIAL RETAIL
15890 GRAND AVE. LAKE ELSINORE, CA 92530

PROJECT INFORMATION:

ENGINEER
PLUMP ENGINEERING, INC.
914 E KATELLA AVE
ANAHEIM, CA 92805
(714) 385-1835

ARCHITECT
EMPIRE DESIGN GROUP, INC.
511 N MAIN STREET
LAKE ELSINORE, CA
(951) 696-1490

VICINITY MAP N.T.S. N.A.



SITE DATA:

IMPROVEMENT AREA:

BUILDING:	20,603 S.F.
LANDSCAPING:	43,605 S.F.
IMPERVIOUS:	91,332 S.F.
UNDISTRUBED LAND:	90,509 S.F.
PUBLIC R/W:	61,890 S.F.
GROSS TOTAL:	307,939 S.F.

DISTRUBED AREA: 3.57 ACRES (155,540 S.F.)

GRADING CONSTRUCTION NOTES

1. CONSTRUCT 6" CURB
2. CONSTRUCT 6" CURB & GUTTER
3. SEE OFFSITE IMPROVEMENTS PLAN
4. CONSTRUCT COMMERCIAL DRIVEWAY
5. CONSTRUCT CURB OPENING
6. CONSTRUCT 3' WIDE V-GUTTER
7. CONSTRUCT 4" WALKWAY
8. CONSTRUCT AC OVER AB PAVEMENT
9. CONSTRUCT PCC OVER AB PAVEMENT
10. CONSTRUCT BIO-RETENTION BASIN
11. CONSTRUCT 4FT RETAINING WALL
12. RE-GRADE AREA AS NEEDED TO JOIN EXISTING
13. FURNISH & INSTALL SD LINE PER UTILITIES PLAN
14. CONSTRUCT PARKWAY CULVERT DRAIN
15. CONSTRUCT 6" TRENCH DRAIN
16. CONSTRUCT ADA RAMP WITH HANDRAIL
17. CONSTRUCT OFF-SITE 8" CURB & GUTTER
18. CONSTRUCT SUMP PUMP STRUCTURE
19. PROPOSED STREET LIGHT LS-2B SYSTEM
20. CONSTRUCT 2FT WIDE V-GUTTER
21. GRID AND OVERLAY
22. PROPOSED TRASH ENCLOSURE
23. PROPOSED 7FT SOUND WALL

NOTE:

1. ALL EXISTING UTILITIES WITHIN GRAND AVENUE WIDENING DEVELOPMENT SHALL BE UNDERGROUND EXCEPT ELECTRICAL OVER 34.5KV SHALL BE RELOCATED PER SCE REQUIREMENTS
2. FIRE ACCESS ROAD SHALL BE 24FT WIDTH MINIMUM WITH 80,000LBS CAPACITY

LEGEND:

- LANDSCAPE AREA
- CONCRETE WALKWAY
- AC/AB PAVEMENT
- PCC/AB PAVEMENT
- GRIND & OVERLAY

30' 0 30' 60' 90'
SCALE: 1" = 30'

P:\ACAD\PBD.bmp

CONSULTING ENGINEERS IN CIVIL, SURVEYING, AND STRUCTURAL ENGINEERING
914 E. KATELLA AVENUE
ANAHEIM, CALIFORNIA 92805
(714) 385-1835, FAX (714) 385-1834

ARCHITECT:
EMPIRE DESIGN GROUP Inc.
24861 Washington Ave.
Murrieta, Calif. 92562
Tel 951-696-1490 Fax 951-696-1443

CLIENT:
ORTEGA PLAZA, LLC

COMMERCIAL RETAIL
APN: 381-320-025-6
15890 GRAND AVE.
LAKE ELSINORE, CA 92530

ENGINEER OF RECORD:
TRYFON TRYFONOPOULOS, PE
914 E KATELLA AVE.
ANAHEIM, CA 92805
(714)385-1835

SEAL:
REGISTERED PROFESSIONAL ENGINEER
TRYFON P. TRYFONOPOULOS
NO. 65859
EXP.12/31/21
CIVIL
STATE OF CALIFORNIA

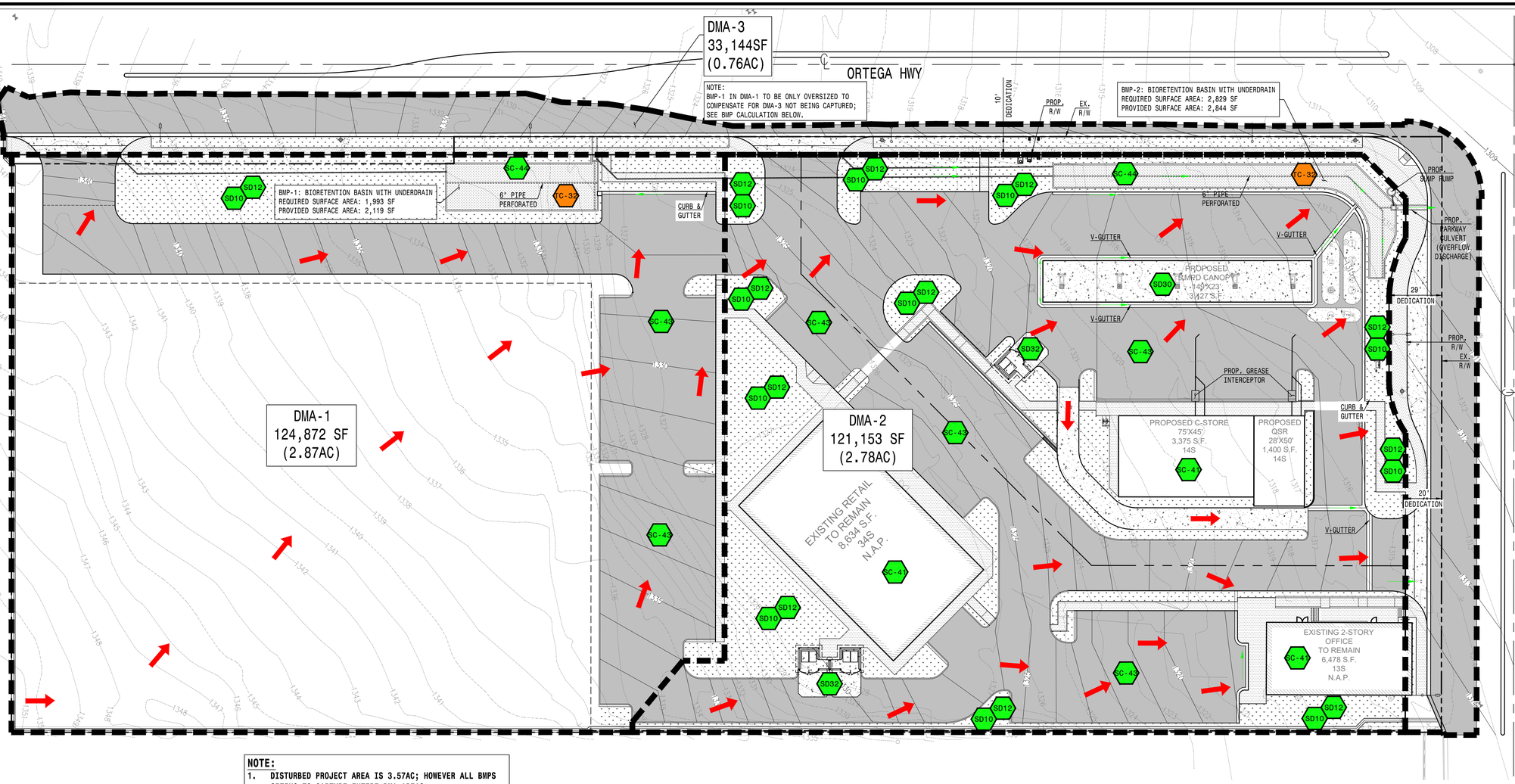
Date: 5-3-2024
Project Number: 2006012

NO.	DATE	REVISION DESCRIPTION

DESIGNED BY: TT
CHECKED BY: TT
DRAWN BY: AL

DRAWING TITLE:
PRELIMINARY GRADING PLAN

SHEET NO:
C01



LEGEND:

- PROPOSED LANDSCAPE AREA
- SHEET FLOW
- CONCENTRATED FLOW
- DMA BOUNDARY
- DMA-X XX,XXX SF X.XX ac — DMA INFORMATION

SOURCE CONTROL BMP'S:

- SD10 — SITE DESIGN & LANDSCAPE PLANNING
- SD12 — EFFICIENT IRRIGATION
- SD30 — FUELING AREAS
- SD32 — ROOFED TRASH STORAGE AREAS

NON STRUCTURAL CONTROL BMP'S:

- N4 — EDUCATION FOR PROPERTY OWNERS, TENANTS AND OCCUPANTS (ENTIRE SITE)

TREATMENT CONTROL BMP'S:

- TC32 — BIORETENTION BASIN WITH UNDERDRAIN AND IMPERMEABLE LINER

CASQA BMPS:

- SC-41 — BUILDING & GROUND MAINTENANCE
- SC-43 — PARKING LOT MAINTENANCE
- SC-44 — DRAINAGE SYSTEM MAINTENANCE

NOTE:

1. DISTURBED PROJECT AREA IS 3.57AC; HOWEVER ALL BMPS SIZING TO CAPTURE ENTIRE DMA AREAS
2. ONCE UNDISTURBED LAND AREA IN DMA 1 FULLY DEVELOPED, BMP SIZING SHALL BE UPDATED TO ULTIMATE CONDITION

SITE DATA:

IMPROVEMENT AREA:

BUILDING:	20,603 S.F.
LANDSCAPING:	43,605 S.F.
IMPERVIOUS:	91,332 S.F.
UNDISTRUBED LAND:	90,509 S.F.
PUBLIC R/W:	61,890 S.F.
GROSS TOTAL:	307,939 S.F.

DISTRUBED AREA: 3.57 ACRES (155,540 S.F.)

DCV CALCULATIONS

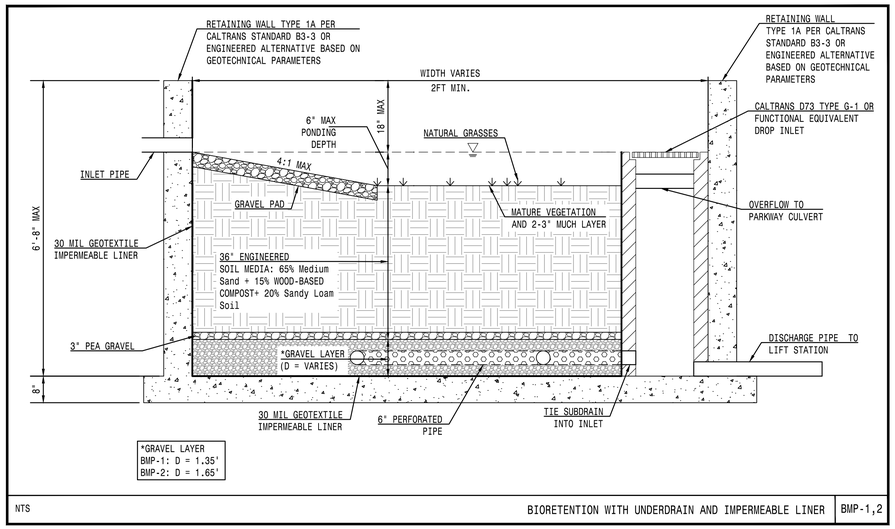
PERVIOUS AND IMPERVIOUS AREA

DMA	PERVIOUS AREA (SF)	IMPERVIOUS AREA (SF)	TOTAL AREA (SF)	DCV (CF)
1	97,344	27,528	124,872	1,855
2	29,292	91,861	121,153	4,986
3	3,776	29,369	33,144	1,686
TOTAL	130,411.25	148,757	279,168	8,527

BMP CALCULATION

BIORETENTION FACILITY DESIGN (PER RIVERSIDE COUNTY LID DESIGN MANUAL)

BMP	VBMP	SOIL DEPTH	TOP WIDTH	EFFECTIVE DEPTH	REQUIRED SURFACE AREA	PROVIDED SURFACE AREA
	CF	FT	FT	FT	SF	SF
1	1,855+1,676= 3,531	3.0	25.3	1.77	1,993	2,119
2	4,922	3.0	12.6	1.74	2,829	2,861



NTS — BIORETENTION WITH UNDERDRAIN AND IMPERMEABLE LINER — BMP-1,2

30' 0 30' 60' 90'

SCALE: 1" = 30'

P:\ACAD\PBD.bmp

CONSULTING ENGINEERS IN CIVIL, SURVEYING, AND STRUCTURAL ENGINEERING
914 E. KATELLA AVENUE
ANAHEIM, CALIFORNIA 92805
(714) 385-1835, FAX (714) 385-1834

ARCHITECT:
EMPIRE DESIGN GROUP Inc.
24861 Washington Ave.
Murrieta, Calif. 92562
Tel 951-696-1400 Fax 951-696-1443

CLIENT:
ORTEGA PLAZA, LLC

COMMERCIAL RETAIL
APN: 381-320-025-6
15890 GRAND AVE.
LAKE ELSINORE, CA 92530

ENGINEER OF RECORD:
TRYFON TRYFONOPOULOS, PE
914 E KATELLA AVE.
ANAHEIM, CA 92805
(714)385-1835

SEAL:
REGISTERED PROFESSIONAL ENGINEER TRYFON P. TRYFONOPOULOS NO. 65859 EXP.12/31/21 CIVIL STATE OF CALIFORNIA

Date: 5-3-2024
Project Number: 2006012

NO.	DATE	REVISION DESCRIPTION

DESIGNED BY: TT
CHECKED BY: TT
DRAWN BY: AL

DRAWING TITLE:
WQMP SITE PLAN

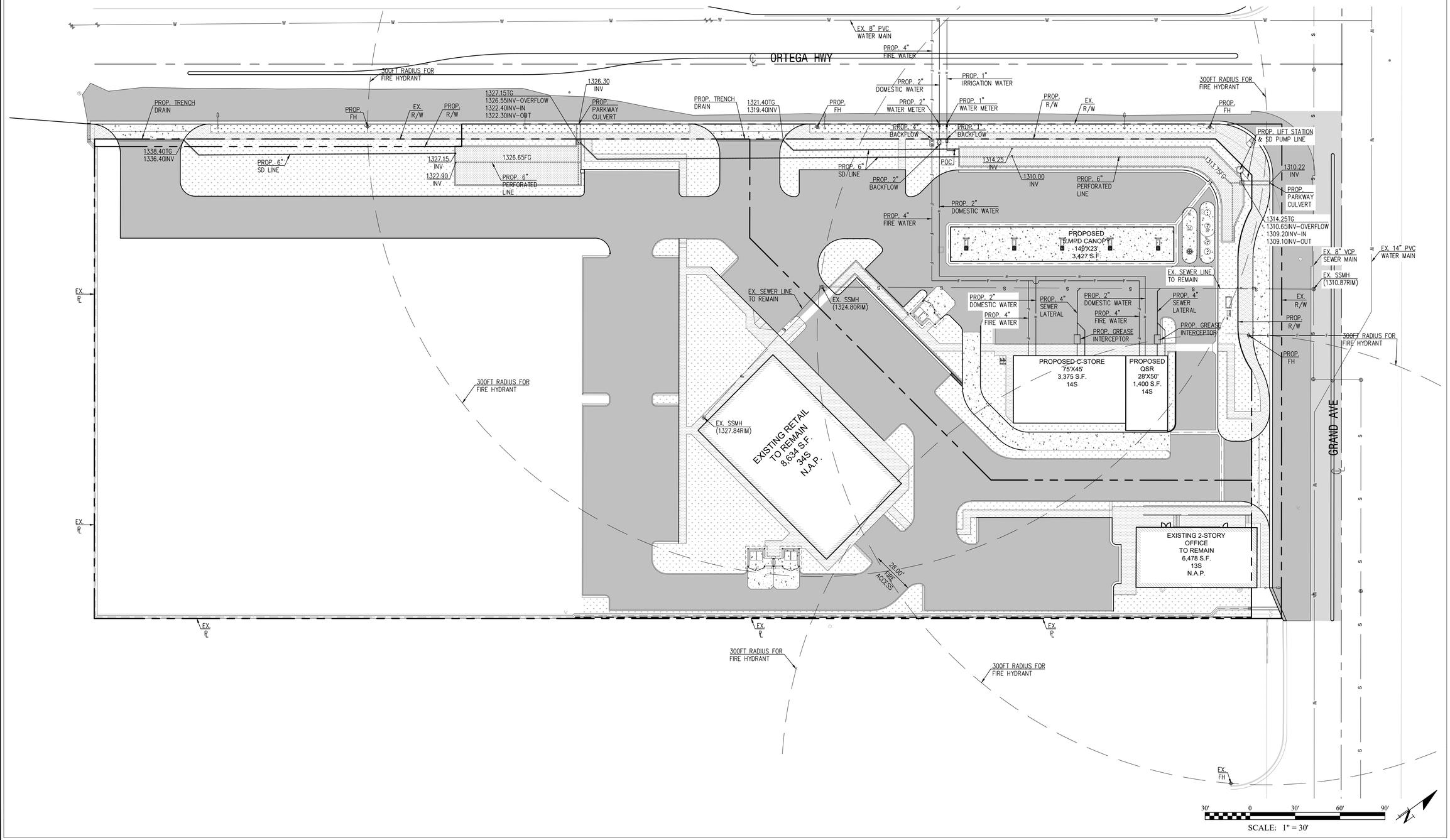
SHEET NO:
C02

NOTE:

WATER METER AND BACKFLOW DEVICE SIZE MAY VARY BASED ON WATER DEMAND FOR EACH BUILDING.

ELSINORE VALLEY WATER DISTRICT NOTES:

1. THE OWNER/DEVELOPER SHALL PROVIDE A WATER STUDY ANALYZING THE ONSITE WATER DEMAND. PRIOR TO THE FINAL APPROVAL OF CONSTRUCTION DOCUMENTS.
2. THE OWNER/DEVELOPER SHALL PROVIDE A SEWER STUDY ANALYZING THE ONSITE SEWER DISCHARGE. PRIOR TO THE FINAL APPROVAL OF CONSTRUCTION DOCUMENTS.
3. THE OWNER/DEVELOPER SHALL CONSTRUCT AN IRRIGATION WATER SERVICE WITH BACKFLOW DEVICE TO SERVE THE ENTIRE PROPERTY'S LANDSCAPE AREA. PRIOR TO THE FINAL APPROVAL OF CONSTRUCTION DOCUMENTS.
4. THE OWNER/DEVELOPER SHALL RECORD A WATER RIGHTS GRANT DEED TO GRANT THE WATER RIGHTS TO THE DISTRICT. PRIOR TO THE FINAL APPROVAL OF CONSTRUCTION DOCUMENTS.
5. THE OWNER/DEVELOPER SHALL SUBMIT A WATER AND SEWER IMPROVEMENT PLAN TO THE DISTRICT. THE PLAN SUBMITTAL SHALL INCLUDE WATER FIXTURE UNIT CALCULATION CONFORMING TO THE CURRENT CALIFORNIA PLUMBING CODE TO CONFIRM ADEQUATE METER SIZE. PRIOR TO THE FINAL APPROVAL OF CONSTRUCTION DOCUMENTS.
6. THE OWNER/DEVELOPER SHALL SUBMIT LANDSCAPE PLANS TO THE DISTRICT FOR REVIEW PRIOR TO CITY APPROVAL OF THE PLANS.



P:\ACAD\PBD.bmp

CONSULTING ENGINEERS IN CIVIL, SURVEYING, AND STRUCTURAL ENGINEERING
914 E. KATELLA AVENUE
ANAHEIM, CALIFORNIA 92805
(714) 385-1835, FAX (714) 385-1834

ARCHITECT:
EMPIRE DESIGN GROUP Inc.
24861 Washington Ave.
Murrieta, Calif. 92562
Tel 951-696-1490 Fax 951-696-1443

CLIENT:

ORTEGA PLAZA, LLC

COMMERCIAL RETAIL
APN: 381-320-025-6
15890 GRAND AVE.
LAKE ELSINORE, CA 92530

ENGINEER OF RECORD:
TRYFON TRYFONOPOULOS, PE
914 E KATELLA AVE.
ANAHEIM, CA 92805
(714)385-1835

SEAL:

REGISTERED PROFESSIONAL ENGINEER
TRYFON P. TRYFONOPOULOS
NO. 65859
EXP.12/31/21
CIVIL
STATE OF CALIFORNIA

Date: 5-3-2024

Project Number: 2006012

NO.	DATE	REVISION DESCRIPTION

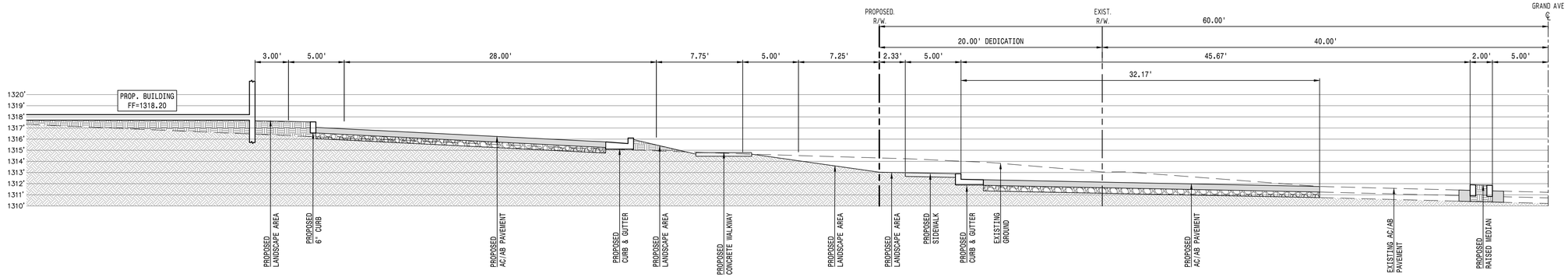
DESIGNED BY: TT
CHECKED BY: TT
DRAWN BY: AL

DRAWING TITLE:

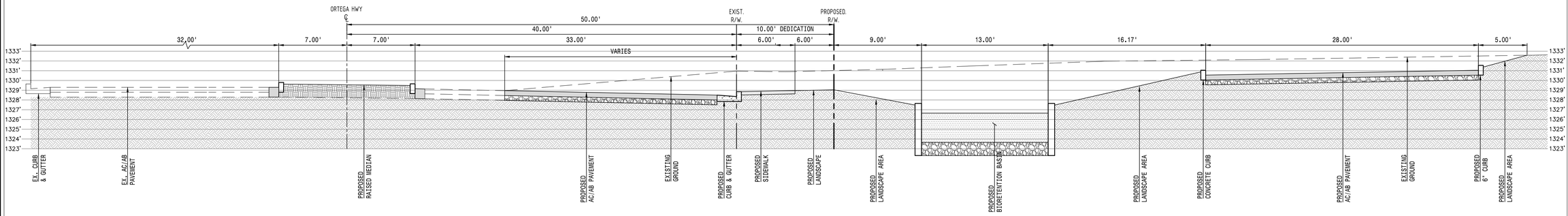
PRELIMINARY UTILITY PLAN

SHEET NO:

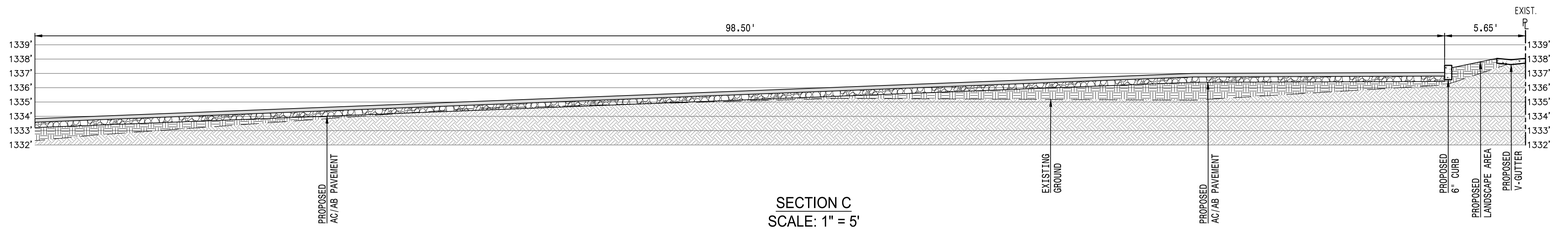
C03



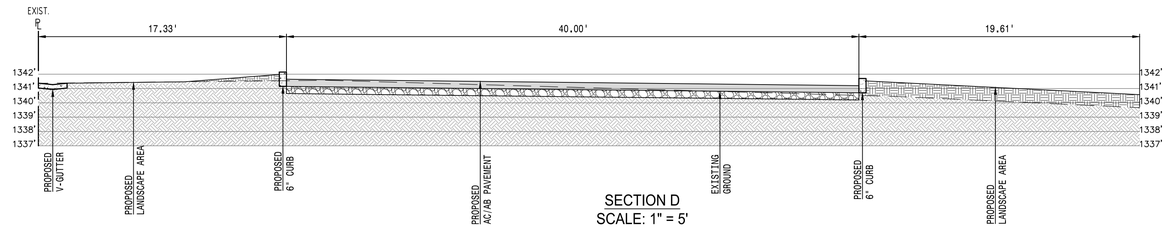
SECTION A
SCALE: 1" = 5'



SECTION B
SCALE: 1" = 5'



SECTION C
SCALE: 1" = 5'



SECTION D
SCALE: 1" = 5'

P:\ACAD\PBD.bmp

CONSULTING ENGINEERS
IN CIVIL, SURVEYING,
AND STRUCTURAL
ENGINEERING
914 E. KATELLA AVENUE
ANAHEIM, CALIFORNIA 92805
(714) 385-1835, FAX (714) 385-1834

ARCHITECT:
EMPIRE DESIGN GROUP Inc.
24861 Washington Ave.
Murrieta, Calif. 92562
Tel 951-696-1490 Fax 951-696-1443

CLIENT:
ORTEGA PLAZA, LLC

COMMERCIAL RETAIL
APN: 381-320-025-6
15890 GRAND AVE.
LAKE ELSINORE, CA 92530

ENGINEER OF RECORD:
TRYFON TRYFONOPOULOS, PE
914 E KATELLA AVE.
ANAHEIM, CA 92805
(714)385-1835

SEAL:
REGISTERED PROFESSIONAL ENGINEER
TRYFON P. TRYFONOPOULOS
NO. 65859
EXP.12/31/21
CIVIL
STATE OF CALIFORNIA

Date: 5-3-2024
Project Number: 2006012

NO.	DATE	REVISION DESCRIPTION

DESIGNED BY: TT
CHECKED BY: TT
DRAWN BY: AL

DRAWING TITLE:
SITE SECTIONS

SHEET NO:
C04

Appendix 3: Soils Information

Geotechnical Study and Other Infiltration Testing Data

Earth Strata Geotechnical Services, Inc.
Geotechnical, Environmental and Materials Testing Consultants

July 13, 2020

Project No. 203217-10A

Mr. Greg Hann
Empire Design Group
P.O. BOX 944
Murrieta, CA 92564

Subject: **Preliminary Geotechnical Interpretive Report, Proposed Commercial Development, Assessor's Parcel Number 381-320-025, Lot Number 8 of Parcel Map Number 8/377 Located at 15890 Grand Avenue, City of Lake Elsinore, Riverside County, California**

Earth Strata Geotechnical Services is pleased to present our preliminary geotechnical interpretive report for the proposed commercial development, Assessor's Parcel Number 381-320-025, Lot Number 8 of Parcel Map Number 8/377, located at 15890 Grand Avenue in the City of Lake Elsinore, Riverside County, California. This work was performed in accordance with the scope of work described in our proposal, dated June 18, 2020. The purpose of this study is to evaluate the nature, distribution, engineering properties, and geologic strata underlying the site with respect to the proposed development.

Earth Strata Geotechnical Services appreciates the opportunity to offer our consultation and advice on this project. In the event that you have any questions, please do not hesitate to contact the undersigned at your earliest convenience.

Respectfully submitted,

EARTH STRATA GEOTECHNICAL SERVICES

Stephen M. Poole, PE, GE
Principal Engineer

REGISTERED PROFESSIONAL ENGINEER
STEPHEN MICHAEL POOLE
No. 692
GEOTECHNICAL
STATE OF CALIFORNIA

SMP/jf

Distribution: (2) Addressee

TABLE OF CONTENTS

Section **Page**

INTRODUCTION 1
SITE DESCRIPTION 1
PROPOSED DEVELOPMENT AND GRADING 1
FIELD EXPLORATION AND LABORATORY TESTING 3
Field Exploration 3
Laboratory Testing 3
FINDINGS 3
Regional Geology 3
Local Geology 4
Faulting 6
Landslides 6
CONCLUSIONS AND RECOMMENDATIONS 6
General 6
Earthwork 7
Earthwork and Grading 7
Clearing and Grubbing 7
Excavation Characteristics 7
Groundwater 7
Ground Preparation for Fill Areas 7
Oversize Rock 8
Compacted Fill Placement 8
Import Earth Materials 8
Cut/Fill Transitions 9
Cut Areas 10
Shrinkage, Bulking and Subsidence 10
Geotechnical Observations 10
Post Grading Considerations 10
Slope Landscaping and Maintenance 10
Site Drainage 11
Utility Trenches 11
SEISMIC DESIGN CONSIDERATIONS 11
Ground Motions 11
Secondary Seismic Hazards 12
Liquefaction and Lateral Spreading 13
General 13
Allowable Bearing Values 13
Settlement 14
Lateral Resistance 14
Structural Setbacks and Building Clearance 14
Foundation Observations 15
Expansive Soil Considerations 16
Very Low Expansion Potential (Expansion Index of 20 or Less) 16
Footings 16
Building Floor Slabs 16

Corrosivity 17
RETAINING WALLS 18
Active and At-Rest Earth Pressures 18
Subdrain System 18
Temporary Excavations 19
Retaining Wall Backfill 19
CONCRETE FLATWORK 19
Thickness and Joint Spacing 19
Subgrade Preparation 19
PRELIMINARY ASPHALTIC CONCRETE PAVEMENT DESIGN 20
GRADING PLAN REVIEW AND CONSTRUCTION SERVICES 20
REPORT LIMITATIONS 21

Attachments:

Figure 1 – Vicinity Map (Page 2)
Figure 2 – Regional Geologic Map (Page 5)
APPENDIX A – References (Rear of Text)
APPENDIX B – Exploratory Logs (Rear of Text)
APPENDIX C – Laboratory Procedures and Test Results (Rear of Text)
APPENDIX D – Seismicity (Rear of Text)
APPENDIX E – Liquefaction Analysis (Rear of Text)
APPENDIX F - Asphaltic Concrete Pavement Calculations (Rear of Text)
APPENDIX G – General Earthwork and Grading Specifications (Rear of Text)
Plate 1 – Geotechnical Map (In Pocket)

INTRODUCTION

Earth Strata Geotechnical Services is pleased to present our preliminary geotechnical interpretive report for the proposed development. The purpose of this study was to evaluate the nature, distribution, engineering properties, and geologic strata underlying the site with respect to the proposed development, and then provide preliminary grading and foundation design recommendations based on the plans you provided. The general location of the subject property is indicated on the Vicinity Map, Figure 1. The plans you provided were used as the base map to show geologic conditions within the subject site, see Geotechnical Map, Plate 1.

SITE DESCRIPTION

The subject property is located at 15890 Grand Avenue in the City of Lake Elsinore, Riverside County, California. The approximate location of the site is shown on the Vicinity Map, Figure 1.

The subject property is comprised of approximately 5.91 acres of developed land. The site has been graded. Topographic relief at the subject property is relatively low with the terrain being generally flat. Elevations at the site range from approximately 1,312 to 1,350 feet above mean sea level (msl), for a difference of about 38± feet across the entire site. Drainage within the subject property generally flows to the northwest.

The site is currently bordered by residential development to the north, east, south, and west. Most of the vegetation on the site consists of landscape grasses, along with small to large trees positioned throughout the subject site.

PROPOSED DEVELOPMENT AND GRADING

The proposed commercial development is expected to consist of concrete, wood or steel framed one- and/or two-story structures utilizing slab on grade construction with associated streets, landscape areas, and utilities. The current development plans include two (2) existing buildings to remain and two (2) proposed structures that includes one (1) convenience story and one (1) gas station canopy positioned on the northern portion the site. The southern portion of the site will be used for future development.

The plans provided by you were utilized in our exploration and form the base for our Geotechnical Map, Plate 1.

"© 2007 DeLorme (www.delorme.com) Topo USA®".

Earth Strata Geotechnical Services, Inc.
Geotechnical, Environmental and Materials Testing Consultants
www.ESGSINC.com (951) 397-8315

PROPOSED GAS STATION AND GAS STATION CANOPY | 203217-10A

VICINITY MAP | SCALE 1:40,625

JULY 2020 | FIGURE 1

FIELD EXPLORATION AND LABORATORY TESTING

Field Exploration

Subsurface exploration within the subject site was performed on June 25, 2020 for the exploratory excavations. A truck mounted hollow-stem-auger drill rig was utilized to drill four (4) borings throughout the site to a maximum depth of 37 feet. An underground utilities clearance was obtained from Underground Service Alert of Southern California, prior to the subsurface exploration.

Earth materials encountered during exploration were classified and logged in general accordance with the Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) of ASTM D 2488. Upon completion of laboratory testing, exploratory logs and sample descriptions may have been reconciled to reflect laboratory test results with regard to ASTM D 2487.

Associated with the subsurface exploration was the collection of bulk (disturbed) samples and relatively undisturbed samples of earth materials for laboratory testing and analysis. The relatively undisturbed samples were obtained with a 3 inch outside diameter modified California split-spoon sampler lined with 1-inch-high brass rings. Samples obtained using a hollow stem auger drill rig, were mechanically driven with successive 30 inch drops of a 140-pound automatic trip safety hammer. The blow count per one-foot increment was recorded in the boring logs. The central portions of the driven samples were placed in sealed containers and transported to our laboratory for testing and analysis. The approximate exploratory locations are shown on Plate 1 and descriptive logs are presented in Appendix B.

Laboratory Testing

Maximum dry density/optimum moisture content, expansion potential, R-value, pH, resistivity, sulfate content, chloride content, and in-situ density/moisture content were determined for selected undisturbed and bulk samples of earth materials, considered representative of those encountered. An evaluation of the test data is reflected throughout the Conclusions and Recommendations section of this report. A brief description of laboratory test criteria and summaries of test data are presented in Appendix C.

FINDINGS

Regional Geology

Regionally, the site is located in the Peninsular Ranges Geomorphic Province of California. The Peninsular Ranges are characterized by northwest trending steep mountain ranges separated by sediment filled elongated valleys. The dominant structural geologic features reflect the northwest trend of the province. Associated with and subparallel to the San Andreas Fault are the San Jacinto Fault, Newport-Inglewood, and the Whittier-Elsinore Fault. The Santa Ana Mountains abut the west side of the Elsinore Fault while the Perris Block forms the other side of the fault zone to the east. The Perris Block is bounded to the east by the San Jacinto Fault. The northern perimeter of the Los Angeles basin forms part of a northerly dipping blind thrust fault at the boundary between the Peninsular Ranges Province and the Transverse Range Province.

The mountainous regions within the Peninsular Ranges Province are comprised of Pre-Cretaceous, metasedimentary, and metavolcanic rocks along with Cretaceous plutonic rocks of the Southern California

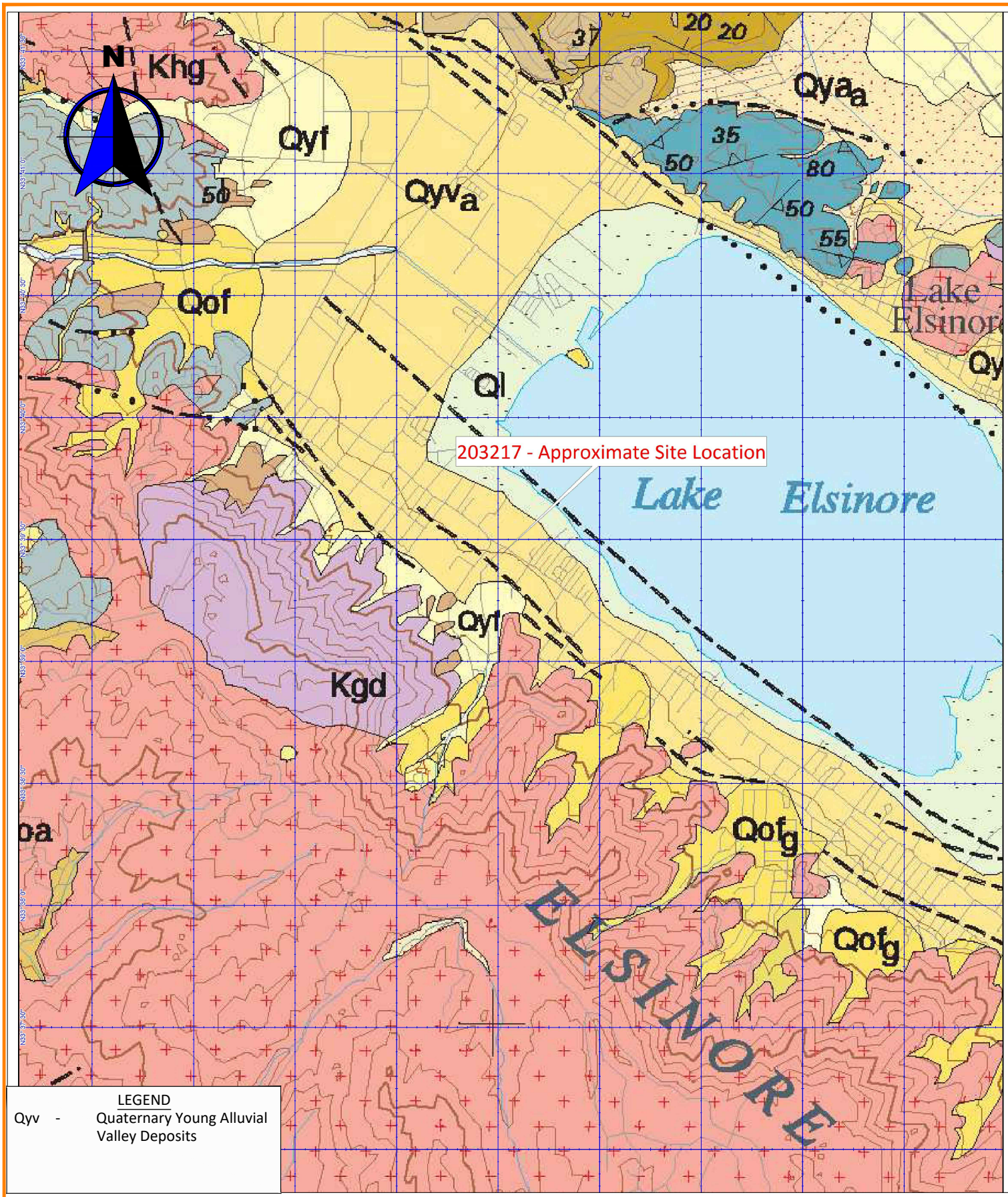
Batholith. The low lying areas are primarily comprised of Tertiary and Quaternary non-marine alluvial sediments consisting of alluvial deposits, sandstones, claystones, siltstones, conglomerates, and occasional volcanic units. A map illustrating the regional geology is presented on the Regional Geologic Map, Figure 2.

Local Geology

The earth materials on the site are primarily comprised of artificial fill and Quaternary alluvial materials. A general description of the dominant earth materials observed on the site is provided below:

- Artificial Fill, Undocumented (map symbol Afu): Undocumented artificial fill materials were encountered throughout the site within the upper 3 to 5 feet during exploration. These materials are typically locally derived from the native materials and consist generally of yellowish brown to dark yellowish-brown silty sand. These materials are generally inconsistent, poorly consolidated fills.

- Quaternary Young Alluvial Valley Deposits (map symbol Qyv): Quaternary young alluvial valley deposits were encountered beneath the fill to a maximum depth of 37 feet. These young alluvial deposits consist of olive brown to yellowish brown, fine to coarse grained silty sand. These deposits were generally noted to be in a slightly moist, loose to very dense state.



LEGEND

Qyv - Quaternary Young Alluvial Valley Deposits

REFERNCES: Morton, D.M., Hauser, Rachel M., and Ruppert, Kelly R., 2004, Preliminary Digital Geologic Map of the San Bernardino and Santa Ana 30' x 60' Quadrangle, Southern California, Version 2.0: U.S. Geological Survey Open-File Report 99-0172.

"© 2007 DeLorme (www.delorme.com) Topo USA®".

Earth Strata Geotechnical Services, Inc.
Geotechnical, Environmental and Materials Testing Consultants
www.ESGSINC.com (951) 397-8315

PROPOSED GAS STATION AND GAS STATION CANOPY | 203217-10A

REGIONAL GEOLOGIC MAP | SCALE 1:40,625

JULY 2020 | FIGURE 2

Faulting

The project is located in a seismically active region and as a result, significant ground shaking will likely impact the site within the design life of the proposed project. The geologic structure of the entire southern California area is dominated by northwest-trending faults associated with the San Andreas Fault system, which accommodates for most of the right lateral movement associated with the relative motion between the Pacific and North American tectonic plates. Known active faults within this system include the Newport-Inglewood, Whittier-Elsinore, San Jacinto and San Andreas Faults.

While the site does not lie within an Alquist-Priolo Earthquake Fault Zone, established by the State of California to restrict the construction of new habitable structures across identifiable traces of known active faults; the site does lie within the Riverside County Fault Zone established for the Willard Fault, which trends through the southeastern portion of the site. An active fault is defined by the State of California as having surface displacement within the past 11,000 years or during the Holocene geologic time period. Based on our mapping of the subject site, review of current and historical aerial imagery, lack of lineaments indicative of active faulting, and the data compiled during the preparation of this report, it is our interpretation that the potential for surface rupture to adversely impact the proposed structures is very low to remote.

Based on our review of regional geologic maps and applicable computer programs (USGS 2008 Interactive Deaggregation, Caltrans ARS online, and USGS Earthquake Hazard Programs), the Elsinore Fault with an approximate source to site distance of 0.29 kilometers is the closest known active fault anticipated to produce the highest ground accelerations, with an anticipated maximum modal magnitude of 7.0. A list of faults as well as a list of significant historical seismic events within a 100km radius of the subject site are included in Appendix D.

Landslides

Landslide debris was not observed during our subsurface exploration and no ancient landslides are known to exist on the site. No landslides are known to exist, or have been mapped, in the vicinity of the site. Geologic mapping of the site conducted during our investigation, and review of aerial imagery of the site, reveal no geomorphic expressions indicative of landsliding. The materials encountered in the pad area were found to be very hard and no oversteepened slopes exist on the site or are proposed.

CONCLUSIONS AND RECOMMENDATIONS

General

From geotechnical and engineering geologic points of view, the subject property is considered suitable for the proposed development, provided the following conclusions and recommendations are incorporated into the plans and are implemented during construction.

Earthwork

Earthwork and Grading

The provisions of the 2019 California Building Code (CBC), including the General Earthwork and Grading Specifications in the last Appendix of this report, should be applied to all earthwork and grading operations, as well as in accordance with all applicable grading codes and requirements of the appropriate reviewing agency. Unless specifically revised or amended herein, grading operations should also be performed in accordance with applicable provisions of our General Earthwork and Grading Specifications within the last appendix of this report.

Clearing and Grubbing

Vegetation including trees, grasses, weeds, brush, shrubs, or any other debris should be stripped from the areas to be graded and properly disposed of offsite. In addition, laborers should be utilized to remove any roots, branches, or other deleterious materials during grading operations.

Earth Strata Geotechnical Services should be notified at the appropriate times to provide observation and testing services during Clearing and Grubbing operations. Any buried structures or unanticipated conditions should be brought to our immediate attention.

Excavation Characteristics

Based on the results of our exploration and experience with similar projects in similar settings, the near surface earth materials, will be readily excavated with conventional earth moving equipment. Excavation difficulty is a function of the degree of weathering and amount of fracturing within the bedrock. Bedrock generally becomes harder and more difficult to excavate with increasing depth.

Groundwater

Groundwater was not observed during our subsurface exploration. It should be noted that localized groundwater could be encountered during grading due to the limited number of exploratory locations or other factors.

Ground Preparation for Fill Areas

For each area to receive compacted fill, the removal of low density, compressible earth materials, such as upper alluvial materials and undocumented artificial fill, should continue until firm competent alluvium is encountered. Removal excavations are subject to verification by the project engineer, geologist or their representative. Prior to placing compacted fills, the exposed bottom in each removal area should be scarified to a depth of 6 inches or more, watered or air dried as necessary to achieve near optimum moisture conditions and then compacted to a minimum of 90 percent of the maximum dry density determined by ASTM D 1557.

The intent of remedial grading is to diminish the potential for hydro-consolidation, slope instability, and/or settlement. Remedial grading should extend beyond the perimeter of the proposed structures a horizontal distance equal to the depth of excavation or a minimum of 5 feet, whichever

is greater. For cursory purposes the anticipated removal depths are shown on the enclosed Geotechnical Map, Plate 1. In general, the anticipated removal depths should vary from 9 to 11 feet below existing grade.

Wet Removals

Wet alluvial materials will probably not be encountered within the low lying areas of the site. If removals of wet alluvial materials are required, special grading equipment and procedures can greatly reduce overall costs. Careful planning by an experienced grading contractor can reduce the need for special equipment, such as swamp cats, draglines, excavators, pumps, and top loading earthmovers. Possible solutions may include the placement of imported angular rock and/or geotextile ground reinforcement. More specific recommendations can be provided based on the actual conditions encountered. Drying or mixing of wet materials with dry materials will be needed to bring the wet materials to near optimum moisture prior to placing wet materials into compacted fills.

Oversize Rock

Oversize rock is not expected to be encountered during grading. Oversize rock that is encountered (i.e., rock exceeding a maximum dimension of 12 inches) should be disposed of offsite or stockpiled onsite and crushed for future use. The disposal of oversize rock is discussed in greater detail in General Earthwork and Grading Specifications within the last appendix of this report.

Compacted Fill Placement

Compacted fill materials should be placed in 6 to 8 inch maximum (uncompacted) lifts, watered or air dried as necessary to achieve uniform near optimum moisture content and then compacted to a minimum of 90 percent of the maximum dry density determined by ASTM D 1557.

Import Earth Materials

Should import earth materials be needed to achieve final design grades, all potential import materials should be free of deleterious/oversize materials, non-expansive, and approved by the project geotechnical consultant prior to delivery onsite.

Fill Slopes

When properly constructed, fill slopes up to 10 feet high with inclinations of 2:1 (h:v) or flatter are considered to be grossly stable. Keyways are required at the toe of all fill slopes higher than 5 feet and steeper than 5:1 (h:v). Keyways should be a minimum of 10 feet wide and 2 feet into competent earth materials, as measured on the downhill side. In order to establish keyway removals, backcuts should be cut no steeper than 1:1 or as recommended by the geotechnical engineer or engineering geologist. Compacted fill should be benched into competent earth materials.

Cut Slopes

When properly constructed, cut slopes into older alluvium up to 10 feet high with inclinations of 2:1 (h:v) or flatter are considered grossly stable. Cut slopes should be observed by the engineering geologist or his representative during grading, but are anticipated to be stable.

Stabilization Fills

Currently, stabilization fills will not be required for cut slopes in the alluvium. Our engineering geologist or his representative should be called to evaluate all slopes during grading. In the event that unfavorable geologic conditions are encountered, recommendations for stabilization fills or flatter slopes will be provided.

Fill Over Cut Slopes

The fill portion of fill over cut slopes should not be constructed until the cut portion of the slope has been cut to finish grade. The earth materials and geologic structure exposed along the cut slope should be evaluated with regard to suitability for compacted fills or foundations and for stability. If the cut materials are determined to be competent, then the construction of the keyway and subdrain system may commence or additional remedial recommendations will be provided.

Temporary Backcuts

It is the responsibility of the grading contractor to follow all Cal-OSHA requirements with regard to excavation safety. Where existing developments are upslope, adequate slope stability to protect those developments must be maintained. Temporary backcuts will be required to accomplish removals of unsuitable materials and possibly, to perform canyon removals, stabilization fills, and/or keyways. Backcuts should be excavated at a gradient of 1:1 (h:v) or flatter. Flatter backcuts may be required where geologic structure or earth materials are unfavorable. It is imperative that grading schedules minimize the exposure time of the unsupported excavations. All excavations should be stabilized within 30 days of initial excavation.

Cut/Fill Transitions

Cut/fill transitions should be eliminated from all building areas where the depth of fill placed within the "fill" portion exceeds proposed footing depths. This is to diminish distress to structures resulting from excessive differential settlement. The entire foundation of each structure should be founded on a uniform bearing material. This should be accomplished by overexcavating the "cut" portion and replacing the excavated materials as properly compacted fill. Refer to the following table for recommended depths of overexcavation.

DEPTH OF FILL ("fill" portion)	DEPTH OF OVEREXCAVATION ("cut" portion)
Up to 5 feet	Equal Depth
5 to 10 feet	5 feet
Greater than 10 feet	One-half the thickness of fill placed on the "fill" portion (10 feet maximum)

Overexcavation of the "cut" portion should extend beyond the building perimeter a horizontal distance equal to the depth of overexcavation or a minimum of 5 feet, whichever is greater.

Cut Areas

In cut areas, an area a minimum of 5 feet beyond the footprint of the proposed structures should overexcavated until; competent bottoms are achieved; to a minimum 3 feet below the proposed foundations; or per the Overexcavation Table above; (whichever is greater) and replaced with compacted fill. Final determination of areas that require overexcavation should be determined in the field by a representative of Earth Strata Geotechnical Services.

Shrinkage, Bulking and Subsidence

Volumetric changes in earth material quantities will occur when poorly consolidated earth materials are replaced with properly compacted fill. Estimates of the percent shrinkage/bulking factors for the various geologic units observed on the subject property are based on in-place densities and on the estimated average percent of relative compaction achieved during grading.

GEOLOGIC UNIT	SHRINKAGE (%)
Artificial Fill	10 to 15
Alluvium	10 to 15

Subsidence from scarification and recompaction of exposed bottom surfaces is expected to be negligible to approximately 0.01 foot.

The estimates of shrinkage/bulking and subsidence are intended as an aid for project engineers in determining earthwork quantities. Since many variables can affect the accuracy of these estimates, they should be used with caution and contingency plans should be in place for balancing the project.

Geotechnical Observations

Clearing operations, removal of unsuitable materials, and general grading procedures should be observed by the project geotechnical consultant or his representative. No compacted fill should be placed without observations by the geotechnical consultant or his representative to verify the adequacy of the removals.

The project geotechnical consultant or his representative should be present to observe grading operations and to check that minimum compaction requirements and proper lift thicknesses are being met, as well as to verify compliance with the other recommendations presented herein.

Post Grading Considerations

Slope Landscaping and Maintenance

Adequate slope and building pad drainage is essential for the long term performance of the subject site. The gross stability of graded slopes should not be adversely affected, provided all drainage provisions are properly constructed and maintained. Engineered slopes should be landscaped with

deep rooted, drought tolerant maintenance free plant species, as recommended by the project landscape architect.

Site Drainage

Control of site drainage is important for the performance of the proposed project. Roof gutters are recommended for the proposed structures. Pad and roof drainage should be collected and transferred to driveways, adjacent streets, storm-drain facilities, or other locations approved by the building official in non-erosive drainage devices. Drainage should not be allowed to pond on the pad or against any foundation or retaining wall. Drainage should not be allowed to flow uncontrolled over any descending slope. Planters located within retaining wall backfill should be sealed to prevent moisture intrusion into the backfill. Planters located next to structures should be sealed to the depth of the footings. Drainage control devices require periodic cleaning, testing and maintenance to remain effective.

At a minimum, pad drainage should be designed at the minimum gradients required by the CBC. To divert water away from foundations, the ground surface adjacent to foundations should also be graded at the minimum gradients required per the CBC.

Utility Trenches

All utility trench backfill should be compacted at near optimum moisture to a minimum of 90 percent of the maximum dry density determined by ASTM D 1557. For utility trench backfill within pavement areas the upper 6 inches of subgrade materials should be compacted to 95 percent of the maximum dry density determined by ASTM D 1557. This includes within the street right-of-ways, utility easements, under footings, sidewalks, driveways and building floor slabs, as well as within or adjacent to any slopes. Backfill should be placed in approximately 6 to 8 inch maximum loose lifts and then mechanically compacted with a hydro-hammer, rolling with a sheepsfoot, pneumatic tampers, or similar equipment. The utility trenches should be tested by the project geotechnical engineer or their representative to verify minimum compaction requirements are obtained.

In order to minimize the penetration of moisture below building slabs, all utility trenches should be backfilled with compacted fill, lean concrete or concrete slurry where they undercut the perimeter foundation. Utility trenches that are proposed parallel to any building footings (interior and/or exterior trenches), should not be located within a 1:1 (h:v) plane projected downward from the outside bottom edge of the footing.

SEISMIC DESIGN CONSIDERATIONS

Ground Motions

Structures are required to be designed and constructed to resist the effects of seismic ground motions as provided in the 2019 California Building Code Section 1613. The design is dependent on the site class, occupancy category I, II, III, or IV, mapped spectral accelerations for short periods (S_s), and mapped spectral acceleration for a 1-second period (S_1).

In order for structural design to comply with the 2019 CBC, the USGS "US Seismic Design Maps" online tool was used to compile spectral accelerations for the subject property based on data and maps jointly compiled by the United States Geological Survey (USGS) and the California Geological Survey (CGS). The data found in the following table is based on the Maximum Considered Earthquake (MCE) with 5% damped ground motions having a 2% probability of being exceeded in 50 years (2,475 year return period).

The seismic design coefficients were determined by a combination of the site class, mapped spectral accelerations, and occupancy category. The following seismic design coefficients should be implemented during design of the proposed structures. Summaries of the Seismic Hazard Deaggregation graphs and test data are presented in Appendix D.

2019 CBC	FACTOR (ASCE 7-16)
Site Location	Latitude: 33.657651° (North) Longitude: -117.375674°(West)
Site Class	D
Mapped Spectral Accelerations for short periods, S_S	2.094 g
Mapped Spectral Accelerations for 1-Second Period, S_1	0.747 g
Maximum Considered Earthquake Spectral Response Acceleration for Short Periods, S_{MS}	2.094 g
Maximum Considered Earthquake Spectral Response Acceleration for 1-Second Period, S_{M1}	*Null – See Section 11.4.8
Design Spectral Response Acceleration for Short Periods, S_{DS}	1.396 g
Design Spectral Response Acceleration for 1-Second Period, S_{D1}	*Null – See Section 11.4.8
Seismic Design Category	D
Importance Factor Based on Occupancy Category	II

We performed the probabilistic seismic hazard assessment for the site in accordance with the 2019 CBC, Section 1803.5.11 and 1803.5.12. The probabilistic seismic hazard maps and data files were jointly prepared by the United States Geological Survey (USGS) and the California Geological Survey (CGS) and can be found at the CGS Probabilistic Seismic Hazards Mapping Ground Motion Page. Actual ground shaking intensities at the site may be substantially higher or lower based on complex variables such as the near source directivity effects, depth and consistency of earth materials, topography, geologic structure, direction of fault rupture, and seismic wave reflection, refraction, and attenuation rates. The mean peak ground acceleration was calculated to be 0.985 g.

Secondary Seismic Hazards

Secondary effects of seismic shaking considered as potential hazards include several types of ground failure as well as induced flooding. Different types of ground failure, which could occur as a consequence of severe ground shaking at the site, include landslides, ground lurching, shallow ground rupture, and liquefaction/lateral spreading. The probability of occurrence of each type of ground failure depends on the severity of the earthquake, distance from faults, topography, the state of subsurface earth materials, groundwater conditions, and other factors. Based on our experience, subsurface exploration, and laboratory testing, all of the above secondary effects of seismic activity are considered unlikely.

Seismically induced flooding is normally a consequence of a tsunami (seismic sea wave), a seiche (i.e., a wave-like oscillation of surface water in an enclosed basin that may be initiated by a strong earthquake) or failure of a major reservoir or retention system up gradient of the site. Since the site is at an elevation of more than 1,300 feet above mean sea level and is located more than 30 miles inland from the nearest coastline of the Pacific Ocean, the potential for seismically induced flooding due to a tsunami is considered nonexistent. Since no enclosed bodies of water lie adjacent to or up gradient of the site, the likelihood for induced flooding due to a dam failure or a seiche overcoming the dam's freeboard is considered nonexistent.

Liquefaction and Lateral Spreading

Liquefaction occurs as a result of a substantial loss of shear strength or shearing resistance in loose, saturated, cohesionless earth materials subjected to earthquake induced ground shaking. Potential impacts from liquefaction include loss of bearing capacity, liquefaction related settlement, lateral movements, and surface manifestation such as sand boils. Seismically induced settlement occurs when loose sandy soils become denser when subjected to shaking during an earthquake. The three factors determining whether a site is likely to be subject to liquefaction include seismic shaking, type and consistency of earth materials, and groundwater level. The proposed structures will be supported by compacted fill and competent alluvium, with groundwater at a depth of approximately greater than 50 feet. As such, the potential for earthquake induced liquefaction and lateral spreading beneath the proposed structures is considered very low to remote due to the recommended compacted fill, relatively low groundwater level, and the dense nature of the deeper onsite earth materials.

Liquefaction analyses were performed for the existing un-graded and graded conditions, using a conservative groundwater level of 5 feet to represent the historic high groundwater level. The analyses of post graded conditions determined that potentially liquefiable earth materials were encountered in Boring B-2 from 5 to 28 feet. According to Fig. 10 of Ishihara (1995) liquefaction should not manifest itself at the surface, due to the recommended grading, the depth of the liquefiable earth materials, and the volume of overburden materials above the liquefiable zone. We estimate that dynamic settlement of sands due to liquefaction will be on the order of 1.4 inches. The liquefaction potential and dynamic settlement of sands analyses are included within the appendices of this report.

TENTATIVE FOUNDATION DESIGN RECOMMENDATIONS

General

Provided grading is performed in accordance with the recommendations of this report, shallow foundations are considered feasible for support of the proposed structures. Tentative foundation recommendations are provided herein and graphic presentations of relevant recommendations may also be included on the enclosed map.

Allowable Bearing Values

An allowable bearing value of 2,500 pounds per square foot (psf) is recommended for design of 24-inch square pad footings and 12-inch-wide continuous footings founded at a minimum depth of 12 inches below the lowest adjacent final grade. This value may be increased by 20 percent for each additional 1-foot of

width and/or depth to a maximum value of 3,000 psf. Recommended allowable bearing values include both dead and frequently applied live loads and may be increased by one third when designing for short duration wind or seismic forces.

Settlement

Based on the settlement characteristics of the earth materials that underlie the building sites and the anticipated loading, we estimate that the maximum total settlement of the footings will be less than approximately ¾ inch. Differential settlement is expected to be about ½ inch over a horizontal distance of approximately 20 feet, for an angular distortion ratio of 1:480. It is anticipated that the majority of the settlement will occur during construction or shortly after the initial application of loading.

The above settlement estimates are based on the assumption that the grading and construction are performed in accordance with the recommendations presented in this report and that the project geotechnical consultant will observe or test the earth material conditions in the footing excavations.

Lateral Resistance

Passive earth pressure of 250 psf per foot of depth to a maximum value of 2,500 psf may be used to establish lateral bearing resistance for footings. For areas coved with hardscape, passive earth pressure may be taken from the surface. For areas without hardscape, the upper 12 inches of the soil profile must be neglected when calculating passive earth pressure. A coefficient of friction of 0.36 times the dead load forces may be used between concrete and the supporting earth materials to determine lateral sliding resistance. The above values may be increased by one-third when designing for short duration wind or seismic forces. When combining passive and friction for lateral resistance, the passive component should be reduced by one third. In no case shall the lateral sliding resistance exceed one-half the dead load for clay, sandy clay, sandy silty clay, silty clay, and clayey silt.

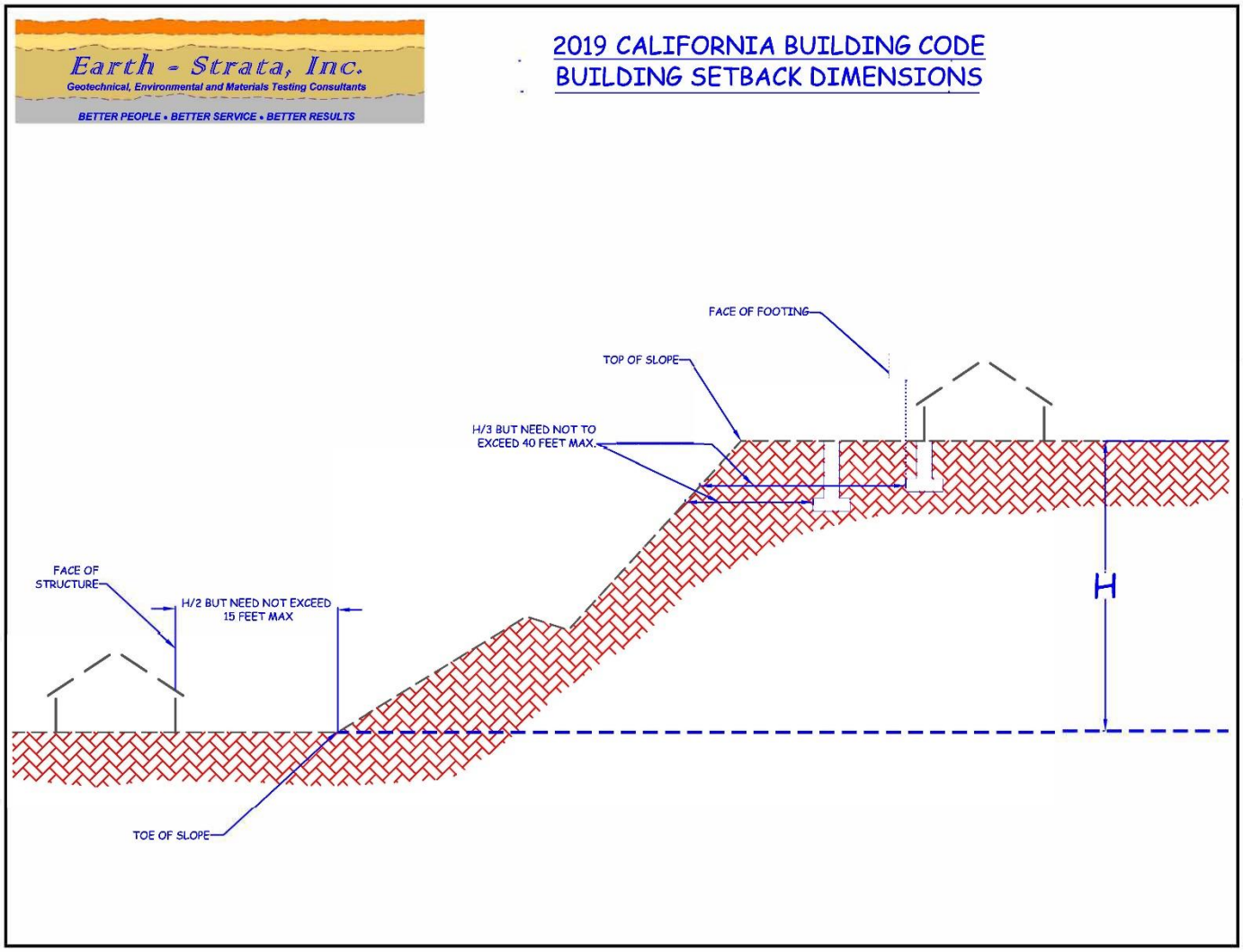
The above lateral resistance values are based on footings for an entire structure being placed directly against either compacted fill or competent alluvium.

Structural Setbacks and Building Clearance

Structural setbacks are required per the 2019 California Building Code (CBC). Additional structural setbacks are not required due to geologic or geotechnical conditions within the site. Improvements constructed in close proximity to natural or properly engineered and compacted slopes can, over time, be affected by natural processes including gravity forces, weathering, and long term secondary settlement. As a result, the CBC requires that buildings and structures be setback or footings deepened to resist the influence of these processes.

For structures that are planned near ascending and descending slopes, the footings should be embedded to satisfy the requirements presented in the CBC, Section 1808.7 as illustrated in the following Foundation Clearances from Slopes diagram.

FOUNDATION CLEARANCES FROM SLOPES



When determining the required clearance from ascending slopes with a retaining wall at the toe, the height of the slope shall be measured from the top of the wall to the top of the slope.

Foundation Observations

In accordance with the 2019 CBC and prior to the placement of forms, concrete, or steel, all foundation excavations should be observed by the geologist, engineer, or his representative to verify that they have been excavated into competent bearing materials. The excavations should be per the approved plans, moistened, cleaned of all loose materials, trimmed neat, level, and square. Any moisture softened earth materials should be removed prior to steel or concrete placement.

Earth materials from foundation excavations should not be placed in slab on grade areas unless the materials are tested for expansion potential and compacted to a minimum of 90 percent of the maximum dry density.

Expansive Soil Considerations

Preliminary laboratory test results indicate onsite earth materials exhibit an expansion potential of **VERY LOW** as classified in accordance with 2019 CBC Section 1803.5.3 and ASTM D 4829. Additional, testing for expansive soil conditions should be conducted upon completion of rough grading. The following recommendations should be considered the very minimum requirements, for the earth materials tested. It is common practice for the project architect or structural engineer to require additional slab thickness, footing sizes, and/or reinforcement.

Very Low Expansion Potential (Expansion Index of 20 or Less)

Our laboratory test results indicate that the earth materials onsite exhibit a **VERY LOW** expansion potential as classified in accordance with 2019 CBC Section 1803.5.3 and ASTM D 4829. Since the onsite earth materials exhibit expansion indices of 20 or less, the design of slab on ground foundations is exempt from the procedures outlined in Section 1808.6.1 or 1808.6.2.

Footings

- Exterior continuous footings may be founded at the minimum depths below the lowest adjacent final grade (i.e. 12-inch minimum depth for one-story, 18-inch minimum depth for two-story, and 24-inch minimum depth for three-story construction). Interior continuous footings for one-, two-, and three-story construction may be founded at a minimum depth of 12 inches below the lowest adjacent final grade. All continuous footings should have a minimum width of 12, 15, and 18 inches, for one-, two-, and three-story structures, respectively per Table 1809.7 of the 2019 CBC, and should be reinforced with a minimum of four (4) No. 4 bars, two (2) top and two (2) bottom.

- Exterior pad footings intended to support roof overhangs, such as second story decks, patio covers and similar construction should be a minimum of 24 inches square and founded at a minimum depth of 18 inches below the lowest adjacent final grade. No special reinforcement of the pad footings will be required.

Building Floor Slabs

- Building floor slabs should be a minimum of 4 inches thick and reinforced with a minimum of No. 3 bars spaced a maximum of 18 inches on center, each way. All floor slab reinforcement should be supported on concrete chairs or bricks to ensure the desired placement at mid-depth.

- Interior floor slabs, within moisture sensitive areas, should be underlain by a minimum 10-mil thick moisture/vapor barrier to help reduce the upward migration of moisture from the underlying earth materials. The moisture/vapor barrier used should meet the performance standards of an ASTM E 1745 Class A material, and be properly installed in accordance with ACI publication 318. It is the responsibility of the contractor to ensure that the moisture/vapor barriers are free of openings, rips, or punctures prior to placing concrete. As an option for additional moisture reduction, higher strength concrete, such as a minimum 28-day compressive strength of 5,000 pounds per square inch (psi) may be used. Ultimately, the design of the moisture/vapor barrier system and recommendations for concrete placement and curing

are the purview of the foundation engineer, taking into consideration the project requirements provided by the architect and owner.

- Garage or canopy slabs should be a minimum of 5 inches thick and should be reinforced in a similar manner as living area floor slabs. Garage floor slabs should be placed separately from adjacent wall footings with a positive separation maintained with ⅜ inch minimum felt expansion joint materials and quartered with weakened plane joints. A 12-inch-wide turn down founded at the same depth as adjacent footings should be provided across garage entrances. The turn down should be reinforced with a minimum of two (2) No. 4 bars, one (1) top and one (1) bottom.

- The subgrade earth materials below all floor slabs should be pre-watered to promote uniform curing of the concrete and minimize the development of shrinkage cracks, prior to placing concrete. The pre-watering should be verified by Earth Strata Geotechnical Services during construction.

Corrosivity

Corrosion is defined by the National Association of Corrosion Engineers (NACE) as "a deterioration of a substance or its properties because of a reaction with its environment." From a geotechnical viewpoint, the "substances" are the reinforced concrete foundations or buried metallic elements (not surrounded by concrete) and the "environment" is the prevailing earth materials in contact with them. Many factors can contribute to corrosivity, including the presence of chlorides, sulfates, salts, organic materials, different oxygen levels, poor drainage, different soil types, and moisture content. It is not considered practical or realistic to test for all of the factors which may contribute to corrosivity.

The potential for concrete exposure to chlorides is based upon the recognized Caltrans reference standard "Bridge Design Specifications", under Subsection 8.22.1 of that document, Caltrans has determined that "Corrosive water or soil contains more than 500 parts per million (ppm) of chlorides". Based on limited preliminary laboratory testing, the onsite earth materials have chloride contents *less* than 500 ppm. As such, specific requirements resulting from elevated chloride contents are not required.

Specific guidelines for concrete mix design are provided in 2019 CBC Section 1904.1 and ACI 318, Section 4.3 Table 4.3.1 when the soluble sulfate content of earth materials exceeds 0.1 percent by weight. Based on limited preliminary laboratory testing, the onsite earth materials are classified in accordance with Table 4.3.1 as having a *negligible* sulfate exposure condition. Therefore, structural concrete in contact with onsite earth materials should utilize Type I or II.

Based on our laboratory testing of resistivity, the onsite earth materials in contact with buried steel should be considered *mildly corrosive*. Additionally, pH values below 5.6 and above 9.1 are recognized as being corrosive to many common metallic components. The pH values for the earth materials tested were *lower* than 9.1 and *higher* than 5.6.

The preliminary test results for corrosivity are based on limited samples, and the initiation of grading may blend various earth materials together. This blending or imported material could alter and increase the detrimental properties of the onsite earth materials. Accordingly, additional testing for chlorides and

sulfates along with testing for pH and resistivity should be performed upon completion of grading. Laboratory test results are presented in Appendix C.

RETAINING WALLS

Active and At-Rest Earth Pressures

Foundations may be designed in accordance with the recommendations provided in the Tentative Foundation Design Recommendation section of this report. The following table provides the minimum recommended equivalent fluid pressures for design of retaining walls a maximum of 8 feet high. The active earth pressure should be used for design of unrestrained retaining walls, which are free to tilt slightly. The at-rest earth pressure should be used for design of retaining walls that are restrained at the top, such as basement walls, curved walls with no joints, or walls restrained at corners. For curved walls, active pressure may be used if tilting is acceptable and construction joints are provided at each angle point and at a minimum of 15 foot intervals along the curved segments.

MINIMUM STATIC EQUIVALENT FLUID PRESSURES (pcf)		
PRESSURE TYPE	BACKSLOPE CONDITION	
	LEVEL	2:1 (h:v)
Active Earth Pressure	40	63
At-Rest Earth Pressure	60	95

The retaining wall parameters provided do not account for hydrostatic pressure behind the retaining walls. Therefore, the subdrain system is a very important part of the design. All retaining walls should be designed to resist surcharge loads imposed by other nearby walls, structures, or vehicles should be added to the above earth pressures, if the additional loads are being applied within a 1.5:1 (h:v) plane projected up from the heel of the retaining wall footing. As a way of minimizing surcharge loads and the settlement potential of nearby buildings, the footings for the building can be deepened below the 1.5:1 (h:v)plane projected up from the heel of the retaining wall footing.

Upon request and under a separate scope of work, more detailed analyses can be performed to address equivalent fluid pressures with regard to stepped retaining walls, actual retaining wall heights, actual backfill inclinations, specific backfill materials, higher retaining walls requiring earthquake design motions, etc.

Subdrain System

We recommend a perforated pipe and gravel subdrain system be provided behind all proposed retaining walls to prevent the buildup of hydrostatic pressure behind the proposed retaining walls. The perforated pipe should consist of 4-inch minimum diameter Schedule 40 PVC or ABS SDR-35, placed with the perforations facing down. The pipe should be surrounded by 1 cubic foot per foot of ¾- or 1½ inch open graded gravel wrapped in filter fabric. The filter fabric should consist of Mirafi 140N or equivalent to prevent infiltration of fines and subsequent clogging of the subdrain system.

In lieu of a perforated pipe and gravel subdrain system, weep holes or open vertical masonry joints may be provided in the lowest row of block exposed to the air to prevent the buildup of hydrostatic pressure behind the proposed retaining walls. Weep holes should be a minimum of 3 inches in diameter and provided at intervals at least every 6 feet along the wall. Open vertical masonry joints should be provided at a minimum of 32 inch intervals. A continuous gravel fill, a minimum of 1 cubic foot per foot, should be placed behind the weep holes or open masonry joints. The gravel should be wrapped in filter fabric consisting of Mirafi 140N or equivalent.

The retaining walls should be adequately coated on the backfilled side of the walls with a proven waterproofing compound by an experienced professional to inhibit infiltration of moisture through the walls.

Temporary Excavations

All excavations should be made in accordance with Cal-OSHA requirements. Earth Strata Geotechnical Services is not responsible for job site safety.

Retaining Wall Backfill

Retaining wall backfill materials should be approved by the geotechnical engineer or his representative prior to placement as compacted fill. Retaining wall backfill should be placed in lifts no greater than 6 to 8 inches, watered or air dried as necessary to achieve near optimum moisture contents. All retaining wall backfill should be compacted to a minimum of 90 percent of the maximum dry density as determined by ASTM D 1557. Retaining wall backfill should be capped with a paved surface drain.

CONCRETE FLATWORK

Thickness and Joint Spacing

Concrete sidewalks and patio type slabs should be at least 3½ inches thick and provided with construction or expansion joints every 6 feet or less, to reduce the potential for excessive cracking. Concrete driveway slabs should be at least 5 inches thick and provided with construction or expansion joints every 10 feet or less.

Subgrade Preparation

In order to reduce the potential for unsightly cracking, subgrade earth materials underlying concrete flatwork should be compacted at optimum moisture to 90 percent of the maximum dry density determined by ASTM D 1557 and then moistened to optimum or slightly above optimum moisture content. This moisture should extend to a depth of 12 inches below subgrade and be maintained prior to placement of concrete. Pre-watering of the earth materials prior to placing concrete will promote uniform curing of the concrete and minimize the development of shrinkage cracks. The project geotechnical engineer or his representative should verify the density and moisture content of the earth materials and the depth of moisture penetration prior to placing concrete.

Cracking within concrete flatwork is often a result of factors such as the use of too high a water to cement ratio and/or inadequate steps taken to prevent moisture loss during the curing of the concrete. Concrete distress can be reduced by proper concrete mix design and proper placement and curing of the concrete. Minor cracking within concrete flatwork is normal and should be expected.

PRELIMINARY ASPHALTIC CONCRETE PAVEMENT DESIGN

Laboratory testing of representative earth materials indicate an R-value of 57. However, an R-value of 50 will be used for preliminary pavement design. The following table includes our minimum recommended asphaltic concrete pavement sections calculated in accordance with the State of California design procedures using assumed Traffic Indices. Final pavement design should be based on sampling and testing of post grading conditions. Alternative pavement sections and calculation sheets have been provided within the appendices of this report.

PRELIMINARY ASPHALTIC CONCRETE PAVEMENT DESIGN			
PARAMETERS	**AUTO PARKING**	**AUTO DRIVES**	**ENTRANCES/TRUCK DRIVES**
Assumed Traffic Index	5.0	6.0	7.0
Design R-Value	50	50	50
AC Thickness (inches)	3*	3	3½
AB Thickness (inches)	4*	4 ¼	5 ½

Notes: AC – Asphaltic Concrete *Minimum Section
AB – Aggregate Base

The subgrade earth materials immediately below the aggregate base (base) should be compacted to a minimum of 95 percent of the maximum dry density determined by ASTM D 1557 to a minimum depth of 12 inches. Base materials should be compacted to a minimum of 95 percent of the maximum dry density determined by ASTM D 1557.

Base materials should consist of Class 2 aggregate base conforming to Section 26-1.02B of the State of California Standard Specifications or crushed aggregate base conforming to Section 200-2 of the Standard Specifications for Public Works Construction (Greenbook). Base materials should be compacted at or slightly below optimum moisture content. Asphaltic concrete materials and construction operations should conform to Section 203 of the Greenbook.

GRADING PLAN REVIEW AND CONSTRUCTION SERVICES

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

We recommend that Earth Strata Geotechnical Services be retained to provide geologic and geotechnical engineering services during grading and foundation excavation phases of the work. In order to allow for design changes in the event that the subsurface conditions differ from those anticipated prior to construction.

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

REPORT LIMITATIONS

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

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

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

APPENDIX A

REFERENCES

APPENDIX A

References

California Building Standards Commission, 2019, *2019 California Building Code, California Code of Regulations Title 24, Part 2, Volume 2 of 2,* Based on 2018 International Building Code.

California Corrosion Guidelines

DeLorme, 2004, (www.delorme.com) *Topo USA*®.

Hart, Earl W. and Bryant, William A., *1997, Fault Rupture Hazard Zones in California, CDMG Special Publication 42,* revised 2003.

Irvine Geotechnical, 2001, Mult Calc 2000, October 10.

Ishihara, K., 1995, *Effects of At-Depth Liquefaction on Embedded Foundations during Earthquakes*, Proc. 10th Asian Regional Conference on Soil Mechanics and Foundation Engineering, August 29-September 2, Beijing, China.

Morton, D.M. (compiler), and Fred K. Miller (compiler), 2006, *Geologic Map of the San Bernardino and Santa Ana 30' x 60' Quadrangles, California*: U.S. Geological Survey, Version 1, California.

National Association of Corrosion Engineers, 1984, *Corrosion Basics An Introduction*, page 191.

Per A.B. Chance® Recommendations, 2003

Southern California Earthquake Center (SCEC), 1999, *Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Liquefaction Hazards in California,* March.

APPENDIX B

EXPLORATORY LOGS

Geotechnical Boring Log B-1

Date: June 25, 2020	**Project Name: Grand Avenue, Lake Elsinore** **Page: 1 of 2**
Project Number: 203217-10A	**Logged By: JF**
Drilling Company: Drilling It	**Type of Rig: B-61**
Drive Weight (lbs): 140	**Drop (in): 30** **Hole Diameter (in): 8**
Top of Hole Elevation (ft): See Map	**Hole Location: See Geotechnical Map**

Depth (ft)	Blow Count Per Foot	Sample Depth	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0						**Artificial Fill, Undocumented (Afu):**
					SM	Silty SAND; dark yellowish brown, dry to slightly moist, loose, fine to coarse
	8	2.5'	106.4	6.7		sand with trace gravel
5	6	5'	99.0	10.5		**Quaternary Young Alluvial Valley Deposits (Qyv):**
					SM	Silty SAND; yellowish brown, slightly moist, loose, fine to coarse sand
	13	7.5'	111.9	7.5		
10	30	10'	117.7	5.8		
	17	12'.5	118.7	6.9		
15	47	15'	122.0	4.6		
20	REF/3"	20'	115.6	7.4		
						Total Depth: 20.5 feet
						No Groundwater
25						
30						

42184 Remington Avenue, Temecula, CA 92590

Earth Strata Geotechnical Services, Inc.
Geotechnical, Environmental and Materials Testing Consultants
www.ESGSINC.com (951) 397-8315

Geotechnical Boring Log B-2

Date: June 25, 2020	**Project Name: Grand Avenue, Lake Elsinore** **Page: 1 of 1**
Project Number: 203217-10A	**Logged By: JF**
Drilling Company: Drilling It	**Type of Rig: B-61**
Drive Weight (lbs): 140	**Drop (in): 30** **Hole Diameter (in): 8**
Top of Hole Elevation (ft): See Map	**Hole Location: See Geotechnical Map**

Depth (ft)	Blow Count Per Foot	Sample Depth	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0		0-5'				**Artificial Fill, Undocumented (Afu):**
					SM	Silty SAND; dark yellowish brown, dry to slightly moist, fine to coarse sand
	14	2.5'	105.2	4.5		
						Quaternary Young Alluvial Valley Deposits (Qyv):
5	9	5'	106.6	8.7	SM	Silty SAND; yellow brown, slightly moist, medium dense, fine to coarse sand
	11	7.5'	110.4	3.6		
10	18	10'	113.7	113.7		
15	15	15'	110.5	7.7		
20	29	20'	113.0	11.7		
25	21	25'	107.7	10.2		
30						

42184 Remington Avenue, Temecula, CA 92590

Earth Strata Geotechnical Services, Inc.
Geotechnical, Environmental and Materials Testing Consultants
www.ESGSINC.com (951) 397-8315

Geotechnical Boring Log B-2

Date: June 25, 2020	**Project Name: Grand Avenue, Lake Elsinore** **Page: 2 of 2**
Project Number: 203217-10A	**Logged By: JF**
Drilling Company: Drilling It	**Type of Rig: B-61**
Drive Weight (lbs): 140	**Drop (in): 30** **Hole Diameter (in): 8**
Top of Hole Elevation (ft): See Map	**Hole Location: See Geotechnical Map**

Depth (ft)	Blow Count Per Foot	Sample Depth	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
30	51	30'	-	-		No Recovery at 30 feet
35	56	35'	125.3	12.0		
						Practical Refusal at 37 feet
						Total Depth: 37 feet
						No Groundwater
40						
45						
50						
55						
60						

42184 Remington Avenue, Temecula, CA 92590

Earth Strata Geotechnical Services, Inc.
Geotechnical, Environmental and Materials Testing Consultants
www.ESGSINC.com (951) 397-8315

Geotechnical Boring Log B-3

Date: June 25, 2020	**Project Name: Grand Avenue, Lake Elsinore** **Page: 1 of 1**
Project Number: 203217-10A	**Logged By: JF**
Drilling Company: Drilling It	**Type of Rig: B-61**
Drive Weight (lbs): 140	**Drop (in): 30** **Hole Diameter (in): 8**
Top of Hole Elevation (ft): See Map	**Hole Location: See Geotechnical Map**

Depth (ft)	Blow Count Per Foot	Sample Depth	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0		0-5'				**Artificial Fill, Undocumented (Afu):**
					SM	Silty SAND; dark yellowish brown, slightly moist, loose, fine to coarse sand
	8	2.5'	108.7	5.9		
						Quaternary Young Alluvial Valley Deposits (Qyv):
					SM	Silty SAND; olive brown, slightly moist, medium dense, fine to coarse sand
5	22	5'	124.0	7.8		
	21	7.5'	117.8	7.1		Yellowish brown below 7.5 feet
10	22	10'	116.1	6.8		
15	23	15'	112.0	7.0		
						Total Depth: 16.5 feet
						No Groundwater
20						
25						
30						

42184 Remington Avenue, Temecula, CA 92590

Earth Strata Geotechnical Services, Inc.
Geotechnical, Environmental and Materials Testing Consultants
www.ESGSINC.com (951) 397-8315

Geotechnical Boring Log B-4

Date: June 25, 2020	**Project Name: Grand Avenue, Lake Elsinore** **Page: 1 of 1**
Project Number: 203217-10A	**Logged By: JF**
Drilling Company: Drilling It	**Type of Rig: B-61**
Drive Weight (lbs): 140	**Drop (in): 30** **Hole Diameter (in): 8**
Top of Hole Elevation (ft): See Map	**Hole Location: See Geotechnical Map**

Depth (ft)	Blow Count Per Foot	Sample Depth	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0						**Artificial Fill, Undocumented (Afu):**
					SM	Silty SAND; yellowish brown, slightly moist, loose, fine to coarse sand
	11	2.5'	115.6	7.6		
						Quaternary Young Alluvial Valley Deposits (Qyv):
					SM	Silty SAND; yellowish brown, slightly moist, loose, fine to coarse sand
5	15	5'	118.2	7.9		
	15	7.5'	114.5	6.8		
10	12	10'	118.1	7.2		
15	14	15'	108.0	11.1		
						Total Depth: 16.5 feet
						No Groundwater
20						
25						
30						

42184 Remington Avenue, Temecula, CA 92590

Earth Strata Geotechnical Services, Inc.
Geotechnical, Environmental and Materials Testing Consultants
www.ESGSINC.com (951) 397-8315

APPENDIX C

LABORATORY PROCEDURES AND TEST RESULTS

APPENDIX C

Laboratory Procedures and Test Results

Laboratory testing provided quantitative and qualitative data involving the relevant engineering properties of the representative earth materials selected for testing. The representative samples were tested in general accordance with American Society for Testing and Materials (ASTM) procedures and/or California Test Methods (CTM).

Soil Classification: Earth materials encountered during exploration were classified and logged in general accordance with the Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) of ASTM D 2488. Upon completion of laboratory testing, exploratory logs and sample descriptions were reconciled to reflect laboratory test results with regard to ASTM D 2487.

Grain Size Distribution: Select samples were tested using the guidelines of ASTM D 1140. The test results are presented in the table below.

SAMPLE LOCATION	MATERIAL DESCRIPTION	% PASSING # 200 SIEVE
B-2 @ 7.5 feet	Silty SAND	31
B-2 @ 15 feet	Silty SAND	17
B-2 @ 25 feet	Silty SAND	20
B-2 @ 35 feet	Poorly-graded SAND with Silt	7

Moisture and Density Tests: For select samples moisture content was determined using the guidelines of ASTM D 2216 and dry density determinations were made using the guidelines of ASTM D 2937. These tests were performed on relatively undisturbed samples and the test results are presented on the exploratory logs.

Maximum Density Tests: The maximum dry density and optimum moisture content of representative samples were determined using the guidelines of ASTM D 1557. The test results are presented in the table below.

SAMPLE LOCATION	MATERIAL DESCRIPTION	MAXIMUM DRY DENSITY (pcf)	OPTIMUM MOISTURE CONTENT (%)
Bulk 1 @ 0 - 5 feet	Silty SAND	131.5	7.0

Expansion Index: The expansion potential of representative samples was evaluated using the guidelines of ASTM D 4829. The test results are presented in the table below.

SAMPLE LOCATION	MATERIAL DESCRIPTION	EXPANSION INDEX	EXPANSION POTENTIAL
Bulk 1 @ 0 - 5 feet	Silty SAND	7	Very Low

R-Value: The R-value of representative samples was determined using the guidelines of CTM 301. The test results are presented in the table below.

SAMPLE LOCATION	MATERIAL DESCRIPTION	R-VALUE
Bulk 1 @ 0 - 5 feet	Silty SAND	57

Minimum Resistivity and pH Tests: Minimum resistivity and pH Tests of select samples were performed using the guidelines of CTM 643. The test results are presented in the table below.

SAMPLE LOCATION	MATERIAL DESCRIPTION	pH	MINIMUM RESISTIVITY (ohm-cm)
Bulk 1 @ 0 - 5 feet	Silty SAND	7.3	3,900

Soluble Sulfate: The soluble sulfate content of select samples was determined using the guidelines of CTM 417. The test results are presented in the table below.

SAMPLE LOCATION	MATERIAL DESCRIPTION	SULFATE CONTENT (% by weight)	SULFATE EXPOSURE
Bulk 1 @ 0 - 5 feet	Silty SAND	0.001	Negligible

Chloride Content: Chloride content of select samples was determined using the guidelines of CTM 422. The test results are presented in the table below.

SAMPLE LOCATION	MATERIAL DESCRIPTION	CHLORIDE CONTENT (ppm)
Bulk 1 @ 0 - 5 feet	Silty SAND	50

APPENDIX D

SEISMICITY

ARS Online V3.0.2

Using the tool: Specify latitude and longitude in decimal degrees in the input boxes below. Alternatively, **Google Maps** can be used to find the site location. Specify the time-averaged shear-wave velocity in the upper 30m (Vs30) in the input box. After submitting the data, the USGS 2014 hazard data for a 975-year return period will be reported along with adjustment factors required by Caltrans Seismic Design Criteria (SDC) V2.0.

Latitude: 33.657651 **Longitude:** -117.375674 **Vs30 (m/s):** 270 Submit

Caltrans Design Spectrum (5% damping)

Period(s)	Sa_{2008}(g)	Sa_{2014}(g)	$Basin_{2008}$	$Basin_{2014}$	Near Fault Amp	Design Sa_{2008}(g)	Design Sa_{2014}(g)
PGA	0.65	0.69	1	1	1	0.65	0.69
0.10	1.08	1.14	1	1	1	1.08	1.14
0.20	1.36	1.56	1	1	1	1.36	1.56
0.30	1.4	1.73	1	1	1	1.4	1.73
0.50	1.32	1.64	1	1	1	1.32	1.64
0.75	1.13	1.32	1	1	1.1	1.24	1.45
1.0	0.94	1.08	1	1	1.2	1.12	1.29
2.0	0.53	0.53	1	1	1.2	0.64	0.63
3.0	0.35	0.33	1	1	1.2	0.41	0.39
4.0	0.25	0.22	1	1	1.2	0.3	0.26
5.0	0.2	0.16	1	1	1.2	0.24	0.19

Copy table

Deaggregation (based on 2014 hazard)

mean magnitude (for PGA)	6.66
mean site-source distance (km, for Sa at 1s)	8.5

Option: recalculate Near Fault amplification with user specified distance

Site-source distance (km): 8.5 Update

U.S. Geological Survey - Earthquake Hazards Program

2008 National Seismic Hazard Maps - Source Parameters

New Search

Distance in Kilometers	Name	State	Pref Slip Rate (mm/yr)	Dip (degrees)	Dip Dir	Slip Sense	Rupture Top (km)	Rupture Bottom (km)	Length (km)
0.29	Elsinore;T	CA	5	90	V	strike slip	0	14	52
0.29	Elsinore;T+J+CM	CA	n/a	85	NE	strike slip	0	16	169
0.29	Elsinore;T+J	CA	n/a	86	NE	strike slip	0	17	127
2.35	Elsinore;GI+T+J	CA	n/a	86	NE	strike slip	0	17	153
2.35	Elsinore;GI+T	CA	5	90	V	strike slip	0	14	78
2.35	Elsinore;W+GI+T+J+CM	CA	n/a	84	NE	strike slip	0	16	241
2.35	Elsinore;W+GI+T+J	CA	n/a	84	NE	strike slip	0	16	199
2.35	Elsinore;W+GI+T	CA	n/a	84	NE	strike slip	0	14	124
2.35	Elsinore;GI+T+J+CM	CA	n/a	86	NE	strike slip	0	16	195
2.61	Elsinore;GI	CA	5	90	V	strike slip	0	13	37
2.61	Elsinore;W+GI	CA	n/a	81	NE	strike slip	0	14	83
25.58	Chino, alt 2	CA	1	65	SW	strike slip	0	14	29
27.54	Elsinore;W	CA	2.5	75	NE	strike slip	0	14	46
28.56	San Joaquin Hills	CA	0.5	23	SW	thrust	2	13	27
29.80	Chino, alt 1	CA	1	50	SW	strike slip	0	9	24
35.71	San Jacinto;A+C	CA	n/a	90	V	strike slip	0	17	118
35.71	San Jacinto;A+CC+B+SM	CA	n/a	90	V	strike slip	0.1	15	178
35.71	San Jacinto;A+CC+B	CA	n/a	90	V	strike slip	0.1	15	152

35.71	San Jacinto;A	CA	9	90	V	strike slip	0	17	71
35.71	San Jacinto;A+CC	CA	n/a	90	V	strike slip	0	16	118
37.91	San Jacinto;SBV+SJV+A	CA	n/a	90	V	strike slip	0	16	134
37.91	San Jacinto;SJV+A+CC+B+SM	CA	n/a	90	V	strike slip	0.1	15	196
37.91	San Jacinto;SJV+A+CC+B	CA	n/a	90	V	strike slip	0.1	15	170
37.91	San Jacinto;SJV+A+CC	CA	n/a	90	V	strike slip	0	16	136
37.91	San Jacinto;SJV+A+C	CA	n/a	90	V	strike slip	0	17	136
37.91	San Jacinto;SJV+A	CA	n/a	90	V	strike slip	0	17	89
37.91	San Jacinto;SBV+SJV+A+CC+B+SM	CA	n/a	90	V	strike slip	0.1	15	241
37.91	San Jacinto;SBV+SJV+A+CC+B	CA	n/a	90	V	strike slip	0.1	15	215
37.91	San Jacinto;SBV+SJV+A+CC	CA	n/a	90	V	strike slip	0	16	181
37.91	San Jacinto;SBV+SJV+A+C	CA	n/a	90	V	strike slip	0	17	181
38.04	San Jacinto;SJV	CA	18	90	V	strike slip	0	16	43
38.04	San Jacinto;SBV+SJV	CA	n/a	90	V	strike slip	0	16	88
40.54	Newport-Inglewood (Offshore)	CA	1.5	90	V	strike slip	0	10	66
40.54	Newport Inglewood Connected alt 1	CA	1.3	89		strike slip	0	11	208
40.54	Newport Inglewood Connected alt 2	CA	1.3	90	V	strike slip	0	11	208
41.86	San Jacinto;SBV	CA	6	90	V	strike slip	0	16	45
48.94	Elsinore;J+CM	CA	3	84	NE	strike slip	0	17	118
48.94	Elsinore;J	CA	3	84	NE	strike slip	0	19	75
52.11	Newport-Inglewood, alt 1	CA	1	88		strike slip	0	15	65
52.82	Puente Hills (Coyote Hills)	CA	0.7	26	N	thrust	2.8	15	17

55.66	S. San Andreas;CH+CC+BB+NM+SM+NSB+SSB	CA	n/a	90	V	strike slip	0	14	384
55.66	S. San Andreas;CH+CC+BB+NM+SM+NSB+SSB+BG+CO	CA	n/a	86		strike slip	0.1	13	512
55.66	S. San Andreas;SSB+BG	CA	n/a	71		strike slip	0	13	101
55.66	S. San Andreas;NSB+SSB+BG+CO	CA	n/a	79		strike slip	0.2	12	206
55.66	S. San Andreas;CC+BB+NM+SM+NSB+SSB	CA	n/a	90	V	strike slip	0	14	322
55.66	S. San Andreas;CC+BB+NM+SM+NSB+SSB+BG	CA	n/a	85		strike slip	0	14	380
55.66	S. San Andreas;CC+BB+NM+SM+NSB+SSB+BG+CO	CA	n/a	86		strike slip	0.1	13	449
55.66	S. San Andreas;CH+CC+BB+NM+SM+NSB+SSB+BG	CA	n/a	86		strike slip	0	14	442
55.66	S. San Andreas;NM+SM+NSB+SSB	CA	n/a	90	V	strike slip	0	13	213
55.66	S. San Andreas;NM+SM+NSB+SSB+BG	CA	n/a	83		strike slip	0	14	271
55.66	S. San Andreas;NM+SM+NSB+SSB+BG+CO	CA	n/a	84		strike slip	0.1	13	340
55.66	S. San Andreas;NSB+SSB	CA	n/a	90	V	strike slip	0	13	79
55.66	S. San Andreas;NSB+SSB+BG	CA	n/a	75		strike slip	0	14	136
55.66	S. San Andreas;PK+CH+CC+BB+NM+SM+NSB+SSB	CA	n/a	90	V	strike slip	0.1	13	421
55.66	S. San Andreas;PK+CH+CC+BB+NM+SM+NSB+SSB+BG	CA	n/a	86		strike slip	0.1	13	479
55.66	S. San Andreas;PK+CH+CC+BB+NM+SM+NSB+SSB+BG+CO	CA	n/a	86		strike slip	0.1	13	548
55.66	S. San Andreas;SM+NSB+SSB	CA	n/a	90	V	strike slip	0	13	176
55.66	S. San Andreas;SM+NSB+SSB+BG	CA	n/a	81		strike slip	0	13	234
55.66	S. San Andreas;SM+NSB+SSB+BG+CO	CA	n/a	83		strike slip	0.1	13	303
55.66	S. San Andreas;SSB	CA	16	90	V	strike slip	0	13	43
55.66	S. San Andreas;SSB+BG+CO	CA	n/a	77		strike slip	0.2	12	170
55.66	S. San Andreas;BB+NM+SM+NSB+SSB	CA	n/a	90	V	strike slip	0	14	263

55.66	S. San Andreas;BB+NM+SM+NSB+SSB+BG	CA	n/a	84		strike slip	0	14	321
55.66	S. San Andreas;BB+NM+SM+NSB+SSB+BG+CO	CA	n/a	85		strike slip	0.1	13	390
56.42	S. San Andreas;NM+SM+NSB	CA	n/a	90	V	strike slip	0	13	170
56.42	S. San Andreas;CC+BB+NM+SM+NSB	CA	n/a	90	V	strike slip	0	14	279
56.42	S. San Andreas;NSB	CA	22	90	V	strike slip	0	13	35
56.42	S. San Andreas;SM+NSB	CA	n/a	90	V	strike slip	0	13	133
56.42	S. San Andreas;CH+CC+BB+NM+SM+NSB	CA	n/a	90	V	strike slip	0	14	341
56.42	S. San Andreas;BB+NM+SM+NSB	CA	n/a	90	V	strike slip	0	14	220
56.42	S. San Andreas;PK+CH+CC+BB+NM+SM+NSB	CA	n/a	90	V	strike slip	0.1	13	377
57.30	Cucamonga	CA	5	45	N	thrust	0	8	28
57.68	San Jose	CA	0.5	74	NW	strike slip	0	15	20
59.50	Rose Canyon	CA	1.5	90	V	strike slip	0	8	70
61.70	Sierra Madre Connected	CA	2	51		reverse	0	14	76
61.70	Sierra Madre	CA	2	53	N	reverse	0	14	57
62.41	S. San Andreas;BG	CA	n/a	58		strike slip	0	13	56
62.41	S. San Andreas;BG+CO	CA	n/a	72		strike slip	0.3	12	125
64.83	Palos Verdes	CA	3	90	V	strike slip	0	14	99
64.83	Palos Verdes Connected	CA	3	90	V	strike slip	0	10	285
65.48	Coronado Bank	CA	3	90	V	strike slip	0	9	186
66.83	Puente Hills (Santa Fe Springs)	CA	0.7	29	N	thrust	2.8	15	11
68.94	Cleghorn	CA	3	90	V	strike slip	0	16	25
73.80	North Frontal (West)	CA	1	49	S	reverse	0	16	50
74.81	S. San Andreas;NM+SM	CA	n/a	90	V	strike slip	0	14	134

74.81	S. San Andreas;BB+NM+SM	CA	n/a	90	V	strike slip	0	14	184
74.81	S. San Andreas;PK+CH+CC+BB+NM+SM	CA	n/a	90	V	strike slip	0.1	13	342
74.81	S. San Andreas;SM	CA	29	90	V	strike slip	0	13	98
74.81	S. San Andreas;CH+CC+BB+NM+SM	CA	n/a	90	V	strike slip	0	14	306
74.81	S. San Andreas;CC+BB+NM+SM	CA	n/a	90	V	strike slip	0	14	243
74.89	Pinto Mtn	CA	2.5	90	V	strike slip	0	16	74
77.65	Puente Hills (LA)	CA	0.7	27	N	thrust	2.1	15	22
77.92	Clamshell-Sawpit	CA	0.5	50	NW	reverse	0	14	16
79.88	Raymond	CA	1.5	79	N	strike slip	0	16	22
80.02	San Jacinto;CC+B+SM	CA	n/a	90	V	strike slip	0.2	14	103
80.02	San Jacinto;CC+B	CA	n/a	90	V	strike slip	0.2	14	77
80.02	San Jacinto;CC	CA	4	90	V	strike slip	0	16	43
81.10	Elysian Park (Upper)	CA	1.3	50	NE	reverse	3	15	20
82.13	San Jacinto;C	CA	14	90	V	strike slip	0	17	47
89.16	Verdugo	CA	0.5	55	NE	reverse	0	15	29
90.29	Helendale-So Lockhart	CA	0.6	90	V	strike slip	0	13	114
90.47	Earthquake Valley	CA	2	90	V	strike slip	0	19	20
92.19	North Frontal (East)	CA	0.5	41	S	thrust	0	16	27
94.25	Hollywood	CA	1	70	N	strike slip	0	17	17
96.20	Burnt Mtn	CA	0.6	67	W	strike slip	0	16	21
97.90	Santa Monica Connected alt 2	CA	2.4	44		strike slip	0.8	11	93

USGS

Search Results

1 of 1 earthquakes in map area.

Click for more information

6.5 **Gulf of Santa Catalina, California**
1800-11-22 21:30:00 (UTC) –

Didn't find what you were looking for?

- Check your Settings.
- Which earthquakes are included on the map and list?
- Felt something not shown – report it here.

Earthquakes updated

Hazards by Location

Search Information

Coordinates: 33.657651, -117.375674

Elevation: 1322 ft

Timestamp: 2020-07-22T19:47:59.177Z

Hazard Type: Seismic

Reference Document: ASCE7-16

Risk Category: II

Site Class: D

Basic Parameters

Name	Value	Description
S_S	2.094	MCE_R ground motion (period=0.2s)
S_1	0.747	MCE_R ground motion (period=1.0s)
S_{MS}	2.094	Site-modified spectral acceleration value
S_{M1}	* null	Site-modified spectral acceleration value
S_{DS}	1.396	Numeric seismic design value at 0.2s SA
S_{D1}	* null	Numeric seismic design value at 1.0s SA

* See Section 11.4.8

Additional Information

Name	Value	Description
SDC	* null	Seismic design category
F_a	1	Site amplification factor at 0.2s
F_v	* null	Site amplification factor at 1.0s
CR_S	0.899	Coefficient of risk (0.2s)
CR_1	0.899	Coefficient of risk (1.0s)
PGA	0.895	MCE_G peak ground acceleration
F_{PGA}	1.1	Site amplification factor at PGA
PGA_M	0.985	Site modified peak ground acceleration
T_L	8	Long-period transition period (s)

SsRT	2.094	Probabilistic risk-targeted ground motion (0.2s)
SsUH	2.33	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
SsD	2.299	Factored deterministic acceleration value (0.2s)
S1RT	0.747	Probabilistic risk-targeted ground motion (1.0s)
S1UH	0.832	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
S1D	0.912	Factored deterministic acceleration value (1.0s)
PGAd	0.969	Factored deterministic acceleration value (PGA)

* See Section 11.4.8

The results indicated here DO NOT reflect any state or local amendments to the values or any delineation lines made during the building code adoption process. Users should confirm any output obtained from this tool with the local Authority Having Jurisdiction before proceeding with design.

Disclaimer

Hazard loads are provided by the U.S. Geological Survey Seismic Design Web Services.

While the information presented on this website is believed to be correct, ATC and its sponsors and contributors assume no responsibility or liability for its accuracy. The material presented in the report should not be used or relied upon for any specific application without competent examination and verification of its accuracy, suitability and applicability by engineers or other licensed professionals. ATC does not intend that the use of this information replace the sound judgment of such competent professionals, having experience and knowledge in the field of practice, nor to substitute for the standard of care required of such professionals in interpreting and applying the results of the report provided by this website. Users of the information from this website assume all liability arising from such use. Use of the output of this website does not imply approval by the governing building code bodies responsible for building code approval and interpretation for the building site described by latitude/longitude location in the report.

APPENDIX E

LIQUEFACTION ANALYSIS

LIQUEFACTION & SETTLEMENT OF SANDS ANALYSIS

Project Name: GRAND AVE / ORTEGA HWY
Project Number: 203217-10A
Boring Number: B-2 (INSITU)

Horizontal Ground Acceleration (% g)	0.895	Energy Ratio C_E (Auto-hammer)	1.70
Analyzed Groundwater Depth (feet)	5.0	Borehole Diameter C_B (6 - 8 inches)	1.00
Average Wet Unit Weight (pcf)	120.8	Groundwater Depth in Boring (feet)	>30
Design Magnitude Earthquake	7.7		
Magnitude Scaling Factor (MSF)	0.9		

Depth (feet)	Blow Count SPT	Blow Count Cal. Mod.	SPT N_m	Total Stress (tons/ft2)	Effective Stress (tons/ft2)	Fines Content FC(%)	C_R	Overburden C_N	rd	Sampler Type C_S	$(N_1)_{60}$	$(N_1)_{60cs}$	NCEER 1998 CSR	NCEER 1998 CRR*MSF	Liquefaction Safety Factor	Layer Thickness t (ft)	Layer Thickness t (inches)	Percent Volumetric Strain	Settlement Per Sand Layer (inches)
3		30	22.680	0.181	0.181	31	0.75	1.59	0.99	1.00	46	58	0.58	---	Corrected SPT >30*	3.00	36.00	0.00	0.00
6		30	22.680	0.362	0.331	31	0.75	1.41	0.99	1.00	41	52	0.63	---	Corrected SPT >30*	3.00	36.00	0.00	0.00
9		30	22.680	0.544	0.419	31	0.75	1.26	0.98	1.00	36	47	0.74	---	Corrected SPT >30*	3.00	36.00	0.00	0.00
12		30	22.680	0.725	0.506	31	0.85	1.14	0.97	1.00	37	48	0.81	---	Corrected SPT >30*	3.00	36.00	0.00	0.00
14		25	18.900	0.846	0.565	17	0.85	1.08	0.97	1.00	29	34	0.84	---	Corrected SPT >30*	2.00	24.00	0.00	0.00
16		15	11.340	0.966	0.623	17	0.85	1.02	0.96	1.00	17	21	0.87	0.2090	0.24	2.00	24.00	1.90	0.46
21		29	21.924	1.268	0.769	17	0.95	0.89	0.95	1.00	32	36	0.91	---	Corrected SPT >30*	5.00	60.00	0.00	0.00
26		21	15.876	1.570	0.915	20	0.95	0.79	0.94	1.00	20	26	0.94	0.2842	0.30	5.00	60.00	1.60	0.96
31		51	38.556	1.872	1.061	20	1.00	0.72	0.92	1.00	47	54	0.95	---	Corrected SPT >30*	5.00	60.00	0.00	0.00
36		56	42.336	2.174	1.207	7	1.00	0.65	0.88	1.00	47	47	0.92	---	Corrected SPT >30*	5.00	60.00	0.00	0.00

Total Settlement (inches): 1.4

Procedure established by T.L. Youd and I.M. Idriss, et. al., 1996 NCEER-96-0022 Workshop & S.C.E.C. SP117
Evaluation of settlements in sand due to earthquake shaking, Tokimatsu and Seed, 1987

3 Extension of rod above boring (feet)

* CRR 7.5 is not defined for $(N_1)60cs$ greater than 30. Soils with (N1)60cs > 30 are considered too dense to liquefy (NCEER Workshop)

$(N_1)_{60} = N_M C_N C_E C_B C_R C_S$ $(N_1)_{60CS} = K_S(N_1)_{60}$

LIQUEFACTION & SETTLEMENT OF SANDS ANALYSIS

Project Name: GRAND AVE / ORTEGA HWY
Project Number: 203217-10A
Boring Number: B-2 (5-foot-removals)

Horizontal Ground Acceleration (% g)	0.895	Energy Ratio C_E (Auto-hammer)	1.70
Analyzed Groundwater Depth (feet)	5.0	Borehole Diameter C_B (6 - 8 inches)	1.00
Average Wet Unit Weight (pcf)	120.8	Groundwater Depth in Boring (feet)	> 30 feet
Design Magnitude Earthquake	7.7		
Magnitude Scaling Factor (MSF)	0.9		

Depth (feet)	Blow Count SPT	Blow Count Cal. Mod.	SPT N_m	Total Stress (tons/ft2)	Effective Stress (tons/ft2)	Fines Content FC(%)	C_R	Overburden C_N	rd	Sampler Type C_S	$(N_1)_{60}$	$(N_1)_{60cs}$	NCEER 1998 CSR	NCEER 1998 CRR*MSF	Liquefaction Safety Factor	Layer Thickness t (ft)	Layer Thickness t (inches)	Percent Volumetric Strain	Settlement Per Sand Layer (inches)
3		30	22.680	0.181	0.181	31	0.75	1.59	0.99	1.00	46	58	0.58	---	Corrected SPT >30*	3.00	36.00	0.00	0.00
6		30	22.680	0.362	0.331	31	0.75	1.41	0.99	1.00	41	52	0.63	---	Corrected SPT >30*	3.00	36.00	0.00	0.00
9		11	8.316	0.544	0.419	31	0.75	1.26	0.98	1.00	13	20	0.74	0.2051	0.28	3.00	36.00	2.10	0.76
12		18	13.608	0.725	0.506	31	0.85	1.14	0.97	1.00	22	31	0.81	0.5109	Corrected SPT >30*	3.00	36.00	0.00	0.00
14		25	18.900	0.846	0.565	17	0.85	1.08	0.97	1.00	29	34	0.84	---	Corrected SPT >30*	2.00	24.00	0.00	0.00
16		15	11.340	0.966	0.623	17	0.85	1.02	0.96	1.00	17	21	0.87	0.2090	0.24	2.00	24.00	1.90	0.46
21		29	21.924	1.268	0.769	17	0.95	0.89	0.95	1.00	32	36	0.91	---	Corrected SPT >30*	5.00	60.00	0.00	0.00
26		21	15.876	1.570	0.915	20	0.95	0.79	0.94	1.00	20	26	0.94	0.2842	0.30	5.00	60.00	1.60	0.96
31		51	38.556	1.872	1.061	20	1.00	0.72	0.92	1.00	47	54	0.95	---	Corrected SPT >30*	5.00	60.00	0.00	0.00
36		56	42.336	2.174	1.207	7	1.00	0.65	0.88	1.00	47	47	0.92	---	Corrected SPT >30*	5.00	60.00	0.00	0.00

Total Settlement (inches): 2.2

Procedure established by T.L. Youd and I.M. Idriss, et. al., 1996 NCEER-96-0022 Workshop & S.C.E.C. SP117
Evaluation of settlements in sand due to earthquake shaking, Tokimatsu and Seed, 1987

3 Extension of rod above boring (feet)

* CRR 7.5 is not defined for $(N_1)60cs$ greater than 30. Soils with (N1)60cs > 30 are considered too dense to liquefy (NCEER Workshop)

$(N_1)_{60} = N_M C_N C_E C_B C_R C_S$ $(N_1)_{60CS} = K_S(N_1)_{60}$

LIQUEFACTION & SETTLEMENT OF SANDS ANALYSIS

Project Name: GRAND AVE / ORTEGA HWY
Project Number: 203217-10A
Boring Number: B-2 (7-foot-removals)

Horizontal Ground Acceleration (% g)	0.895	Energy Ratio C_E (Auto-hammer)	1.70
Analyzed Groundwater Depth (feet)	5.0	Borehole Diameter C_B (6 - 8 inches)	1.00
Average Wet Unit Weight (pcf)	120.8	Groundwater Depth in Boring (feet)	> 30 feet
Design Magnitude Earthquake	7.7		
Magnitude Scaling Factor (MSF)	0.9		

Depth (feet)	Blow Count SPT	Blow Count Cal. Mod.	SPT N_m	Total Stress (tons/ft2)	Effective Stress (tons/ft2)	Fines Content FC(%)	C_R	Overburden C_N	rd	Sampler Type C_S	$(N_1)_{60}$	$(N_1)_{60cs}$	NCEER 1998 CSR	NCEER 1998 CRR*MSF	Liquefaction Safety Factor	Layer Thickness t (ft)	Layer Thickness t (inches)	Percent Volumetric Strain	Settlement Per Sand Layer (inches)
3		30	22.680	0.181	0.181	4.8	0.75	1.59	0.99	1.00	46	46	0.58	---	Corrected SPT >30*	3.00	36.00	0.00	0.00
6		30	22.680	0.362	0.331	31	0.75	1.41	0.99	1.00	41	52	0.63	---	Corrected SPT >30*	3.00	36.00	0.00	0.00
9		30	22.680	0.544	0.419	31	0.75	1.26	0.98	1.00	36	47	0.74	---	Corrected SPT >30*	3.00	36.00	0.00	0.00
12		18	13.608	0.725	0.506	31	0.85	1.14	0.97	1.00	22	31	0.81	0.5109	Corrected SPT >30*	3.00	36.00	0.00	0.00
14		25	18.900	0.846	0.565	17	0.85	1.08	0.97	1.00	29	34	0.84	---	Corrected SPT >30*	2.00	24.00	0.00	0.00
16		15	11.340	0.966	0.623	17	0.85	1.02	0.96	1.00	17	21	0.87	0.2090	0.24	2.00	24.00	1.90	0.46
21		29	21.924	1.268	0.769	17	0.95	0.89	0.95	1.00	32	36	0.91	---	Corrected SPT >30*	5.00	60.00	0.00	0.00
26		21	15.876	1.570	0.915	20	0.95	0.79	0.94	1.00	20	26	0.94	0.2842	0.30	5.00	60.00	1.60	0.96
31		51	38.556	1.872	1.061	20	1.00	0.72	0.92	1.00	47	54	0.95	---	Corrected SPT >30*	5.00	60.00	0.00	0.00
36		56	42.336	2.174	1.207	7	1.00	0.65	0.88	1.00	47	47	0.92	---	Corrected SPT >30*	5.00	60.00	0.00	0.00

Total Settlement (inches): 1.4

Procedure established by T.L. Youd and I.M. Idriss, et. al., 1996 NCEER-96-0022 Workshop & S.C.E.C. SP117
Evaluation of settlements in sand due to earthquake shaking, Tokimatsu and Seed, 1987

3 Extension of rod above boring (feet)

* CRR 7.5 is not defined for $(N_1)60cs$ greater than 30. Soils with (N1)60cs > 30 are considered too dense to liquefy (NCEER Workshop)

$(N_1)_{60} = N_M C_N C_E C_B C_R C_S$ $(N_1)_{60CS} = K_S(N_1)_{60}$

LIQUEFACTION & SETTLEMENT OF SANDS ANALYSIS

Project Name: GRAND AVE / ORTEGA HWY
Project Number: 203217-10A
Boring Number: B-2 (10-foot-removals)

Horizontal Ground Acceleration (% g)	0.895	Energy Ratio C_E (Auto-hammer)	1.70
Analyzed Groundwater Depth (feet)	5.0	Borehole Diameter C_B (6 - 8 inches)	1.00
Average Wet Unit Weight (pcf)	120.8	Groundwater Depth in Boring (feet)	> 30 feet
Design Magnitude Earthquake	7.7		
Magnitude Scaling Factor (MSF)	0.9		

Depth (feet)	Blow Count SPT	Blow Count Cal. Mod.	SPT N_m	Total Stress (tons/ft2)	Effective Stress (tons/ft2)	Fines Content FC(%)	C_R	Overburden C_N	rd	Sampler Type C_S	$(N_1)_{60}$	$(N_1)_{60cs}$	NCEER 1998 CSR	NCEER 1998 CRR*MSF	Liquefaction Safety Factor	Layer Thickness t (ft)	Layer Thickness t (inches)	Percent Volumetric Strain	Settlement Per Sand Layer (inches)
3		30	22.680	0.181	0.181	4.8	0.75	1.59	0.99	1.00	46	46	0.58	---	Corrected SPT >30*	3.00	36.00	0.00	0.00
6		30	22.680	0.362	0.331	31	0.75	1.41	0.99	1.00	41	52	0.63	---	Corrected SPT >30*	3.00	36.00	0.00	0.00
9		30	22.680	0.544	0.419	31	0.75	1.26	0.98	1.00	36	47	0.74	---	Corrected SPT >30*	3.00	36.00	0.00	0.00
12		30	22.680	0.725	0.506	31	0.85	1.14	0.97	1.00	37	48	0.81	---	Corrected SPT >30*	3.00	36.00	0.00	0.00
14		25	18.900	0.846	0.565	17	0.85	1.08	0.97	1.00	29	34	0.84	---	Corrected SPT >30*	2.00	24.00	0.00	0.00
16		15	11.340	0.966	0.623	17	0.85	1.02	0.96	1.00	17	21	0.87	0.2090	0.24	2.00	24.00	1.90	0.46
21		29	21.924	1.268	0.769	17	0.95	0.89	0.95	1.00	32	36	0.91	---	Corrected SPT >30*	5.00	60.00	0.00	0.00
26		21	15.876	1.570	0.915	20	0.95	0.79	0.94	1.00	20	26	0.94	0.2842	0.30	5.00	60.00	1.60	0.96
31		51	38.556	1.872	1.061	20	1.00	0.72	0.92	1.00	47	54	0.95	---	Corrected SPT >30*	5.00	60.00	0.00	0.00
36		56	42.336	2.174	1.207	7	1.00	0.65	0.88	1.00	47	47	0.92	---	Corrected SPT >30*	5.00	60.00	0.00	0.00

Total Settlement (inches): 1.4

Procedure established by T.L. Youd and I.M. Idriss, et. al., 1996 NCEER-96-0022 Workshop & S.C.E.C. SP117
Evaluation of settlements in sand due to earthquake shaking, Tokimatsu and Seed, 1987

3 Extension of rod above boring (feet)

* CRR 7.5 is not defined for $(N_1)60cs$ greater than 30. Soils with (N1)60cs > 30 are considered too dense to liquefy (NCEER Workshop)

$(N_1)_{60} = N_M C_N C_E C_B C_R C_S$ $(N_1)_{60CS} = K_S(N_1)_{60}$

APPENDIX F

ASPHALT CONCRETE PAVEMENT CALCULATIONS

PAVING DESIGN

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

JN: **203217-10A** CONSULT: **SMP**
PROJECT: **GRAND AVE / ORTEGA HWY**

CALCULATION SHEET # **AutoParking**

CALTRANS METHOD FOR DESIGN OF FLEXIBLE PAVEMENT

Input "R" value or "CBR" of native soil	50	
Type of Index Property - "R" value or "CBR" (C or R)	R	R Value
R Value used for Caltrans Method	50	
Input Traffic Index (TI)	5	
Calculated Total Gravel Equivalent (GE)	0.8	feet
Calculated Total Gravel Equivalent (GE)	9.6	inches
Calculated Gravel Factor (Gf) for A/C paving	2.53	
Gravel Factor for Base Course (Gf)	1.1	

Pavement sections provided below are considered equal; but, do not reflect reviewing agency minimums.

Gravel Equivalent GE (feet)	GE (inches)	Delta (inches)	INCHES A/C Section Thickness (inches)	INCHES Minimum Base (inches)	FEET A/C Section Thickness (feet)	FEET Minimum Base (feet)
0.63	7.60	2.00	3.0	1.8	0.25	0.15
0.69	8.24	1.36	3.3	1.2	0.27	0.10
0.74	8.87	0.73	3.5	0.6	0.29	0.05
0.79	9.51	0.09	3.8	0.0	0.31	0.00
0.84	10.14	-0.54	4.0	0.0	0.33	0.00
0.90	10.77	-1.17	4.3	0.0	0.35	0.00
0.95	11.41	-1.81	4.5	0.0	0.38	0.00
1.06	12.67	-3.07	5.0	0.0	0.42	0.00
1.27	15.21	-5.61	6.0	0.0	0.50	0.00
2.11	25.35	-15.75	10.0	0.0	0.83	0.00
2.53	30.42	-20.82	12.0	0.0	1.00	0.00

PAVING DESIGN

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

JN: **203217-10A** CONSULT: **SMP**
PROJECT: **GRAND AVE / ORTEGA HWY**

CALCULATION SHEET # **AutoDrives**

CALTRANS METHOD FOR DESIGN OF FLEXIBLE PAVEMENT

Input "R" value or "CBR" of native soil	50	
Type of Index Property - "R" value or "CBR" (C or R)	R	R Value
R Value used for Caltrans Method	50	
Input Traffic Index (TI)	6	
Calculated Total Gravel Equivalent (GE)	0.96	feet
Calculated Total Gravel Equivalent (GE)	11.52	inches
Calculated Gravel Factor (Gf) for A/C paving	2.31	
Gravel Factor for Base Course (Gf)	1.1	

Pavement sections provided below are considered equal; but, do not reflect reviewing agency minimums.

Gravel Equivalent GE (feet)	GE (inches)	Delta (inches)	INCHES A/C Section Thickness (inches)	Minimum Base (inches)	FEET A/C Section Thickness (feet)	Minimum Base (feet)
0.58	6.94	4.58	3.0	4.2	0.25	0.35
0.63	7.52	4.00	3.3	3.6	0.27	0.30
0.67	8.10	3.42	3.5	3.0	0.29	0.25
0.72	8.68	2.84	3.8	2.4	0.31	0.20
0.77	9.26	2.26	4.0	1.8	0.33	0.15
0.82	9.83	1.69	4.3	1.8	0.35	0.15
0.87	10.41	1.11	4.5	1.2	0.38	0.10
0.96	11.57	-0.05	5.0	0.0	0.42	0.00
1.16	13.88	-2.36	6.0	0.0	0.50	0.00
1.93	23.14	-11.62	10.0	0.0	0.83	0.00
2.31	27.77	-16.25	12.0	0.0	1.00	0.00

PAVING DESIGN

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

JN: **203217-10A** CONSULT: **SMP**
PROJECT: **GRAND AVE / ORTEGA HWY**

CALCULATION SHEET # **Entrances/TruckDrives**

CALTRANS METHOD FOR DESIGN OF FLEXIBLE PAVEMENT

Input "R" value or "CBR" of native soil	50	
Type of Index Property - "R" value or "CBR" (C or R)	R	R Value
R Value used for Caltrans Method	50	
Input Traffic Index (TI)	7	
Calculated Total Gravel Equivalent (GE)	1.12	feet
Calculated Total Gravel Equivalent (GE)	13.44	inches
Calculated Gravel Factor (Gf) for A/C paving	2.14	
Gravel Factor for Base Course (Gf)	1.1	

Pavement sections provided below are considered equal; but, do not reflect reviewing agency minimums.

Gravel Equivalent GE (feet)	GE (inches)	Delta (inches)	INCHES A/C Section Thickness (inches)	Minimum Base (inches)	FEET A/C Section Thickness (feet)	Minimum Base (feet)
0.62	7.50	5.94	3.5	5.4	0.29	0.45
0.67	8.03	5.41	3.8	4.8	0.31	0.40
0.71	8.57	4.87	4.0	4.2	0.33	0.35
0.80	9.64	3.80	4.5	3.6	0.38	0.30
0.89	10.71	2.73	5.0	2.4	0.42	0.20
0.98	11.78	1.66	5.5	1.8	0.46	0.15
1.07	12.85	0.59	6.0	0.6	0.50	0.05
1.25	15.00	-1.56	7.0	0.0	0.58	0.00
1.43	17.14	-3.70	8.0	0.0	0.67	0.00
1.79	21.42	-7.98	10.0	0.0	0.83	0.00
2.14	25.71	-12.27	12.0	0.0	1.00	0.00

APPENDIX G

GENERAL EARTHWORK AND GRADING SPECIFICATIONS

EARTH-STRATA

General Earthwork and Grading Specifications

General

Intent: These General Earthwork and Grading Specifications are intended to be the minimum requirements for the grading and earthwork shown on the approved grading plan(s) and/or indicated in the geotechnical report(s). These General Earthwork and Grading Specifications should be considered a part of the recommendations contained in the geotechnical report(s) and if they are in conflict with the geotechnical report(s), the specific recommendations in the geotechnical report shall supersede these more general specifications. Observations made during earthwork operations by the project Geotechnical Consultant may result in new or revised recommendations that may supersede these specifications and/or the recommendations in the geotechnical report(s).

The Geotechnical Consultant of Record: The Owner shall employ a qualified Geotechnical Consultant of Record (Geotechnical Consultant), prior to commencement of grading or construction. The Geotechnical Consultant shall be responsible for reviewing the approved geotechnical report(s) and accepting the adequacy of the preliminary geotechnical findings, conclusions, and recommendations prior to the commencement of the grading or construction.

Prior to commencement of grading or construction, the Owner shall coordinate with the Geotechnical Consultant, and Earthwork Contractor (Contractor) to schedule sufficient personnel for the appropriate level of observation, mapping, and compaction testing.

During earthwork and grading operations, the Geotechnical Consultant shall observe, map, and document the subsurface conditions to confirm assumptions made during the geotechnical design phase of the project. Should the observed conditions differ significantly from the interpretive assumptions made during the design phase, the Geotechnical Consultant shall recommend appropriate changes to accommodate the observed conditions, and notify the reviewing agency where required.

The Geotechnical Consultant shall observe the moisture conditioning and processing of the excavations and fill materials. The Geotechnical Consultant should perform periodic relative density testing of fill materials to verify that the attained level of compaction is being accomplished as specified.

The Earthwork Contractor: The Earthwork Contractor (Contractor) shall be qualified, experienced, and knowledgeable in earthwork logistics, preparation and processing of earth materials to receive compacted fill, moisture-conditioning and processing of fill, and compacting fill. The Contractor shall be provided with the approved grading plans and geotechnical report(s) for his review and acceptance of responsibilities, prior to commencement of grading. The Contractor shall be solely responsible for performing the grading in accordance with the approved grading plans and geotechnical report(s). Prior to commencement of grading, the Contractor shall prepare and submit to the Owner and the Geotechnical Consultant a work plan that indicates the sequence of earthwork grading, the number of "equipment" of work and the estimated quantities of daily earthwork contemplated for the site. The Contractor shall inform the Owner and the Geotechnical Consultant of work schedule changes and revisions to the work plan at least 24 hours in advance of such changes so that appropriate personnel will be available for observation and testing. No assumptions shall be made by the Contractor with regard to whether the Geotechnical Consultant is aware of all grading operations.

It is the sole responsibility of the Contractor to provide adequate equipment and methods to accomplish the earthwork operations in accordance with the applicable grading codes and agency ordinances, these specifications, and the recommendations in the approved geotechnical report(s) and grading plan(s). At the sole discretion of the Geotechnical Consultant, any unsatisfactory conditions, such as unsuitable earth materials, improper moisture conditioning, inadequate compaction, insufficient buttress keyway size, adverse weather conditions, etc., resulting in a quality of work less than required in the approved grading plans and geotechnical report(s), the Geotechnical Consultant shall reject the work and may recommend to the Owner that grading be stopped until conditions are corrected.

Preparation of Areas for Compacted Fill

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

The Geotechnical Consultant shall evaluate the extent of these removals on a site by site basis. Earth materials to be placed as compacted fill shall not contain more than 1 percent organic materials (by volume). No compacted fill lift shall contain more than 10 percent organic matter.

Should potentially hazardous materials be encountered, the Contractor shall stop work in the affected area, and a hazardous materials specialist shall immediately be consulted to evaluate the potentially hazardous materials, prior to continuing to work in that area.

It is our understanding that the State of California defines most refined petroleum products (gasoline, diesel fuel, motor oil, grease, coolant, etc.) as hazardous waste. As such, indiscriminate dumping or spillage of these fluids may constitute a misdemeanor, punishable by fines and/or imprisonment, and shall be prohibited. The contractor is responsible for all hazardous waste related to his operations. The Geotechnical Consultant does not have expertise in this area. If hazardous waste is a concern, then the Owner should contract the services of a qualified environmental assessor.

Processing: Exposed earth materials that have been observed to be satisfactory for support of compacted fill by the Geotechnical Consultant shall be scarified to a minimum depth of 6 inches. Exposed earth materials that are not observed to be satisfactory shall be removed or alternative recommendations may be provided by the Geotechnical Consultant. Scarification shall continue until the exposed earth materials are broken down and free of oversize material and the working surface is reasonably uniform, flat, and free of uneven features that would inhibit uniform compaction. The earth materials should be moistened or air dried to near optimum moisture content, prior to compaction.

Overexcavation: The Cut Lot Typical Detail and Cut/Fill Transition Lot Typical Detail, included herein provides a graphic illustration that depicts typical overexcavation recommendations made in the approved geotechnical report(s) and/or grading plan(s).

Keyways and Benching: Where fills are to be placed on slopes steeper than 5:1 (horizontal to vertical units), the ground shall be thoroughly benched as compacted fill is placed. Please see the three Keyway and Benching Typical Details with subtitles Cut Over Fill Slope, Fill Over Cut Slope, and Fill Slope for a graphic illustration. The lowest bench or smallest keyway shall be a minimum of 15 feet wide (or ½ the proposed slope height) and at least 2 feet into competent earth materials as advised by the Geotechnical Consultant. Typical benches shall be excavated a minimum height of 4 feet into competent earth materials or as recommended by the Geotechnical Consultant. Fill placed on slopes steeper than 5:1 should be thoroughly benched or otherwise excavated to provide a flat subgrade for the compacted fill.

Evaluation/Acceptance of Bottom Excavations: All areas to receive compacted fill (bottom excavations), including removal excavations, processed areas, keyways, and benching, shall be observed, mapped, general elevations recorded, and/or tested prior to being accepted by the Geotechnical Consultant as suitable to receive compacted fill. The Contractor shall obtain a written acceptance from the Geotechnical Consultant prior to placing compacted fill. A licensed surveyor shall provide the survey control for determining elevations of bottom excavations, processed areas, keyways, and

benching. The Geotechnical Consultant is not responsible for erroneously located, fills, subdrain systems, or excavations.

Fill Materials

General: Earth material to be used as compacted fill should to a large extent be free of organic matter and other deleterious substances as evaluated and accepted by the Geotechnical Consultant.

Oversize: Oversize material is rock that does not break down into smaller pieces and has a maximum diameter greater than 8 inches. Oversize rock shall not be included within compacted fill unless specific methods and guidelines acceptable to the Geotechnical Consultant are followed. For examples of methods and guidelines of oversize rock placement see the enclosed Oversize Rock Disposal Detail. The inclusion of oversize materials in the compacted fill shall only be acceptable if the oversize material is completely surrounded by compacted fill or thoroughly jetted granular materials. No oversize material shall be placed within 10 vertical feet of finish grade or within 2 feet of proposed utilities or underground improvements.

Import: Should imported earth materials be required, the proposed import materials shall meet the requirements of the Geotechnical Consultant. Well graded, very low expansion potential earth materials free of organic matter and other deleterious substances are usually sought after as import materials. However, it is generally in the Owners best interest that potential import earth materials are provided to the Geotechnical Consultant to determine their suitability for the intended purpose. At least 48 hours should be allotted for the appropriate laboratory testing to be performed, prior to starting the import operations.

Fill Placement and Compaction Procedures

Fill Layers: Fill materials shall be placed in areas prepared to receive fill in nearly horizontal layers not exceeding 8 inches in loose thickness. Thicker layers may be accepted by the Geotechnical Consultant, provided field density testing indicates that the grading procedures can adequately compact the thicker layers. Each layer of fill shall be spread evenly and thoroughly mixed to obtain uniformity within the earth materials and consistent moisture throughout the fill.

Moisture Conditioning of Fill: Earth materials to be placed as compacted fill shall be watered, dried, blended, and/or mixed, as needed to obtain relatively uniform moisture contents that are at or slightly above optimum. The maximum density and optimum moisture content tests should be performed in accordance with the American Society of Testing and Materials (ASTM test method D1557-00).

Compaction of Fill: After each layer has been moisture-conditioned, mixed, and evenly spread, it should be uniformly compacted to a minimum of 90 percent of maximum dry density as determined by ASTM test method D1557-00. Compaction equipment shall be adequately sized and be either specifically designed for compaction of earth materials or be proven to consistently achieve the required level of compaction.

Compaction of Fill Slopes: In addition to normal compaction procedures specified above, additional effort to obtain compaction on slopes is needed. This may be accomplished by backrolling of slopes with sheepsfoot rollers as the fill is being placed, by overbuilding the fill slopes, or by other methods producing results that are satisfactory to the Geotechnical Consultant. Upon completion of grading, relative compaction of the fill and the slope face shall be a minimum of 90 percent of maximum density per ASTM test method D1557-00.

Compaction Testing of Fill: Field tests for moisture content and relative density of the compacted fill earth materials shall be periodically performed by the Geotechnical Consultant. The location and frequency of tests shall be at the Geotechnical Consultant's discretion based on field observations. Compaction test locations will not necessarily be random. The test locations may or may not be selected to verify minimum compaction requirements in areas that are typically prone to inadequate compaction, such as close to slope faces and near benching.

Frequency of Compaction Testing: Compaction tests shall be taken at minimum intervals of every 2 vertical feet and/or per 1,000 cubic yards of compacted materials placed. Additionally, as a guideline, at least one (1) test shall be taken on slope faces for each 5,000 square feet of slope face and/or for each 10 vertical feet of slope. The Contractor shall assure that fill placement is such that the testing schedule described herein can be accomplished by the Geotechnical Consultant. The Contractor shall stop or slow down the earthwork operations to a safe level so that these minimum standards can be obtained.

Compaction Test Locations: The approximate elevation and horizontal coordinates of each test location shall be documented by the Geotechnical Consultant. The Contractor shall coordinate with the Surveyor to assure that sufficient grade stakes are established. This will provide the Geotechnical Consultant with sufficient accuracy to determine the approximate test locations and elevations. The Geotechnical Consultant can not be responsible for staking erroneously located by the Surveyor or Contractor. A minimum of two grade stakes should be provided at a maximum horizontal distance of 100 feet and vertical difference of less than 5 feet.

Subdrain System Installation

Subdrain systems shall be installed in accordance with the approved geotechnical report(s), the approved grading plan, and the typical details provided herein. The Geotechnical Consultant may recommend additional subdrain systems and/or changes to the subdrain systems described herein, with regard to the extent, location, grade, or material depending on conditions encountered during grading or other factors. All subdrain systems shall be surveyed by a licensed land surveyor (except for retaining wall subdrain systems) to verify line and grade after installation and prior to burial. Adequate time should be allowed by the Contractor to complete these surveys.

Excavation

All excavations and over-excavations for remedial purposes shall be evaluated by the Geotechnical Consultant during grading operations. Remedial removal depths indicated on the geotechnical plans are estimates only. The actual removal depths and extent shall be determined by the Geotechnical Consultant based on the field evaluation of exposed conditions during grading operations. Where fill over cut slopes are planned, the cut portion of the slope shall be excavated, evaluated, and accepted by the Geotechnical Consultant prior to placement of the fill portion of the proposed slope, unless specifically addressed by the Geotechnical Consultant. Typical details for cut over fill slopes and fill over cut slopes are provided herein.

Trench Backfill

1) The Contractor shall follow all OHSA and Cal/OSHA requirements for trench excavation safety.

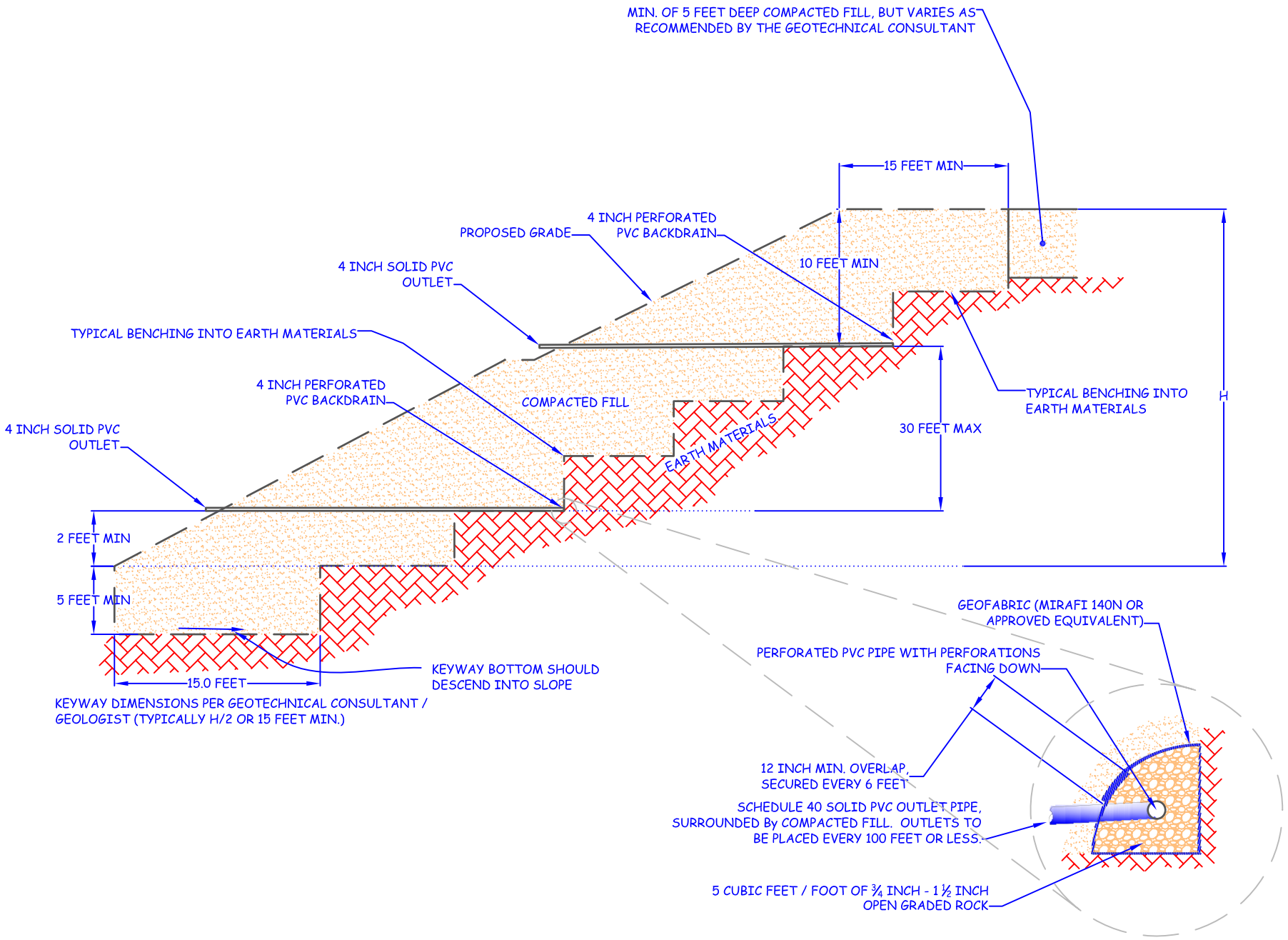
2) Bedding and backfill of utility trenches shall be done in accordance with the applicable provisions in the Standard Specifications of Public Works Construction. Bedding materials shall have a Sand Equivalency more than 30 (SE>30). The bedding shall be placed to 1 foot over the conduit and thoroughly jetting to provide densification. Backfill should be compacted to a minimum of 90 percent of maximum dry density, from 1 foot above the top of the conduit to the surface.

3) Jetting of the bedding materials around the conduits shall be observed by the Geotechnical Consultant.

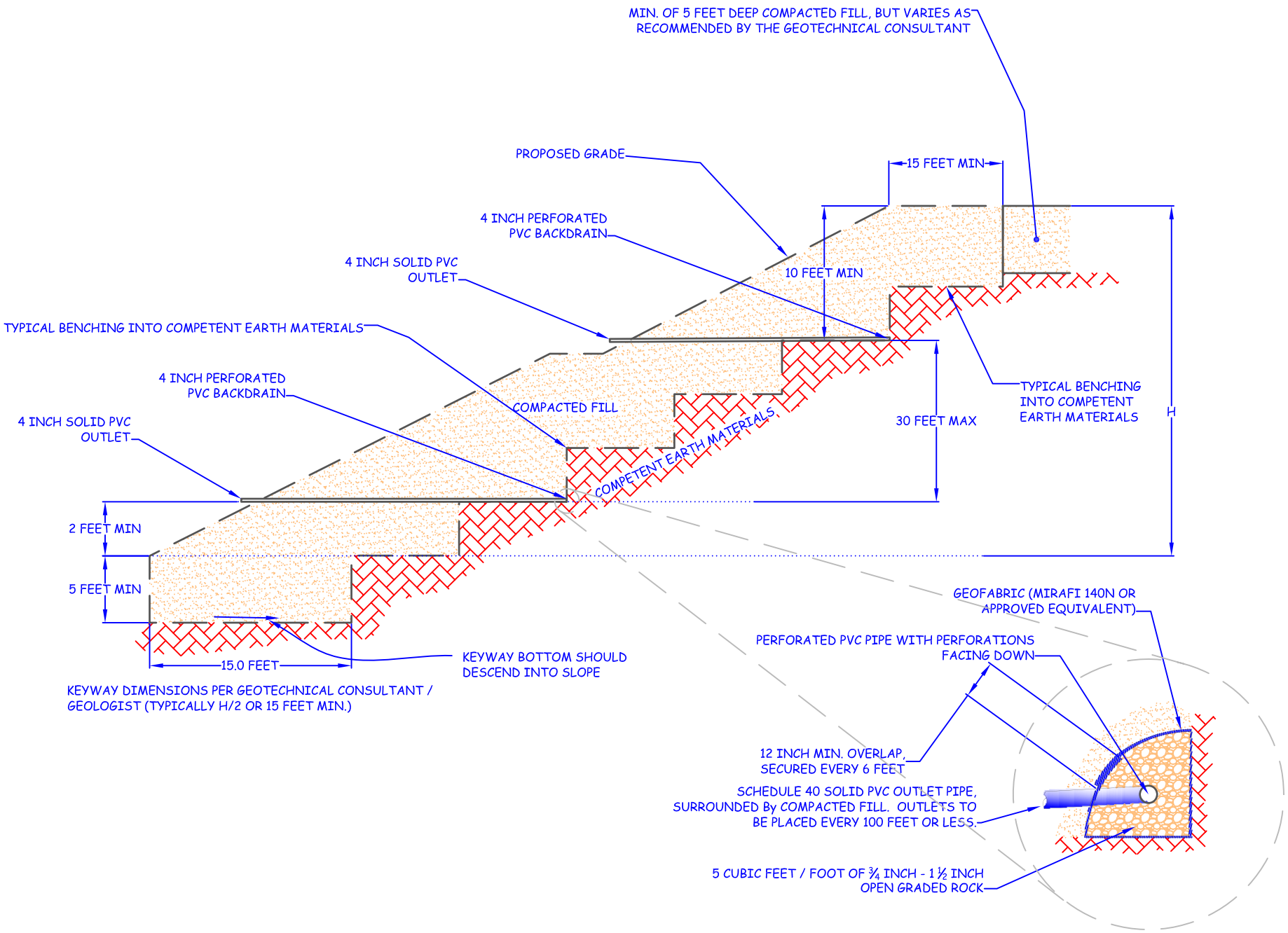
4) The Geotechnical Consultant shall test trench backfill for the minimum compaction requirements recommended herein. At least one test should be conducted for every 300 linear feet of trench and for each 2 vertical feet of backfill.

5) For trench backfill the lift thicknesses shall not exceed those allowed in the Standard Specifications of Public Works Construction, unless the Contractor can demonstrate to the Geotechnical Consultant that the fill lift can be compacted to the minimum relative compaction by his alternative equipment or method.

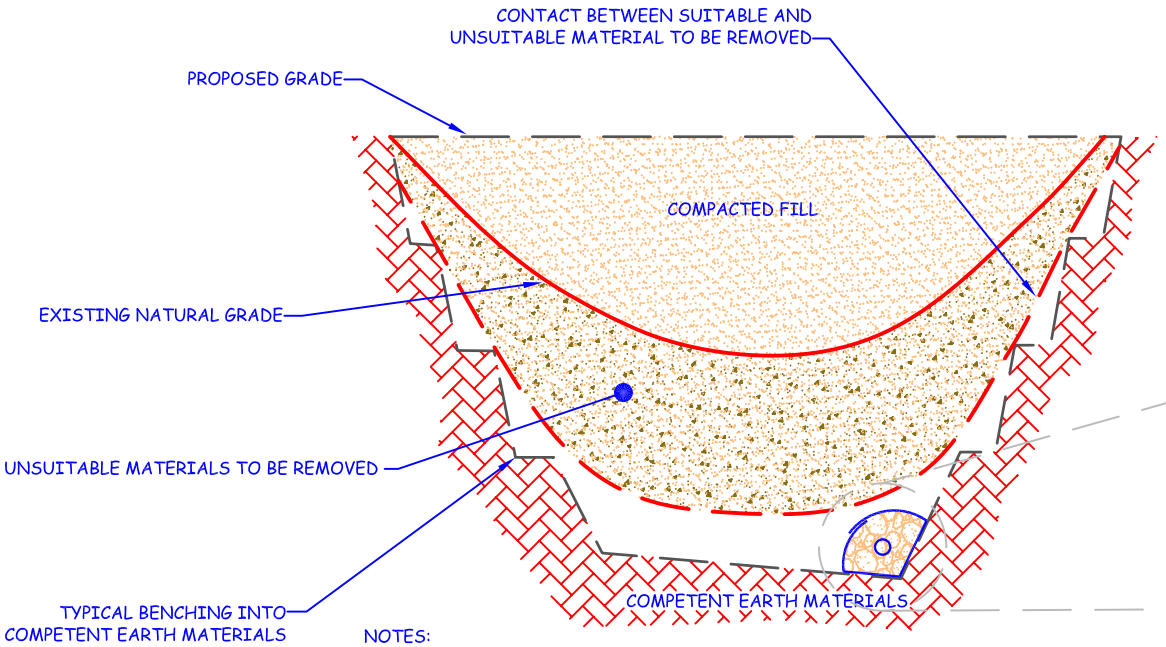
STABILIZATION FILL TYPICAL DETAIL

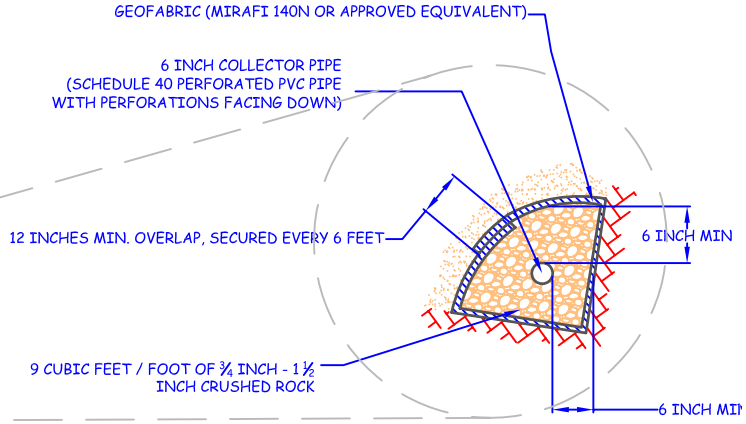


BUTTRESS TYPICAL DETAIL



CANYON SUBDRAIN SYSTEM TYPICAL DETAIL

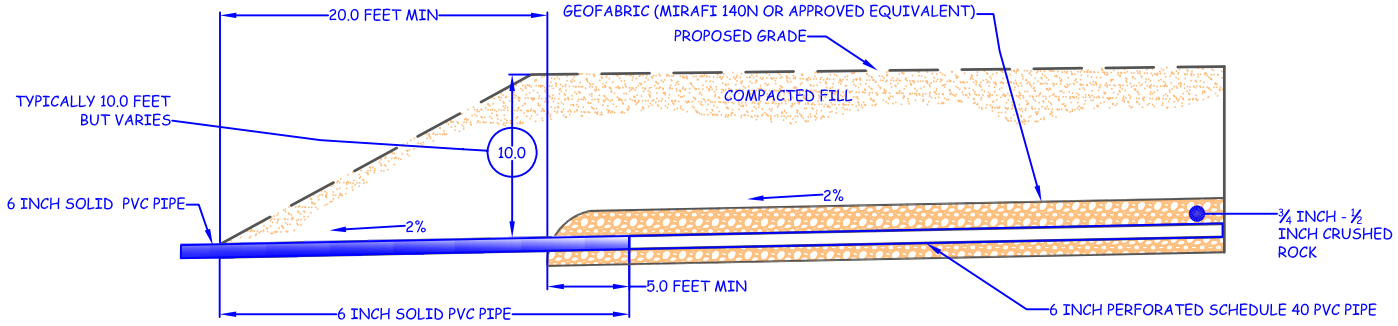




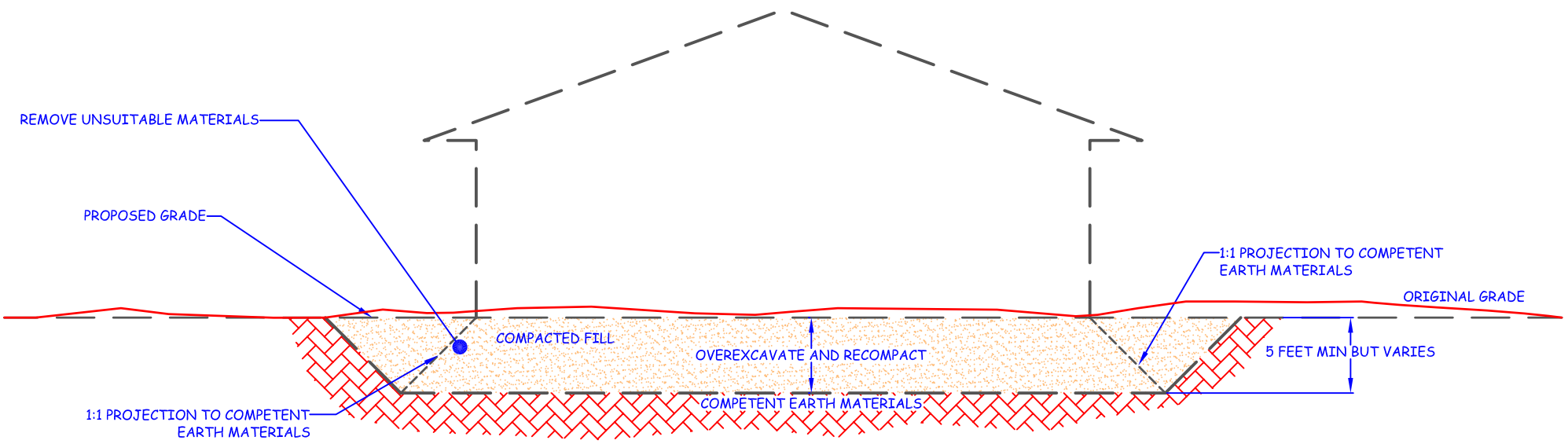
NOTES:
1 - CONTINUOUS RUNS IN EXCESS OF 500 FEET LONG WILL REQUIRE AN 8 INCH DIAMETER PIPE.

2 - FINAL 20 FEET OF PIPE AT OUTLET WILL BE SOLID AND BACKFILLED WITH COMPACTED FINE-GRAINED EARTH MATERIALS.

CANYON SUBDRAIN TYPICAL OUTLET



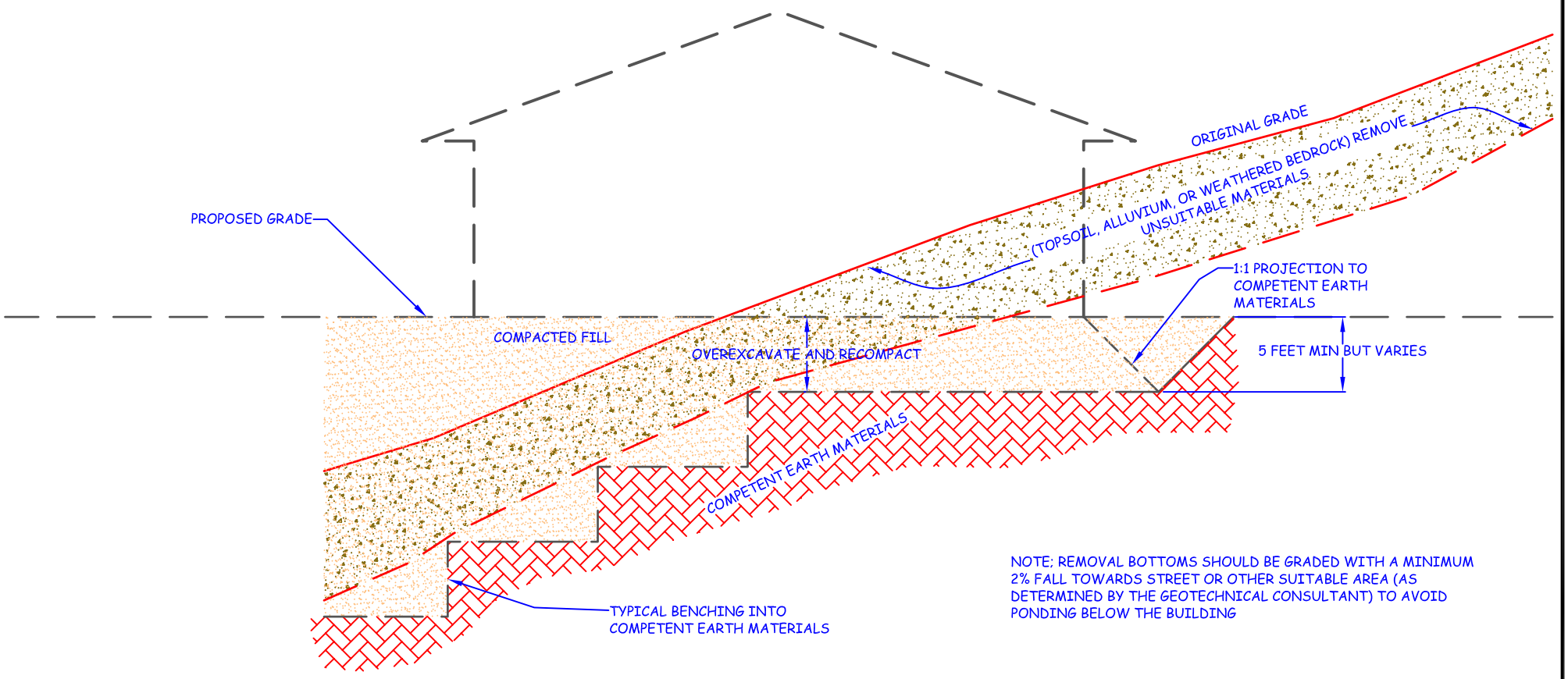
CUT LOT TYPICAL DETAIL



NOTE: REMOVAL BOTTOMS SHOULD BE GRADED WITH A MINIMUM 2% FALL TOWARDS STREET OR OTHER SUITABLE AREA (AS DETERMINED BY THE GEOTECHNICAL CONSULTANT) TO AVOID PONDING BELOW THE BUILDING

NOTE: WHERE DESIGN CUT LOTS ARE EXCAVATED ENTIRELY INTO COMPETENT EARTH MATERIALS, OVEREXCAVATION MAY STILL BY NEEDED FOR HARD-ROCK CONDITIONS OR MATERIALS WITH VARIABLE EXPANSION POTENTIALS

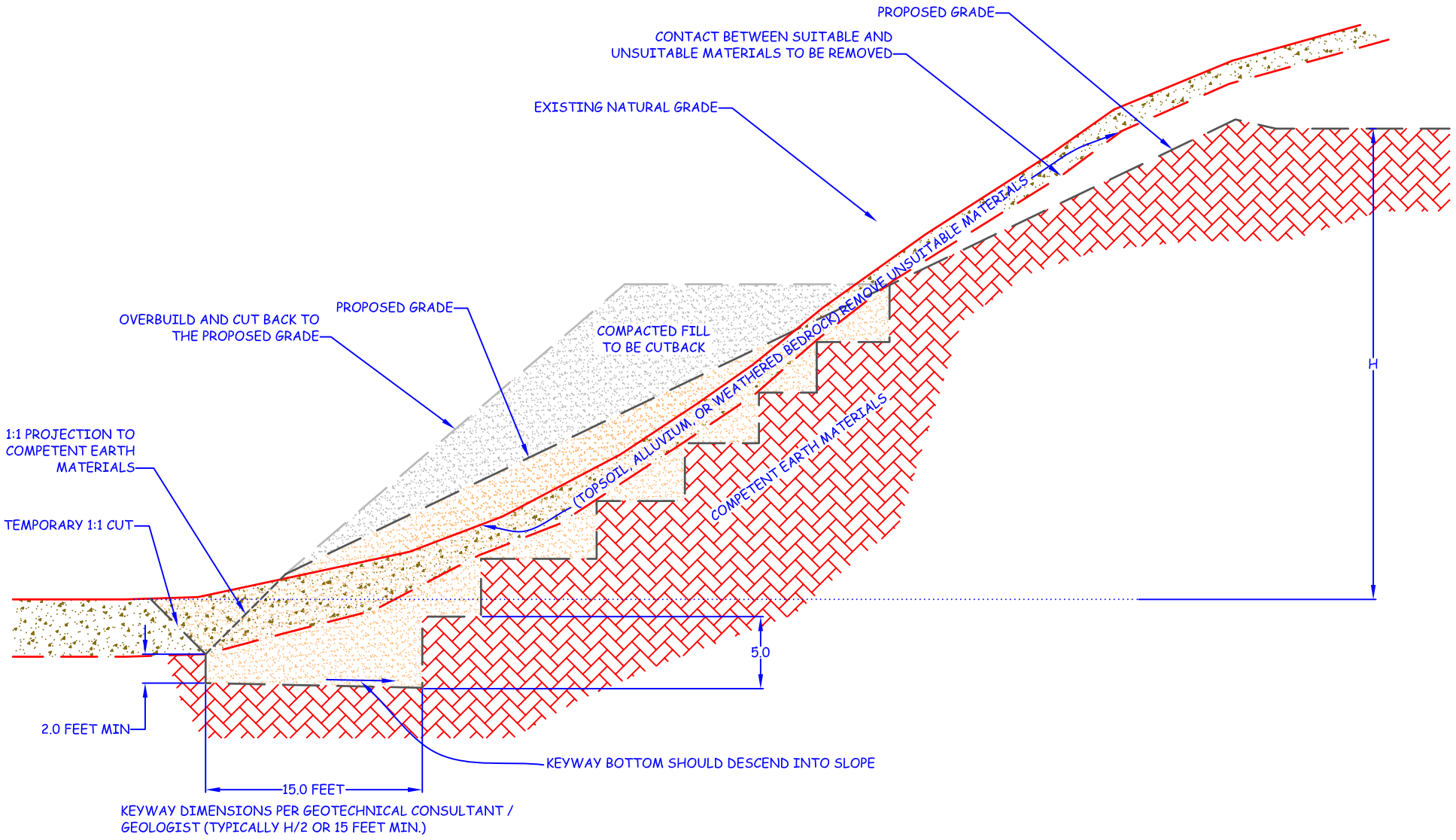
CUT / FILL TRANSITION LOT TYPICAL DETAIL



NOTE; REMOVAL BOTTOMS SHOULD BE GRADED WITH A MINIMUM 2% FALL TOWARDS STREET OR OTHER SUITABLE AREA (AS DETERMINED BY THE GEOTECHNICAL CONSULTANT) TO AVOID PONDING BELOW THE BUILDING

NOTE: WHERE DESIGN CUT LOTS ARE EXCAVATED ENTIRELY INTO COMPETENT EARTH MATERIALS, OVEREXCAVATION MAY STILL BY NEEDED FOR HARD-ROCK CONDITIONS OR MATERIALS WITH VARIABLE EXPANSION POTENTIALS

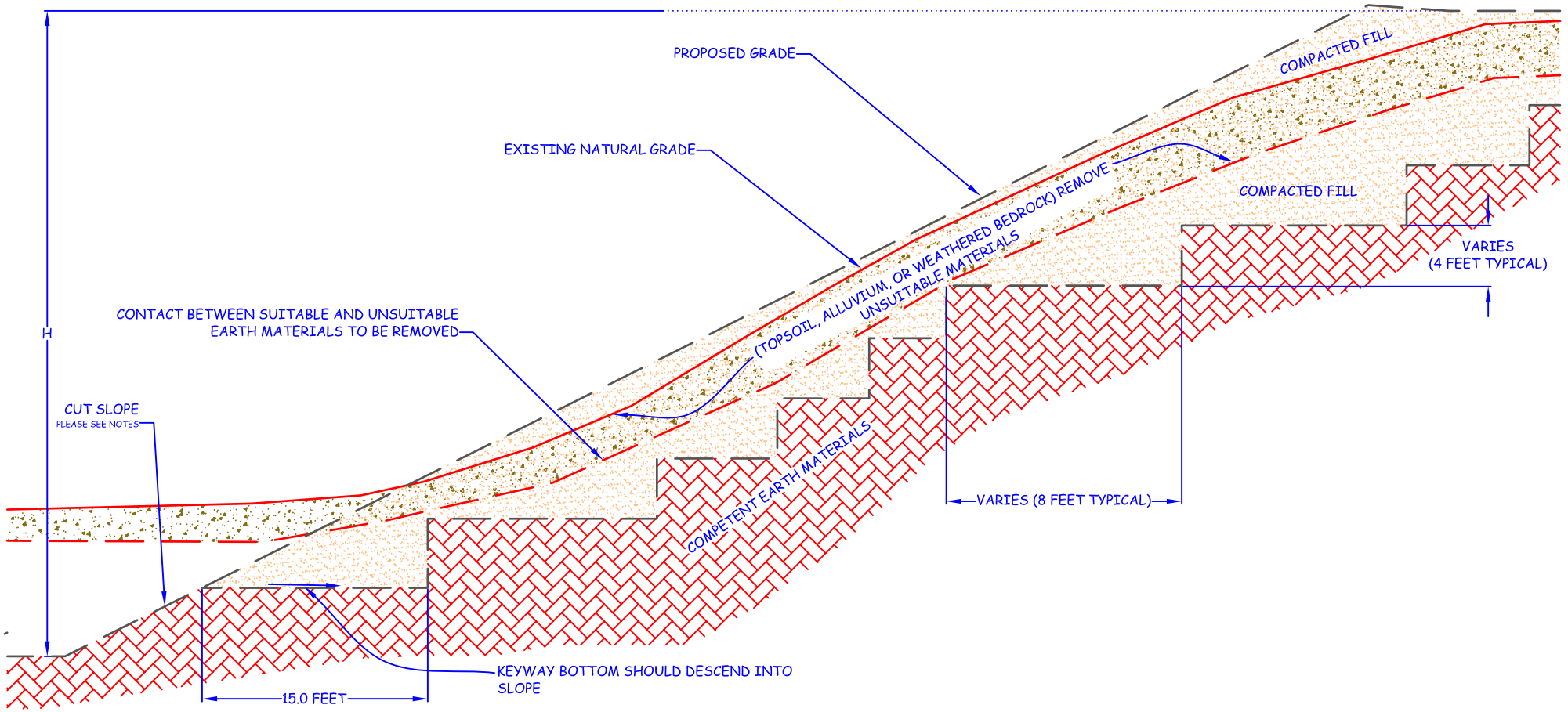
KEYWAY & BENCHING TYPICAL DETAILS
CUT OVER FILL SLOPE



NOTE:

NATURAL SLOPES STEEPER THAN 5:1 (H:V) MUST BE BENCHED INTO COMPETENT EARTH MATERIALS

KEYWAY & BENCHING TYPICAL DETAILS
FILL OVER CUT SLOPE



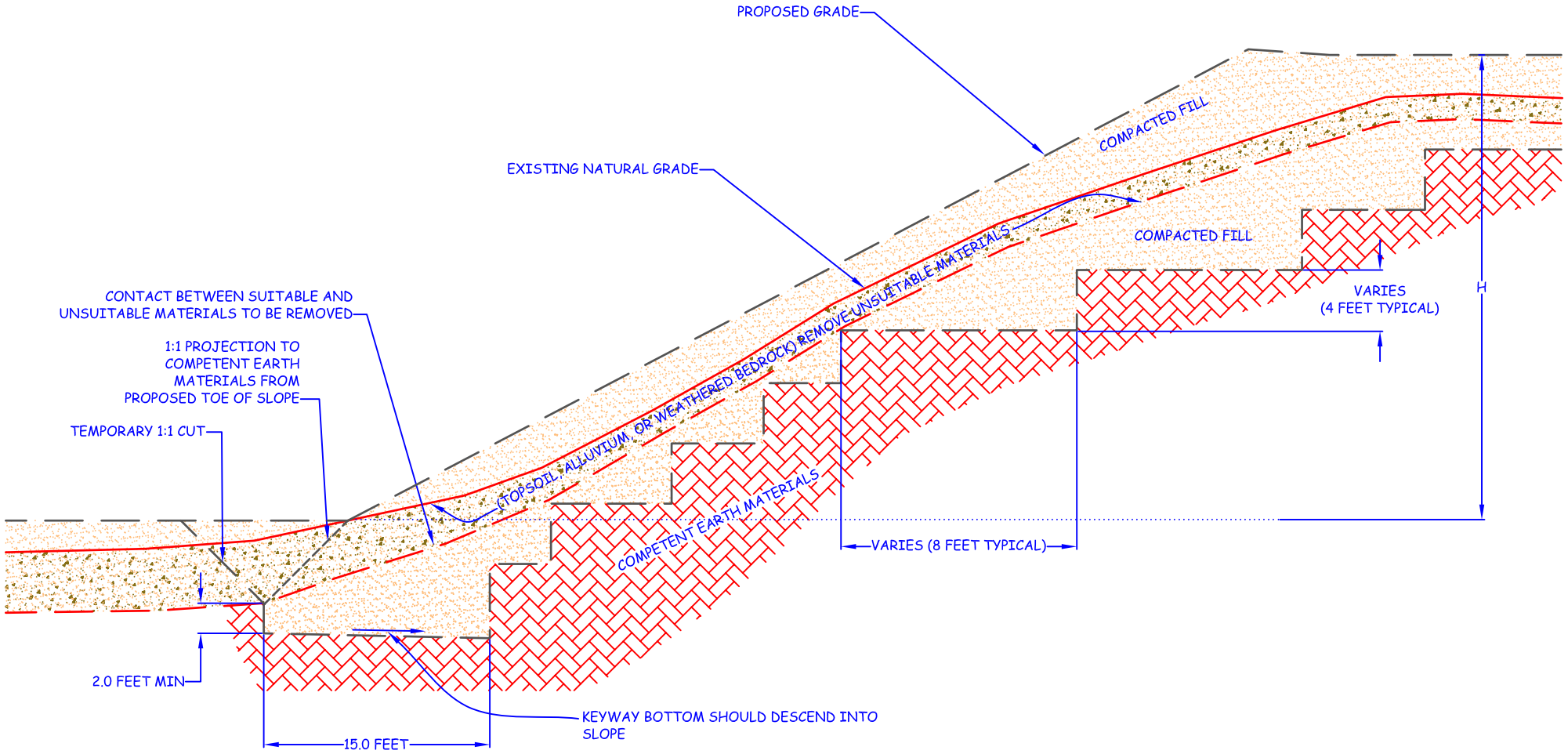
KEYWAY DIMENSIONS PER GEOTECHNICAL CONSULTANT / GEOLOGIST (TYPICALLY H/2 OR 15 FEET MIN.)

NOTES:

NATURAL SLOPES STEEPER THAN 5:1 (H:V) MUST BE BENCHED INTO COMPETENT EARTH MATERIALS

THE CUT SLOPE MUST BE CONSTRUCTED FIRST

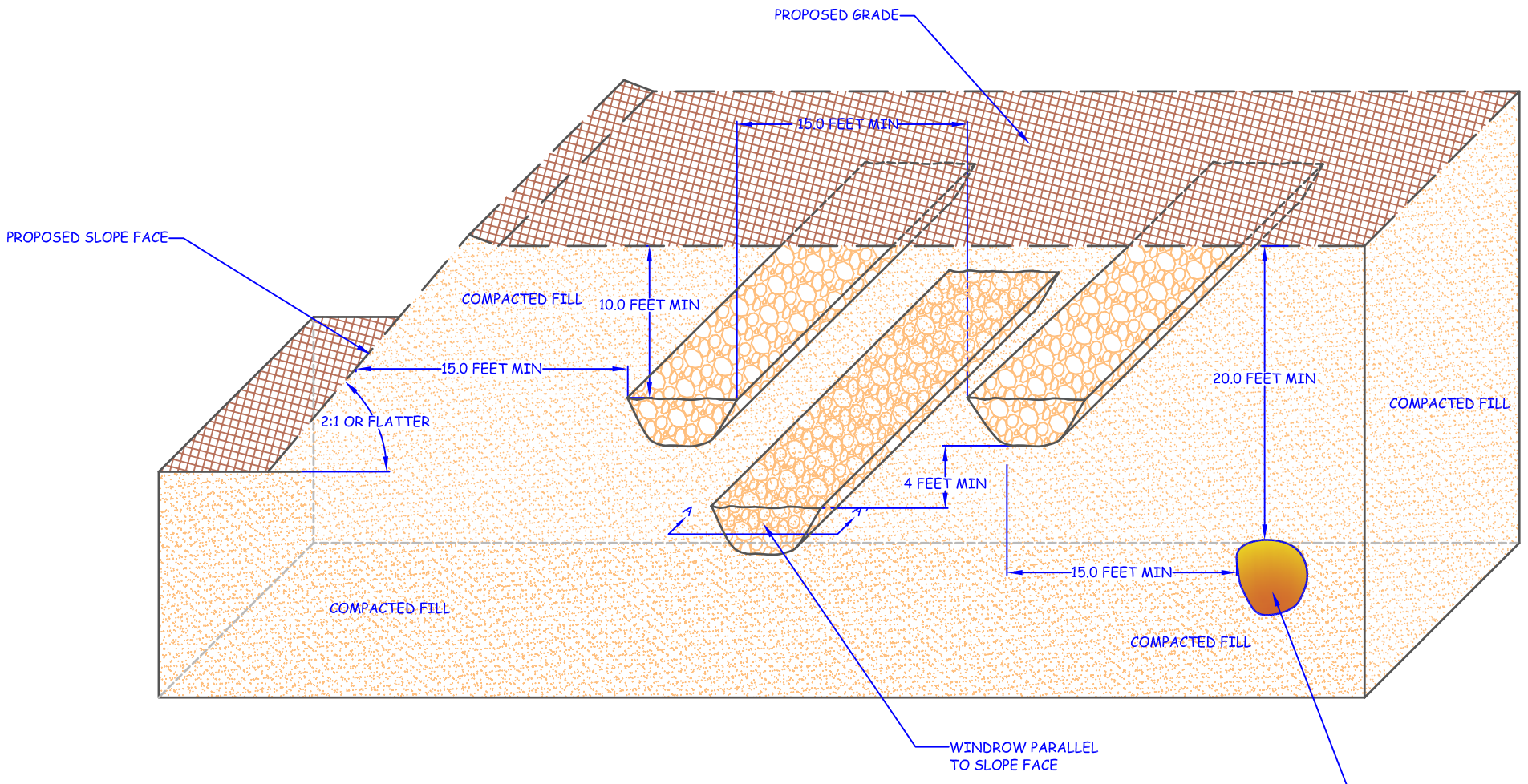
KEYWAY & BENCHING TYPICAL DETAILS
FILL SLOPE



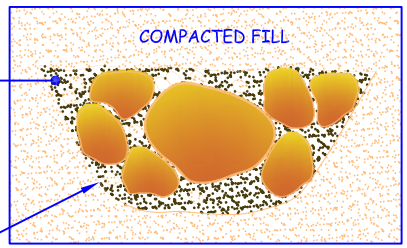
NOTES:

NATURAL SLOPES STEEPER THAN 5:1 (H:V) MUST BE BENCHED INTO COMPETENT EARTH MATERIALS

OVERSIZE ROCK TYPICAL DETAIL

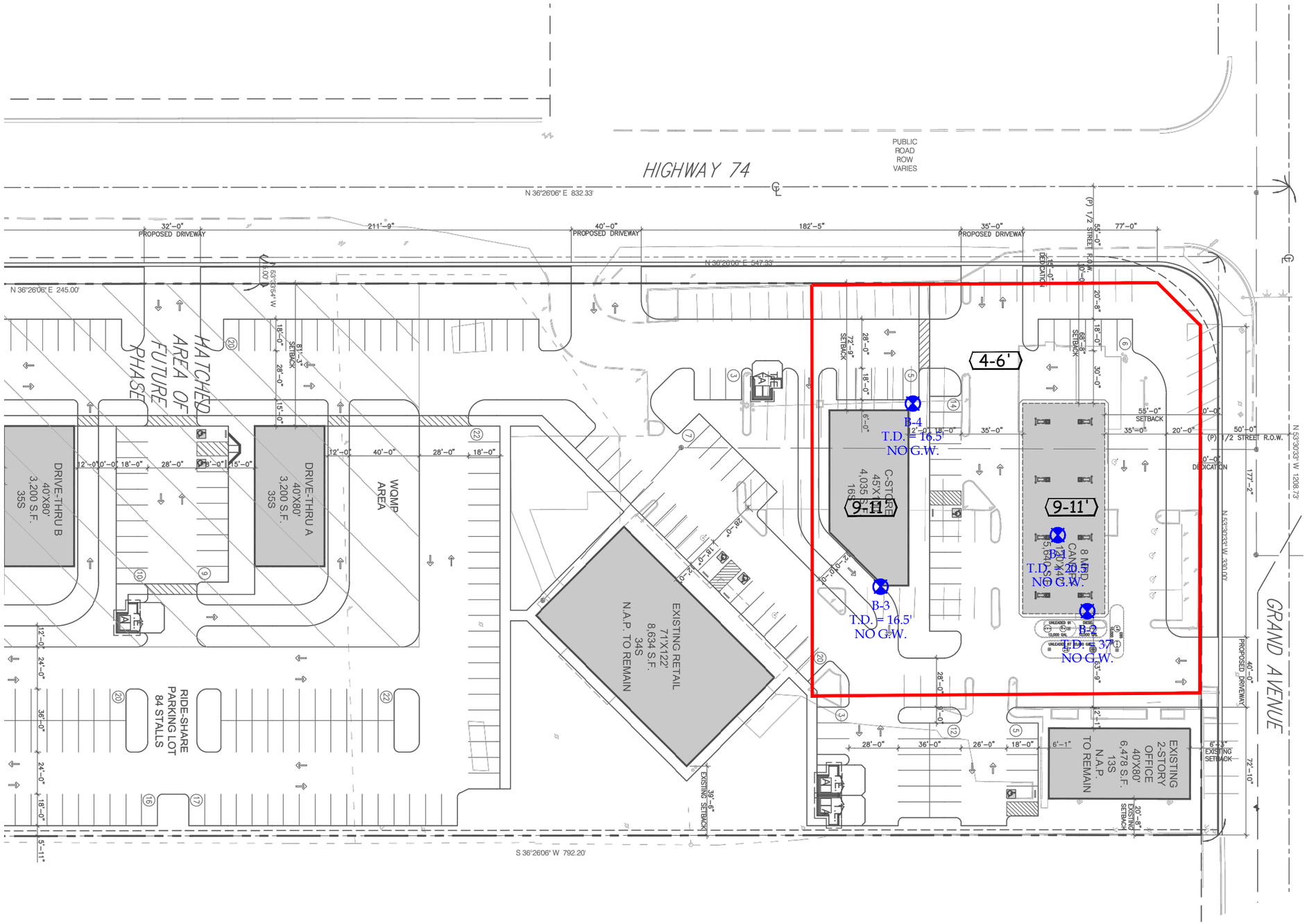


CROSS SECTION A-A'



NOTES:

OVERSIZE ROCK IS LARGER THAN
8 INCHES IN MAX DIAMETER



LEGEND

Locations are Approximate

Geologic Units

Afu - Artificial Fill, Undocumented

Qyv - Quaternary Young Alluvial Valley Deposits (Circled Where Buried)

Symbols

- Limits of Report

B-4
T.D. = 16.5'
NO G.W.

- Boring Location
  Including Total Depth and Depth to Groundwater

9-11' - Recommended Removal Depth

North

INFILTRATION MAP

LOCATED AT 15890 GRAND AVENUE

CITY OF LAKE ELSINORE, RIVERSIDE COUNTY, CALIFORNIA

APN 381-320-025

PROJECT	***PROPOSED CONVENIENCE STORE AND GAS STATION CANOPY***		
CLIENT	***MR. GREG HANN***		
PROJECT NO.	***203217-10A***		
DATE	***JULY 2020***		
SCALE	***1:60***		
DWG XREFS			
REVISION			
DRAWN BY	***JDG***	***PLATE***	***1 OF 1***

Earth Strata Geotechnical Services, Inc.

Geotechnical, Environmental and Materials Testing Consultants

www.ESGSINC.com (951) 397-8315

Earth Strata Geotechnical Services, Inc.
Geotechnical, Environmental and Materials Testing Consultants

July 27, 2020

Project No. 203217-12A

Mr. Greg Hann
EMPIRE DESIGN GROUP
P.O. Box 944
Murrieta, CA 92564

Subject: **Infiltration Testing for Water Quality Treatment Areas, Proposed Commercial Development, Assessor Parcel Number 381-320-025, Lot Number 8 of Parcel Map Number 8/377, Located at 15890 Grand Avenue, City of Lake Elsinore, Riverside County, California**

INTRODUCTION

Earth Strata Geotechnical Services Inc. is pleased to present this infiltration feasibility report for the proposed commercial development, located at 15890 Grand Avenue, Assessor Parcel Number 381-320-025, in the City of Lake Elsinore, Riverside County, California. The purpose of our study was to determine the infiltration rates and physical characteristics of the subsurface earth materials at the approximate depth of the proposed WQMP area within the proposed development. This feasibility report provides the onsite infiltration rates for the earth materials near the proposed WQMP area.

PROPERTY DESCRIPTION

The subject property is located at 15890 Grand Avenue in the City of Lake Elsinore, Riverside County, California. The approximate location of the site is shown on the Vicinity Map, Figure 1.

The subject property is comprised of approximately 5.91 acres of partially developed land with an existing grocery store, offices, and a drive thru restaurant at the northeast end of the site. The existing developments are not part of the scope of this infiltration report. The proposed site has not been graded. Topographic relief at the subject property is relatively low with the terrain being generally flat. Elevations at the site range from approximately 1315 to 1355 feet above mean sea level (msl), for a difference of about 40± feet across the entire site. Drainage within the subject property generally flows to the north.

The site is currently bordered by residential development to the southeast, vacant property to the southwest, Grand Avenue to the northeast, and State Highway 74 to the northwest. Most of the vegetation on the site consists of light to moderate amounts of annual weeds/grasses.

PROPOSED CONSTRUCTION

Based on the proposed site plan provided by Empire Design Group, the proposed development as illustrated on the conceptual grading plans will consist of a commercial development complete with interior streets, utilities, driveways, parking and one (1) onsite water quality treatment basin.

SUBSURFACE EXPLORATION

Subsurface Exploration

Subsurface exploration within the subject site was performed on June 25, 2020 for the exploratory excavations. A truck mounted hollow-stem-auger drill rig was utilized to drill four (4) borings throughout the site to a maximum depth of 37 feet. The exploratory holes were excavated for geotechnical evaluation purposes with respect to the proposed developments and to interpret whether groundwater or impermeable soil layers were present. An underground utilities clearance was obtained from Underground Service Alert of Southern California, prior to the subsurface exploration. The approximate locations of the exploratory excavations are shown on the attached Infiltration Location Map, Plate 1 and descriptive logs are presented in Appendix A.

Earth materials encountered during exploration were classified and logged in general accordance with the Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) of ASTM D 2488. Upon completion of laboratory testing, exploratory logs and sample descriptions may have been reconciled to reflect laboratory test results with regard to ASTM D 2487.

Earth Materials

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

- Artificial Fill, Undocumented (map symbol Afu): Undocumented artificial fill materials were encountered throughout the site within the upper 3 to 5 feet during exploration. These materials are typically locally derived from the native materials and consist generally of yellowish brown to dark yellowish-brown silty sand. These materials are generally inconsistent, poorly consolidated fills.

- Quaternary Young Alluvial Valley Deposits (map symbol Qyv): Quaternary young alluvial valley deposits were encountered beneath the fill to a maximum depth of 37 feet. These young alluvial deposits consist of olive brown to yellowish brown, fine to coarse grained silty sand. These deposits were generally noted to be in a slightly moist, loose to very dense state.

INFILTRATION TESTING

The double ring infiltrometer test method was utilized to perform a total of two (2) infiltration tests on July 23, 2020 to evaluate near surface infiltration rates in order to estimate the amount of storm water runoff that can infiltrate into the onsite water quality treatment plan areas. The infiltration tests were performed in general accordance with the requirements of double ring infiltration testing, ASTM D 3385 and Appendix A of the Riverside County Flood Control and Water Conservation District.

The infiltration tests were performed using double ring infiltrometer and Mariotte tubes at a depth of 5 feet below existing grades. The locations of the infiltration tests are indicated on the attached infiltration Location Map, Plate 1. The double ring infiltrometer tests were located by property boundary measurement on the site plan and by using geographic features. Infiltration test data recorded in the field are summarized in the following table and is included within Appendix B including the graph of Infiltration Rate versus Elapsed Time.

Infiltration Test Summary

TEST NUMBER	INFILTRATION HOLE DEPTH (ft.)	INFILTRATION RATE (in/hr)	DESCRIPTION
DR-1	5	0.27	Silty SAND
DR-2	5	0.81	Silty SAND

The infiltration test rates ranged from 0.27 to 0.81 inches per hour (in/hr).

CONCLUSIONS AND RECOMMENDATIONS

General

From geotechnical and engineering geologic points of view, the proposed WQMP areas, where tested, is considered suitable for infiltration for the proposed development. Provided the following conclusions and recommendations are implemented, it is the opinion of this professional that the proposed development is suitable for an infiltration based WQMP.

Groundwater

Groundwater was not observed during our subsurface exploration to a total depth of 37 feet. Potential groundwater impact is considered very low due to the location of proposed development and conditions encountered in the field. Local well data from the California Department of Water Resources indicates groundwater levels at approximately 30 feet below existing surface elevation 1260, which meets the minimum separation of 10 feet from the bottom of the infiltration facility to the groundwater mark.

Geologic/ Geotechnical Screening

The proposed WQMP areas (see Plate 1) will be located away from the proposed structures in competent native earth materials.

The proposed structures will be supported by compacted fill and competent earth materials, with no shallow groundwater. According to the County of Riverside reports, the subject site is located in an area where liquefaction potential is considered moderate. However, the proposed WQMP area will be located away from the proposed building and as such, the potential for earthquake induced liquefaction and lateral spreading beneath the proposed structures will not be increased by infiltration.

Preliminary laboratory test results indicate onsite earth materials exhibit an expansion potential of **VERY LOW** as classified in accordance with 2019 CBC Section 1803.5.3 and ASTM D 4829.

Therefore, infiltration within the proposed WQMP area will not encroach on any proposed structures and will not increase the risk of geologic hazards.

Recommended Factor of Safety

The minimum recommended factor of safety for the infiltration design, in accordance with the Riverside County Water Quality Management Plan for the Santa Ana Region, is 2.

Based on the data presented in this report and the recommendations set forth herein, it is the opinion of Earth Strata Geotechnical Services that the proposed WQMP area, utilizing a factor of safety of 2, can be designed for an infiltration rate of 0.14 in/hr in the vicinity of DR-1 and 0.41 in/hr in the vicinity of DR-2.

GRADING PLAN REVIEW AND CONSTRUCTION SERVICES

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

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

Earth Strata should review any changes in the project and modify and approve in writing the conclusions and recommendations of this report. This report and the drawings contained within are intended for design input purposes only and are not intended to act as construction drawings or specifications. In the

event that conditions encountered during grading or construction operations appear to be different than those indicated in this report, this office should be notified immediately, as revisions may be required.

REPORT LIMITATIONS

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

Earth materials vary in type, strength, and other geotechnical properties between points of observation and exploration. Groundwater and moisture conditions can also vary due to natural processes or the works of man on this or adjacent properties. As a result, we do not and cannot have complete knowledge of the subsurface conditions beneath the subject property. No practical study can completely eliminate uncertainty with regard to the anticipated geotechnical conditions in connection with a subject property.

The conclusions and recommendations within this report are based upon the findings at the points of observation and are subject to confirmation by Earth Strata during construction. This report is considered valid for a period of one year from the time the report was issued.

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

Respectfully submitted,

EARTH STRATA GEOTECHNICAL SERVICES

Stephen M. Poole, PE 40219
President
Principal Engineer

SMP/jmr

Distribution: (1) Addressee

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

FIGURE 1

VICINITY MAP

"© 2007 DeLorme (www.delorme.com) Topo USA®".

Earth Strata Geotechnical Services, Inc.
Geotechnical, Environmental and Materials Testing Consultants
www.ESGSINC.com (951) 397-8315

PROPOSED GAS STATION AND GAS STATION CANOPY | 203217-10A

VICINITY MAP | SCALE 1:40,625

JULY 2020 | FIGURE 1

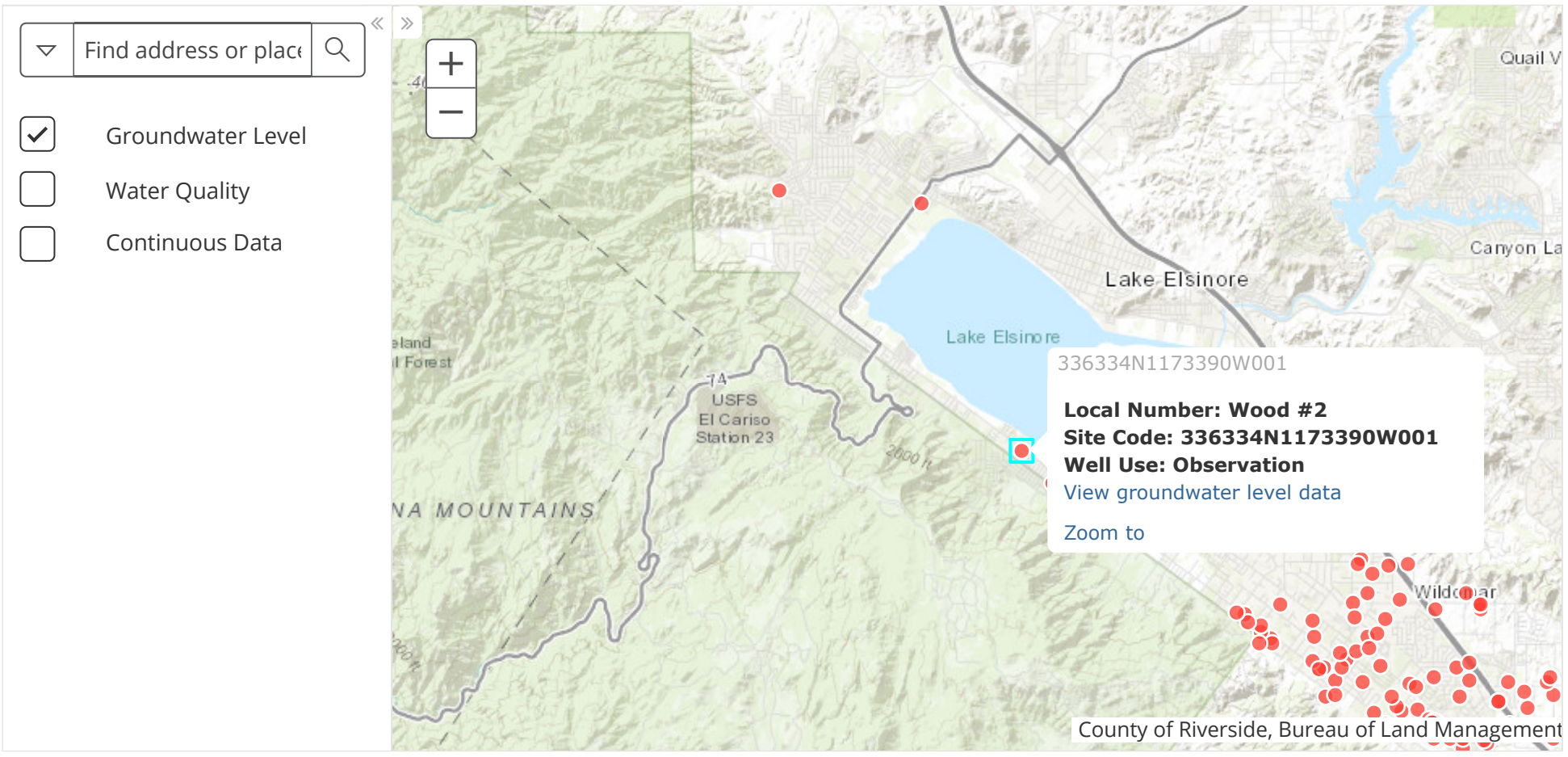
Contact WDL

CALIFORNIA DEPARTMENT OF
WATER RESOURCES

WDL Station Map | Water Quality | Groundwater | Continuous Data

Water Data Library (WDL) Station Map

Use the map below to locate monitoring stations. You can find an area of interest if you zoom and pan the map. Use the search box below to find features on the map such as the name of a city, park, landmark, lake, water feature, or zip code within California. Additional searches by data type are possible by clicking the links above.



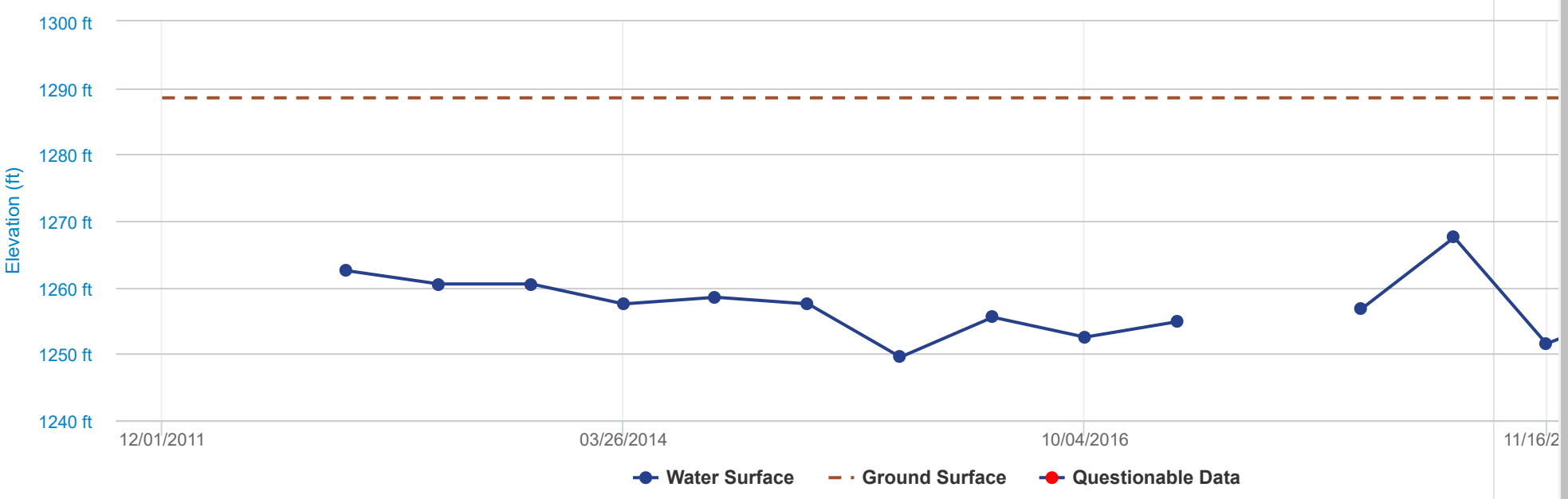
Back to Search

Groundwater Level Report

Station 336334N1173390W001

Station Data | **Groundwater Level Data**

Groundwater Levels for Well 336334N1173390W001



Download Data in CSV format

Date	RPE	GSE	RPWS	WSE	GS to WS	Msmt code	Agency	Comments
12/01/2011 00:00:00	1288.500	1288.500				N-7	384	Failed to take measurement this month
05/31/2012 00:00:00	1288.500	1288.500				N-7	384	No Measurement taken at this well
11/21/2012 00:00:00	1288.500	1288.500	26	1262.5	26		384	
05/28/2013 00:00:00	1288.500	1288.500	28	1260.5	28		384	
12/12/2013 00:00:00	1288.500	1288.500	28	1260.5	28		384	
03/26/2014 00:00:00	1288.500	1288.500	31	1257.5	31		384	
10/23/2014 00:00:00	1288.500	1288.500	30	1258.5	30		384	
03/23/2015 00:00:00	1288.500	1288.500	31	1257.5	31		384	
09/29/2015 00:00:00	1288.500	1288.500	39	1249.5	39		384	
05/24/2016 00:00:00	1288.500	1288.500	33	1255.5	33		384	
10/04/2016 00:00:00	1288.500	1288.500	36	1252.5	36		384	

APPENDIX A

EXPLORATORY LOGS

Geotechnical Boring Log B-1

Date: June 25, 2020	**Project Name: Grand Avenue, Lake Elsinore** **Page: 1 of 2**
Project Number: 203217-10A	**Logged By: JF**
Drilling Company: Drilling It	**Type of Rig: B-61**
Drive Weight (lbs): 140	**Drop (in): 30** **Hole Diameter (in): 8**
Top of Hole Elevation (ft): See Map	**Hole Location: See Geotechnical Map**

Depth (ft)	Blow Count Per Foot	Sample Depth	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0						**Artificial Fill, Undocumented (Afu):**
					SM	Silty SAND; dark yellowish brown, dry to slightly moist, loose, fine to coarse
	8	2.5'	106.4	6.7		sand with trace gravel
5	6	5'	99.0	10.5		**Quaternary Young Alluvial Valley Deposits (Qyv):**
					SM	Silty SAND; yellowish brown, slightly moist, loose, fine to coarse sand
	13	7.5'	111.9	7.5		
10	30	10'	117.7	5.8		
	17	12'.5	118.7	6.9		
15	47	15'	122.0	4.6		
20	REF/3"	20'	115.6	7.4		
						Total Depth: 20.5 feet
						No Groundwater
25						
30						

42184 Remington Avenue, Temecula, CA 92590

Earth Strata Geotechnical Services, Inc.
Geotechnical, Environmental and Materials Testing Consultants
www.ESGSINC.com (951) 397-8315

Geotechnical Boring Log B-2

Date: June 25, 2020	**Project Name: Grand Avenue, Lake Elsinore** **Page: 1 of 1**
Project Number: 203217-10A	**Logged By: JF**
Drilling Company: Drilling It	**Type of Rig: B-61**
Drive Weight (lbs): 140	**Drop (in): 30** **Hole Diameter (in): 8**
Top of Hole Elevation (ft): See Map	**Hole Location: See Geotechnical Map**

Depth (ft)	Blow Count Per Foot	Sample Depth	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0		0-5'				**Artificial Fill, Undocumented (Afu):**
					SM	Silty SAND; dark yellowish brown, dry to slightly moist, fine to coarse sand
	14	2.5'	105.2	4.5		
						Quaternary Young Alluvial Valley Deposits (Qyv):
5	9	5'	106.6	8.7	SM	Silty SAND; yellow brown, slightly moist, medium dense, fine to coarse sand
	11	7.5'	110.4	3.6		
10	18	10'	113.7	113.7		
15	15	15'	110.5	7.7		
20	29	20'	113.0	11.7		
25	21	25'	107.7	10.2		
30						

42184 Remington Avenue, Temecula, CA 92590

Earth Strata Geotechnical Services, Inc.
Geotechnical, Environmental and Materials Testing Consultants
www.ESGSINC.com (951) 397-8315

Geotechnical Boring Log B-2

Date: June 25, 2020	**Project Name: Grand Avenue, Lake Elsinore** **Page: 2 of 2**
Project Number: 203217-10A	**Logged By: JF**
Drilling Company: Drilling It	**Type of Rig: B-61**
Drive Weight (lbs): 140	**Drop (in): 30** **Hole Diameter (in): 8**
Top of Hole Elevation (ft): See Map	**Hole Location: See Geotechnical Map**

Depth (ft)	Blow Count Per Foot	Sample Depth	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
30	51	30'	-	-		No Recovery at 30 feet
35	56	35'	125.3	12.0		
						Practical Refusal at 37 feet
						Total Depth: 37 feet
						No Groundwater
40						
45						
50						
55						
60						

42184 Remington Avenue, Temecula, CA 92590

Earth Strata Geotechnical Services, Inc.
Geotechnical, Environmental and Materials Testing Consultants
www.ESGSINC.com (951) 397-8315

Geotechnical Boring Log B-3

Date: June 25, 2020	**Project Name: Grand Avenue, Lake Elsinore** **Page: 1 of 1**
Project Number: 203217-10A	**Logged By: JF**
Drilling Company: Drilling It	**Type of Rig: B-61**
Drive Weight (lbs): 140	**Drop (in): 30** **Hole Diameter (in): 8**
Top of Hole Elevation (ft): See Map	**Hole Location: See Geotechnical Map**

Depth (ft)	Blow Count Per Foot	Sample Depth	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0		0-5'				**Artificial Fill, Undocumented (Afu):**
					SM	Silty SAND; dark yellowish brown, slightly moist, loose, fine to coarse sand
	8	2.5'	108.7	5.9		
						Quaternary Young Alluvial Valley Deposits (Qyv):
					SM	Silty SAND; olive brown, slightly moist, medium dense, fine to coarse sand
5	22	5'	124.0	7.8		
	21	7.5'	117.8	7.1		Yellowish brown below 7.5 feet
10	22	10'	116.1	6.8		
15	23	15'	112.0	7.0		
						Total Depth: 16.5 feet
						No Groundwater
20						
25						
30						

42184 Remington Avenue, Temecula, CA 92590

Earth Strata Geotechnical Services, Inc.
Geotechnical, Environmental and Materials Testing Consultants
www.ESGSINC.com (951) 397-8315

Geotechnical Boring Log B-4

Date: June 25, 2020	**Project Name: Grand Avenue, Lake Elsinore** **Page: 1 of 1**
Project Number: 203217-10A	**Logged By: JF**
Drilling Company: Drilling It	**Type of Rig: B-61**
Drive Weight (lbs): 140	**Drop (in): 30** **Hole Diameter (in): 8**
Top of Hole Elevation (ft): See Map	**Hole Location: See Geotechnical Map**

Depth (ft)	Blow Count Per Foot	Sample Depth	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0						**Artificial Fill, Undocumented (Afu):**
					SM	Silty SAND; yellowish brown, slightly moist, loose, fine to coarse sand
	11	2.5'	115.6	7.6		
						Quaternary Young Alluvial Valley Deposits (Qyv):
					SM	Silty SAND; yellowish brown, slightly moist, loose, fine to coarse sand
5	15	5'	118.2	7.9		
	15	7.5'	114.5	6.8		
10	12	10'	118.1	7.2		
15	14	15'	108.0	11.1		
						Total Depth: 16.5 feet
						No Groundwater
20						
25						
30						

42184 Remington Avenue, Temecula, CA 92590

Earth Strata Geotechnical Services, Inc.
Geotechnical, Environmental and Materials Testing Consultants
www.ESGSINC.com (951) 397-8315

APPENDIX B

INFILTRATION TEST SHEETS

Test No.	DR-1	Location	See Map	Turf-Tec International - Record Chart for IN10-W - (12 & 24 Inch Infiltration Rings)

Earth Strata Geotechnical Services, Inc.
Geotechnical, Environmental and Materials Testing Consultants
www.ESGSINC.com (951) 397-8315

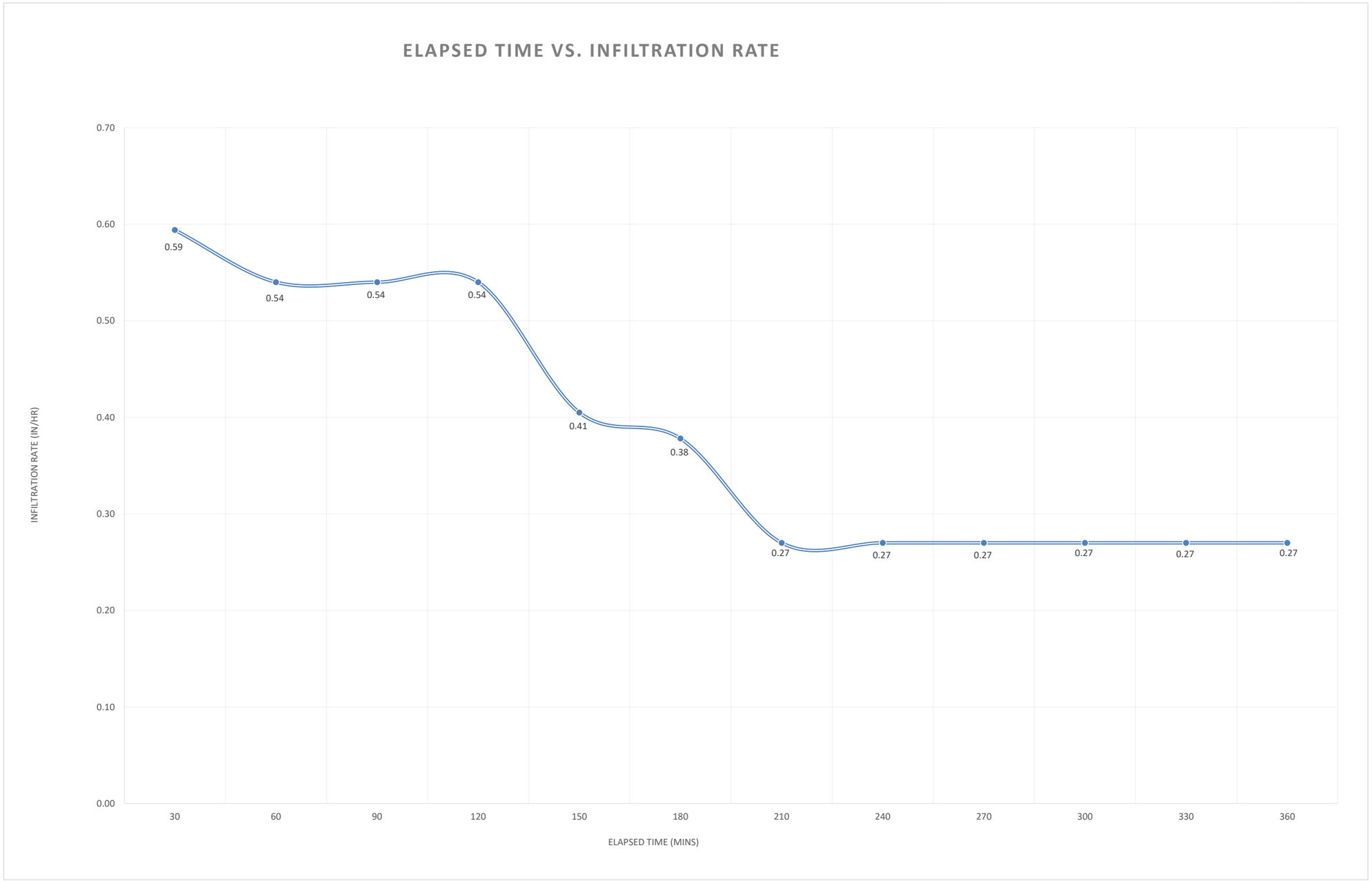
				Constants	Area cm2	Depth of Liquid (cm)	Liquid Container Number	Marriotte Tube Volume
Project Identification:	Grand Ave - Lake Elsinore							
Test Location:	DR-1			Inner Ring	729	10.0	1	3000
Liquid Used:	TAP WATE	pH:	8.0	Annular Ring	2189	10.0	2	10000
Tested By:		Date	7/23/2020	Liquid level maintained	(X) Flow Valve ( ) Float Valve ( ) Mariotte Tubes			
Depth to water table:		Depth of Test	5'	Penetration Depth of Outer Ring:	9 cm			Other

Trial #	Start / End	Date MM/DD/YY	Time HR:MIN	Time Increment /(Total)	Elapsed Time (Min)	Flow Readings: Inner Ring Reading cm	Inner Maroitte Tube Flow (ml)	Annular Space Reading cm	Annular Space Marriotte Tube Flow (ml)	Liquid Temp ºF	Infiltration Rates: Inner Infiltration Rate cm/h	Inner Infiltration Rate In/h	Annular Infiltration Rate cm/h	Annular Infiltration Rate In/h	Ground Temperature: Ground Temp Depth (cm)	Temp at Depth (c)	Remarks: Weather conditions Etc...
	Start Test	7/23/2020	10:00	0:30	30												
1	End Test	7/23/2020	10:30	0:30		6.00	550	6.00	10000		1.51	0.59	9.14	3.60			
	Start Test	7/23/2020	10:35	0:30	60												
2	End Test	7/23/2020	11:05	1:00		6.00	500	6.00	10000		1.37	0.54	9.14	3.60			
	Start Test	7/23/2020	11:10	0:30	90												
3	End Test	7/23/2020	11:40	1:30		6.00	500	6.00	8750		1.37	0.54	7.99	3.15			
	Start Test	7/23/2020	11:45	0:30	120												
4	End Test	7/23/2020	12:15	2:00		6.00	500	6.00	6500		1.37	0.54	5.94	2.34			
	Start Test	7/23/2020	12:20	0:30	150												
5	End Test	7/23/2020	12:50	2:30		6.00	375	6.00	7000		1.03	0.41	6.40	2.52			
	Start Test	7/23/2020	12:55	0:30	180												
6	End Test	7/23/2020	13:25	3:00		6.00	350	6.00	7000		0.96	0.38	6.40	2.52			
	Start Test	7/23/2020	13:30	0:30	210												
7	End Test	7/23/2020	14:00	3:30		6.00	250	6.00	6000		0.69	0.27	5.48	2.16			
	Start Test	7/23/2020	14:05	0:30	240												
8	End Test	7/23/2020	14:35	4:00		6.00	250	6.00	6000		0.69	0.27	5.48	2.16			
	Start Test	7/23/2020	14:40	0:30	270												
9	End Test	7/23/2020	15:10	4:30		6.00	250	6.00	6000		0.69	0.27	5.48	2.16			
	Start Test	7/23/2020	15:15	0:30	300												
10	End Test	7/23/2020	15:45	5:00		6.00	250	6.00	6000		0.69	0.27	5.48	2.16			
	Start Test	7/23/2020	15:50	0:30	330												
11	End Test	7/23/2020	16:20	5:30		6.00	250	6.00	6000		0.69	0.27	5.48	2.16			
	Start Test	7/23/2020	16:25	0:30	360												
12	End Test	7/23/2020	16:55	6:00		6.00	250	6.00	6000		0.69	0.27	5.48	2.16			

Turf-Tec International

Project Identification:	Grand Ave - Lake Elsinore		
Test Location:	DR-1		
Liquid Used:	TAP WATE	**pH:**	8.0
Tested By:	0		
Depth to water table:	0		

Earth Strata Geotechnical Services, Inc.
Geotechnical, Environmental and Materials Testing Consultants
www.ESGSINC.com (951) 397-8315



Test No.	DR-2	Location	See Map	Turf-Tec International - Record Chart for IN10-W - (12 & 24 Inch Infiltration Rings)

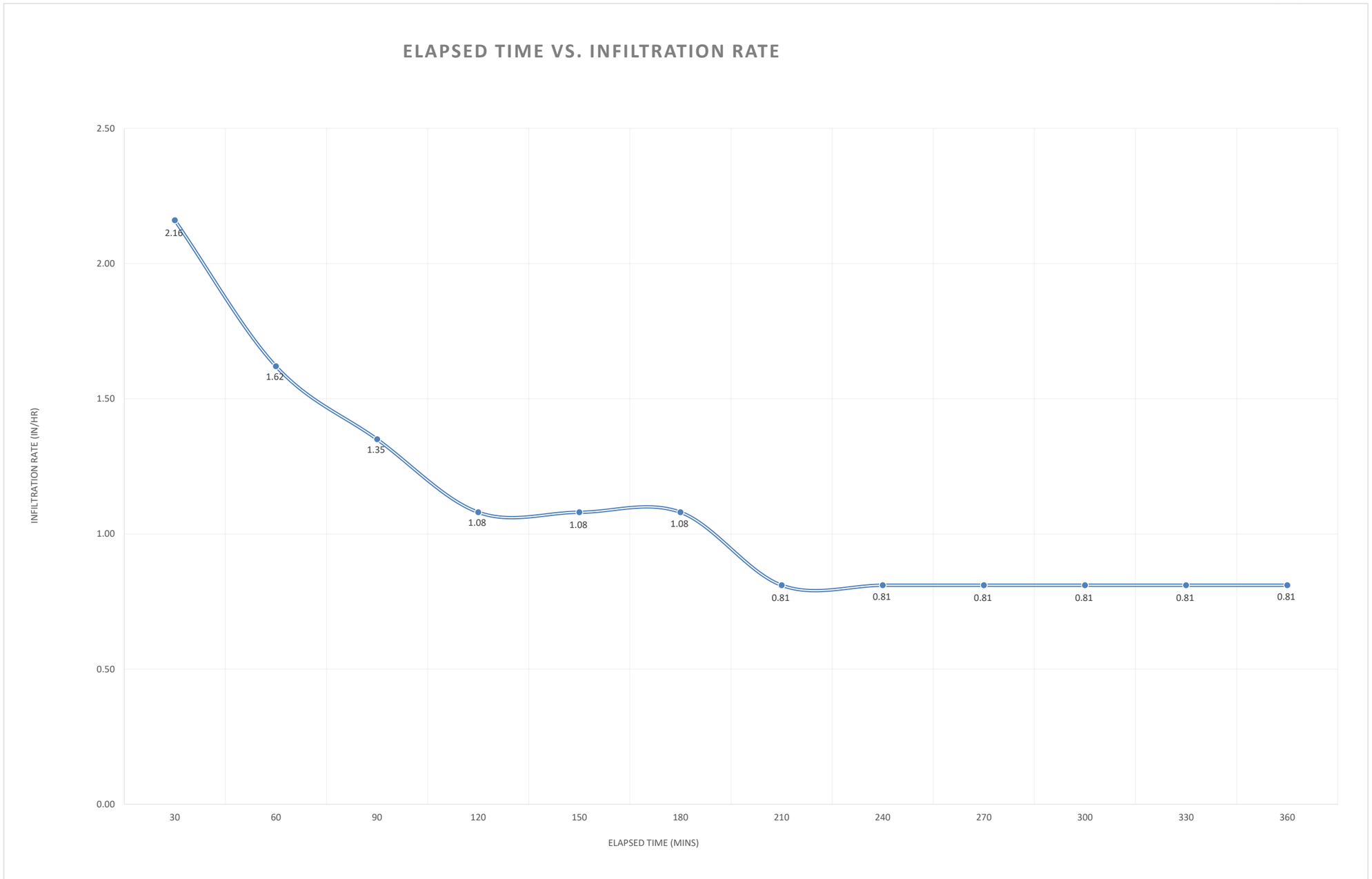
Project Identification:	Grand Ave - Lake Elsinore			**Constants**	**Area cm2**	**Depth of Liquid (cm)**	**Liquid Container Number**		**Marriotte Tube Volume**	Earth Strata Geotechnical Services, Inc.
Test Location:	DR-2			**Inner Ring**	729	10.0	1		3000	Geotechnical, Environmental and Materials Testing Consultants
Liquid Used:	TAP WATE	**pH:**	8.0	**Annular Ring**	2189	10.0	2		10000	www.ESGSINC.com (951) 397-8315
Tested By:		**Date**	7/23/2020	**Liquid level maintained**	(X) Flow Valve	( ) Float Valve	( ) Mariotte Tubes			
Depth to water table:	> 30 Feet	**Depth of Test**	5'	**Penetration Depth of Outer Ring:**	9 cm	**Other**				

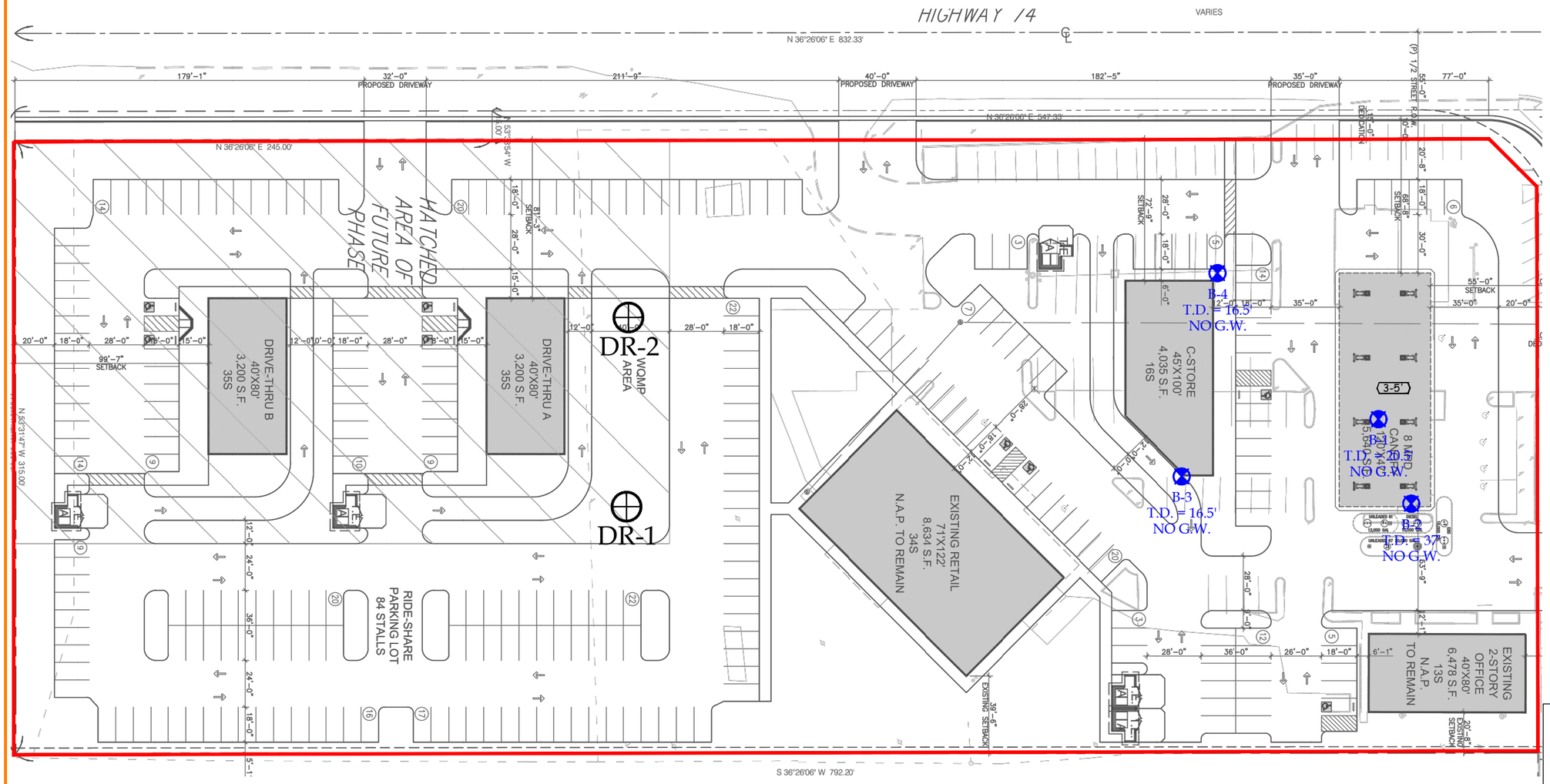
						Flow Readings					Infiltration Rates				Ground Temperature		Remarks
Trial #	**Start / End**	**Date MM/DD/YY**	**Time HR:MIN**	**Time Increment /(Total)**	**Elapsed Time (Min)**	**Inner Ring Reading cm**	**Inner Maroitte Tube Flow (ml)**	**Annular Space Reading cm**	**Annular Space Marriotte Tube Flow (ml)**	**Liquid Temp ºF**	**Inner Infiltration Rate cm/h**	**Inner Infiltration Rate In/h**	**Annular Infiltration Rate cm/h**	**Annular Infiltration Rate In/h**	**Ground Temp Depth (cm)**	**Temp at Depth (c)**	**Weather conditions Etc...**
1	Start Test	7/23/2020	10:30	0:30	30	5.00		5.00									
	End Test	7/23/2020	11:00	0:30		5.00	2000	5.00	9000		5.49	**2.16**	8.22	**3.24**			
2	Start Test	7/23/2020	11:05	0:30	60	5.00		5.00									
	End Test	7/23/2020	11:35	1:00		6.00	1500	5.00	9000		4.12	**1.62**	8.22	**3.24**			
3	Start Test	7/23/2020	11:40	0:30	90	5.00		5.00									
	End Test	7/23/2020	12:10	1:30		5.00	1250	5.00	10000		3.43	**1.35**	9.14	**3.60**			
4	Start Test	7/23/2020	12:15	0:30	120	5.00		5.00									
	End Test	7/23/2020	12:45	2:00		5.00	1000	5.00	9000		2.74	**1.08**	8.22	**3.24**			
5	Start Test	7/23/2020	12:50	0:30	150	5.00		5.00									
	End Test	7/23/2020	13:20	2:30		5.00	1000	5.00	9000		2.74	**1.08**	8.22	**3.24**			
6	Start Test	7/23/2020	13:25	0:30	180	5.00		5.00									
	End Test	7/23/2020	13:55	3:00		5.00	1000	5.00	9000		2.74	**1.08**	8.22	**3.24**			
7	Start Test	7/23/2020	14:00	0:30	210	5.00		5.00									
	End Test	7/23/2020	14:30	3:30		5.00	750	5.00	9000		2.06	**0.81**	8.22	**3.24**			
8	Start Test	7/23/2020	14:35	0:30	240	5.00		5.00									
	End Test	7/23/2020	15:05	4:00		5.00	750	5.00	9000		2.06	**0.81**	8.22	**3.24**			
9	Start Test	7/23/2020	15:10	0:30	270	5.00		5.00									
	End Test	7/23/2020	15:40	4:30		5.00	750	5.00	9000		2.06	**0.81**	8.22	**3.24**			
10	Start Test	7/23/2020	15:45	0:30	300	5.00		5.00									
	End Test	7/23/2020	16:15	5:00		5.00	750	5.00	9000		2.06	**0.81**	8.22	**3.24**			
11	Start Test	7/23/2020	16:20	0:30	330	5.00		5.00									
	End Test	7/23/2020	16:50	5:30		5.00	750	5.00	9000		2.06	**0.81**	8.22	**3.24**			
12	Start Test	7/23/2020	16:55	0:30	360	5.00		5.00									
	End Test	7/23/2020	17:25	6:00		5.00	750	5.00	9000		2.06	**0.81**	8.22	**3.24**			

Turf-Tec International

Project Identification:	Grand Ave - Lake Elsinore		
Test Location:	DR-2		
Liquid Used:	TAP WATE	**pH:**	8.0
Tested By:			0
Depth to water table:	> 30 Feet		

Earth Strata Geotechnical Services, Inc.
Geotechnical, Environmental and Materials Testing Consultants
www.ESGSINC.com (951) 397-8315





LEGEND

Locations are Approximate

Symbols

- Limits of Report
- B-4 T.D. = 16.5' NO G.W. — Boring Location, Including Total Depth and Depth to Groundwater
- DR-2 — Double Ring Test Location

INFILTRATION MAP

LOCATED AT 15890 GRAND AVENUE

CITY OF LAKE ELSINORE, RIVERSIDE COUNTY, CALIFORNIA

APN 381-320-025

PROJECT	***PROPOSED COMMERCIAL DEVELOPMENT***		
CLIENT	***MR. GREG HANN***		
PROJECT NO.	***203217-12A***		
DATE	***JULY 2020***		
SCALE	***1:60***		
DWG XREFS			
REVISION			
DRAWN BY	***JDG***	***PLATE***	***1 OF 1***

Earth Strata Geotechnical Services, Inc.

Geotechnical, Environmental and Materials Testing Consultants

www.ESGSINC.com (951) 397-8315

Appendix 4: Historical Site Conditions

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

N/A

Appendix 5: LID Infeasibility

LID Technical Infeasibility Analysis

N/A

Appendix 6: BMP Design Details

BMP Sizing, Design Details and other Supporting Documentation

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

(Rev. 10-2011)

Legend: Required Entries / Calculated Cells

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

Company Name: PEI | Date: 9/15/2023

Designed by: AL | Case No:

Company Project Number/Name: 2006012

BMP Identification

BMP NAME / ID: BMP 1 - BIOFILTRATION BASIN WITH UNDERDRAIN AND IMPERMEABLE LINER

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

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

D_{85}= 0.92 inches

Drainage Management Area Tabulation

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

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Storm Depth (in)*	*Design Capture Volume, V_{BMP} (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
DMA1	*124872*	*Mixed Surface Types*	*0.242*	*0.19*	*24198.7*			
DMA 3	*32341*	*Mixed Surface Types*	*0.861*	*0.68*	*21856.9*			
	157213		***Total***		**46055.6**	**0.92**	***3530.9***	***3751***

Notes:

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

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: Plump Engineering Inc. — Date: 4/12/2023
Designed by: — Case No:
Company Project Number/Name: Lake Elsinore Ortega Plaza

BMP Identification

BMP NAME / ID: BMP-2: Biofiltration Basin with Underdrain and Impermeable Liner

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

85th Percentile, 24-hour Rainfall Depth, from the Isohyetal Map in Handbook Appendix E — D_{85}= 0.92 inches

Drainage Management Area Tabulation

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

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Storm Depth (in)*	*Design Capture Volume, V_{BMP} (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
DMA-2	*121955.46*	*Mixed Surface Types*	*0.74*	*0.53*	*65040.6*			
	121955.46	***Total***			65040.6	0.92	***4986.4***	***5383.43***

Notes:

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

Company Name:	PEI	Date:	
Designed by:	AL	County/City Case No.:	

Design Volume

Enter the area tributary to this feature	A_T=	3.61	acres
Enter V_{BMP} determined from Section 2.1 of this Handbook	V_{BMP}=	3,531	ft^3

Type of Bioretention Facility Design

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

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

Bioretention Facility Surface Area

Depth of Soil Filter Media Layer	d_S =	3.0	ft
Top Width of Bioretention Facility, excluding curb	w_T =	25.3	ft
Total Effective Depth, d_E $d_E = (0.3) \times d_S + (0.4) \times 1 - (0.7/w_T) + 0.5$	d_E =	1.77	ft
Minimum Surface Area, A_m $A_M\ (ft^2) = \frac{V_{BMP}\ (ft^3)}{d_E\ (ft)}$	A_M =	1,993	ft^2
Proposed Surface Area	A=	2,119	ft^2

Bioretention Facility Properties

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

Notes: DMA 1 + DMA 3

Bioretention Facility - Design Procedure	BMP ID: DMA-2	Legend:	Required Entries / Calculated Cells

Company Name: Plump Engineering Inc. Date: 9/11/2020

Designed by: County/City Case No.:

Design Volume

Enter the area tributary to this feature A_T = 2.80 acres

Enter V_{BMP} determined from Section 2.1 of this Handbook V_{BMP} = 4,986 ft^3

Type of Bioretention Facility Design

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

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

Bioretention Facility Surface Area

Depth of Soil Filter Media Layer d_S = 3.0 ft

Top Width of Bioretention Facility, excluding curb w_T = 12.6 ft

Total Effective Depth, d_E

$d_E = (0.3) \times d_S + (0.4) \times 1 - (0.7/w_T) + 0.5$ d_E = 1.74 ft

Minimum Surface Area, A_m

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

A_M = 2,859 ft^2

Proposed Surface Area A= 2,861 ft^2

Bioretention Facility Properties

Side Slopes in Bioretention Facility z = 4 :1

Diameter of Underdrain 6 inches

Longitudinal Slope of Site (3% maximum) 0.5 %

6" Check Dam Spacing 0 feet

Describe Vegetation: Natural Grasses

Notes:

Appendix 7: Hydromodification

Supporting Detail Relating to Hydrologic Conditions of Concern

N/A

Appendix 8: Source Control

Pollutant Sources/Source Control Checklist

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

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

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

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

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

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

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

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

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

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

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

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

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

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

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

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

Appendix 9: O&M

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

WATER QUALITY MANAGEMENT PLAN
STORMWATER BMP
OPERATION AND MAINTENANCE AGREEMENT GUIDANCE

- **Explanation of Operation and Maintenance Agreement**
- **Inspection & Maintenance Agreement**
- **Long Term Maintenance Plan Instructions**
- **BMP Inspections Checklists (Templates)**

Explanation of Operation and Maintenance Agreement

The Operation and Maintenance Agreement is a required component of the Operations and Maintenance Plan (OMP). Guidance on the preparation of the OMP can be found at Chapter 6, Step 5 of the Riverside County, Santa Ana Region WQMP Guidance Document and Template (www.lake-elsinore.org WQMP web page).

The Operation and Maintenance (O&M) Agreement for a site is comprised of the following elements:

1. An Inspection and Maintenance Agreement signed by the developer or BMP owner.

2. A Long-term Maintenance Plan written by the design engineer or plan designer. The maintenance plan must include a description of the stormwater system and its components, inspection priorities and inspection schedule for each component, and a schematic for each BMP.

3. Drawing of easements on a plat or a system location map and decimal longitude and latitude to enable City of Lake Elsinore to locate BMPs as needed.

The O&M Agreement **must be submitted** for City of Lake Elsinore review and approval with the final Water Quality Management Plan. Under the terms of the Inspection and Maintenance Agreement, the property owner or owners are responsible for inspections and maintenance of BMPs and privately-owned stormwater system components outside of the right-of-way. **The O&M Agreement is to be recorded by the Developer/Owner at the Office of the Riverside County Recorder, with a conformed copy provided to the City Engineering Div. before a site is granted occupancy**. If the final configuration of the stormwater system components or BMPs differs from that described in the recorded O&M Agreement, a revised O&M Agreement must be recorded.

An **Inspection and Maintenance Agreement** is contained in this section, as are templates for inspection checklists for each type of structural BMP, including water quality buffers. As noted above, inspection priorities and schedules for each BMP type must be submitted as a component of the long-term maintenance plan for the site. The inspection checklists can serve this purpose, as well as serving as inspection reports for each facility. The template checklists are a general guideline of inspection elements; however, engineers may modify checklists to include inspections and maintenance elements as needed.

RECORDING REQUESTED BY

AND WHEN RECORDED MAIL TO:

Owner Information

TAX STATEMENTS
DO NOT CHANGE MAILING

(Space above this line for City and Recorder's use)

APN'S: 381-320-025-6

STORMWATER MANAGEMENT FACILITIES OPERATIONS AND MAINTENANCE AGREEMENT AND RIGHT OF ENTRY

PROJECT: Lake Elsinore Ortega Plaza
Project Address**, 15890 Grand Ave. ,**
Lake Elsinore, CA 92530

OWNER'S NAMES: David Cutler

by _____

This page intentionally left blank

INSPECTION AND MAINTENANCE AGREEMENT FOR PRIVATE STORMWATER FACILITIES

This page intentionally left blank

INSPECTION AND MAINTENANCE AGREEMENT
FOR STORMWATER MANAGEMENT FACILITIES

Map & Parcel No: _____

Project Name & Address: Lake Elsinore Ortega Plaza / 15890 Grand Ave., Lake Elsinore, CA

THIS AGREEMENT, made this _____ day of _____, 20 ____ , by and between _____,

hereinafter referred to as the "OWNER(S)" of the following property and CITY OF LAKE ELSINORE, a municipal corporation, located in the County of Riverside, State of California hereinafter referred to as the "CITY".

WHEREAS, the OWNER(S) own real property ("Property") in the City of Lake Elsinore, County of Riverside, State of California, more specifically described in Exhibit "A" and show in Exhibit "B" attached hereto and incorporate herein by this reference;

WHEREAS, at the time of initial approval of development project know as
Lake Elsinore Ortega Plaza

Within the Property described herein, the CITY required the project to employ Best Management Practices (BMP), hereinafter referred to as "BMPs", to minimize pollutants in urban runoff;

WHEREAS, the OWNER(S) has chosen to install and/or implement BMPs as described in the Water Quality Management Plan (WQMP) on file with the CITY to minimize pollutants in urban runoff and to minimize other adverse impacts of urban runoff;

WHEREAS, the OWNER(S) in said WQMP at Section I have identified the funding and maintenance sources for the BMPs. The OWNER(S) has agreed to provide funding for and conduct the maintenance of the stormwater quality facilities identified in Exhibit "C" attached hereto and incorporated herein by this reference;

WHEREAS, the OWNER(S) is aware that periodic and continuous maintenance, including, but not necessarily limited to, filter material replacement and sediment removal, is required to assure peak performance of all BMPs in the WQMP and that furthermore, such maintenance activity will require compliance with all Local, State, or Federal laws and regulations, including those pertaining to confined space and waste disposal methods, in effect at the time such maintenance occurs;

WITNESSETH WE, the OWNER(S), with full authority to execute deeds, mortgages, other covenants, do hereby covenant with the CITY and agree as follows:

1. The OWNER(S) covenant and agree with the CITY that the OWNER(S) shall provide for adequate long term funding and maintenance and continuation of the stormwater quality measures described in the Long Term Maintenance Plan and shown in the location map, deed of easement drawing or plat attached hereto to ensure that the facilities are and remain in

proper working condition in accordance with approved design standards, rules and regulations, and applicable laws. The OWNER(S) shall perform preventative maintenance activities at intervals described in the inspection schedule included in the Long Term Maintenance Plan along with necessary landscaping (grass cutting, etc.) and trash removal as part of regular maintenance. All reasonable precautions shall be exercised by OWNER(S) and OWNER(S) representative or contractor in the removal and extraction of any material(s) from the BMPs and the ultimate disposal of the materials(s) in a manner consistent with all relevant laws and regulations in effect at the time. As may be requested from time to time and provided in the annual report to the CITY, the OWNER shall provide the CITY with documentation identifying the material(s) removed, the quantity, and disposal destination.

2. The OWNER(S) shall submit to the CITY an **annual report and certification prepared by a Registered Civil Engineer by July 1st** of each year. The report shall include the Long Term Maintenance Plan that documents the inspection schedule, times of inspection, remedial actions taken to repair, modify or reconstruct the system, the state of control measures, and notification of any planned change in responsibility for the system.

3. The OWNER(S) shall grant to the CITY or its agent or contractor the right of entry at reasonable times and in a reasonable manner for the purpose of inspecting, operating, installing, constructing, reconstructing, maintaining or repairing the facility at the OWNER(S) expense as provided in paragraph 5 below.

4. The OWNER(S) shall grant to the CITY the necessary easements and rights-of-way and maintain perpetual access from public rights-of-way to the facility for CITY or its agent and contractor.

5. If, upon inspection, the CITY finds that OWNER(S) has failed to properly maintain the facilities, the CITY may order the work performed within ten (10) days. In the event the work is not performed within the specified time, the OWNER(S) agrees to allow the CITY to enter the property and take whatever steps it deems necessary to maintain the stormwater quality facilities. This provision shall not be construed to allow the CITY to erect any structure of a permanent nature on the land of the OWNER(S) without first obtaining written approval of the OWNER(S).

6. The CITY is under no obligation to maintain or repair said facilities, and in no event shall this Agreement be construed to impose any such obligation on the CITY The OWNER(S) shall reimburse the CITY upon demand the costs incurred in the maintenance of the facilities.

7. The CITY may require the OWNER(S) to post security in form and for a time period satisfactory to the CITY to quarantee the performance of the obligations stated herein. Should the OWNER fail to perform the obligations under the Agreement, the CITY may, in the case of a cash bond, act for the OWNER(S) using the proceeds from it, or in the case of a surety bond, require the sureties to perform the obligations of the Agreement. As an additional remedy, the CITY may withdraw any previous stormwater related approval with respect to the property on which BMPs have been installed and/or implemented until such time as OWNER(S) repays to CITY its reasonable costs incurred in accordance with paragraph 5 above.

8. If the OWNER(S) fails to pay the CITY for the above expenses after forty-five (45) days written notice, the OWNER(S) authorizes the CITY to collect said expenses from the

OWNER(S) through appropriate legal action and the OWNER(S) shall be liable for the reasonable expenses of collection, court costs, and attorney fees.

9. The OWNER(S) and the OWNER(S) heirs, administrators, executors, assigns, and any other successor in interest shall indemnify and hold harmless the CITY and its officers, agents and employees for any and all damages, accidents, casualties, occurrences, claims or attorney's fees which might arise or be asserted, in whole or in part, against the CITY from the construction, presence, existence, or maintenance of the stormwater control facilities subject to this AGREEMENT. In the event a claim is asserted against the CITY, its officers, agents or employees, the CITY shall notify OWNER(S) and the OWNER(S) shall defend at OWNER(S) expense any suit based on such claim. If any judgment or claims against the CITY, its officers, agents or employees, shall be allowed, the OWNER(S) shall pay all costs and expenses in connection therewith. The CITY will not indemnify, defend or hold harmless in any fashion the OWNER(S) from any claims arising from any failure, regardless of any language in any attachment or other document that the OWNER(S) may provide.

10. The OWNER(S) shall not be able to transfer, assign or modify its responsibilities with respect to this agreement without the CITY'S written prior consent. Nothing herein shall be construed to prohibit a transfer by OWNER(S

11. No waiver of any provision of this AGREEMENT shall affect the right of any party thereafter to enforce such provision or to exercise any right or remedy available to it in the event of any other default.

12. The OWNER(S) shall record a plat showing and accurately defining the easements for stormwater control facilities. The plat must reference the Instrument Number where this AGREEMENT and its or attachments are recorded and contain a note that the OWNER(S) is responsible for maintaining the stormwater management facilities.

13. The OWNER(S) shall record this AGREEMENT in the Office of the Recorder of Riverside County, California, at the expense of the OWNER(S) and shall constitute notice to all successors and assigns of the title to said Property of the obligation herein set forth, and also a lien in such amount as will fully reimburse the CITY, including interest as herein above set forth, subject to foreclosure in event of default in payment.

14. It is the intent of the parties hereto that burdens and benefits herein undertaken shall constitute a covenant running with the land, and shall be binding upon the OWNER(S) and the OWNER(S) heirs, administrators, executors, assigns, and any other successors in interest and constitute a lien there against OWNER(S) shall provide such notice prior to such successor obtaining an interest in all or part of the Property. Owner shall provide a copy of such notice to the CITY at the same time such notice is provided to the successor.

15. Time is of the essence in the performance of this Agreement.

16. Any notice to a party required or called for in this Agreement shall be served in person, or by deposit in the U.S. Mail, first class postage prepaid, to the address set forth below. Notice(s) shall be deemed effective upon receipt, or seventy-two (72) hours after deposit in the U.S. Mail, whichever is earlier. A party may change a notice address only by providing written notice thereof to the other party.

IF TO CITY: City of Lake Elsinore
Engineering Division
130 South Main Street
Lake Elsinore, CA 92530

IF TO OWNER(S): _____

_____

_____

_____

[SIGNATURES ON NEXT PAGE]

In WITNESS WHEREOF, the OWNER(S) has caused this agreement to be executed this _____ day of _____, 20___.

OWNER(S):

SIGNED: _____

BY: ___David Cutler_____
Type Name & Title on line above

FOR: ___Woodbridge investments, Inc._
Type Name of Company on line above

SIGNED: _____

BY: _____
Type Name & Title on line above

FOR: _____
Type Name of Company on line above

CITY OF LAKE ELSINORE

BY:_____
City Manager
CITY OF LAKE ELSINORE

ATTEST:

_____
City Clerk
CITY OF LAKE ELSINORE

NOTARIES ON FOLLOWING PAGE

This page intentionally left blank

EXHIBIT A
(Legal Description)

LEGAL DESCRIPTION

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

SOUTHEAST HALF OF LOT 8 IN BLOCK "C" AS SHOWN BY MAP SHOWING SUBDIVISIONS IN ELSINORE ON FILE IN BOOK 8, PAGE 377 OF MAPS, RECORDS OF SAN DIEGO COUNTY, CALIFORNIA.

EXCEPTING THAT PORTION CONVEYED TO THE STATE OF CALIFORNIA BY DEED RECORDED MARCH 26, 1991 AS INSTRUMENT NO. 98098, OF OFFICIAL RECORDS OF RIVERSIDE COUNTY, CALIFORNIA.

APN: 381-320-025-6

This page intentionally left blank

EXHIBIT B
(Plat Exhibit)

RECORD DESCRIPTION

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

SOUTHEAST HALF OF LOT 8 IN BLOCK "C" AS SHOWN BY MAP SHOWING SUBDIVISIONS IN ELSINORE ON FILE IN BOOK 8, PAGE 377 OF MAPS, RECORDS OF SAN DIEGO COUNTY, CALIFORNIA.

EXCEPTING THAT PORTION CONVEYED TO THE STATE OF CALIFORNIA BY DEED RECORDED MARCH 26, 1991 AS INSTRUMENT NO. 98098, OF OFFICIAL RECORDS OF RIVERSIDE COUNTY, CALIFORNIA.

APN: 381-320-025-6

MISCELLANEOUS NOTES

(MN1) THERE WAS NO OBSERVED EVIDENCE OF CEMETRIES/BURIAL GROUNDS ON THE SUBJECT PROPERTY.

(MN2) THERE WAS OBSERVED EVIDENCE OF BUILDING DEMOLITION, CONSTRUCTION AND/OR BUILDING ADDITION ON THE SUBJECT PROPERTY.

(MN3) THERE WAS NO OBSERVED EVIDENCE OF ANY CHANGES IN STREET RIGHT OF WAY LINES, SIDEWALK CONSTRUCTION AND/OR REPAIRS EITHER COMPLETED OR PROPOSED AND AVAILABLE FROM CONTROLLING JURISDICTION ON THE SUBJECT PROPERTY.

(MN4) PROPERTY HAS DIRECT ACCESS TO AND FROM GRAND AVENUE AND ORTEGA HIGHWAY, DULY DEDICATED AND ACCEPTED PUBLIC STREETS.

(MN5) THE SURVEYOR WAS NOT PROVIDED ANY DOCUMENTATION, WAS NOT MADE AWARE AND DID NOT OBSERVE ANY GROUND MARKINGS ON THE SURVEYED PROPERTY WITH REGARDS TO WETLANDS ON THE SURVEYED PROPERTY. NO ENVIRONMENTAL ASSESSMENT OR AUDIT WAS PERFORMED ON THE SUBJECT PARCEL BY DELTA SURVEYING & MAPPING.

(MN6) *INVERT ELEVATION OF THE SANITARY SEWER LINE ARE PROVIDED BY THE CITY OF LAKE ELSINORE AND MAY BE BASED ON THE NGVD29 DATUM

UTILITY NOTE

(UN1) THE LOCATION OF UTILITIES SHOWN HEREON ARE BASED ON THE OBSERVED EVIDENCE OF ABOVE GROUND APPURTENANCES. THE SURVEYOR WAS NOT PROVIDED WITH UNDERGROUND PLANS OR SURFACE GROUND MARKINGS TO DETERMINE THE LOCATION OF ANY SUBTERRANEAN USES.

(UN2) FROM OBSERVED ABOVE GROUND APPURTENANCES ONLY AS SHOWN HEREON, GAS, ELECTRIC, STORM SEWER, SANITARY SEWER, TELEPHONE AND WATER LINES AND/OR SERVICE IS AVAILABLE FOR THE SUBJECT PROPERTY WITHIN THE PUBLIC RIGHT OF WAY OF GRAND AVENUE.

BASIS OF BEARINGS

BASIS OF BEARINGS FOR THIS SURVEY WAS THE CENTER LINE OF GRAND AVENUE AS SHOWN ON TRACT NO. 20139-1, RECORDS OF RIVERSIDE COUNTY CALIFORNIA SAID BEARING BEING NORTH 53°32'06" WEST.

FLOOD NOTE

By graphic plotting only, this property is in Zone X of the Flood Insurance Rate Map, Community No. 060636, Map No. 06065C2036G which bears an effective date of 08/28/2008 and is in a Special Flood Hazard Area. As shown on FEMA website (fema.gov) by firmette created on 09/21/2019we have learned this community does currently participate in the program.

SIGNIFICANT OBSERVATIONS

NONE

COPYRIGHT 2019

ALTA/NSPS LAND TITLE SURVEY

15890 GRAND AVENUE,
LAKE ELSINORE, CA 92530

Based on Preliminary Report No.000600895-995-zw1 of Ticor Title Company bearing an effective date of April 26, 2019

Surveyor's Certification

To:

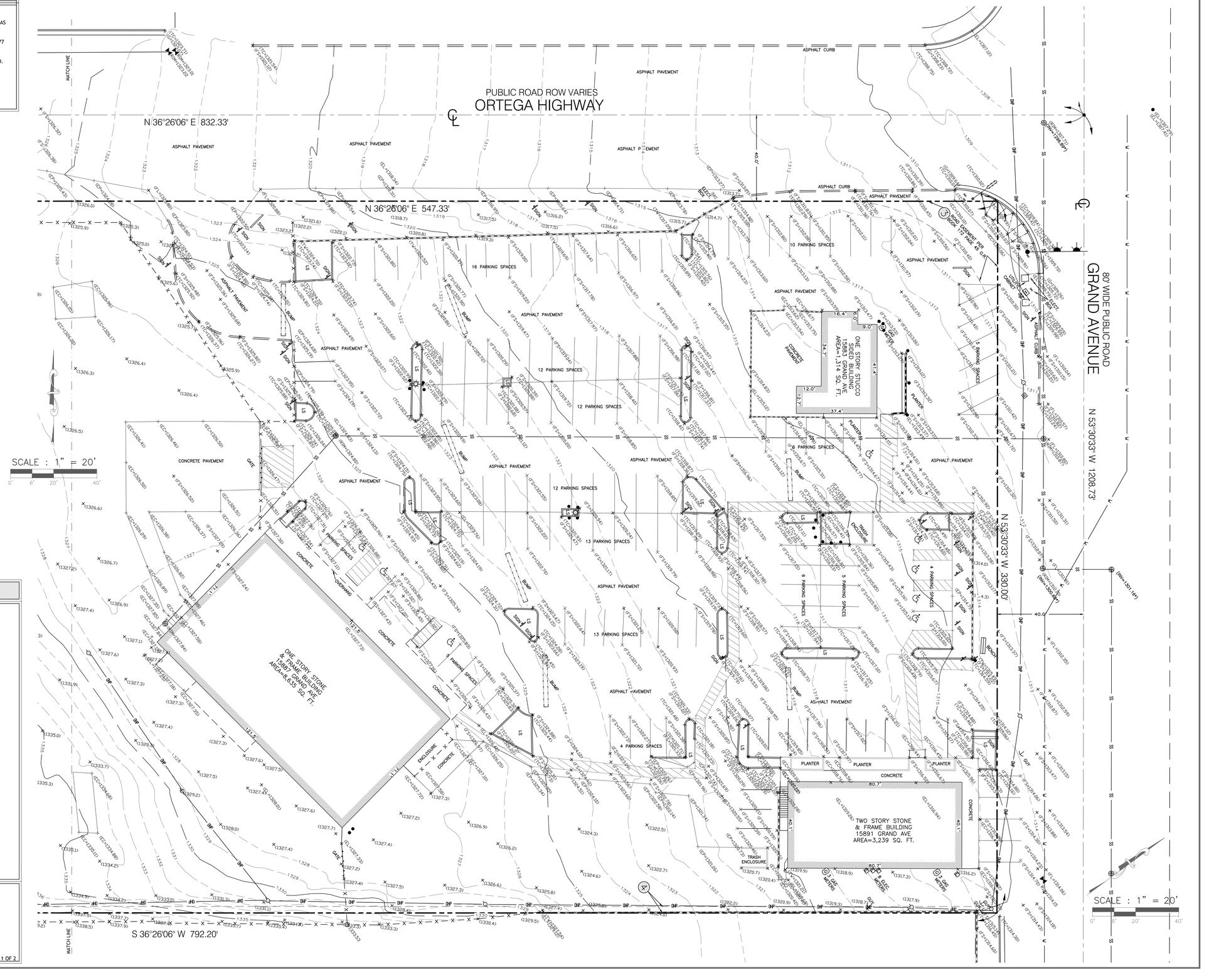
This is to certify that this map or plat and the survey on which it is based were made in accordance with the 2016 Minimum Standard Detail Requirements for ALTA/NSPS Land Title Surveys, jointly established and adopted by ALTA and NSPS, and includes Items 2, 3, 4, 5, 6a, 6b, 7a, 7b1, 7c, 8, 9, 13, 14, 16, 17, 18, 19 and 20 of Table A thereof. The fieldwork was completed on September 25, 2019.

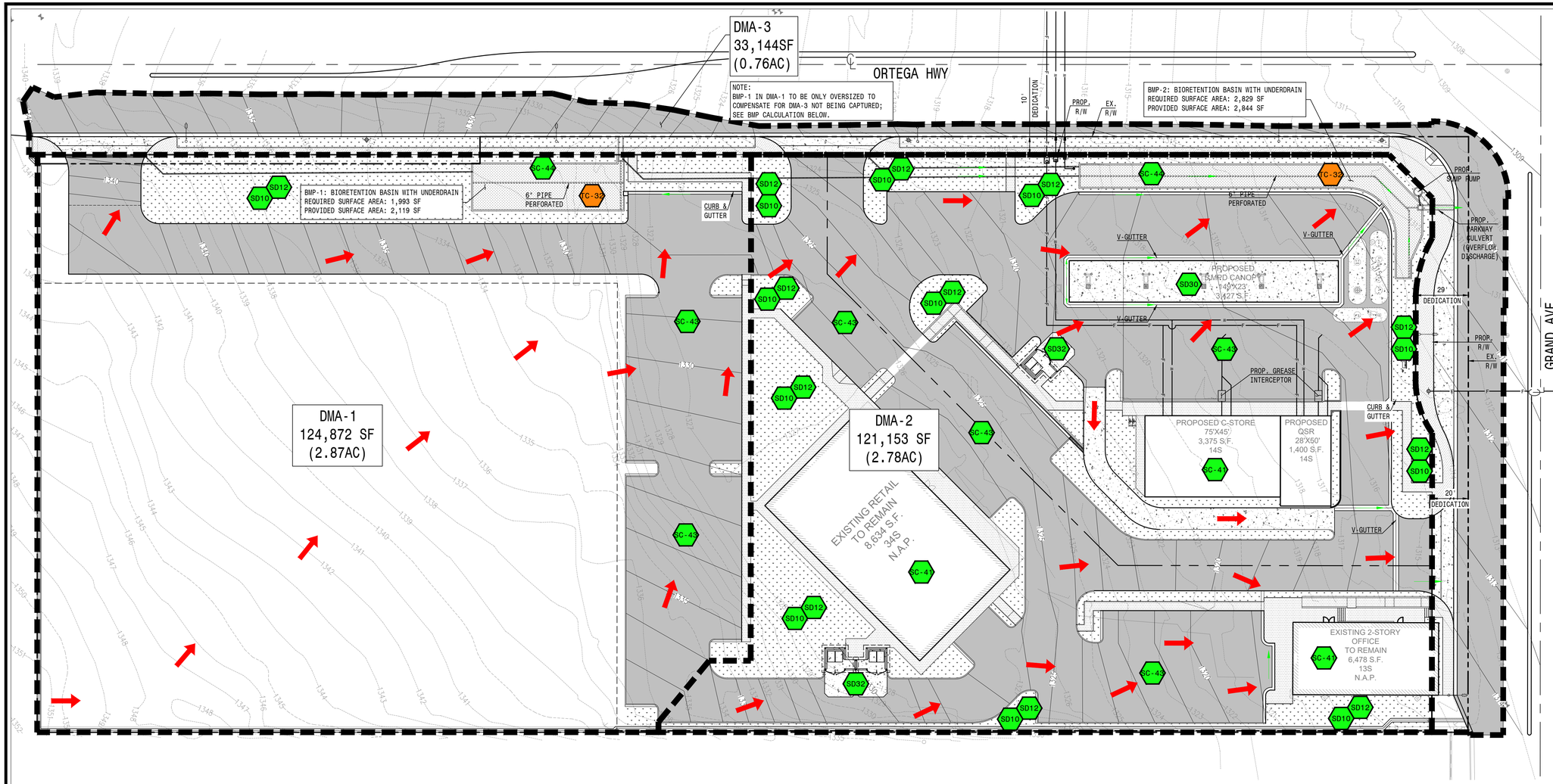
REGISTERED PROFESSIONAL SURVEYOR
RAY ZEQOLLARI
LS 8346
EXP. 12-31-19
LAND SURVEYOR
STATE OF CALIFORNIA

Ray R. Zeqollari
Registration No. 8346
In the state of California
Date of Survey: SEPTEMBER 25, 2019
Date of Last Revision: OCTOBER 5, 2019

Survey performed by: DELTA SURVEYING & MAPPING
39305 Salinas Drive,
Murrieta, CA 92563
Phone: 951-764-0158
Fax: 951-816-3235
Email: dsmsurveyor@verizon.net
FILE NO. 19177

DELTA
SURVEYING AND MAPPING
28101 SYCAMORE MESA RD TEMECULA CA 92590
Phone: 951-764-0158





LEGEND:

- PROPOSED LANDSCAPE AREA
- SHEET FLOW
- CONCENTRATED FLOW
- DMA BOUNDARY
- DMA-X XX,XXX SF X.XX ac — DMA INFORMATION

SOURCE CONTROL BMP'S:

- SD10 — SITE DESIGN & LANDSCAPE PLANNING
- SD12 — EFFICIENT IRRIGATION
- SD30 — FUELING AREAS
- SD32 — ROOFED TRASH STORAGE AREAS

NON STRUCTURAL CONTROL BMP'S:

- N4 — EDUCATION FOR PROPERTY OWNERS, TENANTS AND OCCUPANTS (ENTIRE SITE)

TREATMENT CONTROL BMP'S:

- TC32 — BIORETENTION BASIN WITH UNDERDRAIN AND IMPERMEABLE LINER

CASQA BMPS:

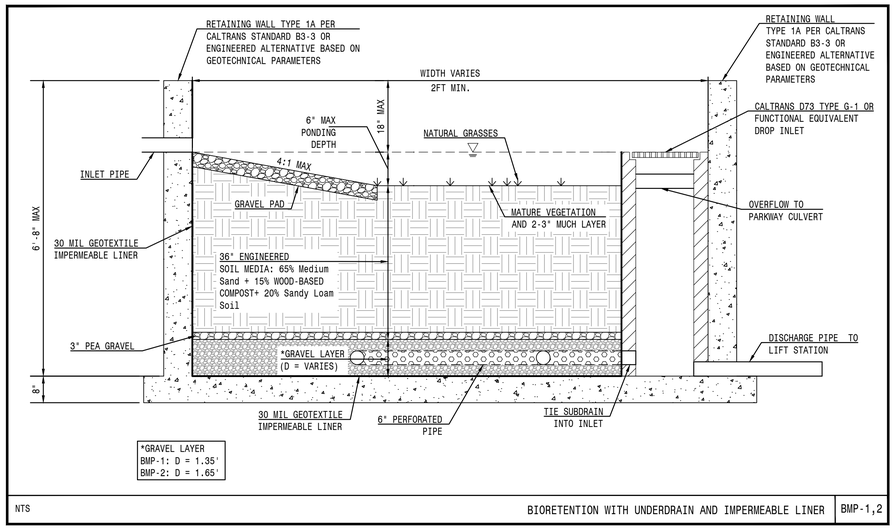
- SC-41 — BUILDING & GROUND MAINTENANCE
- SC-43 — PARKING LOT MAINTENANCE
- SC-44 — DRAINAGE SYSTEM MAINTENANCE

DCV CALCULATIONS

PERVIOUS AND IMPERVIOUS AREA				
DMA	PERVIOUS AREA (SF)	IMPERVIOUS AREA (SF)	TOTAL AREA (SF)	DCV (CF)
1	97,344	27,528	124,872	1,855
2	29,292	91,861	121,153	4,986
3	3,776	29,369	33,144	1,686
TOTAL	130,411.25	148,757	279,168	8,527

BMP CALCULATION

BIORETENTION FACILITY DESIGN (PER RIVERSIDE COUNTY LID DESIGN MANUAL)						
BMP	VBMP	SOIL DEPTH	TOP WIDTH	EFFECTIVE DEPTH	REQUIRED SURFACE AREA	PROVIDED SURFACE AREA
	CF	FT	FT	FT	SF	SF
1	1,855+1,676= 3,531	3.0	25.3	1.77	1,993	2,119
2	4,922	3.0	12.6	1.74	2,829	2,861



30' 0 30' 60' 90'

SCALE: 1" = 30'

P:\ACAD\PBD.bmp

CONSULTING ENGINEERS
IN CIVIL, SURVEYING,
AND STRUCTURAL
ENGINEERING
914 E. KATELLA AVENUE
ANAHEIM, CALIFORNIA 92805
(714) 385-1835, FAX (714) 385-1834

ARCHITECT:
EMPIRE DESIGN GROUP Inc.
24861 Washington Ave.
Murrieta, Calif. 92562
Tel 951-696-1400 Fax 951-696-1443

CLIENT:
ORTEGA PLAZA, LLC

COMMERCIAL RETAIL
APN: 381-320-025-6
15890 GRAND AVE.
LAKE ELSINORE, CA 92530

ENGINEER OF RECORD:
TRYFON TRYFONOPOULOS, PE
914 E KATELLA AVE.
ANAHEIM, CA 92805
(714)385-1835

SEAL:
REGISTERED PROFESSIONAL ENGINEER
TRYFON P. TRYFONOPOULOS
NO. 65859
EXP.12/31/21
CIVIL
STATE OF CALIFORNIA

Date: 5-2-2024
Project Number: 2006012

NO.	DATE	REVISION DESCRIPTION

DESIGNED BY: TT
CHECKED BY: TT
DRAWN BY: AL

DRAWING TITLE:
WQMP SITE PLAN

SHEET NO:
C02

This page intentionally left blank

EXHIBIT C

LONG TERM BMP MAINTENANCE PLAN

This page intentionally left blank

Long Term Maintenance Plan Instructions

The Long Term Maintenance Plan is a component of the Operation and Maintenance Agreement for the development or site. One of the purposes of the Long Term Maintenance Plan is to inform property owners about the system components on their properties, so that they will know the locations and maintenance needs of the components and structural BMPs

Using the Schedule Format provided the Long-Term Maintenance Plan must include or address the following elements:

- Description and locations of stormwater system components to be inspected, prepared by the engineer. GIS Decimal Degree longitude and latitude coordinates of each BMP to be maintained.

- Schedule of inspections and the techniques used to inspect and maintain the systems to ensure that they are functioning properly as designed. Documentation checklists for each type of BMP including the inspection schedule and potential maintenance items that must be addressed. Templates for checklists are found in this document.

- Where and how the trash, sediment and other pollutants removed from the stormwater system will be disposed.

- Schematics of BMPs located on the site.

- Person(s) and phone number(s) of who will be responsible for inspection and maintenance. If the organization that will be responsible is yet to be organized, list the name, address and phone number of the person or entity with interim responsibility.

- Provisions for permanent access and maintenance easements.

Long Term Maintenance Table Instructions: delete word "SAMPLE", delete BMPs listed in table and insert your project specific BMPs in their place.

STORMWATER STRUCTURAL BMP INSPECTION CHECKLIST TEMPLATES
Instructions: delete non-applicable inspection templates; edit 'checklist' to reflect templates included.

This page intentionally left blank

TABLE FOR LONG TERM MAINTENANCE PLAN –

POST CONSTRUCTION BMP LONG TERM MAINTENANCE SCHEDULE						
TYPE OF BMP	**LOCATION (see attached site plan)**	**INSPECTION FREQUENCY**	**MAINTENANCE FREQUENCY**	**POLLUTANT DISPOSAL METHOD**	**O&M RESPONSIBLE PERSON**	
					NAME	**PHONE #**
Bioretention Basin With underdrain and impermeable liner	Fronting the property along Grand Ave. and Ortega Hwy	Monthly and after Rain Events	Min monthly, with remediation as needed	Landfill as hazardous waste	David Cutler	619-218-3663

(1) See attached manufacturer data sheets
(2) See attached site plan

This page intentionally left blank

STORMWATER STRUCTURAL BMP INSPECTION CHECKLIST TEMPLATES

(COMPONENT OF LONG-TERM MAINTENANCE PLAN)

- **ANNUAL CERTIFICATION FORM**
- **WATER QUALITY DETENTION BASIN**
- **CONSTRUCTED WETLANDS**
- **BIORETENTION**
- **SAND FILTER**
- **INFILTRATION TRENCH**
- **ENHANCED SWALE/GRASS CHANNEL/FILTER STRIP**
- **BUFFERS**
- **PROPRIETARY BMP**
- **GREEN ROOF**
- **PERMEABLE PAVEMENT**

This page intentionally left blank

CITY OF LAKE ELSINORE

ANNUAL WATER QUALITY MANAGEMENT PLAN
FACILITY CERTIFICATION

Complete one form for each water quality facility or facility type (ex. all catch basins on one form, separate form for each water quality basin) – if additional forms are needed contact rthompson@lake-elsinore.org or make copies using this form as a master. Return completed form(s) with Civil Engineer's Certification and/or direct questions to Rita Thompson, Engineering Division, City of Lake Elsinore by ***JULY 1st****.*

1. Facility Information:

Facility/Project Name: _____

Facility/Project Address: _____

Owner/Operator Name(s): _____

Mailing Address: _____

City/State/Zip: _____

Telephone No./Email.: P:_____/ EM: _____

2. Water Quality Facility Information:

Water Quality Facility Type (circle one):

BASIN - Detention (Bioretention) Retention Regional Detention DeSilting

OTHER - Infiltration Trench BioSwale Vegetated Swale Catch Basin Inserts Underground Detention/Infiltration

Proprietary - _____

Water Quality Facility Location on Site:

Provide either a copy of site plan highlighting location of water quality facility or decimal degree longitude and latitude - not required for catch basin inserts.

BMP-1: Longitude: 33.65694 Latitude: -117.37667

BMP-2: Longitude: 33.65801 Latitude: -117.37575

3. Facility Inspections: Summarize below and/or attach separate documentation of inspections performed during the past year:

Date: _____ / Results/Cleanout:_____

Date: _____ / Results/Cleanout: _____

Date: _____ / Results/Cleanout:_____

Date: _____ / Results/Cleanout:_____

Attach a separate sheet for additional inspections and/or results of inspections as needed.

4. Certification:

I, being a Registered Professional Engineer in California, do hereby certify that to the best of my knowledge and belief based upon personal observation that the above facility approved under the Water Quality Management Plan / SWPPP is clear of debris and operational as of _____.
date

_____
Signature / RCE License No. / Expiration Date

_____ Seal
Name - please print or type

Firm or Agency: _____

Address: _____ / City/State/Zip: _____

Telephone _____Email: _____

This page intentionally left blank

Bioretention
Inspections and Maintenance Checklist

Site Name: Owner Change since last inspection? Y ☐ N ☐

Location:

Owner Name:

Address: Phone Number

Site Status:

Date: Time: Site conditions:

Inspection Frequency Key: A=annual; M=monthly; S=after major storms. ***BOLD*** *= recommended frequency*

Inspection Items	Inspection Frequency	Inspected? (Yes/No)	Maintenance Needed? (Yes/No)	Comments/Description
Treatment Area				
Treatment area free of debris?	A / **M** / S			
Inlets and Outlets unobstructed?	A / **M** / S			
Is there standing water longer than 24 hours after a storm event?	A / M / **S**			
Evidence of erosion?	A / **M** / **S**			
Vegetation				
Surrounding area fully stabilized? (no evidence of material eroding into Bioretention area)	**A** / M / S			
Grass height not more than 6 inches?	A / **M** / S			
Plant height not less than design water depth?	**A** / M / S			
Plant composition according to approved plan?	**A** / M / S			
Vegetation overgrown?	**A** / M / S			
Other				
Hazards				
Have there been complaints from residents?	A / **M** / S			
Public hazards noted?	A / **M** / S			

Inspector Comments: _____

_____

_____

_____

Overall Condition of Facility: ☐: Acceptable ☐ Unacceptable

If any of the above Inspection items are checked "Yes" for "Maintenance Needed", list Maintenance actions and their

completion dates below:

Maintenance Action Needed	Due Date

The next routine inspection is scheduled for approximately: _____

Inspected by: (signature) _____

Inspected by: (printed) _____

CITY OF LAKE ELSINORE
DREAM EXTREME

Proprietary BMP
Inspections and Maintenance Checklist

Site Name: _____ Owner Change since last inspection? Y ☐ N ☐

Location: _____

Owner Name: _____

Address: _____ Phone Number _____

Site Status: _____

Date: _____ Time: _____ Site conditions: _____

Inspection Frequency Key: A=annual; M=monthly; S=after major storms. ***BOLD*** *= recommended frequency*

Inspection Items	**Inspection Frequency**	**Inspected? (Yes/No)**	**Maintenance Needed? (Yes/No)**	**Comments/Description**
Debris Removal				
Adjacent area free of debris?	A / **M** / S			
Inlets and Outlets free of debris?	A / **M** / S			
Facility (internally) free of debris?	A / **M** / S			
Vegetation				
Surroundng area fully stabilized? (no evidence of material eroding into sand filter)	**A** / M / S			
Grass mowed?	A / **M** / S			
Water Retention (where required)				
Water holding chambers at normal pool?	A / **M** / S			
Evidence of erosion?	A / **M** / S			
Sediment Deposition				
Filtration chamber free of sediments?	**A** / M / S			
Sedimentation chamber not more than 50% full?	**A** / M / S			
Structural Components				
Any evidence of structural deterioration?	**A** / M / S			
Grates in good condition?	**A** / M / S			
Spalling or cracking of structural parts?	**A** / M / S			
Outlet/Overflow Spillway	**A** / M / S			
Other				
Noticeable odors?	**A** / M / S			
Any evidence of filter(s) clogging?	A / **M** / S			
Evidence of flow bypassing facility?	**A** / M / S			

Inspector Comments: _____

_____

_____

_____

Overall Condition of Facility: ☐: Acceptable ☐ Unacceptable

If any of the above Inspection items are checked “Yes” for “Maintenance Needed”, list Maintenance actions and their completion dates below:

Maintenance Action Needed	Due Date

The next routine inspection is scheduled for approximately: _____

Inspected by: (signature) _____

Inspected by: (printed) _____

Lake Elsinore Ortega plaza

15890 Grand Avenue, Lake Elsinore, Ca 92530

Book 8, page 377 of maps, records of San Diego County, Califirnia

REQUIRED PERMITS

This section must list any permits required for the implementation, operation, and maintenance of the BMPs. Possible examples are:

- Permits for connection to sanitary sewer
- Permits from California Department of Fish and Game
- Encroachment permits

If no permits are required, a statement to that effect should be made.

RECORDKEEPING

All records must be made available for review upon request.

RESPONSIBLE PARTY

The owner is aware of the maintenance responsibilities of the proposed BMPs. A funding mechanism is in place to maintain the BMPs at the frequency stated in the LID Plan. The contact information for the entity responsible is below:

Name:	David Cutler
Company:	Woodbridge Investments, Inc.
Title:	Owner
Address 1:	3111 Camino Del Rio North San Diego, CA 92108
Address 2:	
Phone Number:	(619) 218-3663
Email:	dcutler53@aol.com

BMP Name	BMP Implementation, Maintenance, and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Source Control BMPs			
Storm Drain Inlets & Messaging	Owners shall annually inspect and maintain all stenciled or placarded messaging on storm drain inlets, for legibility. Owners shall also regularly inspect/maintain all storm drain inlets free of debris and/or trash accumulations, including inspection for evidence of illegal/illicit discharges into inlets. Owners shall 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."	Ongoing, Annually, Before Raining Season (Oct 1st)	Responsible Party: Woodbridge Investments, Inc. 3111 Camino Del Rio North San Diego, CA 92108 Attn: David Cutler (619) 218-3663 dcutler53@aol.com
Landscape / Outdoor Pest	Owners shall be responsible for landscape maintenance practices and proper collection/disposal of landscape cuttings & waste, to keep it out of storm drain inlets. Owners shall be responsible for irrigation system maintenance and repair of broken pipes, sprinkler heads, etc., to conserve water and prevent erosion of soil.	Monthly	Responsible Party: Woodbridge Investments, Inc. 3111 Camino Del Rio North San Diego, CA 92108 Attn: David Cutler (619) 218-3663 dcutler53@aol.com
Fueling Dispensing Areas	Owners shall inspect/maintain fueling areas' floors, canopy routinely. Owners shall dry sweep the fueling area routinely.	Monthly, Annually	Responsible Party: Woodbridge Investments, Inc. 3111 Camino Del Rio North San Diego, CA 92108 Attn: David Cutler (619) 218-3663 dcutler53@aol.com

BMP Name	BMP Implementation, Maintenance, and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Miscellaneous Drain or Wash Water or Other Sources - Roofing, gutters, and trim	Owners shall inspect/maintain roofing, gutter, and trim routinely to avoid these made of copper or other unprotected metals that may leach into runoff. Owners shall collect all wastewater from pressure washing to prevent entry into the storm drain system. Owners shall collect wash water containing any cleaning agent or degreaser and discharge it to the sanitary sewer not to a storm drain.	Ongoing, Annually, Before wet Season	Responsible Party: Woodbridge Investments, Inc. 3111 Camino Del Rio North San Diego, CA 92108 Attn: David Cutler (619) 218-3663 dcutler53@aol.com

BMP Name	BMP Implementation, Maintenance, and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Plazas, sidewalks, and parking lots - (Street Sweeping)	Owners shall vacuum sweep plazas, sidewalks, and parking lots at least monthly to prevent accumulation of litter and debris.	Monthly	Responsible Party: Woodbridge Investments, Inc. 3111 Camino Del Rio North San Diego, CA 92108 Attn: David Cutler (619) 218-3663 dcutler53@aol.com
Food Service (Grease Interceptor & Equipment)	Owners shall inspect/maintain the grease interceptor routinely. Owners shall maintain all cleaning areas and cooling equipment routinely to avoid discharge to the street or storm drain.	Ongoing, Annually	Responsible Party: Woodbridge Investments, Inc. 3111 Camino Del Rio North San Diego, CA 92108 Attn: David Cutler (619) 218-3663 dcutler53@aol.com

BMP Name	BMP Implementation, Maintenance, and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Refuse Area (Trash Enclosure)	Owners shall provide an adequate number of receptacles. Owners shall inspect receptacles regularly; repair or replace leaky receptacles. Owners shall keep receptacles covered and prohibit/ prevent dumping of liquid or hazardous wastes. Owners shall post "no hazardous materials" signs. Owners shall inspect and pick up litter daily and clean up spills immediately and keep spill control materials available on-site.	Ongoing, Annually	Responsible Party: Woodbridge Investments, Inc. 3111 Camino Del Rio North San Diego, CA 92108 Attn: David Cutler (619) 218-3663 dcutler53@aol.com
Education of Site Owners, Tenants, Site Employees, Occupants, and Contractors	Owners shall familiarize himself and/or herself with the contents of this WQMP and shall utilize BMP Educational Materials in Appendix 10 to provide stormwater pollution prevention information to new site owners, lessees, site employees, and operators/contractors. Owners shall provide education training program as it would apply to future employees of individual business on-site.	Ongoing, Annually	Responsible Party: Woodbridge Investments, Inc. 3111 Camino Del Rio North San Diego, CA 92108 Attn: David Cutler (619) 218-3663 dcutler53@aol.com

BMP Name	BMP Implementation, Maintenance, and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Treatment Control BMPs			
Bioretention Basin with Underdrain TC-32	Owners shall routinely maintain vegetation and remove debris and litter from basin areas to minimize clogging and improve aesthetics. After major storm events, owners shall inspect basin areas for standing water, and inspect/clean inlets and outlets. If the basin takes more than 72 hours to drain, then the soil fill and should be removed and the perforated drain should be checked and/or replaced.	Monthly, After Major Storm Events	Responsible Party: Woodbridge Investments, Inc. 3111 Camino Del Rio North San Diego, CA 92108 Attn: David Cutler (619) 218-3663 dcutler53@aol.com
Sump Pump	Owners shall test the pump every year before the "wet season" in early spring. Owners shall routinely remove any dirt, sand, gravel or other debris from the pump opening, and check for worn parts. Owners shall follow the manufacturer's maintenance schedule.	Annually, Before "Wet Season"	Responsible Party: Woodbridge Investments, Inc. 3111 Camino Del Rio North San Diego, CA 92108 Attn: David Cutler (619) 218-3663 dcutler53@aol.com

Appendix 10: Educational Materials

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

After the Storm

A Citizen's Guide to Understanding Stormwater

EPA 833-B-03-002

January 2003

For more information contact:

or visit
www.epa.gov/npdes/stormwater
www.epa.gov/nps

What is stormwater runoff?

Stormwater runoff occurs when precipitation from rain or snowmelt flows over the ground. Impervious surfaces like driveways, sidewalks, and streets prevent stormwater from naturally soaking into the ground.

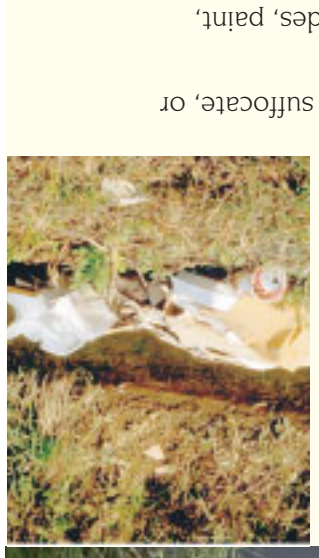
Stormwater can pick up debris, chemicals, dirt, and other pollutants and flow into a storm sewer system or directly to a lake, stream, river, wetland, or coastal water. Anything that enters a storm sewer system is discharged untreated into the waterbodies we use for swimming, fishing, and providing drinking water.

Why is stormwater runoff a problem?

The effects of pollution

Polluted stormwater runoff can have many adverse effects on plants, fish, animals, and people.

- Sediment can cloud the water and make it difficult or impossible for aquatic plants to grow. Sediment also can destroy aquatic habitats.
- Excess nutrients can cause algae blooms. When algae die, they sink to the bottom and decompose in a process that removes oxygen from the water. Fish and other aquatic organisms can't exist in water with low dissolved oxygen levels.
- Bacteria and other pathogens can wash into swimming areas and create health hazards, often making beach closures necessary.
- Debris—plastic bags, six-pack rings, bottles, and cigarette butts—washed into waterbodies can choke, suffocate, or disable aquatic life like ducks, fish, turtles, and birds.
- Household hazardous wastes like insecticides, pesticides, paint, solvents, used motor oil, and other auto fluids can poison aquatic life. Land animals and people can become sick or die from eating diseased fish and shellfish or ingesting polluted water.
- Polluted stormwater often affects drinking water sources. This, in turn, can affect human health and increase drinking water treatment costs.



Stormwater Pollution Solutions

Residential

Recycle or properly dispose of household products that contain chemicals, such as insecticides, pesticides, paint, solvents, and used motor oil and other auto fluids. Don't pour them onto the ground or into storm drains.

Lawn care

Excess fertilizers and pesticides applied to lawns and gardens wash off and pollute streams. In addition, yard clippings and leaves can wash into storm drains and contribute nutrients and organic matter to streams.

- Don't overwater your lawn. Consider using a soaker hose instead of a sprinkler.
- Use pesticides and fertilizers sparingly. When use is necessary, use these chemicals in the recommended amounts. Use organic mulch or safer pest control methods whenever possible.
- Compost or mulch yard waste. Don't leave it in the street or sweep it into storm drains or streams.
- Cover piles of dirt or mulch being used in landscaping projects.

Septic systems

Leaking and poorly maintained septic systems release nutrients and pathogens (bacteria and viruses) that can be picked up by stormwater and discharged into nearby waterbodies. Pathogens can cause public health problems and environmental concerns.

- Inspect your system every 3 years and pump your tank as necessary (every 3 to 5 years).
- Don't dispose of household hazardous waste in sinks or toilets.

Auto care

Washing your car and degreasing auto parts at home can send detergents and other contaminants through the storm sewer system. Dumping automotive fluids into storm drains has the same result as dumping the materials directly into a waterbody.

- Use a commercial car wash that treats or recycles its wastewater, or wash your car on your yard so the water infiltrates into the ground.
- Repair leaks and dispose of used auto fluids and batteries at designated drop-off or recycling locations.

Pet waste

Pet waste can be a major source of bacteria and excess nutrients in local waters.

- When walking your pet, remember to pick up the waste and dispose of it properly. Flushing pet waste is the best disposal method. Leaving pet waste on the ground increases public health risks by allowing harmful bacteria and nutrients to wash into the storm drain and eventually into local waterbodies.

Education is essential to changing people's behavior. Signs and markers near storm drains warn residents that pollutants entering the drains will be carried untreated into a local waterbody.

Residential landscaping

Permeable Pavement—Traditional concrete and asphalt don't allow water to soak into the ground. Instead these surfaces rely on storm drains to divert unwanted water. Permeable pavement systems allow rain and snowmelt to soak through, decreasing stormwater runoff.

Rain Barrels—You can collect rainwater from rooftops in mosquito-proof containers. The water can be used later on lawn or garden areas.

Rain Gardens and Grassy Swales—Specially designed areas planted with native plants can provide natural places for rainwater to collect and soak into the ground. Rain from rooftop areas or paved areas can be diverted into these areas rather than into storm drains.

Vegetated Filter Strips—Filter strips are areas of native grass or plants created along roadways or streams. They trap the pollutants stormwater picks up as it flows across driveways and streets.

Commercial

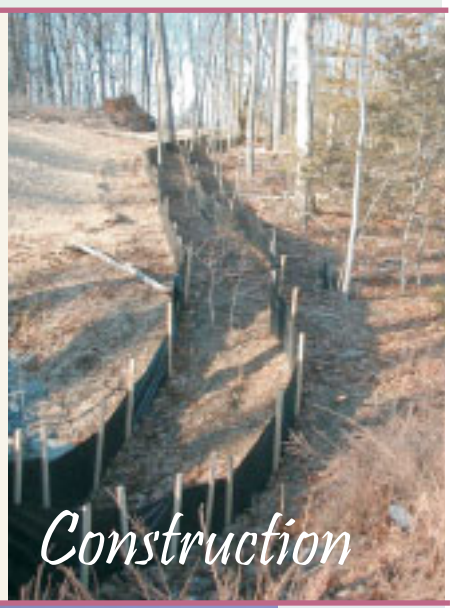
Dirt, oil, and debris that collect in parking lots and paved areas can be washed into the storm sewer system and eventually enter local waterbodies.

- Sweep up litter and debris from sidewalks, driveways and parking lots, especially around storm drains.
- Cover grease storage and dumpsters and keep them clean to avoid leaks.
- Report any chemical spill to the local hazardous waste cleanup team. They'll know the best way to keep spills from harming the environment.

Construction

Erosion controls that aren't maintained can cause excessive amounts of sediment and debris to be carried into the stormwater system. Construction vehicles can leak fuel, oil, and other harmful fluids that can be picked up by stormwater and deposited into local waterbodies.

- Divert stormwater away from disturbed or exposed areas of the construction site.
- Install silt fences, vehicle mud removal areas, vegetative cover, and other sediment and erosion controls and properly maintain them, especially after rainstorms.
- Prevent soil erosion by minimizing disturbed areas during construction projects, and seed and mulch bare areas as soon as possible.



Agriculture

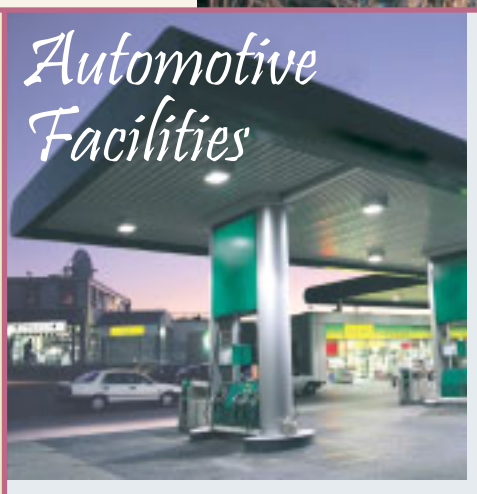
Lack of vegetation on streambanks can lead to erosion. Overgrazed pastures can also contribute excessive amounts of sediment to local waterbodies. Excess fertilizers and pesticides can poison aquatic animals and lead to destructive algae blooms. Livestock in streams can contaminate waterways with bacteria, making them unsafe for human contact.

- Keep livestock away from streambanks and provide them a water source away from waterbodies.
- Store and apply manure away from waterbodies and in accordance with a nutrient management plan.
- Vegetate riparian areas along waterways.
- Rotate animal grazing to prevent soil erosion in fields.
- Apply fertilizers and pesticides according to label instructions to save money and minimize pollution.

Forestry

Improperly managed logging operations can result in erosion and sedimentation.

- Conduct preharvest planning to prevent erosion and lower costs.
- Use logging methods and equipment that minimize soil disturbance.
- Plan and design skid trails, yard areas, and truck access roads to minimize stream crossings and avoid disturbing the forest floor.
- Construct stream crossings so that they minimize erosion and physical changes to streams.
- Expedite revegetation of cleared areas.



Automotive Facilities

Uncovered fueling stations allow spills to be washed into storm drains. Cars waiting to be repaired can leak fuel, oil, and other harmful fluids that can be picked up by stormwater.

- Clean up spills immediately and properly dispose of cleanup materials.
- Provide cover over fueling stations and design or retrofit facilities for spill containment.
- Properly maintain fleet vehicles to prevent oil, gas, and other discharges from being washed into local waterbodies.
- Install and maintain oil/water separators.

3.5 Bioretention Facility

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

Description

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

Siting Considerations

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

- ✓ Parking islands
- ✓ Medians
- ✓ Site entrances

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

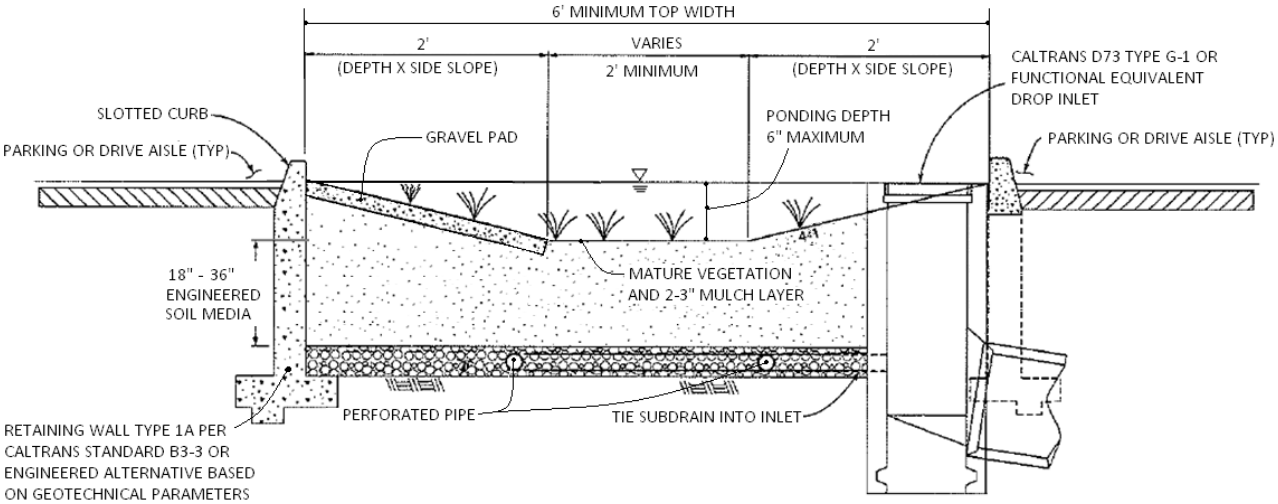
- *Depressing* landscaped areas below adjacent impervious surfaces, rather than elevating those areas
- Grading the site to direct runoff from those impervious surfaces *into* the Bioretention Facility, rather than away from the landscaping
- Sizing and designing the depressed landscaped area as a Bioretention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

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

Design and Sizing Criteria

The recommended cross section necessary for a Bioretention Facility includes:

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



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

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

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

Figure 1: Standard Layout for a Bioretention Facility

Engineered Soil Media Requirements

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

Table 1: Mineral Component Range Requirements

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

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

Vegetation Requirements

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

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

Curb Cuts

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

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

Figure 2: Curb Cut located in a Bioretention Facility

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

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

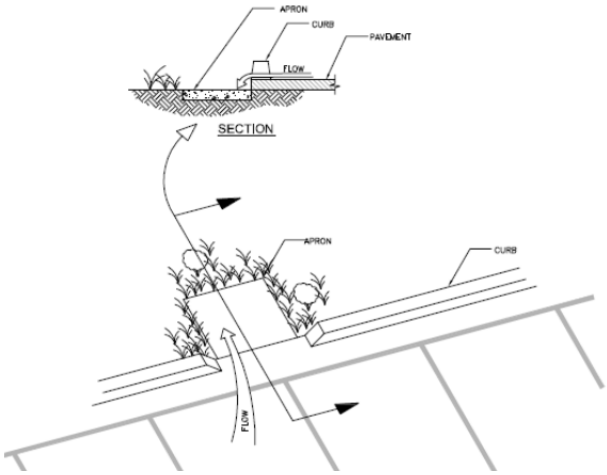


Figure 3: Apron located in a Bioretention Facility

Terracing the Landscaped Filter Basin

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

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

Table 2: Check Dam Spacing

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

Roof Runoff

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

Retaining Walls

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

Side Slope Requirements

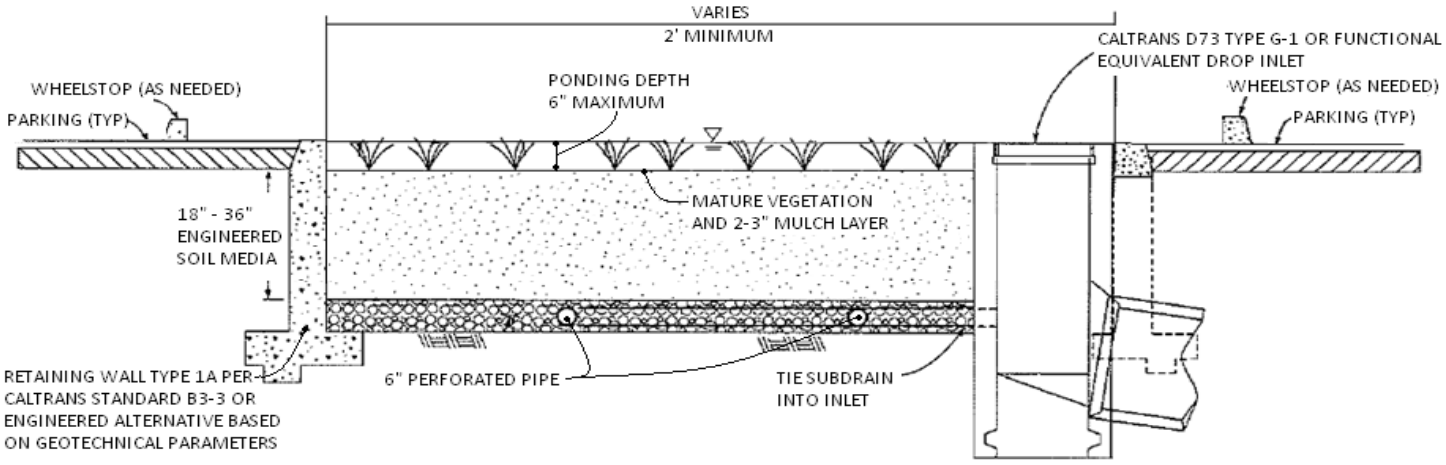
Bioretention Facilities Requiring Side Slopes

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

Bioretention Facilities Not Requiring Side Slopes

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

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



Planter Boxes

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

Figure 5: Planter Box
Source: LA Team Effort

Overflow

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

Underdrain Gravel and Pipes

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

Figure 6: Incorrect Placement of an Overflow Inlet.

Inspection and Maintenance Schedule

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

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

Bioretention Facility Design Procedure

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

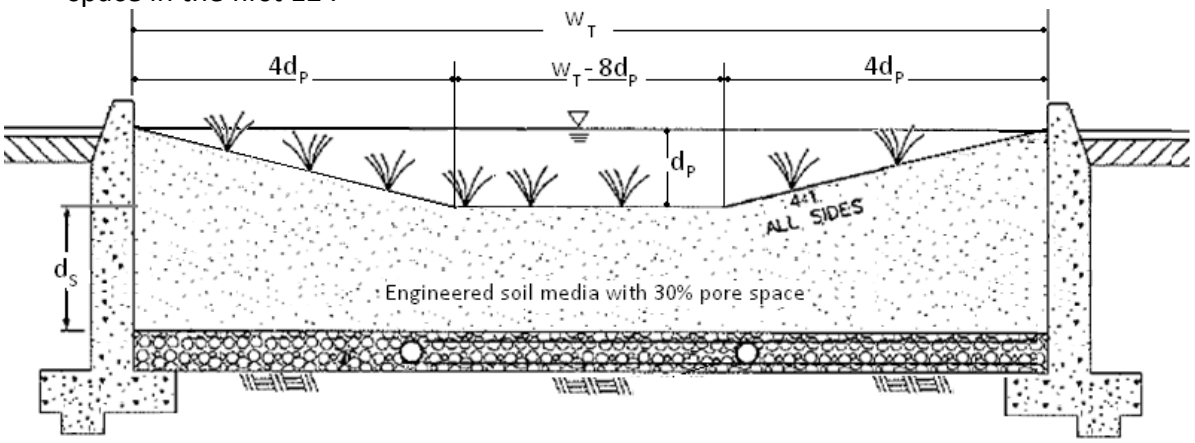
2) Enter the Design Volume, $V_{BMP,}$ determined from Section 2.1 of this Handbook.

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

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

5) Enter the top width of the Bioretention Facility.

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



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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

13) Describe the vegetation used within the Bioretention Facility.

References Used to Develop this Fact Sheet

Anderson, Dale V. "Landscaped Filter Basin Soil Requirements." Riverside, May 2010.

California Department of Transportation. CalTrans Standard Plans. 15 September 2005. May 2010 <http://www.dot.ca.gov/hq/esc/oe/project_plans/HTM/stdplns-met-new99.htm>.

Camp Dresser and McKee Inc.; Larry Walker Associates. California Stormwater Best Management Practice Handbook for New Development and Redevelopment. California Stormwater Quality Association (CASQA), 2004.

Contra Costa Clean Water Program. Stormwater Quality Requirements for Development Applications. 3rd Edition. Contra Costa, 2006.

County of Los Angeles Public Works. Stormwater Best Management Practice Design and Maintenance Manual. Los Angeles, 2009.

Kim, Hunho, Eric A. Seagren and Allen P. Davis. "Engineered Bioretention for Removal of Nitrate from Stormwater Runoff." Water Environment Research 75.4 (2003): 355-366.

LA Team Effort. LA Team Effort: FREE Planter Boxes for Businesses. 2 November 2009. May 2010 <http://lateameffort.blogspot.com/2009/11/free-planter-boxes-for-businesses-est.html>.

Montgomery County Maryland Department of Permitting Services Water Resources Section. Biofiltration (BF). Montgomery County, 2005.

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

United States Environmental Protection Agency. Storm Water Technology Fact Sheet Bioretention. Washington D.C, 1999.

Urban Drainage and Flood Control District. Urban Storm Drainage Criteria Manual Volume 3 - Best Management Practices. Vol. 3. Denver, 2008. 3 vols.

Urbonas, Ben R. Stormwater Sand Filter Sizing and Design: A Unit Operations Approach. Denver: Urban Drainage and Flood Control District, 2002.

APPENDIX B – UNDERDRAINS

Where underdrains are specified, the following information provides guidance for underdrain requirements.

Underdrain Material Types
Underdrain pipe shall be 6-inch diameter ABS pipe or PVC pipe. ABS pipe shall meet the requirements of ASTM Designation D-2751, SDR 23.5, and PVC pipe shall meet the requirements of ASTM Designation D-2665. Perforations shall be as described in ASTM Designation C-700. It should be noted that placing the pipe such that the perforations are oriented upward may help to maximize infiltration in unlined BMP's with underdrains. If the BMP is constructed with an impermeable liner, the perforations should be angled downward to maximize the volume of water that will be drained from the BMP.

Underdrain Connections
Pipe joints and storm drain structure connections must be adequately sealed to avoid piping conditions (water seeping through pipe or structure joints). Pipe sections shall be coupled using suitable connection rings and flanges. Field connections to storm drain structures and pipes shall be sealed with polymer grout material that is capable of adhering to surfaces. Underdrain pipe shall be capped (at structure) until completion of site construction. Underdrains connected directly to a storm drainage structure shall be non-perforated for an appropriate distance from the structure interface to avoid possible piping problems.

Underdrain Slope
Underdrains must "daylight" or connect to an existing drainage system to achieve positive flow. All underdrains must be placed with a minimum slope of 0.5% (s = 0.005 ft/ft).

Underdrains Layout and Spacing
Typically, there are two main layouts for underdrains. One is a non-perforated central collector pipe with perforated lateral feeder pipes, the other is simply a series of longitudinal perforated pipes. Both layouts connect to a non-perforated outlet pipe before "daylighting" or connecting to an existing drainage system. The minimum spacing is shown below.

BMP Type	Underdrains Center to Center Spacing
Sand Filter Basin	20'
Extended Detention Basins (Bottom stage 500 sq ft. or greater)	20'
Extended Detention Basins (Bottom stage < 500 sq ft.)	10'
Bioretention Facility	5'

Underdrain Gravel

Gravel bed materials should be used to protect an underdrain pipe and to reduce clogging potential. Placement of gravel over the underdrain must be done with care. Avoid dropping the gravel from excessive heights from a backhoe or front-end loader bucket. Spill directly over underdrain and spread manually.

Recommended construction specifications for gravel used to protect underdrains are as follows:

- AASHTO #57 stone preferred
- Geotextile fabrics should be avoided because tearing and/or plugging can dramatically affect performance. If the designer is concerned about the engineered soil media migrating into the underdrain, a 3-inch thick layer of "pea gravel" may be added to create a “choker” course.

Maintenance

Access for cleaning underdrains is required for each system. Clean-outs, with diameters equal to the underdrain, should extend 6 inches above the media and have a lockable screw cap for easy access. Cleanouts should be located for every 50 feet of lateral, at the collector drain line connection, and at any bends.

Underdrain Orifice Plate

When designing a BMP to meet Hydraulic Conditions of Concern (HCOC) criteria in addition to water quality criteria, it is sometimes necessary to install an orifice plate near the downstream end of the underdrain system. The orifice plate restricts the opening of the underdrain to mitigate flows to a specific lower flow threshold. Proper maintenance access should be provided to the orifice plate location to facilitate maintenance activities, specifically the removal of accumulated sediment and debris upstream of the orifice plate.

Waste Handling & Disposal SC-34

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

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, re-use, and recycling; and preventing runon and runoff.

Targeted Constituents

Sediment	☑
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	☑
Oil and Grease	☑
Organics	☑
Oxygen Demanding	☑

Approach

Pollution Prevention

- Reduction in the amount of waste generated can be accomplished using the following source controls such as:
  - 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.

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

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 runon 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 or leaks regularly. Repair or replace damaged containers as necessary.
- Secure solid waste containers; containers must be closed tightly when not in use.
- Place waste containers under cover if possible.
- 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.
- Stencil storm drains on the facility's property with prohibitive message regarding waste disposal.

Chemical/Hazardous Wastes

- Select designated hazardous waste collection areas on-site.
- Store hazardous materials and wastes in covered containers protected from vandalism, and in compliance with fire and hazardous waste codes.
- Place hazardous waste containers in secondary containment.
- Make sure that hazardous waste is collected, removed, and disposed of only at authorized disposal areas.

Runon/Runoff Prevention

- Prevent stormwater runon from entering the waste management area by enclosing the area or building a berm around the area.
- Prevent the 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 pollution prevention measures and proper disposal methods.
- Train employees and contractors proper spill containment and cleanup. The employee should have the tools and knowledge to immediately begin cleaning up a spill if one should occur.
- Train employees and subcontractors in proper hazardous waste management.

Spill Response and Prevention

- Refer to SC-11, Spill Prevention, Control & Cleanup.
- Keep your Spill Prevention Control and countermeasure (SPCC) plan up-to-date, and implement accordingly.
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.
- Vehicles transporting waste should have spill prevention equipment that can prevent spills during transport. The spill prevention equipment includes:
  - Vehicles equipped with baffles for liquid waste
  - Trucks with sealed gates and spill guards for solid waste

Other Considerations

- Hazardous waste cannot be re-used or recycled; it must be disposed of by a licensed hazardous waste hauler.

Requirements

Costs

- Capital and operation and maintenance costs 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 the runoff of polluted stormwater from land application of municipal waste on-site 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, 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.

References and Resources

King County Stormwater Pollution Control Manual - http://dnr.metrokc.gov/wlr/dss/spcm.htm

Orange County Stormwater Program
http://www.ocwatersheds.com/StormWater/swp_introduction.asp

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Associations (BASMAA). On-line: http://www.basmaa.org

Building & Grounds Maintenance SC-41

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	☑
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	☑
Oil and Grease	☑
Organics	☑
Oxygen Demanding	☑

Description

Stormwater runoff from building and grounds maintenance activities can be contaminated with toxic hydrocarbons in solvents, fertilizers and pesticides, suspended solids, heavy metals, and abnormal pH. Utilizing the following protocols 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

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.
- 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.

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

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 waste 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 water 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 he 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. Ensure that this practice does not kill grass.

Landscaping Activities

- Do not apply any chemicals (insecticide, herbicide, or fertilizer) directly to surface waters, unless the application is approved and permitted by the state.
- 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.
- Check irrigation schedules so pesticides will not be washed away and to minimize non-stormwater discharge.

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 paint brushes 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. 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. In which case you should direct the water through hay bales and filter fabric or use other sediment filters or traps.
- Store toxic material under cover with secondary containment 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 or mechanical 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.
- Follow manufacturers' recommendations and label directions. Pesticides must never be applied if precipitation is occuring or predicted. Do not apply insecticides within 100 feet of surface waters such as lakes, ponds, wetlands, and streams.
- Use less toxic pesticides that will do the job, whenever possible. 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.
- Work fertilizers into the soil rather than dumping or broadcasting them 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 use of pesticides 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

- Refer to SC-11, Spill Prevention, Control & Cleanup
- Keep your Spill Prevention Control and countermeasure (SPCC) plan up-to-date, and implement accordingly.
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

Other Considerations

- Alternative pest/weed controls may not be available, suitable, or effective in many cases.

Requirements

Costs

- Overall costs should be low in comparison to other BMPs.

Maintenance

- Sweep paved areas regularly to collect loose particles, and 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, between flushes and 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

King County - ftp://dnr.metrokc.gov/wlr/dss/spcm/Chapter%203.PDF

Orange County Stormwater Program
http://www.ocwatersheds.com/StormWater/swp_introduction.asp

Mobile Cleaners Pilot Program: Final Report. 1997. Bay Area Stormwater Management Agencies Association (BASSMA) http://www.basmaa.org/

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA) http://www.basmaa.org/

San Diego Stormwater Co-permittees Jurisdictional Urban Runoff Management Program (URMP) -
http://www.projectcleanwater.org/pdf/Model%20Program%20Municipal%20Facilities.pdf

SC-42 Building Repair and Construction

Description

Site modifications are common, particularly at large industrial sites. The activity can range from minor and normal building repair to major remodeling and the construction of new facilities. These activities can generate pollutants that include solvents, paints, paint and varnish removers, finishing residues, spent thinners, soap cleaners, kerosene, asphalt and concrete materials, adhesive residues, and old asbestos insulation. Protocols in this fact sheet are intended to prevent or reduce the discharge of pollutants to stormwater from building repair, remodeling, and minor construction by using soil erosion controls, enclosing or covering building material storage areas, using good housekeeping practices, using safer alternative products, and training employees.

This fact sheet is intended to be used for minor repairs and construction. If major construction is required, the guidelines in the *Construction BMP Handbook* should be followed.

Approach

The best management practice (BMP) approach is to reduce the potential for pollutant discharges 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

- ☐ Recycle residual paints, solvents, lumber, and other materials to the maximum extent practicable.
- ☐ Avoid outdoor repairs and construction during periods of wet weather.
- ☐ Use safer alternative products to the maximum extent practicable. See also SC-35 Safer Alternative Products for more information.

Objectives
■ *Cover*
■ *Contain*
■ *Educate*
■ *Reduce/Minimize*
■ *Substitute Products*

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	✓

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION®

- Buy recycled products to the maximum extent practicable.
- Inform on-site contractors of company policy on these matters and include appropriate provisions in their contracts to ensure that certain proper housekeeping and disposal practices are implemented.
- Make sure that nearby storm drains are well marked to minimize the chance of inadvertent disposal of residual paints and other liquids.

Good Housekeeping

Repair and Remodeling

- Keep the work site clean and orderly. Remove debris in a timely fashion. Sweep and vacuum the area regularly to remove sediment and small debris.
- Cover raw materials of particular concern that must be left outside, especially during the rainy season. See also SC-33 Outdoor Storage of Raw Materials for more information.
- Use equipment and tools such as bag sanders to reduce accumulation of debris.
- Limit/prohibit work on windy days; implement roll-down walls or other measures to reduce wind transport of pollutants.
- Do not dump waste liquids down the storm drain.
- Dispose of wash water, sweepings, and sediments properly.
- Store liquid materials properly that are normally used in repair and remodeling such as paints and solvents. See also SC-31 Outdoor Liquid Container Storage for more information.
- Sweep out rain gutters or wash the gutter and trap the particles at the outlet of the downspout. A sock or geofabric placed over the outlet may effectively trap the materials. If the downspout is tight lined, place a temporary plug at the first convenient point in the storm drain and pump out the water with a vactor truck, and clean the catch basin sump where you placed the plug.
- Clean the storm drain system in the immediate vicinity of the construction activity after it is completed. See also SC-44 Drainage System Maintenance for more information.

Painting

- Enclose painting operations consistent with local air quality and Occupational Safety and Health Administration (OSHA) regulations.
- Local air pollution regulations may, in many areas of the state, specify painting procedures that, if properly carried out, are usually sufficient to protect water quality.
- Develop paint-handling procedures for proper use, storage, and disposal.

- Transport paint and materials to and from job sites in containers with secure lids and tied down to the transport vehicle.
- Test and inspect spray equipment prior to starting to paint. Tighten all hoses and connections and do not overfill paint containers.
- Mix paint indoors before using it so that any spill will not be exposed to rain. Do so even during dry weather because cleanup of a spill will never be 100 percent effective.
- Transfer and load paint and hot thermoplastic away from storm drain inlets.
- When there is risk of a spill reaching storm drains, plug nearby storm drain inlets prior to starting to paint and remove the plugs when the job is complete.
- If sandblasting is used to remove paint, cover nearby storm drain inlets prior to starting work.
- If painting requires scraping or sandblasting of the existing surface, use a ground cloth to collect the chips. Dispose of the residue properly.
- Cover or enclose painting operations properly to avoid drift.
- If water-based paints are being used, clean the application equipment in a sink that is connected to the sanitary sewer.
- Capture all cleanup-water and dispose of it properly.
- Dispose properly of paints containing lead or tributyl tin and considered a hazardous waste.
- If leftover paints are to be kept for the next job, store them properly, or dispose of them properly.
- Recycle paint when possible. Dispose of paint at an appropriate household hazardous waste facility.

Spill and Leak Prevention and Response

- Keep your spill prevention, control, and countermeasure (SPCC) plan up to date.
- Place a stockpile of spill cleanup materials where they are readily accessible.
- Clean up spills immediately.
- Excavate and remove the contaminated (stained) soil if a spill occurs on dirt.

Material Handling and Waste Management

- Post “No littering” signs, and enforce antilitter laws.
- Provide a sufficient number of litter receptacles for the facility.

- Clean out litter receptacles frequently and cover them to prevent spillage.
- Keep waste collection areas clean.
- Inspect solid waste containers regularly for structural damage. 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 put in the solid waste container. Certain wastes such as hazardous wastes, appliances, fluorescent lamps, and pesticides may not be disposed of in solid waste containers
- Do not mix wastes; this can cause chemical reactions, make recycling impossible, and complicate disposal. Affix labels to all waste containers clearly stating what they contain.
- Make sure that hazardous waste is collected, removed, and disposed of properly. See also SC-34 Waste Handling and Disposal for more information.

Erosion and Sediment Controls

- Limit disturbance of bare soils and preserve natural vegetation whenever possible. See also EC-2 Preservation of Existing Vegetation in the *Construction BMP Handbook*.
- Stabilize loose soils by revegetating whenever possible. See also EC-4 Hydroseeding in the *Construction BMP Handbook*.
- Use nonvegetative stabilization methods for areas prone to erosion where vegetative options are not feasible. Examples include:
  - ✓ Areas of vehicular or pedestrian traffic such as roads or paths;
  - ✓ Arid environments where vegetation would not provide timely ground coverage, or would require excessive irrigation;
  - ✓ Rocky substrate, infertile or droughty soils where vegetation would be difficult to establish; and
  - ✓ Areas where vegetation will not grow adequately within the construction time frame.

  There are several nonvegetative stabilization methods and selection should be based on site-specific conditions. See also EC-16 Non-Vegetative Stabilization in the *Construction BMP Handbook*.
- Use chemical stabilization when needed. See also EC-5 Soil Binders in the *Construction BMP Handbook*.

- Use geosynthetic membranes to control erosion if feasible. See also EC-7 Geotextiles and Mats in the *Construction BMP Handbook*.
- Stabilize all roadways, entrances, and exits to sufficiently control discharges of erodible materials from discharging or being tracked off the site. See also TC 1-3 Tracking Control in the *Construction BMP Handbook*.
- Refer to the supplemental information later in this fact sheet for projects that involve more extensive soil disturbance activities.

Employee Training Program

- Educate employees about pollution prevention measures and goals.
- Train employees how to properly implement the source control BMPs described above. Detailed information for erosion and sediment control BMPs is provided in the *Construction BMP Handbook*.
- Proper education of off-site contractors is often overlooked. The conscientious efforts of well-trained employees can be wasted by unknowing off-site contractors, so make sure they are well informed about pollutant source control responsibilities.
- Use a training log or similar method to document training.

Quality Assurance and Record Keeping

- Keep accurate maintenance logs that document minimum BMP activities performed for building repair and construction, types and quantities of waste disposed of, and any improvement actions.
- Keep accurate logs of spill response actions that document what was spilled, how it was cleaned up, and the method used to dispose of the waste.
- Establish procedures to complete logs and file them in the central office.

Potential Limitations and Work-Arounds

Some facilities may have space constraints, limited staffing, and time limitations that preclude implementation of BMPs. The following are typical limitations and recommended work-arounds.

- This BMP is for minor construction only. The state's General Construction Activity Stormwater Permit has more extensive requirements for larger projects that would disturb 1 or more acres of surface.
  - ✓ Refer to the companion *Construction BMP Handbook* for specific guidance and BMPs for larger scale projects.
- Time constraints might require some outdoor repairs and construction during wet weather.

- ✓ Require employees to understand and follow good housekeeping and spill and leak prevention BMPs.
- ✓ Inspect erosion and sediment control BMPs daily during periods of wet weather and repair or improve BMP implementation as necessary.

- Hazardous waste that cannot be reused or recycled must be disposed of by a licensed hazardous waste hauler.
  - ✓ Minimize use of hazardous materials to the maximum extent practicable.
- Be certain that actions to help stormwater quality are consistent with Cal/ and Fed/OSHA and air quality regulations.
- Prices for recycled/safer alternative materials and fluids may be higher than those of conventional materials.

Potential Capital Facility Costs and Operation & Maintenance Requirements

Facilities

- Limited capital investments may be required at some sites if cover and containment facilities are inadequate for construction materials and wastes.
- Purchase and installation of erosion and sediment controls, if needed, will require additional capital investments, and this amount will vary depending on site characteristics and the types of BMPs being implemented.
- Minimize costs by maintaining existing vegetation and limiting construction operations on bare soils.

Maintenance

- The erosion and sediment control BMPs described above require periodic inspection and maintenance to remain effective. The cost of these actions will vary depending on site characteristics and the types of BMPs being implemented.
- Irrigation costs may be required to establish and maintain vegetation.

Supplemental Information

Soil/Erosion Control

If the work involves exposing large areas of soil, employ the appropriate soil erosion and control techniques. See the *Construction BMP Handbook*. If old buildings are being torn down and not replaced in the near future, stabilize the site using measures described in SC-40 Contaminated and Erodible Areas.

If a building is to be placed over an open area with a storm drainage system, make sure the storm inlets within the building are covered or removed, or the storm line is connected to the sanitary sewer. If, because of the remodeling, a new drainage system is

to be installed or the existing system is to be modified, consider installing catch basins as they serve as effective "in-line" treatment devices. Include in the catch basin a "turn-down" elbow or similar device to trap floatables.

References and Resources

City of Seattle. 2016. *City of Seattle Stormwater Manual*. Seattle Public Utilities Department of Planning and Development. Available online at http://www.seattle.gov/dpd/cs/groups/pan/@pan/documents/web_informational/p2358283.pdf.

California Stormwater Quality Association, 2019. *Construction Stormwater Best Management Practice Handbook*. Available at http://www.casqa.org.

Kennedy/Jenks Consultants. 2007. *The Truckee Meadows Industrial and Commercial Storm Water Best Management Practices Handbook*. Available online at https://www.washoecounty.us/csd/engineering_capitalprojects/files-engineering-capital-projects/development_review_forms/Industrial and Commercial Storm Water Best Management Practices Handbook.pdf.

Sacramento Stormwater Management Program. n.d. *Best Management Practices for Industrial Storm Water Pollution Control*. Available online at http://www.waterresources.saccounty.net/stormwater/documents/industrial-BMP-manual.pdf.

US EPA. 2005. *Construction Site Stormwater Runoff Control*. Available online at: https://www3.epa.gov/npdes/pubs/fact2-6.pdf.

Parking/Storage Area Maintenance SC-43

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	✓
Nutrients	
Trash	✓
Metals	✓
Bacteria	
Oil and Grease	✓
Organics	✓

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.

CASQA California Stormwater Quality Association

SC-43 Parking/Storage Area Maintenance

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.

SC-43 Parking/Storage Area Maintenance

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/

SC-44 Drainage System Maintenance

Description

As a consequence of its function, the stormwater drainage facilities on site convey stormwater that may contain certain pollutants either to the off-site conveyance system that collects and transports urban runoff and stormwater, or directly to receiving waters. The protocols in this fact sheet are intended to reduce pollutants leaving the site to the offsite drainage infrastructure or to receiving waters through proper on-site conveyance system operation and maintenance. The targeted constituents will vary depending on site characteristics and operations.

Approach

Successful implementation depends on effective training of employees on applicable best management practices (BMPs) and general pollution prevention strategies and objectives.

General Pollution Prevention Protocols

- ☐ 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 proper hydraulic functioning of the system to avoid flooding.

- ☐ Develop and follow a site-specific drainage system maintenance plan that describes maintenance locations, methods, required equipment, water sources, sediment collection areas, disposal requirements, and any other pertinent information.

Good Housekeeping

Illicit Connections and Discharges

- ☐ Look for evidence of illegal discharges or illicit connections during routine maintenance of conveyance system and drainage structures:

Objectives
■ *Cover*
■ *Contain*
■ *Educate*
■ *Reduce/Minimize*

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 and Record Keeping	✓

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION®

- ✓ Identify evidence of spills such as paints, discoloring, and odors.
- ✓ Record locations of apparent illegal discharges or illicit connections.
- ✓ Track flows back to potential discharges and conduct aboveground inspections. This can be done through visual inspection of upgradient manholes or alternate techniques that include zinc chloride smoke testing, fluorometric dye testing, physical inspection testing, and television camera inspection.
- ✓ Eliminate the discharge once the origin of the 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" or similar wording stenciled on or 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 for additional information.

Illegal Dumping

- ☐ Inspect regularly and clean up hot spots and other storm drainage areas 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 for additional information.

Preventative Maintenance

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 percent full. Catch basins should be cleaned as frequently as necessary to meet this standard.

- 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. Prioritize storm drain inlets; clean and repair them 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 disposed of properly. Do not dewater near a storm drain or stream.

Storm Drain Conveyance System

- Locate reaches of the 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 removal, and enhance channel/creek aesthetic and habitat value.
- Conduct channel modification and improvement in accordance with existing laws. Any person, government agency, or public utility proposing an activity that will change the natural state of any river, stream, or lake in California must enter into a stream or lake alteration agreement with the Department of Fish and Wildlife. The developer-applicant should also contact local governments (city, county, or special districts), other state agencies (SWRCB, RWQCB, Department of Forestry, or Department of Water Resources), and the U.S. Army Corps of Engineers and U.S. Fish and Wildlife Service.

SC-44 Drainage System Maintenance

Spill and Leak Prevention and Response

- ☐ Keep your spill prevention, control, and countermeasure (SPCC) plan up to date.
- ☐ Investigate promptly all reports of spills, leaks, and illegal dumping.
- ☐ Place a stockpile of spill cleanup materials where they are readily accessible or at a central location.
- ☐ 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.

Employee Training Program

- ☐ Educate employees about pollution prevention measures and goals.
- ☐ Train employees how to properly handle and dispose of waste using the source control BMPs described above.
- ☐ Train employees and subcontractors in proper hazardous waste management.
- ☐ Use a training log or similar method to document training.
- ☐ Ensure that employees are familiar with the site's SPCC plan and/or proper spill cleanup procedures.
- ☐ Have staff involved in detection and removal of illicit connections trained in the following:
  - ✓ OSHA-required health and safety training (Title 29 of the Code of Federal Regulations [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).

Quality Assurance and Record Keeping

- ☐ Keep accurate maintenance logs that document minimum BMP activities performed for drainage system maintenance, types and quantities of waste disposed of, and any improvement actions.
- ☐ Keep accurate logs of spill response actions that document what was spilled, how it was cleaned up, and the method used to dispose of the waste.
- ☐ Keep accurate logs of illicit connections, illicit discharges, and illegal dumping into the storm drain system, including how wastes were cleaned up and disposed of.
- ☐ Establish procedures to complete logs and file them in the central office.

Potential Limitations and Work-Arounds

The following are typical limitations and recommended work-arounds for drainage system maintenance:

- Cleanup activities might create a slight disturbance for local aquatic species. Access to items and material on private property might be limited. Trade-offs might 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.
  - ✓ Perform all maintenance on-site and do not flush accumulated material downstream to private property or riparian habitats.
- Storm drain flushing is most effective in small-diameter pipes (i.e., a pipe 36 inches in diameter or less, depending on water supply and sediment collection capacity). Other considerations associated with storm drain flushing include the availability of a water source, finding a downstream area to collect sediments, and liquid/sediment disposal.
  - ✓ Develop and follow a site-specific drainage system maintenance plan that describes maintenance locations, methods, required equipment, water sources, sediment collection areas, disposal requirements, and any other pertinent information.
- Regulations might include adoption of substantial penalties for illegal dumping and disposal.
  - ✓ Do not dump illegal materials anywhere on-site.
  - ✓ Identify illicit connections, illicit discharge, and illegal dumping.
  - ✓ Clean up spills immediately, and properly dispose of wastes.
- Local municipal codes might include sections prohibiting discharge of soil, debris, refuse, hazardous wastes, and other pollutants into the sanitary sewer system.
  - ✓ Collect all materials and pollutants accumulated in the drainage system and dispose of them according to local regulations.
  - ✓ Install debris excluders in areas with a trash total maximum daily load.

Potential Capital Facility Costs and Operation & Maintenance Requirements

Facilities

- Capital costs will vary substantially depending on the size of the facility and characteristics of the drainage system. Significant capital costs may be associated with purchasing water trucks, vacuum trucks, and any other necessary cleaning equipment or improving the drainage infrastructure to reduce the potential.

- Developing and implementing a site-specific drainage system maintenance plan will require additional capital if a similar program is not already in place.

Maintenance

- Two-person teams might 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.
- Methods used for illicit connection detection (e.g., smoke testing, dye testing, visual inspection, and flow monitoring) can be costly and time-consuming. Site-specific factors such as the amount of impervious area, the density and ages of buildings, and type of land use will determine the level of investigation necessary.

Supplemental Information

Storm Drain Flushing

Flushing is a common maintenance activity used to improve pipe hydraulics and to remove pollutants from 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 drains usually are flushed along segments of pipe with grades that are too flat to maintain adequate velocity to keep particles in suspension. An inflatable device is placed in an upstream manhole to temporarily plug 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, 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 might be used to recollect the water after the force of the flushing wave has dissipated. A pump could then be used to transfer the water and accumulated material to the sanitary sewer for treatment. In some cases, an interceptor structure might be more practical or required to recollect the flushed waters.

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 percent for organics and 55–65 percent 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 if allowed or that fire hydrant line flushing coincide with storm sewer flushing.

References and Resources

City of Seattle. 2016. *City of Seattle Stormwater Manual*. Seattle Public Utilities Department of Planning and Development. Available online at http://www.seattle.gov/dpd/cs/groups/pan/@pan/documents/web_informational/p2358283.pdf.

Knox County, Tennessee. 2008. Drainage System Maintenance. Chapter 5 in *Stormwater Management Manual*. Available online at http://www.knoxcounty.org/stormwater/manual/Volume 1/knoxco_swmm_v1_chap5_jan2008.pdf.

U.S. Environmental Protection Agency. 2016. National Pollutant Discharge Elimination System. *National Menu of Best Management Practices (BMPs) for Stormwater*. Available online at https://www.epa.gov/npdes/national-menu-best-management-practices-bmps-stormwater#edu

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

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

– 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.

Fueling Areas SD-30

Photo Credit: Geoff Brosseau

Design Objectives

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

Description

Fueling areas have the potential to contribute oil and grease, solvents, car battery acid, coolant and gasoline to the stormwater conveyance system. Spills at vehicle and equipment fueling areas can be a significant source of pollution because fuels contain toxic materials and heavy metals that are not easily removed by stormwater treatment devices.

Approach

Project plans must be developed for cleaning near fuel dispensers, emergency spill cleanup, containment, and leak prevention.

Suitable Applications

Appropriate applications include commercial, industrial, and any other areas planned to have fuel dispensing equipment, including retail gasoline outlets, automotive repair shops, and major non-retail dispensing areas.

Design Considerations

Design requirements for fueling areas are governed by Building and Fire Codes and by current local agency ordinances and zoning requirements. Design requirements described in this fact sheet are meant to enhance and be consistent with these code and ordinance requirements.

Designing New Installations

Covering

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

Fuel dispensing areas should provide an overhanging roof structure or canopy. The cover's minimum dimensions must be equal to or greater than the area within the grade break. The cover must not drain onto the fuel dispensing area and the downspouts must be routed to prevent drainage across the fueling area. The fueling area should drain to the project's treatment control BMP(s) prior to discharging to the stormwater conveyance system. Note - If fueling large equipment or vehicles that would prohibit the use of covers or roofs, the fueling island should be designed to sufficiently accommodate the larger vehicles and equipment and to prevent stormwater run-on and runoff. Grade to direct stormwater to a dead-end sump.

Surfacing

Fuel dispensing areas should be paved with Portland cement concrete (or equivalent smooth impervious surface). The use of asphalt concrete should be prohibited. Use asphalt sealant to protect asphalt paved areas surrounding the fueling area. This provision may be made to sites that have pre-existing asphalt surfaces.

The concrete fuel dispensing area should be extended a minimum of 6.5 ft from the corner of each fuel dispenser, or the length at which the hose and nozzle assembly may be operated plus 1 ft, whichever is less.

Grading/Contouring

Dispensing areas should have an appropriate slope to prevent ponding, and be separated from the rest of the site by a grade break that prevents run-on of urban runoff. (Slope is required to be 2 to 4% in some jurisdictions' stormwater management and mitigation plans.)

Fueling areas should be graded to drain toward a dead-end sump. Runoff from downspouts/roofs should be directed away from fueling areas. Do not locate storm drains in the immediate vicinity of the fueling area.

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

- In the case of an emergency, provide storm drain seals, such as isolation valves, drain plugs, or drain covers, to prevent spills or contaminated stormwater from entering the stormwater conveyance system.

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.

Trash Storage Areas SD-32

Description

Trash storage areas are areas where a trash receptacle (s) are located for use as a repository for solid wastes. Stormwater runoff from areas where trash is stored or disposed of can be polluted. In addition, loose trash and debris can be easily transported by water or wind into nearby storm drain inlets, channels, and/or creeks. Waste handling operations that may be sources of stormwater pollution include dumpsters, litter control, and waste piles.

Approach

This fact sheet contains details on the specific measures required to prevent or reduce pollutants in stormwater runoff associated with trash storage and handling. Preventative measures including enclosures, containment structures, and impervious pavements to mitigate spills, should be used to reduce the likelihood of contamination.

Design Objectives

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

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

Design requirements for waste handling areas are governed by Building and Fire Codes, and by current local agency ordinances and zoning requirements. The design criteria described in this fact sheet are meant to enhance and be consistent with these code and ordinance requirements. Hazardous waste should be handled in accordance with legal requirements established in Title 22, California Code of Regulation.

Wastes from commercial and industrial sites are typically hauled by either public or commercial carriers that may have design or access requirements for waste storage areas. The design criteria in this fact sheet are recommendations and are not intended to be in conflict with requirements established by the waste hauler. The waste hauler should be contacted prior to the design of your site trash collection areas. Conflicts or issues should be discussed with the local agency.

Designing New Installations

Trash storage areas should be designed to consider the following structural or treatment control BMPs:

- Design trash container areas so that drainage from adjoining roofs and pavement is diverted around the area(s) to avoid run-on. This might include berming or grading the waste handling area to prevent run-on of stormwater.
- Make sure trash container areas are screened or walled to prevent off-site transport of trash.

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

Bioretention TC-32

Design Considerations

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

Description

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

Targeted Constituents

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

Legend ***(Removal Effectiveness)***

- ● Low
- ▲ Medium
- ■ High

California Experience

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

Advantages

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

Limitations

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

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

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

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

Design and Sizing Guidelines

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

Construction/Inspection Considerations

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

Performance

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

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

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

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

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

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

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

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

Siting Criteria

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

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

Additional Design Guidelines

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

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

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

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

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

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

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

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

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

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

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

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

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

Maintenance

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

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

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

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

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

Cost

Construction Cost

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

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

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

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

Maintenance Cost

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

References and Sources of Additional Information

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

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

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

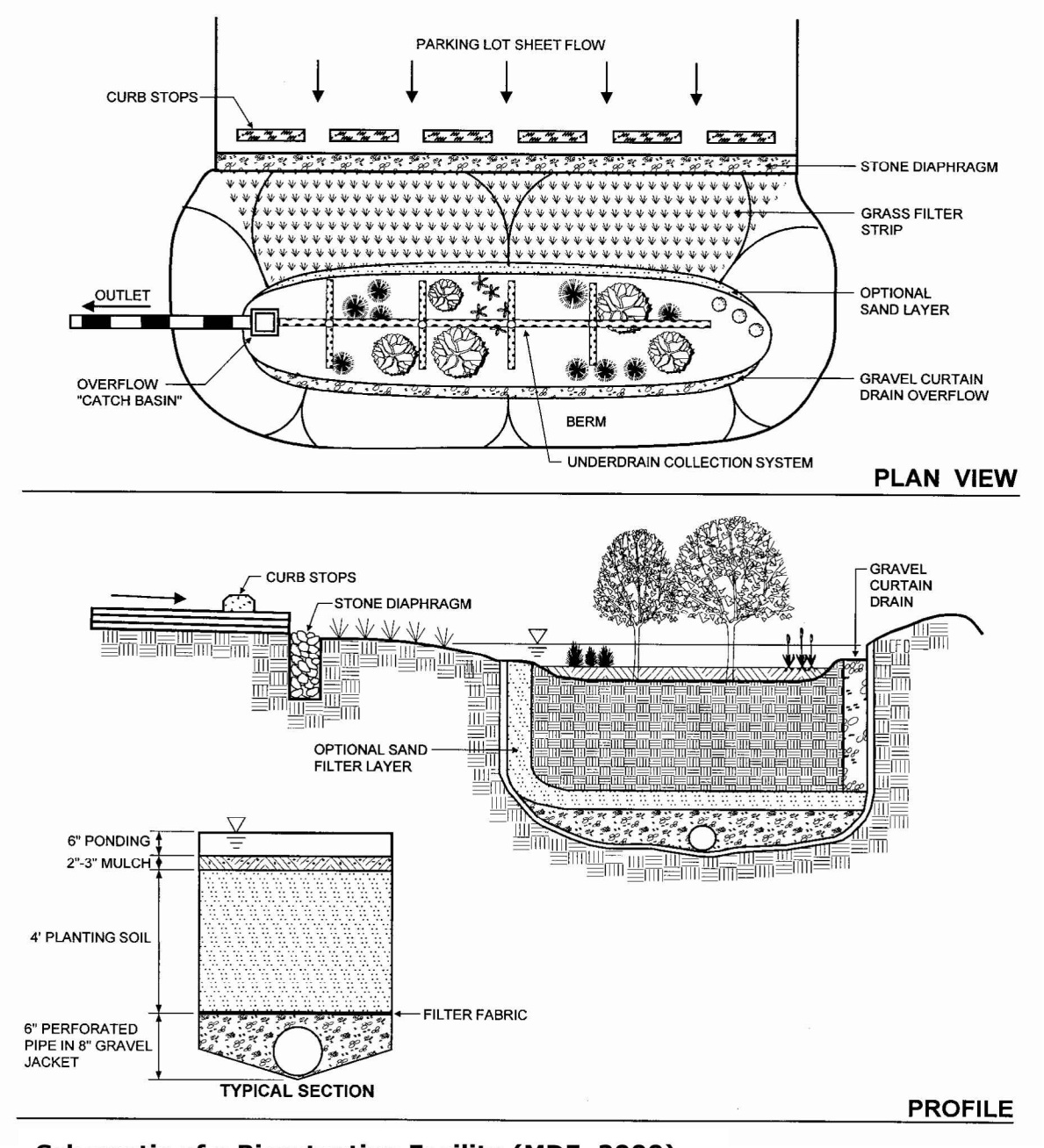
Kim, H., Seagren, E.A., and Davis, A.P., "Engineered Bioretention for Removal of Nitrate from Stormwater Runoff," ***WEFTEC 2000 Conference Proceedings on CDROM Research Symposium, Nitrogen Removal***, Session 19, Anaheim CA, October 2000.

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

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

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

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



Schematic of a Bioretention Facility (MDE, 2000)

Drain Inserts MP-52

Description

Drain inserts are manufactured filters or fabric placed in a drop inlet to remove sediment and debris. There are a multitude of inserts of various shapes and configurations, typically falling into one of three different groups: socks, boxes, and trays. The sock consists of a fabric, usually constructed of polypropylene. The fabric may be attached to a frame or the grate of the inlet holds the sock. Socks are meant for vertical (drop) inlets. Boxes are constructed of plastic or wire mesh. Typically a polypropylene "bag" is placed in the wire mesh box. The bag takes the form of the box. Most box products are one box; that is, the setting area and filtration through media occur in the same box. Some products consist of one or more trays or mesh grates. The trays may hold different types of media. Filtration media vary by manufacturer. Types include polypropylene, porous polymer, treated cellulose, and activated carbon.

California Experience

The number of installations is unknown but likely exceeds a thousand. Some users have reported that these systems require considerable maintenance to prevent plugging and bypass.

Advantages

- Does not require additional space as inserts as the drain inlets are already a component of the standard drainage systems.
- Easy access for inspection and maintenance.
- As there is no standing water, there is little concern for mosquito breeding.
- A relatively inexpensive retrofit option.

Limitations

Performance is likely significantly less than treatment systems that are located at the end of the drainage system such as ponds and vaults. Usually not suitable for large areas or areas with trash or leaves than can plug the insert.

Design and Sizing Guidelines

Refer to manufacturer's guidelines. Drain inserts come any many configurations but can be placed into three general groups: socks, boxes, and trays. The sock consists of a fabric, usually constructed of polypropylene. The fabric may be attached to a frame or the grate of the inlet holds the sock. Socks are meant for vertical (drop) inlets. Boxes are constructed of plastic or wire mesh. Typically a polypropylene "bag" is placed in the wire mesh box. The bag takes the form of the box. Most box products are

Design Considerations

- Use with other BMPs
- Fit and Seal Capacity within Inlet

Targeted Constituents

- ☑ Sediment
- ☑ Nutrients
- ☑ Trash
- ☑ Metals
- Bacteria
- ☑ Oil and Grease
- ☑ Organics

Removal Effectiveness

See New Development and Redevelopment Handbook-Section 5.

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

one box; that is, the setting area and filtration through media occurs in the same box. One manufacturer has a double-box. Stormwater enters the first box where setting occurs. The stormwater flows into the second box where the filter media is located. Some products consist of one or more trays or mesh grates. The trays can hold different types of media. Filtration media vary with the manufacturer: types include polypropylene, porous polymer, treated cellulose, and activated carbon.

Construction/Inspection Considerations

Be certain that installation is done in a manner that makes certain that the stormwater enters the unit and does not leak around the perimeter. Leakage between the frame of the insert and the frame of the drain inlet can easily occur with vertical (drop) inlets.

Performance

Few products have performance data collected under field conditions.

Siting Criteria

It is recommended that inserts be used only for retrofit situations or as pretreatment where other treatment BMPs presented in this section area used.

Additional Design Guidelines

Follow guidelines provided by individual manufacturers.

Maintenance

Likely require frequent maintenance, on the order of several times per year.

Cost

- The initial cost of individual inserts ranges from less than $100 to about $2,000. The cost of using multiple units in curb inlet drains varies with the size of the inlet.
- The low cost of inserts may tend to favor the use of these systems over other, more effective treatment BMPs. However, the low cost of each unit may be offset by the number of units that are required, more frequent maintenance, and the shorter structural life (and therefore replacement).

References and Sources of Additional Information

Hrachovec, R., and G. Minton, 2001, Field testing of a sock-type catch basin insert, Planet CPR, Seattle, Washington

Interagency Catch Basin Insert Committee, Evaluation of Commercially-Available Catch Basin Inserts for the Treatment of Stormwater Runoff from Developed Sites, 1995

Larry Walker Associates, June 1998, NDMP Inlet/In-Line Control Measure Study Report

Manufacturers literature

Santa Monica (City), Santa Monica Bay Municipal Stormwater/Urban Runoff Project - Evaluation of Potential Catch basin Retrofits, Woodward Clyde, September 24, 1998

Woodward Clyde, June 11, 1996, Parking Lot Monitoring Report, Santa Clara Valley Nonpoint Source Pollution Control Program.