SNUG HARBOR

Preliminary Water Quality Management Plan (PWQMP)

Prepared for:
Back Bay Barrels, LLC
3857 Birch Street, Suite 521
Newport Beach, CA 92660
949-836-3055

Prepared By
Fuscoe Engineering, Inc.
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Project Manager
Oriana Slasor
P.E.

Date Prepared: August 14, 2024
Date Revised: November 5, 2024

Project Number: 4206-001-01

PRELIMINARY
WATER QUALITY MANAGEMENT PLAN
(WQMP)

Snug Harbor Surf Camp

3100 Irvine Avenue, Newport Beach, CA 92660, County of Orange

TRACT, LOT NUMBERS, APPLICATION OR GRADING PERMIT NO: *PENDING*
APN 119-200-38 & 119-200-41

Prepared for:

Back Bay Barrels, LLC
3857 Birch Street, Suite 521
Newport Beach, CA 92660
949-836-3055

Prepared by:

Fuscoe Engineering, Inc.
15535 Sand Canyon Ave, Suite 100
Irvine, CA 92618
949.474.1960
Oriana Slasor, P.E.

Date Prepared: 8/14/2024
Date Revised: 11/5/2024

PROJECT OWNER'S CERTIFICATION			
Permit/Application No.:	PENDING	Grading Permit No.:	PENDING
Tract/Parcel Map and Lot(s)No.:	PENDING	Building Permit No.:	PENDING
Address of Project Site and APN:	3100 Irvine Avenue, Newport Beach, CA 92660 APN 119-200-38 & 119-200-41		

This Water Quality Management Plan (WQMP) has been prepared for BACK BAY BARRELS, LLC by FUSCOE ENGINEERING, INC. The WQMP is intended to comply with the requirements of the County of Orange NPDES Stormwater Program requiring the preparation of the plan.

The undersigned, while it owns the subject property, is responsible for the implementation of the provisions of this plan , including the ongoing operation and maintenance of all best management practices (BMPs), and will ensure that this plan is amended as appropriate to reflect up-to-date conditions on the site consistent with the current Orange County Drainage Area Management Plan (DAMP) and the intent of the non-point source NPDES Permit for Waste Discharge Requirements for the County of Orange, Orange County Flood Control District and the incorporated Cities of Orange County within the Santa Ana Region. Once the undersigned transfers its interest in the property, its successors-in-interest shall bear the aforementioned responsibility to implement and amend the WQMP. An appropriate number of approved and signed copies of this document shall be available on the subject site in perpetuity.

OWNER: BACK BAY BARRELS, LLC			
Name:	Adam Cleary		
Title:	President		
Address:	3857 Birch Street, Suite 521, Newport Beach, CA 92660		
Email:	adam@surffarm.com		
Telephone #:	949-836-3055		
I understand my responsibility to implement the provisions of this WQMP including the ongoing operation and maintenance of the best management practices (BMPs) described herein.			
Owner Signature:		Date:	

<table>
<tr><td colspan="4">Preparer (Engineer): Oriana Slasor</td></tr>
<tr><td>Title</td><td>P.E.</td><td>PE Registration #</td><td>63451</td></tr>
<tr><td>Company</td><td colspan="3">Fuscoe Engineering, Inc.</td></tr>
<tr><td>Address</td><td colspan="3">15535 Sand Canyon Ave, Irvine, CA 92618</td></tr>
<tr><td>Email</td><td colspan="3">oslasor@fuscoe.com</td></tr>
<tr><td>Telephone #</td><td colspan="3">949-474-1960</td></tr>
<tr><td colspan="4">I hereby certify that this Water Quality Management Plan is in compliance with, and meets the requirements set forth in, Order No. R8-2009-0030/NPDES No. CAS618030, of the Santa Ana Regional Water Quality Control Board.</td></tr>
<tr><td>Preparer Signature</td><td></td><td>Date</td><td></td></tr>
<tr><td>Place
Stamp
Here</td><td colspan="3"></td></tr>
</table>

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SECTION I DISCRETIONARY PERMITS AND WATER QUALITY CONDITIONS

<table>
<tr><th colspan="4">PROJECT INFORMATION</th></tr>
<tr><td>Permit/Application No.:</td><td>PENDING</td><td>Grading or Building Permit No.:</td><td>PENDING</td></tr>
<tr><td>Address of Project Site (or Tract Map and Lot Number if no address) and APN:</td><td colspan="3">3100 Irvine Avenue, Newport Beach, CA 92660
APN 119-200-38 & 119-200-41</td></tr>
<tr><th colspan="4">WATER QUALITY CONDITIONS OF APPROVAL OR ISSUANCE</th></tr>
<tr><td>Discretionary Permit(s):</td><td colspan="3">Pending – to be provided in Final WQMP</td></tr>
<tr><td>Water Quality Conditions of Approval or Issuance applied to this project:
(Please list verbatim.)</td><td colspan="3">Pending – to be provided in Final WQMP</td></tr>
<tr><th colspan="4">CONCEPTUAL WQMP</th></tr>
<tr><td>Was a Conceptual Water Quality Management Plan previously approved for this project?</td><td colspan="3">No. This document is the Preliminary WQMP for the project.</td></tr>
<tr><th colspan="4">WATERSHED-BASED PLAN CONDITIONS</th></tr>
<tr><td>Applicable conditions from watershed - based plans including WIHMPs and TMDLs:</td><td colspan="3">TMDLs include the following:
Based on the 2020-2022 Integrated Report (CWA Section 303[d] List), the 303(d) listed impairments include:
• Newport Bay, Upper: Metals, Nutrients, Pathogens, Pesticides/PCBs, Siltation
• Newport Bay, Lower: Metals, Nutrients, Pathogens, Pesticides/Priority Organics, Siltation</td></tr>
</table>

SECTION II PROJECT DESCRIPTION

II.1 PROJECT DESCRIPTION

The proposed Snug Harbor Surf Camp project site encompasses approximately 15.43 acres in the City of Newport Beach. The project site is bounded by the Santa Ana Delhi Channel to the north, Irvine Avenue to the northeast, existing commercial property to the southeast, and Mesa Drive to the southwest. A Vicinity Map is included in Section VI.

Under existing conditions, the project site is the Newport Beach Golf Course. The Golf course includes three holes, a driving range, pro shop, clubhouse, restaurant, and parking lot. Adjacent land uses include commercial property including a fire station.

The table below summarizes the proposed project.

DESCRIPTION OF PROPOSED PROJECT	
Development Category (Model WQMP, Table 7.11-2; or 7.11-3):	**Category 8:** All significant redevelopment projects, where significant redevelopment is defined as the addition or replacement of 5,000 or more square feet of impervious surface on an already developed site. Redevelopment does not include routine maintenance activities that are conducted to maintain original line and grade, hydraulic capacity, original purpose of the facility, or emergency redevelopment activity required to protect public health and safety. If the redevelopment results in the addition or replacement of less than 50 percent of the impervious area on-site and the existing development was not subject to WQMP requirement, the numeric sizing criteria discussed in Section 7.II-2.0 only applies to the addition or replacement area. If the addition or replacement accounts for 50 percent or more of the impervious area, the Project WQMP requirements apply to the entire development.
Project Area (ft^2):	672,086.61 ft^2 (15.43 acres)
# of Dwelling Units:	Not Applicable
SIC Code:	7992 - Public Golf Course

<table>
<tr><th colspan="5">DESCRIPTION OF PROPOSED PROJECT</th></tr>
<tr><td>Narrative Project Description:</td><td colspan="4">The proposed project site is an irregularly shaped parcel approximately 15.43 ac located east of the intersection of Irvine Avenue and Mesa Drive in the City of Newport Beach. The property is bounded by the Santa Ana Delhi Channel to the north, Irvine Avenue to the northeast, existing commercial property to the southeast, and Mesa Drive to the southwest. The site is currently the Newport Beach Golf Course which consists of three holes, a driving range, pro shop, clubhouse, restaurant, and parking lot.

The proposed Snug Harbor project will include construction of a 13 feet deep surf lagoon, two pools, a 3-story 50,000 square feet clubhouse which will include one subterranean level, a lodging building, parking lots with solar panel canopies, a service yard, pavement, landscaping, utilities, and retaining walls.</td></tr>
<tr><td>Project Area:</td><td>Pervious Area</td><td>Pervious Area Percentage</td><td>Impervious Area</td><td>Impervious Area Percentage</td></tr>
<tr><td>Pre-Project Conditions:</td><td>12.03 ac</td><td>78%</td><td>3.40 ac</td><td>22%</td></tr>
<tr><td>Post-Project Conditions:</td><td>1.54 ac</td><td>10%</td><td>13.89 ac</td><td>90%</td></tr>
</table>

DESCRIPTION OF PROPOSED PROJECT	
Drainage Patterns/ Connections:	Under existing conditions, the project site generally drains in a northerly direction to the Santa Ana Delhi Channel via three (3) storm drain outlets. Onsite there are two (2) catch basins inlets which direct flow into one of the storm drain outlets. A swale also directs flow from the northern portions of the golf course into the western most storm drain outlet. Flows from the parking lot are directed into a parkway drain located on Irvine Avenue. Off-site run-on from adjacent properties on the southeast also contributes to surface flows onto the parking lot, approximately 3.94 acres. An existing cart tunnel also directs flow under Irvine Avenue and into the adjoining golf course to the north. Flows coming from the site discharge into the Santa Ana Delhi Channel. Flows then travel south and enter Newport Bay, and eventually the Pacific Ocean. Under proposed conditions, runoff from the project site is separated into thirteen (13) Drainage Management Areas (DMAs). The proposed site drains to the north and will discharge treated flows into the Santa Ana Delhi Channel via new storm drain systems connecting to modular wetlands systems and bioretention systems with underdrains. After discharging into the Santa Ana Delhi Channel flows are conveyed to the Upper and Lower Newport Bay, respectfully, and eventually into the Pacific Ocean. Offsite run-on is proposed to be diverted from the project site and will not be comingled.

II.2 POTENTIAL STORM WATER POLLUTANTS

The table below, derived from Table 2 of the Countywide Model WQMP Technical Guidance Document (December 2013), summarizes the categories of land use or project features of concern and the general pollutant categories associated with them.

ANTICIPATED & POTENTIAL POLLUTANTS GENERATED BY LAND USE TYPE								
Priority Project Categories and/or Project Features	General Pollutant Categories							
	Suspended Solid/ Sediments	Nutrients	Heavy Metals	Pathogens (Bacteria/ Virus)	Pesticides	Oil & Grease	Toxic Organic Compound	Trash & Debris
Detached Residential Development	E	E	N	E	E	E	N	E
Attached Residential Development	E	E	N	E	E	E(2)	N	E

ANTICIPATED & POTENTIAL POLLUTANTS GENERATED BY LAND USE TYPE								
Priority Project Categories and/or Project Features	General Pollutant Categories							
	Suspended Solid/ Sediments	Nutrients	Heavy Metals	Pathogens (Bacteria/ Virus)	Pesticides	Oil & Grease	Toxic Organic Compound	Trash & Debris
Commercial/Industrial Development	E(1)	E(1)	E(5)	E(3)	E(1)	E	E	E
Automotive Repair Shops	N	N	E	N	N	E	E	E
Restaurants	E(1)(2)	E(1)	E(2)	E	E(1)	E	N	E
Hillside Development >5,000 ft^2	E	E	N	E	E	E	N	E
Parking Lots	E	E(1)	E	E(4)	E(1)	E	E	E
Streets, Highways, & Freeways	E	E(1)	E	E(4)	E(1)	E	E	E
Retail Gasoline Outlets	N	N	E	N	N	E	E	E

Notes:
E = expected to be of concern N = not expected to be of concern
(1) Expected pollutant if landscaping exists on-site, otherwise not expected.
(2) Expected pollutant if the project includes uncovered parking areas, otherwise not expected.
(3) Expected pollutant if land use involves food or animal waste products, otherwise not expected.
(4) Bacterial indicators are routinely detected in pavement runoff.
(5) Expected if outdoor storage or metal roofs, otherwise not expected.
Source: County of Orange. (2013, December 20). Technical Guidance Document for the Preparation of Conceptual/ Preliminary and/or Project Water Quality Management Plans (WQMPs). Table 2.1.

POLLUTANTS OF CONCERN		
Pollutant	E = Expected to be of concern N =Not Expected to be of concern	Additional Information and Comments
Suspended Solid/ Sediment	E	
Nutrients	E	
Heavy Metals	E	
Pathogens (Bacteria/Virus)	E	
Pesticides	E	
Oil & Grease	E	

POLLUTANTS OF CONCERN		
Pollutant	E = Expected to be of concern N =Not Expected to be of concern	Additional Information and Comments
Toxic Organic Compounds	E	
Trash & Debris	E	

II.3 HYDROLOGIC CONDITIONS OF CONCERN

The purpose of this section is to identify any hydrologic conditions of concern (HCOC) with respect to downstream flooding, erosion potential of natural channels downstream, impacts of increased flows on natural habitat, etc. As specified in Section 2.3.3 of the 2011 Model WQMP, projects must identify and mitigate any HCOCs. A HCOC is a combination of upland hydrologic conditions and stream biological and physical conditions that presents a condition of concern for physical and/or biological degradation of streams.

In the North Orange County permit area, HCOCs are considered to exist if any streams located downstream from the project are determined to be potentially susceptible to hydromodification impacts and either of the following conditions exists:

- Post-development runoff volume for the 2-yr, 24-hr storm exceeds the pre-development runoff volume for the 2-yr, 24-hr storm by more than 5 percent

or

- Time of concentration (Tc) of post-development runoff for the 2-yr, 24-hr storm event exceeds the time of concentration of the pre-development condition for the 2-yr, 24-hr storm event by more than 5 percent.

If these conditions do not exist or streams are not potentially susceptible to hydromodification impacts, an HCOC does not exist and hydromodification does not need to be considered further. In the North Orange County permit area, downstream channels are considered not susceptible to hydromodification, and therefore do not have the potential for a HCOC, if all downstream conveyance channels that will receive runoff from the project are engineered, hardened, and regularly maintained to ensure design flow capacity, and no sensitive habitat areas will be affected.

Is the proposed project potentially susceptible to hydromodification impacts?

☒ Yes ☐ No (show map)

2-YEAR, 24-HOUR STORM SUMMARY				
Condition	Acreage	Tc (min)	Peak Runoff (cfs)	Volume (ac-ft)
Pre-development	15.43	12.9	13.9	0.85
Proposed	15.43	7.0	14.1	1.06
Difference	0	-5.9	+0.2	+0.21
% Change		-45.7%	+1.4%	+24.7%

The project is in a HCOC susceptible area and HCOCs exist for the site because the post-development runoff volume for the 2-yr, 24-hr storm exceeds the pre-development runoff volume for the 2-yr, 24-hr storm by more than 5 percent. Infiltration is not feasible for the site, so the 2-yr, 24-hr peak flowrate requires mitigation. The proposed peak flowrate is 14.1 cfs, which is 1.4% greater than the existing peak flowrate. Thus, the proposed condition peak flowrate is less than 5% greater than the existing peak flowrate so no HCOC BMPs are required.

II.4 POST DEVELOPMENT DRAINAGE CHARACTERISTICS

Under proposed conditions, runoff from the project site is separated into twelve (12) Drainage Management Areas (DMAs. The proposed site drains to the north and will discharge treated flows into the Santa Ana Delhi Channel via new storm drain systems connecting to modular wetlands systems and bioretention systems with underdrains. After discharging into the Santa Ana Delhi Channel flows are conveyed to the Upper and Lower Newport Bay, respectfully, and eventually into the Pacific Ocean.

Offsite run-on is proposed to be diverted from the project site.

II.5 PROPERTY OWNERSHIP/MANAGEMENT

PROPERTY OWNERSHIP/MANAGEMENT	
Public Streets:	City of Newport Beach
Private Streets:	Back Bay Barrels, LLC
Landscaped Areas:	Back Bay Barrels, LLC
Open Space:	Not applicable

PROPERTY OWNERSHIP/MANAGEMENT	
Parks:	Not applicable
Buildings:	Back Bay Barrels, LLC
Structural BMPs:	Back Bay Barrels, LLC

The Owner, Back Bay Barrels, LLC shall assume all BMP maintenance and inspection responsibilities for the proposed project. Inspection and maintenance responsibilities are outlined in Section V of this report.

SECTION III SITE DESCRIPTION

III.1 PHYSICAL SETTING

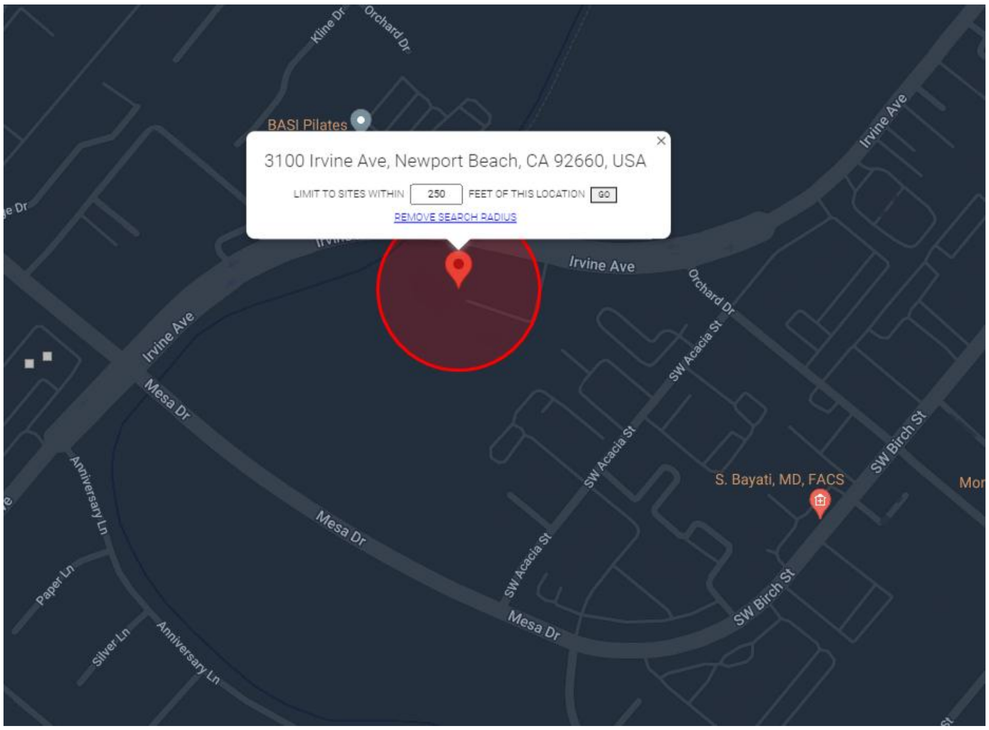
Planning Area/ Community Name:	Snug Harbor
Address:	3100 Irvine Avenue, Newport Beach, CA 92660
Land Use:	Parks and Recreation
Zoning:	SP-7
Acreage:	15.4 acres
Predominant Soil Type:	C and D[1]

III.2 SITE CHARACTERISTICS

Precipitation Zone:	0.75 inches per TGD Figure XVI-1 (See Appendix A)
Topography:	The project site ranges from flat (0.6%) to steep (9.4%), and generally drains towards the north and northwest portion of the site and eventually discharges into the Santa Ana Delhi Channel.
Drainage Patterns/ Connections:	See Section II.1 and Section II.4 for a complete description of existing and proposed drainage patterns and connections.
Soil Type, Geology, and Infiltration Properties:	This site is located in the Santa Ana Heights area adjacent to the Delhi Channel approximately ¾ mile north of Upper Newport Bay. Santa Ana Heights is located northwest of the San Joaquin Hills and is mapped as covered by coastal terrace deposits. The project site is underlain by engineered fill with a thickness ranging from 0 to about 15 feet and described as clayey sand, sandy lean clay, silty sand, and clay. The fill is underlain by late Quaternary to recent alluvium, which is underlain by Quaternary marine terrace deposits consisting primarily of lean clay with interlayers of fine to medium sand, silty sand, and silt layers. See Appendix F for further details.

[1] Source: OC Stormwater Program Land Development Tool Web Map. https://ocgis.com/ocpw/envres/landdev/index.html. Accessed 8/8/2024

Hydrogeologic (Groundwater) Conditions:	Groundwater below the site has been encountered in temporary piezometers at approximately El. +4 to +15 feet msl. This water level is likely the result of a pressurized confined or semiconfined aquifer. The recommended design groundwater level for the site is at El. +8 feet msl, which is approximately two feet above the adjacent concrete-lined Delhi Channel. Widespread dewatering or lowering of a water table is not anticipated to be required. However, isolated seepage zones may be encountered in excavations. Perched water and groundwater would be expected to occur where granular soils are encountered. Fluctuation of the groundwater level and localized zones of perched water should be anticipated below grade. Irrigation of landscaped areas can also impact local groundwater levels or likelihood of perched water or seepage to be encountered in excavations. Appendix F for further details.

Geotechnical Conditions (relevant to infiltration):	According to the geotechnical exploration report, stormwater infiltration is deemed infeasible due to the presence of thick clay layers underlying the site that would be expected to have very low to no permeability, presence of perched water, and evidence of pressurized aquifers below the site. Appendix F for further details. There are no GeoTracker-listed cleanup sites within a 250 feet radius[2]: 
Off-Site Drainage:	Under existing conditions, approximately 3.94 ac of runoff from the adjacent property immediately southeast of the site drains onto the property's parking lot. Under proposed conditions, runoff will be diverted prior to entering the site.
Utility and Infrastructure Information:	Dry and wet utilities will be incorporated into the proposed project and will tie into existing facilities associated with the existing development. One existing SCE easement will be quitclaimed.

III.3 WATERSHED DESCRIPTION

[2] Source: State Water Resources Control Board GeoTracker. https://geotracker.waterboards.ca.gov/. Accessed 8/8/2024

Receiving Waters:	Santa Ana Delhi Channel; Newport Bay (upper and lower); Pacific Ocean
303(d) Listed Impairments:	Based on the 2020-2022 Integrated Report, the 303(d) listed impairments include: • **Newport Bay, Upper**: Chlordane, Copper, DDT, Indicator Bacteria, Malathion, Nutrients, PCBs, Sedimentation/Siltation, Toxicity • **Newport Bay, Lower**: Chlordane, Copper, DDT, Indicator Bacteria, Nutrients, PCBs, Toxicity
Applicable TMDLs:	• **Newport Bay, Upper:** Organophosphate Pesticides, Selenium, Metals, Organochlorine Compounds, Sediment, Nutrients, Pathogens • **Newport Bay, Lower:** Selenium, Metals, Organochlorine Compounds, Sediment, Nutrients, Pathogens
Pollutants of Concern for the Project:	Suspended Solid/Sediments, Nutrients, Heavy Metals, Pathogens (Bacteria/Virus), Pesticides, Oil & Grease, Toxic Organic Compounds, Trash & Debris
Hydrologic Conditions of Concern (HCOCs):	The proposed condition peak flowrate is 14.1 cfs, which is less than 5% greater than the existing condition peak flowrate of 13.9 cfs. Thus, no HCOC BMPs are required. See Section II.3 for details.
Environmentally Sensitive and Special Biological Significant Areas:	Environmentally Sensitive Areas (ESAs) • Upper Newport Bay • West Bay There is no Area of Special Biological Significance (ASBS) in the City of Newport Beach.

SECTION IV BEST MANAGEMENT PRACTICES (BMPs)

IV.1 PROJECT PERFORMANCE CRITERIA

Is there an approved WIHMP or equivalent for the project area that includes more stringent LID feasibility criteria or if there are opportunities identified for implementing LID on regional or sub-regional basis?

☐ Yes ☒ No

PROJECT PERFORMANCE CRITERIA	
Hydromodification Control Performance Criteria: (Model WQMP Section 7.II-2.4.2.2)	If a hydrologic condition of concern (HCOC) exists, priority projects shall implement onsite or regional hydromodification controls such that: ▪ Post-development runoff volume for the two-year frequency storm does not exceed that of the predevelopment condition by more than five percent, and ▪ Time of concentration of post-development runoff for the two-year storm event is not less than that for the predevelopment condition by more than five percent. Where the Project WQMP documents that excess runoff volume from the two-year runoff event cannot feasibly be retained and where in-stream controls cannot be used to otherwise mitigate HCOCs, the project shall implement on-site or regional hydromodification controls to: ▪ Retain the excess volume from the two-year runoff event to the MEP, and ▪ Implement on-site or regional hydromodification controls such that the post-development runoff two-year peak flow rate is no greater than 110 percent of the predevelopment runoff two-year peak flow rate.
LID Performance Criteria: (Model WQMP Section 7.II-2.4.3)	Infiltrate, harvest and use, evapotranspire, or biotreat/biofilter, the 85^{th} percentile, 24-hour storm event (Design Capture Volume). LID BMPs must be designed to retain, on-site, (infiltrate, harvest and use, or evapotranspire) storm water runoff up to 80 percent average annual capture efficiency.

PROJECT PERFORMANCE CRITERIA	
Treatment Control BMP Performance Criteria: (Model WQMP Section 7.II-3.2.2)	If it is not feasible to meet LID performance criteria through retention and/or biotreatment provided on-site or at a sub-regional/regional scale, then treatment control BMPs shall be provided on-site or offsite prior to discharge to waters of the US. Sizing of treatment control BMP(s) shall be based on either the unmet volume after claiming applicable water quality credits, if appropriate.
LID Design Storm Capture Volume:	***DCV*** **=** *(0.75 x* **1.00** *+0.15) x* **0.75** *inches x* **7.70** *ac x 43560 sf/ac x 1/12 in/ft* **= 18,867 cubic feet** *Refer to Section IV.2.2 for specific Drainage Manage Area (DMA) breakdown and Appendix A for detailed calculations (Worksheet B).*

IV.2 SITE DESIGN AND DRAINAGE PLAN

The following section describes the site design BMPs used in this project and the methods used to incorporate them. Careful consideration of site design is a critical first step in storm water pollution prevention from new developments and redevelopments.

IV.2.1 Site Design BMPs

Minimize Impervious Area

Impervious surfaces have been minimized by incorporating landscaped areas throughout the site surrounding the proposed building. Landscaping will be provided throughout the site within the common areas as well as around the perimeter of the building.

Maximize Natural Infiltration Capacity

Infiltration is not recommended for the project site due to the presence of thick clay layers underlying the site. Refer to Section IV.3.2 for details.

Preserve Existing Drainage Patterns and Time of Concentration

Runoff from the site will continue to flow similar to existing conditions to the Santa Ana Delhi Channel. Low-flows and first-flush runoff will drain to BMPs for water quality treatment via bio-filtration.

Disconnect Impervious Areas

Landscaping will be provided adjacent to sidewalks and between the proposed buildings. Low-flows and first-flush runoff will drain to landscaped bioretention cells with underdrains for water quality treatment via bio-filtration. Refer to Section IV.3.4 for further details.

Protect Existing Vegetation and Sensitive Areas, and Revegetate Disturbed Areas

There are no existing vegetated or sensitive areas to preserve on the project site. All disturbed areas will either be paved or landscaped.

Xeriscape Landscaping

Xeriscape landscaping is not proposed for the project. However, native and/or tolerant landscaping will be incorporated into the site design consistent with City guidelines.

IV.2.2 Drainage Management Areas

In accordance with the MS4 permit and the 2011 Model WQMP, the project site has been divided into Drainage Management Areas (DMAs) to be utilized for defining drainage areas and sizing LID and other treatment control BMPs. DMAs have been delineated based on the proposed site grading patterns, drainage patterns, storm drain and catch basin locations.

The design capture volumes (DCV) and treatment flow rates (Q_{Design}) for each DMA are summarized in the table below. These have been derived utilizing the "Simple Method" in accordance with the TGD Section III.1.1. Additional calculations and TGD Worksheets are provided in Appendix A.

DMA	Total Drainage Area (sf)	% Imp.	Runoff Coefficient	Design Storm Depth (in)	Tc (min)	Rainfall Intensity (in/hr)	Simple Method DCV (cf)	QDesign (cfs)
DMA A	1.70	90%	0.825	0.75	5	0.26	3,818	0.365
DMA B	1.94	90%	0.825	0.75	5	0.26	4,357	0.416
DMA C	0.30	90%	0.825	0.75	5	0.26	674	0.064
DMA D	0.26	100%	0.900	0.75	5	0.26	637	0.061
DMA E	0.27	100%	0.900	0.75	5	0.26	662	0.063
DMA F	0.37	0%	0.150	0.75	5	0.26	151	0.014
DMA G	0.20	100%	0.900	0.75	5	0.26	490	0.047
DMA H	0.29	100%	0.900	0.75	5	0.26	711	0.068
DMA I	0.19	30%	0.375	0.75	5	0.26	194	0.019
DMA J	2.27	100%	0.900	0.75	5	0.26	5,562	0.531
DMA K	1.24	100%	0.900	0.75	5	0.26	3,038	0.290
DMA L	5.53	100%	0.900	0.75	5	0.26	13,550	1.294
DMA M	0.87	90%	0.825	0.75	5	0.26	1,954	0.187

The project utilizes biotreatment BMPs to treat site runoff before discharging offsite. There are no BMPs proposed in DMA F due to the area being fully pervious and self-treating. Also, in the proposed project, DMA F mimics existing site conditions. Due to extreme site constraints, runoff in DMA I is not feasibly collected and treated. DMA I consists of an existing cart tunnel that runs under Irvine Avenue and will maintain current conditions with minimal disturbance, other than an increase in pervious area on the slopes adjacent to the cart path. Further site study is needed to determine how flows from the cart tunnel are intercepted in the existing condition. The lagoon, DMA L, will be self-contained, draining to sanitary sewer, and therefore does not require a BMP.

IV.3 LID BMP SELECTION AND PROJECT CONFORMANCE ANALYSIS

Low Impact Development (LID) BMPs are required in addition to site design measures and source controls to reduce pollutants in storm water discharges. LID BMPs are engineered facilities that are designed to retain or biotreat runoff on the project site. The 4th Term MS4 Storm Water Permit (Order R8-2009-0030) requires the evaluation and use of LID features using the following hierarchy of treatment: infiltration, evapotranspiration, harvest/reuse, and biotreatment. The following sections summarize the LID BMPs proposed for the project in accordance with the permit hierarchy and performance criteria outlined in Section IV.1.

IV.3.1 Hydrologic Source Controls (HSCs)

Hydrologic source controls (HSCs) can be considered to be a hybrid between site design practices and LID BMPs. HSCs are distinguished from site design BMPs in that they do not reduce the tributary area or reduce the imperviousness of a drainage area; rather they reduce the runoff volume that would result from a drainage area with a given imperviousness compared to what would result if HSCs were not used.

HYDROLOGIC SOURCE CONTROLS		
ID	Name	Included?
HSC-1	Localized on-lot infiltration	☐
HSC-2	Impervious area dispersion (e.g. roof top disconnection)	☐
HSC-3	Street trees (canopy interception)	☐
HSC-4	Residential rain barrels (not actively managed)	☐
HSC-5	Green roofs/Brown roofs	☐
HSC-6	Blue roofs	☐
HSC-7	Impervious area reduction (e.g. permeable pavers, site design)	☐

No HSCs are proposed within the Project.

IV.3.2 Infiltration BMPs

Infiltration BMPs are LID BMPs that capture, store and infiltrate storm water runoff. These BMPs are engineered to store a specified volume of water and have no design surface discharge (underdrain or outlet structure) until this volume is exceeded. Examples of infiltration BMPs include infiltration trenches, bioretention without underdrains, drywells, permeable pavement, and underground infiltration galleries.

INFILTRATION		
ID	Name	Included?
INF-3 INF-4	Bioretention Without Underdrains	☐
	Rain Gardens	☐
	Porous Landscaping	☐
	Infiltration Planters	☐
	Retention Swales	☐
INF-2	Infiltration Trenches	☐
INF-1	Infiltration Basins	☐
INF-5	Drywells	☐
INF-7	Subsurface Infiltration Galleries	☐
--	French Drains	☐
INF-6	Permeable Asphalt	☐
	Permeable Concrete	☐
	Permeable Concrete Pavers	☐
	Other:	☐

No infiltration BMPs are proposed within the project. As discussed in Section III.2 infiltration is infeasible due to the presence of thick clay layers underlying the site. See Appendix F for further details.

IV.3.3 Rainwater Harvesting BMPs

Harvest and use (aka. Rainwater Harvesting) BMPs are LID BMPs that capture and store storm water runoff for later use. These BMPs are engineered to store a specified volume of water and have no design surface discharge until this volume is exceeded. Harvest and use BMPs include both above-ground and below-ground cisterns. Examples of uses for harvested water include irrigation, toilet and urinal flushing, vehicle washing, evaporative cooling, industrial processes and other non-potable uses.

HARVEST & REUSE / RAINWATER HARVESTING		
ID	Name	Included?
HU-1	Above-ground cisterns and basins	☐
HU-2	Underground detention	☐
--	Other:	☐

For a system to be considered "feasible", the system must be designed with a storage volume equal to the DCV from the tributary area and achieve more than 40% capture. The system must also be able to drawdown in 30 days to meet the 40% capture value. This is determined by calculating the Estimated Applied Water Use (EAWU) equation from Appendix X of the TGD. The EAWU can then be divided by the water quality volume for the project site or DMA to determine drawdown time. If the drawdown time is less than 30 days, harvest and reuse is considered partially feasible and the Effective Irrigated Area to Tributary Area (EIATA) ratio may be utilized to determine the capture efficiency of the system. If drawdown is greater than 30 days, harvest and reuse may be concluded to be infeasible.

As shown by Worksheet J included in Appendix A, harvest and reuse is considered infeasible due insufficient water demand during the wet season to drawdown the water quality volume.

IV.3.4 Biotreatment BMPs

Biotreatment BMPs are a broad class of LID BMPs that reduce storm water volume to the maximum extent practicable, treat storm water using a suite of treatment mechanisms characteristic of biologically active systems, and discharge water to the downstream storm drain system or directly to receiving waters.

BIOTREATMENT		
ID	Name	Included?
BIO-1	Bioretention with underdrains	☒
	Storm Water planter boxes with underdrains	☐
	Rain gardens with underdrains	☐
BIO-5	Constructed wetlands	☐
BIO-2	Vegetated swales	☐
BIO-3	Vegetated filter strips	☐

BIOTREATMENT		
ID	Name	Included?
BIO-7	Proprietary vegetated biotreatment systems	☒
BIO-4	Wet extended detention basin	☐
BIO-6	Dry extended detention basins	☐
--	Other:	☐

Modular Wetlands Systems by Contech are proprietary biotreatment systems that utilize multi-stage treatment processes including screening media filtration, settling, and biofiltration. The pre-treatment chamber contains the first three stages of treatment, and includes a catch basin inlet filter to capture trash, debris, gross solids and sediments, a settling chamber for separating out larger solids, and a media filter cartridge for capturing fine TSS, metals, nutrients, and bacteria. Runoff then flows through the wetland chamber where treatment is achieved through a variety of physical, chemical, and biological processes. As storm water passes down through the planting soil, pollutants are filtered, adsorbed, biodegraded and sequestered by the soil and plants, functioning similar to bioretention systems. The discharge chamber at the end of the unit collects treated flows and discharges back into the storm drain system.

Bioretention planters with underdrains are plant-based biotreatment systems that typically consist of a ponding area, mulch layer, planting soils and plants. As storm water passes down through the planting soil, pollutants are filtered, adsorbed, biodegraded and sequestered by the soil and plants. Underdrains collect the treated water and return it back into the storm drain system.

There are seven (7) MWS and three (3) bioretention planters with underdrains proposed to meet the water quality treatment requirements. The MWS units are sized based on the flowrate of the 85th percentile storm event. See Appendix A for additional calculations.

MODULAR WETLAND DESIGN SUMMARY						
DMA / BMP ID(1)(2)	**Total Drainage Area (ac)**	**% Imp.**	**QDesign(3) (cfs)**	**Sizes / Models(4)**	**Total Treatment Capacity(5) (cfs)**	**Latitude, Longitude**
DMA A	1.70	90%	0.365	MWS-L-8-16	0.462	33.6879, -117.8828
DMA C	0.30	90%	0.064	MWS-L-4-8	0.115	33.6584, -117.8829
DMA D	0.26	100%	0.061	MWS-L-4-8	0.115	33.6588, -117.8826
DMA E	0.27	100%	0.063	MWS-L-4-8	0.115	33.6583, -117.8826
DMA J	2.27	100%	0.531	MWS-L-8-20	0.577	33.6597, -117.8811

MODULAR WETLAND DESIGN SUMMARY						
DMA K	1.24	100%	0.290	MWS-L-8-12	0.346	33.6592, -117.8822
DMA M	0.87	90%	0.187	MWS-L-8-8	0.231	33.6590, -117.8803

Notes:
(1) See also Section IV.2.2
(2) Refer to WQMP Exhibit in Section VI for locations of each drainage area and BMP.
(3) Detailed calculations and worksheets are included in Appendix A.
(4) Unit details and specifications are included in Section VI.
(5) Treatment capacities of each unit are based on wetland media design loading rate (controlled by downstream orifice) and perimeter surface area of wetland media provided. Individual unit sizing calculations provided by the manufacturer are included on each cut sheet/detail included in Section VI.

BIORETENTION WITH UNDERDRAIN DESIGN SUMMARY

DMA / BMP ID(1)(2)	Total Drainage Area (ac)	Time to Drawdown Effective Depth (hr)	Min. Surface Area Required (sq-ft)	Surface Area Provided (sq-ft)	Required Volume (cu-ft)	Design Volume (cu-ft)	Latitude, Longitude
DMA B	1.94	2.4	2,179	4,944	1,089	2,472	33.6586, -117.8835
DMA G	0.20	1.2	392	1,743	98	436	33.6591, -117.8828
DMA H	0.29	1.2	569	1,238	142	310	33.6595, -117.8816

IV.3.5 Hydromodification Control BMPs

No HCOC BMPs are required due to the site design resulting in a peak flowrate less than 5% greater than the existing condition peak flowrate. See Section II.3 for details.

IV.3.6 Regional/Sub-Regional LID BMPs

Not applicable. LID BMPs (biotreatment) will be utilized for water quality treatment on-site in accordance with the MS4 Permit hierarchy identified at the beginning of this Section.

IV.3.7 Treatment Control BMPs

Treatment control BMPs can only be considered if the project conformance analysis indicates that it is not feasible to retain the full design capture volume with LID BMPs.

TREATMENT CONTROL BMPs		
ID	Name	Included?
TRT-1	Sand Filters	☐
TRT-2	Cartridge Media Filter	☐
PRE-1	Hydrodynamic Separation Device	☐
PRE-2	Catch Basin Insert	☐
	Other:	☐

Not applicable. LID BMPs (biotreatment) will be utilized for water quality treatment on-site in accordance with the MS4 Permit hierarchy identified at the beginning of this Section.

IV.3.8 Non-Structural Source Control BMPs

The table below indicates all BMPs to be incorporated in the project. For those designated as not applicable (N/A), a brief explanation why is provided.

NON-STRUCTURAL SOURCE CONTROL BMPs				
ID	Name	Included?	Not Applicable?	If Not Applicable, Provide Brief Reason
N1	Education for Property Owners, Tenants and Occupants	☐	☒	Non-residential development.
N2	Activity Restrictions	☒	☐	
N3	Common Area Landscape Management	☒	☐	
N4	BMP Maintenance	☒	☐	
N5	Title 22 CCR Compliance (How development will comply)	☒	☐	
N6	Local Water Quality Permit Compliance	☐	☒	The City of Newport Beach does not issue water quality permits.
N7	Spill Contingency Plan	☒	☐	
N8	Underground Storage Tank Compliance	☐	☒	No underground storage is proposed.
N9	Hazardous Materials Disclosure Compliance	☒	☐	

NON-STRUCTURAL SOURCE CONTROL BMPs				
ID	Name	Included?	Not Applicable?	If Not Applicable, Provide Brief Reason
N10	Uniform Fire Code Implementation	☒	☐	
N11	Common Area Litter Control	☒	☐	
N12	Employee Training	☒	☐	
N13	Housekeeping of Loading Docks	☐	☒	No loading docks are proposed.
N14	Common Area Catch Basin Inspection	☒	☐	
N15	Street Sweeping Private Streets and Parking Lots	☒	☐	
N16	Retail Gasoline Outlets	☐	☒	No gasoline facilities are proposed

N2, Activity Restrictions

The Owner shall develop ongoing activity restrictions that include those that have the potential to create adverse impacts on water quality. Activities include, but are not limited to: handling and disposal of contaminants, fertilizer and pesticide application restrictions, litter control and pick-up, and vehicle or equipment repair and maintenance in non-designated areas, as well as any other activities that may potentially contribute to water pollution.

N3, Common Area Landscape Management

Management programs will be designed and implemented by the Owner to maintain all the common areas within the project site. These programs will cover how to reduce the potential pollutant sources of fertilizer and pesticide uses, utilization of water-efficient landscaping practices and proper disposal of landscape wastes by the owner/developer and/or contractors.

N4, BMP Maintenance

The Owner will be responsible for the implementation and maintenance of each applicable non-structural BMP, as well as scheduling inspections and maintenance of all applicable structural BMP facilities through its staff, landscape contractor, and/or any other necessary maintenance contractors. Details on BMP maintenance are provided in Section V of this WQMP, and the O&M Plan is included in Appendix D.

N5, Title 22 CCR Compliance (How development will comply)

Where applicable, the proposed project shall comply with Title 22 of the California Code of Regulations and relevant sections of the California Health and Safety Code regarding hazardous waste management, which will be enforced by County Environmental Health on behalf of the State. Compliance shall be maintained on an ongoing basis.

N7, Spill Contingency Plan

Any facilities that store liquid materials or wastes shall maintain procedures for spill response and cleanup activities. Emergency spill kits shall be kept on-site at all times. Spill kits shall include, at a minimum, dry adsorbent material such as kitty litter, mats or pillows, containment booms, wipes, goggles, gloves and disposal bags. Minor spills shall be cleaned up immediately using dry methods, consistent with measures identified in the fact sheets attached to this WQMP. Activities will be coordinated between the respective departments and the Police and Fire departments in the event of a spill. Procedures shall be maintained on an ongoing basis.

N9, Hazardous Materials Disclosure Compliance

Any storage or utilization of hazardous wastes, where applicable, shall comply with the County of Orange Fire Authority hazardous material disclosure requirements. Compliance shall be maintained on an ongoing basis.

N10, Uniform Fire Code Implementation

The Owner shall ensure all structures comply with Article 80 of the Uniform Fire Code, City of Newport Beach Municipal Code, County of Orange Fire Authority, and Orange City Fire Department. Compliance shall be maintained on an ongoing basis.

N11, Common Area Litter Control

The Owner will be responsible for performing trash pickup and sweeping of littered common areas on a weekly basis or whenever necessary. Responsibilities will also include noting improper disposal materials by the public and reporting such violations for investigation.

N12, Employee Training

All employees of the Owner and any contractors will require training to ensure that employees are aware of maintenance activities that may result in pollutants reaching the storm drain. Training will include, but not be limited to, spill cleanup procedures, proper waste disposal, housekeeping practices, etc.

N14, Common Area Catch Basin Inspection

All on-site catch basin inlets and drainage facilities shall be inspected and maintained by the Owner at least once a year, prior to the rainy season, no later than October 1st of each year. The City of Newport Beach shall be responsible for inspection and maintenance of all public catch basins and drainage facilities associated with the project.

N15, Street Sweeping Private Streets and Parking Lots

The Owner shall be responsible for sweeping all on-site streets, drive aisles, and/or uncovered parking areas within the project on a quarterly basis. The applicant shall not spray down or wash down the parking lot or surrounding sidewalks unless the water used is directed through the sanitary sewer system or a filtered drain. No car washing shall be permitted in the parking lot.

IV.3.9 Structural Source Control BMPs

The table below indicates all BMPs to be incorporated in the project. For those designated as not applicable (N/A), a brief explanation why is provided.

STRUCTURAL SOURCE CONTROL BMPs				
ID	Name	Included?	Not Applicable?	If Not Applicable, Provide Brief Reason
S1 SD-13	Provide storm drain system stenciling and signage	☒	☐	
S2 SD-34	Design and construct outdoor material storage areas to reduce pollution introduction	☐	☒	No outdoor material storage areas are proposed.
S3 SD-32	Design and construct trash and waste storage areas to reduce pollution introduction	☒	☐	
S4 SD-12	Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control	☒	☐	
S5	Protect slopes and channels and provide energy dissipation	☒	☐	
S6 SD-31	Properly Design: Dock areas	☐	☒	No loading docks are proposed.
S7 SD-31	Properly Design: Maintenance bays	☐	☒	No maintenance bays are proposed.
S8 SD-33	Properly Design: Vehicle wash areas	☐	☒	No vehicle wash areas are proposed.
S9 SD-36	Properly Design: Outdoor processing areas	☐	☒	No outdoor processing areas are proposed.
S10	Properly Design: Equipment wash areas	☐	☒	No equipment wash areas are proposed.
S11 SD-30	Properly Design: Fueling areas	☐	☒	No fueling areas are proposed.

STRUCTURAL SOURCE CONTROL BMPs				
ID	Name	Included?	Not Applicable?	If Not Applicable, Provide Brief Reason
S12 SD-10	Properly Design: Hillside landscaping	☐	☒	No hillside landscaping is proposed.
S13	Properly Design: Wash water control for food preparation areas	☐	☒	No food preparation areas are proposed.
S14	Properly Design: Community car wash racks	☐	☒	No community car wash racks are proposed.

S1/SD-13, Provide storm drain system stenciling and signage

The phrase "NO DUMPING! DRAINS TO OCEAN", or an equally effective phrase approved by the City, will be stenciled on all major storm drain inlets within the project site to alert the public to the destination of pollutants discharged into storm water. Stencils shall be in place prior to release of certificate of occupancy. Stencils shall be inspected for legibility on an annual basis and re-stenciled as necessary.

S3/SD-32, Design and construct trash and waste storage areas to reduce pollution introduction

All trash and waste shall be stored in containers that have lids or tarps to minimize direct precipitation into the containers. One (1) trash enclosures will be located in the Clubhouse Building. The trash storage areas will be designed to City standards, and will be walled, roofed, have gates and proper drainage per City standards.

S4/SD-12, Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control

The Owner will be responsible for the installation and maintenance of all common landscape areas utilizing similar planting materials with similar water requirements to reduce excess irrigation runoff. The Owner will be responsible for implementing all efficient irrigation systems for common area landscaping including, but not limited to, provisions for water sensors and programmable irrigation cycles. This includes smart timers, rain sensors, and moisture shut-off valves. The irrigation systems shall be in conformance with water efficiency guidelines. Systems shall be tested twice per year, and water used during testing/flushing shall not be discharged to the storm drain system.

S5, Protect slopes and channels and provide energy dissipation

The site drainage design shall include appropriate BMPs to decrease the potential for erosion of slopes and/or channels. The design shall be consistent with Federal, State, and local standards (e.g., RWQCB, ACOE, CDFG). Where feasible, the following principles shall be considered: 1) convey runoff safely from the tops of slopes, 2) avoid disturbing steep or unstable slopes, as well as natural channels, 3) implement a permanent stabilization BMP on disturbed slopes and channels as quickly as possible, such as native vegetation, and 4) install energy dissipaters at the outlets of new storm drains, culverts, or channels.

IV.4 ALTERNATIVE COMPLIANCE PLAN

IV.4.1 Water Quality Credits

Local jurisdictions may develop a water quality credit program that applies to certain types of development projects after they first evaluate the feasibility of meeting LID requirements on-site. If it is not feasible to meet the requirements for on-site LID, project proponents for specific project types can apply credits that would reduce project obligations for selecting and sizing other treatment BMPs or participating in other alternative programs.

WATER QUALITY CREDITS	
Credit	Applicable?
Redevelopment projects that reduce the overall impervious footprint of the project site.	☐
Brownfield redevelopment, meaning redevelopment, expansion, or reuse of real property which may be complicated by the presence or potential presence of hazardous substances, pollutants or contaminants, and which have the potential to contribute to adverse ground or surface water quality if not redeveloped.	☐
Higher density development projects which include two distinct categories (credits can only be taken for one category): those with more than seven units per acre of development (lower credit allowance); vertical density developments, for example, those with a Floor to Area Ratio (FAR) of 2 or those having more than 18 units per acre (greater credit allowance)	☐
Mixed use development, such as a combination of residential, commercial, industrial, office, institutional, or other land uses which incorporate design principles that can demonstrate environmental benefits that would not be realized through single use projects (e.g. reduced vehicle trip traffic with the potential to reduce sources of water or air pollution).	☐
Transit-oriented developments, such as a mixed use residential or commercial area designed to maximize access to public transportation; similar to above criterion, but where the development center is within one half mile of a mass transit center (e.g. bus, rail, light rail or commuter train station). Such projects would not be able to take credit for both categories, but may have greater credit assigned	☐
Redevelopment projects in an established historic district, historic preservation area, or similar significant city area including core City Center areas (to be defined through mapping).	☐

WATER QUALITY CREDITS	
Credit	Applicable?
Developments with dedication of undeveloped portions to parks, preservation areas and other pervious uses.	☐
Developments in a city center area.	☐
Developments in historic districts or historic preservation areas.	☐
Live-work developments, a variety of developments designed to support residential and vocational needs together – similar to criteria to mixed use development; would not be able to take credit for both categories.	☐
In-fill projects, the conversion of empty lots and other underused spaces into more beneficially used spaces, such as residential or commercial areas.	☐

Not applicable. Water quality credits will not be applied for the project. LID BMPs (biotreatment) will be utilized for water quality treatment on-site in accordance with the MS4 Permit hierarchy identified at the beginning of this Section.

IV.4.2 Alternative Compliance Plan Information

Not applicable. LID BMPs (biotreatment) will be utilized for water quality treatment on-site in accordance with the MS4 Permit hierarchy identified at the beginning of this Section.

SECTION V INSPECTION/MAINTENANCE RESPONSIBILITY FOR BMPs

It has been determined that Back Bay Barrels, LLC shall assume all BMP inspection and maintenance responsibilities for the Snug Harbor Surf Camp project.

Contact Name:	Adam Cleary
Company:	Back Bay Barrels, LLC
Address:	3857 Birch Street, #521
Phone:	949-836-3055
Email:	steve@coynedev.com

Should the maintenance responsibility be transferred at any time during the operational life of Snug Harbor Surf Camp, such as when an HOA or POA is formed for a project, a formal notice of transfer shall be submitted to the City of Newport Beach at the time responsibility of the property subject to this WQMP is transferred. The transfer of responsibility shall be incorporated into this WQMP as an amendment.

The Owner shall verify BMP implementation and ongoing maintenance through inspection, self-certification, survey, or other equally effective measure. The certification shall verify that, at a minimum, the inspection and maintenance of all structural BMPs including inspection and performance of any required maintenance in the late summer / early fall, prior to the start of the rainy season. A form that may be used to record implementation, maintenance, and inspection of BMPs is included in Appendix D.

The City of Newport Beach may conduct verifications to assure that implementation and appropriate maintenance of structural and non-structural BMPs prescribed within this WQMP is taking place at the project site. The Owner shall retain operations, inspections and maintenance records of these BMPs and they will be made available to the City or County upon request. All records must be maintained for at least five (5) years after the recorded inspection date for the lifetime of the project.

Long-term funding for BMP maintenance will be provided by Back Bay Barrels, LLC.

The Operations and Maintenance (O&M) Plan can be found in Appendix D.

BMP INSPECTION & MAINTENANCE RESPONSIBILITY MATRIX				
	BMP	Inspection/Maintenance Activities	Minimum Frequency	Responsible Party
BIOTREATMENT BMPs				
BIO-1	Bioretention with Underdrains	Inspections should occur semi-annually or after major storm events to check for the following and remove accordingly: standing water, sediment, and trash & debris. Inspections should also look for potential clogging and clean planters or, if necessary, replace the entire filter bed. Inspect for weeds, and prune and/or replace plants in accordance with routine landscape maintenance activities. Replace mulch and prune shrubs as necessary.	2x per year and after large storm events	Owner
BIO-7	Proprietary Biotreatment	Maintenance activities should include clearing of the accumulation of sediment and debris. Additional media/filter replacement determined by manufacturer maintenance procedures.	4x per year and after large storm events	Owner
NON-STRUCTURAL SOURCE CONTROL BMPs				
N2	Activity Restrictions	The Owner will prescribe activity restrictions to protect surface water quality, through lease terms or other equally effective measure, for the property. Restrictions include, but are not limited to, prohibiting vehicle maintenance or vehicle washing.	Ongoing	Owner

BMP INSPECTION & MAINTENANCE RESPONSIBILITY MATRIX				
	BMP	Inspection/Maintenance Activities	Minimum Frequency	Responsible Party
N3	Common Area Landscape Management	Maintenance shall be consistent with City requirements. Fertilizer and/or pesticide usage shall be consistent with County Management Guidelines for Use of Fertilizers (OC DAMP Section 5.5). Maintenance includes mowing, weeding, and debris removal on a weekly basis. Trimming, replanting, and replacement of mulch shall be performed on an as-needed basis to prevent exposure of erodible surfaces. Trimmings, clippings, and other landscape wastes shall be properly disposed of in accordance with local regulations. Materials temporarily stockpiled during maintenance activities shall be placed away from water courses and storm drains inlets.	Monthly	Owner
N4	BMP Maintenance	Maintenance of structural BMPs implemented at the project site shall be performed at the frequency prescribed in this WQMP. Records of inspections and BMP maintenance shall be kept by the Owner and shall be available for review upon request.	Ongoing	Owner

BMP INSPECTION & MAINTENANCE RESPONSIBILITY MATRIX				
	BMP	Inspection/Maintenance Activities	Minimum Frequency	Responsible Party
N5	Title 22 CCR Compliance (How development will comply)	The Owner will ensure compliance with Title 22 CCR Compliance by ensuring that all trash, litter and other potentially toxic substances are disposed of in an appropriate manner. In addition, the owner/operator shall ensure that no hazardous material escapes the site untreated, thereby potentially contaminating the ground water.	Ongoing	Owner
N6	Local Industrial Permit Compliance	Not Applicable		
N7	Spill Contingency Plan	The Owner of the fuel dispensing site shall prepare a "Spill Contingency Plan (Business Emergency/ Contingency Plan Guidelines and Forms) in accordance with Section 6.95 of the California Health and Safety Code. Spills will be immediately cleaned up according to the Spill Contingency Plan.	Ongoing	Owner

BMP INSPECTION & MAINTENANCE RESPONSIBILITY MATRIX				
	BMP	Inspection/Maintenance Activities	Minimum Frequency	Responsible Party
N9	Hazardous Materials Disclosure Compliance	The Owner is responsible for making appropriate disclosures of the onsite storage of hazardous materials in accordance with County and/or City Ordinances. This BMP applies to any area where hazardous materials are being used, stored, or handled onsite. As a condition of approval (Resolution 3922 items 12.17 and 12.18) the developer was required to submit to the Fire Chief a "Hazardous Materials Disclosure Chemical Inventory and Business Emergency Plan." The Owner and any future operators' will ensure that this list is amended when any changes occur to reflect the current hazardous materials used, stored or handled onsite prior to commencement of gas station operations. The Hazardous Materials Disclosure Chemical Inventory and Business Emergency Plan shall be kept in the manager's office at all times.	Ongoing	Owner
N10	Uniform Fire Code Implementation	The Owner will comply with all applicable requirement of Article 80 of the Uniform Fire Code including obtaining the necessary hazardous material storage permits from the Orange County Fire Authority, request the necessary inspections, maintenance and warning signage per Section 8001.9 prohibiting smoking where applicable.	Ongoing	Owner

BMP INSPECTION & MAINTENANCE RESPONSIBILITY MATRIX				
	BMP	Inspection/Maintenance Activities	Minimum Frequency	Responsible Party
N11	Common Area Litter Control	Litter patrol, violations investigations, reporting and other litter control activities shall be performed on a weekly basis and in conjunction with routine maintenance activities.	Weekly	Owner
N12	Employee Training	The Owner shall educate all new employees/ managers on storm water pollution prevention, particularly good housekeeping practices, prior to the start of the rainy season (October 1). Refresher courses shall be conducted on an as needed basis. Materials that may be utilized on BMP maintenance are included in Appendix D.	Annually	Owner
N14	Common Area Catch Basin Inspection	Remove trash and debris from catch basins and grates. Check for damage, clogging, and standing water. Repair or mitigate clogging/standing water, as needed.	2x per year and after large storm event	Owner
N15	Street Sweeping Private Streets and Parking Lots	On-site parking lots, drive aisles, and the parking structure basement level will be swept on a monthly basis, at minimum.	Monthly	Owner
STRUCTURAL SOURCE CONTROL BMPs				
S1 SD-13	Provide storm drain system stenciling and signage	On-site storm drain stencils shall be inspected for legibility, at minimum, once prior to the storm season, no later than October 1st each year. Those determined to be illegible will be re-stenciled as soon as possible.	Annually	Owner

BMP INSPECTION & MAINTENANCE RESPONSIBILITY MATRIX				
	BMP	Inspection/Maintenance Activities	Minimum Frequency	Responsible Party
S3 SD-32	Design and construct trash and waste storage areas to reduce pollution introduction	Trash receptacles will be monitored and emptied by management of the Bowery. Trash will be taken from the interior trash rooms to the exterior trash storage areas at the time trash collection is set to occur. The four trash storage areas will drain into a water quality inlet to prevent discharge of spilled contaminants, consistent with local design standards.	Ongoing	Owner
S4 SD-12	Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control	In conjunction with routine maintenance, verify that landscape design continues to function properly by adjusting systems to eliminate overspray to hardscape areas and to verify that irrigation timing and cycle lengths are adjusted in accordance to water demands, given the time of year, weather, and day or nighttime temperatures. System testing shall occur twice per year. Water from testing/flushing shall be collected and properly disposed to the sewer system and shall not discharge to the storm drain system.	2x per year	Owner

BMP INSPECTION & MAINTENANCE RESPONSIBILITY MATRIX				
	BMP	Inspection/Maintenance Activities	Minimum Frequency	Responsible Party
S5	Protect slopes and channels and provide energy dissipation	Check slopes, channels, riprap and other conveyance or energy dissipation areas for signs of erosion or scour. Replace material, repair channels, replant vegetation, and/or redesign, as needed for signs of erosion/scour.	Four times per year during the wet season (preferably after rain events), and once during the dry season (ideally in September).	Owner

Any waste generated from maintenance activities will be disposed of properly. Wash water and other waste from maintenance activities is not to be discharged or disposed of into the storm drain system. Clippings from landscape maintenance (i.e. prunings) will be collected and disposed of properly off-site, and will not be washed into the streets, local area drains/conveyances, or catch basin inlets.

SECTION VI SITE PLAN AND DRAINAGE PLAN

The exhibits provided in this section are to illustrate the post construction BMPs prescribed within this WQMP. Drainage flow information of the proposed project, such as general surface flow lines, concrete or other surface drainage conveyances, and storm drain facilities are also depicted. All structural source control and treatment control BMPs are shown as well.

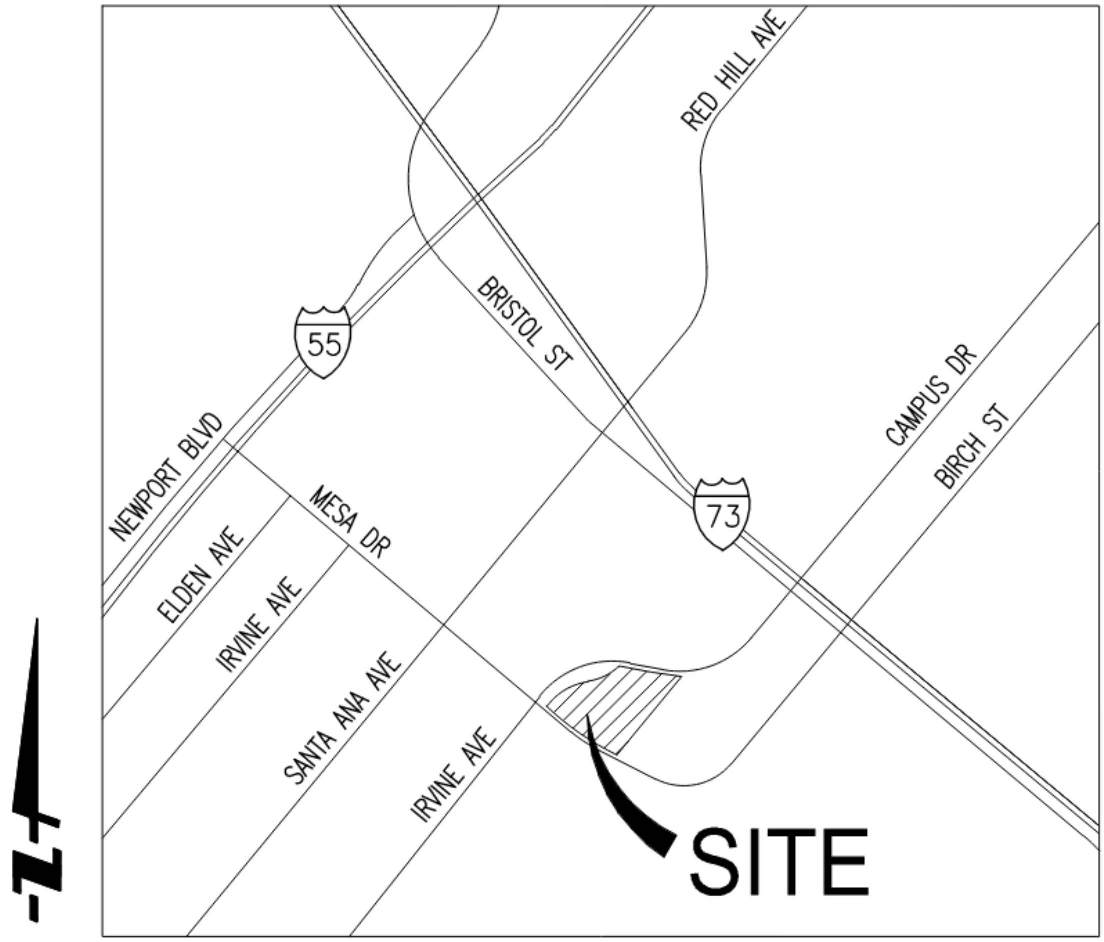
EXHIBITS

- Vicinity Map
- WQMP Exhibit

BMP DETAILS & FACT SHEETS

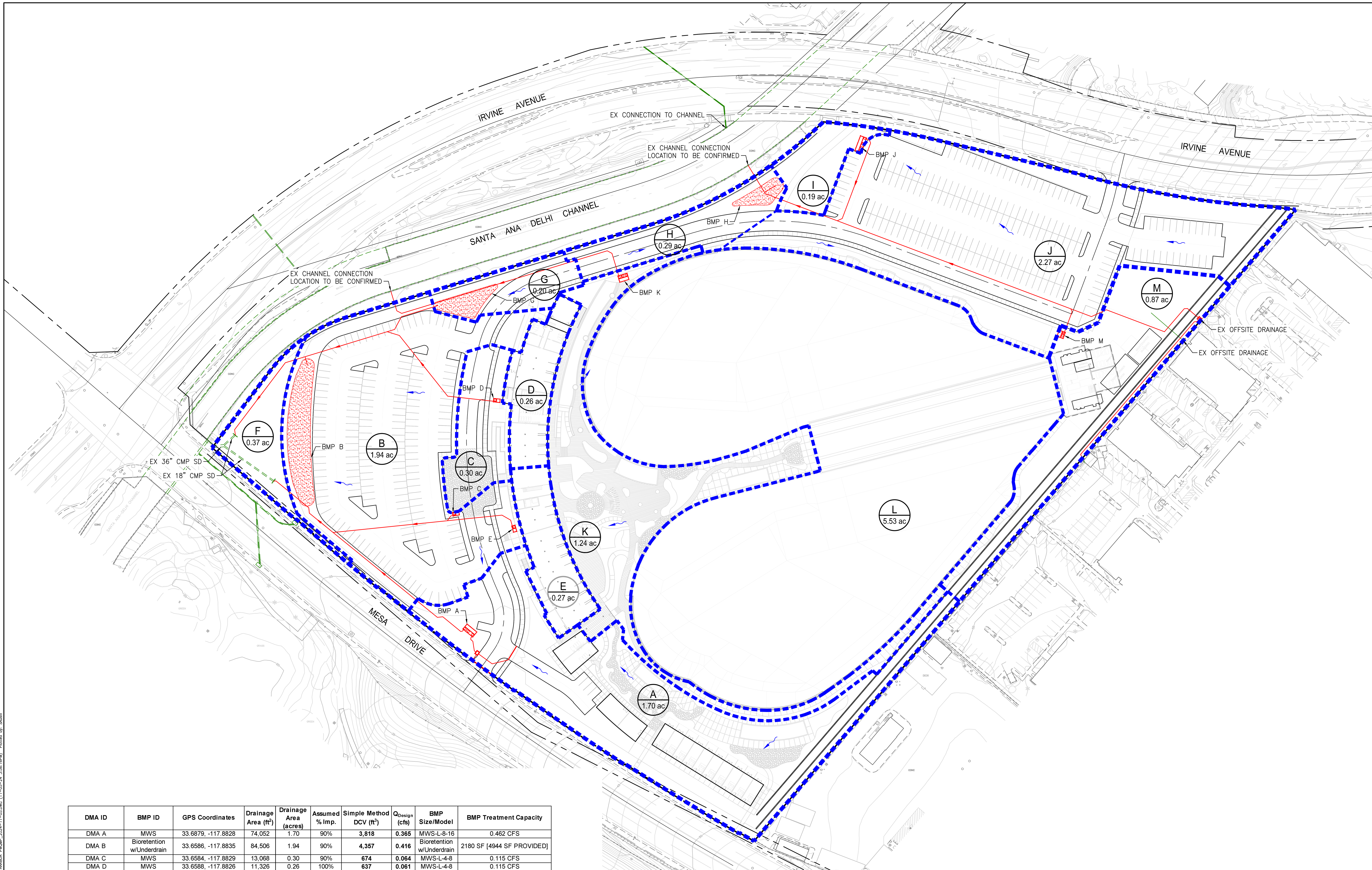
- BIO-1 Bioretention with Underdrains BMP Factsheet
- BIO-7 Proprietary Biotreatment BMP Factsheet
- Modular Wetland System (MWS) Standard Detail, MWS-L-4-8
- Modular Wetland System (MWS) Standard Detail, MWS-L-8-8
- Modular Wetland System (MWS) Standard Detail, MWS-L-8-12
- Modular Wetland System (MWS) Standard Detail, MWS-L-8-16
- Modular Wetland System (MWS) Standard Detail, MWS-L-8-20
- Bioretention with Underdrain Detail

VICINITY MAP



VICINITY MAP

NOT TO SCALE



LEGEND

- PROPERTY LINE / RIGHT OF WAY
- EXISTING STORM DRAIN
- PROPOSED STORM DRAIN
- BMP DRAINAGE AREA BOUNDARY
- PROPOSED CATCH BASIN WITH INSERTS & STENCILING – COMMON AREA CATCH BASIN INSPECTION (N14) & DRAINAGE FACILITY OPERATION & MAINTENANCE (S20)
- X / XX ac — DRAINAGE MANAGEMENT AREA (DMA)
- DIRECTION OF PIPED FLOW
- DIRECTION OF SURFACE FLOW
- MODULAR WETLAND SYSTEM
- BIORETENTION WITH UNDERDRAIN

DMA ID	BMP ID	GPS Coordinates	Drainage Area (ft^2)	Drainage Area (acres)	Assumed % Imp.	Simple Method DCV (ft^3)	Q_{Design} (cfs)	BMP Size/Model	BMP Treatment Capacity
DMA A	MWS	33.6879, -117.8828	74,052	1.70	90%	**3,818**	**0.365**	MWS-L-8-16	0.462 CFS
DMA B	Bioretention w/Underdrain	33.6586, -117.8835	84,506	1.94	90%	**4,357**	**0.416**	Bioretention w/Underdrain	2180 SF [4944 SF PROVIDED]
DMA C	MWS	33.6584, -117.8829	13,068	0.30	90%	**674**	**0.064**	MWS-L-4-8	0.115 CFS
DMA D	MWS	33.6588, -117.8826	11,326	0.26	100%	**637**	**0.061**	MWS-L-4-8	0.115 CFS
DMA E	MWS	33.6583, -117.8826	11,761	0.27	100%	**662**	**0.063**	MWS-L-4-8	0.115 CFS
DMA F	-		16,117	0.37	0%	**151**	**0.014**	-	-
DMA G	Bioretention w/Underdrain	33.6591, -117.8828	8,712	0.20	100%	**490**	**0.047**	Bioretention w/Underdrain	393 SF [1743 PROVIDED]
DMA H	Bioretention w/Underdrain	33.6595, -117.8816	12,632	0.29	100%	**711**	**0.068**	Bioretention w/Underdrain	570 SF [1238 SF PROVIDED]
DMA I	-		8,276	0.19	30%	**194**	**0.019**	-	-
DMA J	MWS	33.6597, -117.8811	98,881	2.27	100%	**5,562**	**0.531**	MWS-L-8-20	0.577 CFS
DMA K	MWS	33.6592, -117.8822	54,014	1.24	100%	**3,038**	**0.290**	MWS-L-8-12	0.346 CFS
DMA L	-		240,887	5.53	100%	**13,550**	**1.294**	-	-
DMA M	MWS	33.6590, -117.8803	37,897	0.87	90%	**1,954**	**0.187**	MWS-L-8-8	0.231 CFS

NON-STRUCTURAL SOURCE CONTROL BMPs

N2	ACTIVITY RESTRICTIONS
N3	COMMON AREA LANDSCAPE MANAGEMENT
N4	BMP MAINTENANCE
N5	TITLE 22 CCR COMPLIANCE
N7	SPILL CONTINGENCY PLAN
N10	UNIFORM FIRE CODE IMPLEMENTATION
N11	COMMON AREA LITTER CONTROL
N12	EMPLOYEE TRAINING
N14	COMMON AREA CATCH BASIN INSPECTION
N15	STREET SWEEPING PRIVATE STREETS AND PARKING LOTS

STRUCTURAL SOURCE CONTROL BMPs

S1	PROVIDE STORM DRAIN SYSTEM STENCILING AND SIGNAGE
S3	DESIGN AND CONSTRUCT TRASH AND WASTE STORAGE AREAS TO REDUCE POLLUTION INTRODUCTION
S4	USE EFFICIENT IRRIGATION SYSTEMS & LANDSCAPE DESIGN, WATER CONSERVATION, SMART CONTROLLERS, AND SOURCE CONTROL
S5	PROTECT SLOPES AND CHANNELS AND PROVIDE ENERGY DISSIPATION

N

60' 0' 30' 60'

SCALE: 1" = 60'

PREPARED FOR:

BACK BAY BARRELS, LLC
3857BIRCH STREET, SUITE 521
NEWPORT BEACH, CA 92660

PREPARED BY:

FUSCOE ENGINEERING
15535 Sand Canyon Ave, Suite 100
Irvine, California 92618
949.474.1960
fuscoe.com

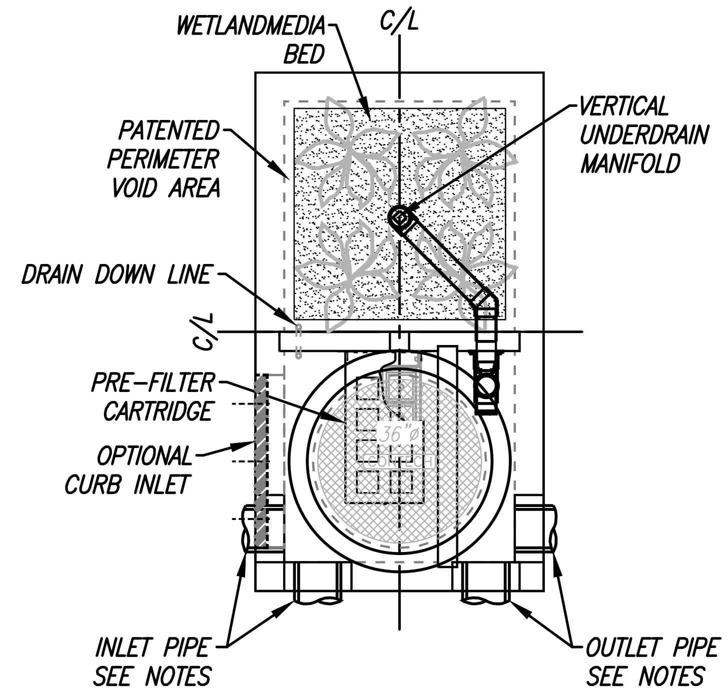
CITY OF NEWPORT BEACH

WQMP EXHIBIT

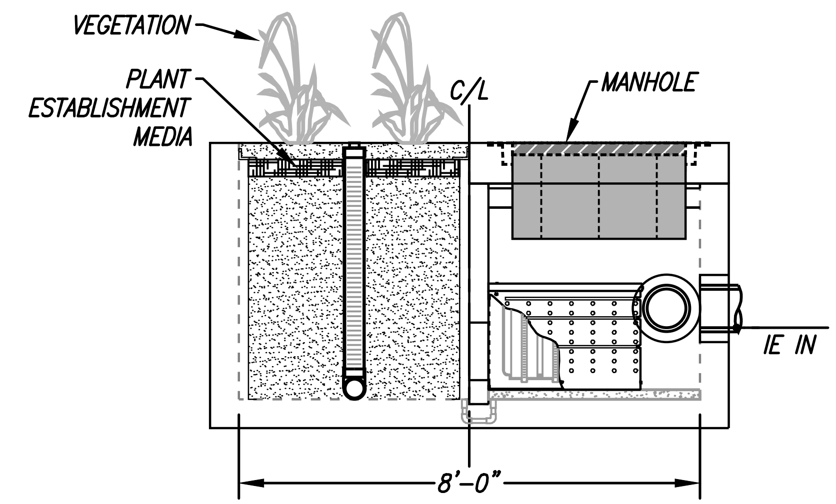
SNUG HARBOR

SITE SPECIFIC DATA			
PROJECT NUMBER			
PROJECT NAME			
PROJECT LOCATION			
STRUCTURE ID			
TREATMENT REQUIRED			
TREATMENT FLOW (CFS)			
PRETREATMENT LOADING RATE (GPM/SF)			2.1 GPM/SF
WETLAND MEDIA LOADING RATE (GPM/SF)			1.0
PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE			____ (CFS)
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE 1			
INLET PIPE 2			
OUTLET PIPE			
	PRETREATMENT	BIOFILTRATION	DISCHARGE
RIM ELEVATION			
SURFACE LOAD	PEDESTRIAN		
NOTES:			

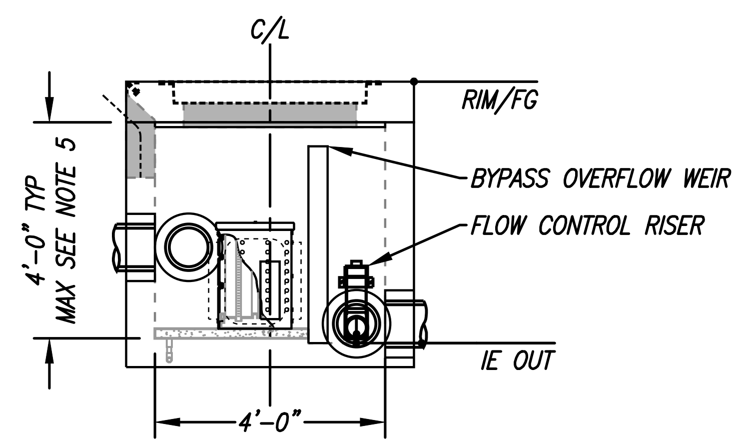
* PRELIMINARY ONLY - NOT FOR CONSTRUCTION



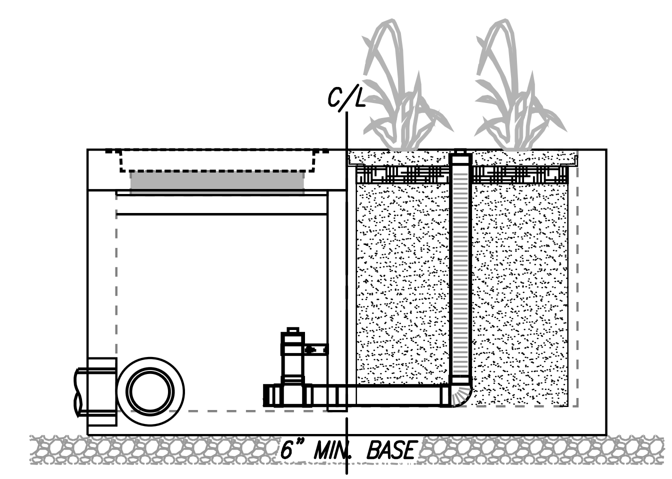
PLAN VIEW



LEFT END VIEW



ELEVATION VIEW



RIGHT END VIEW

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MWS-L-4-8-V
STORMWATER BIOFILTRATION SYSTEM
STANDARD DETAIL

SITE SPECIFIC DATA			
PROJECT NUMBER			
PROJECT NAME			
PROJECT LOCATION			
STRUCTURE ID			
TREATMENT REQUIRED			
TREATMENT FLOW (CFS)			
PRETREATMENT LOADING RATE (GPM/SF)			2.1 GPM/SF
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PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE 1			
INLET PIPE 2			
OUTLET PIPE			
	PRETREATMENT	BIOFILTRATION	DISCHARGE
RIM ELEVATION			
SURFACE LOAD	PEDESTRIAN		
NOTES:			

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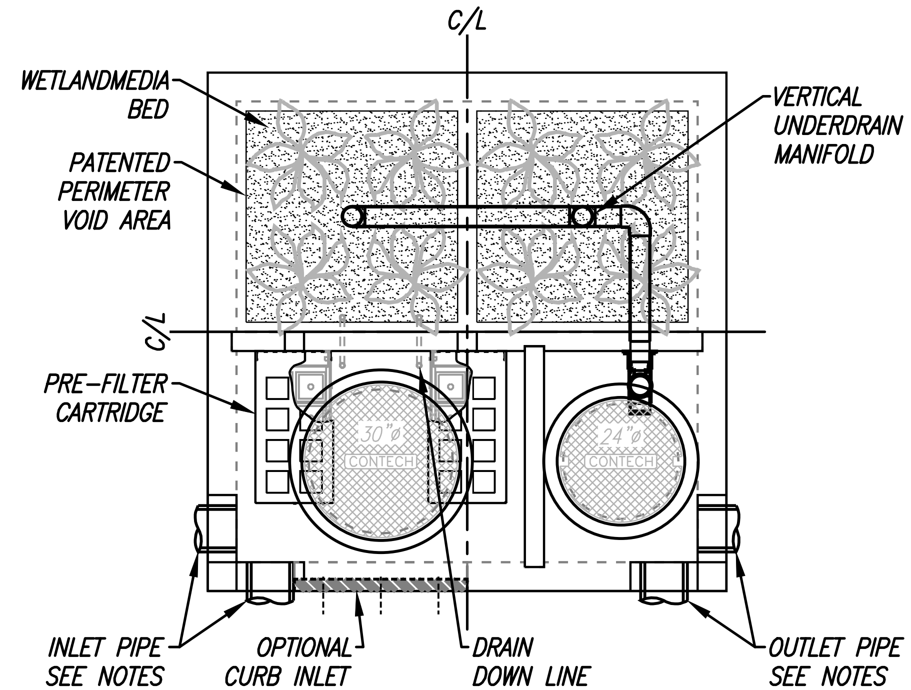
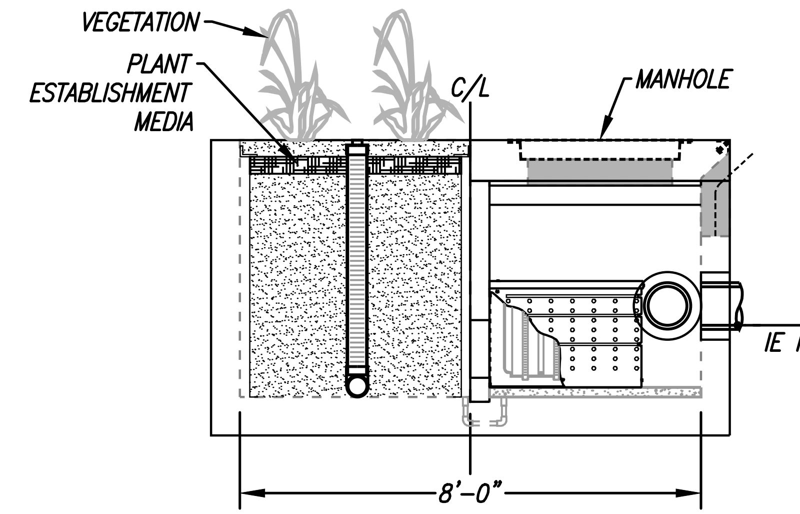
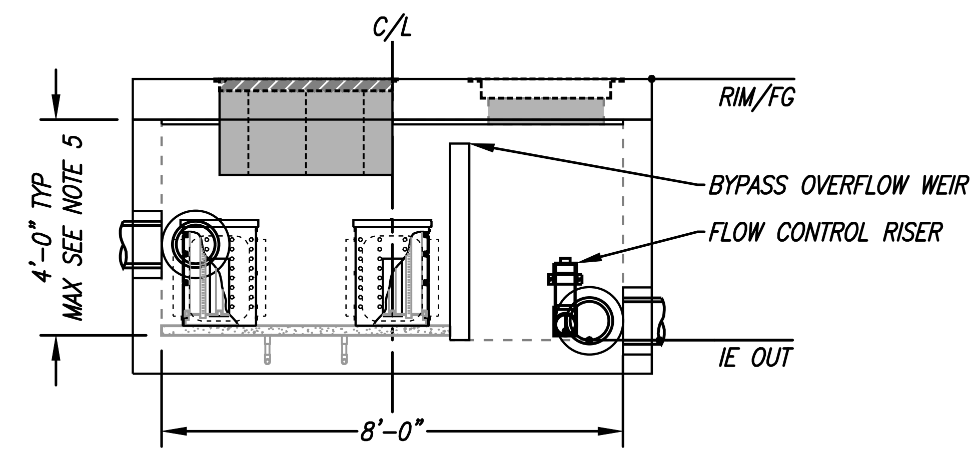


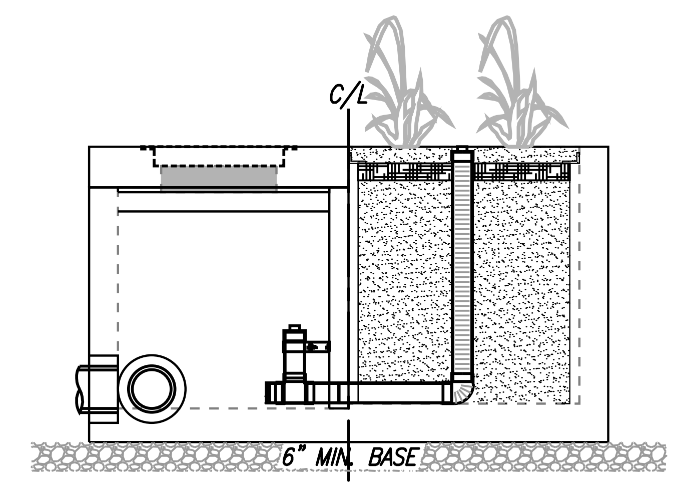
PLAN VIEW



LEFT END VIEW



ELEVATION VIEW



RIGHT END VIEW

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

SITE SPECIFIC DATA

PROJECT NUMBER			
PROJECT NAME			
PROJECT LOCATION			
STRUCTURE ID			
TREATMENT REQUIRED			
TREATMENT FLOW (CFS)			
PRETREATMENT LOADING RATE (GPM/SF)			2.1 GPM/SF
WETLAND MEDIA LOADING RATE (GPM/SF)			1.0
PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE			_____ (CFS)
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE 1			
INLET PIPE 2			
OUTLET PIPE			
	PRETREATMENT	BIOFILTRATION	DISCHARGE
RIM ELEVATION			
SURFACE LOAD	PEDESTRIAN		
NOTES:			

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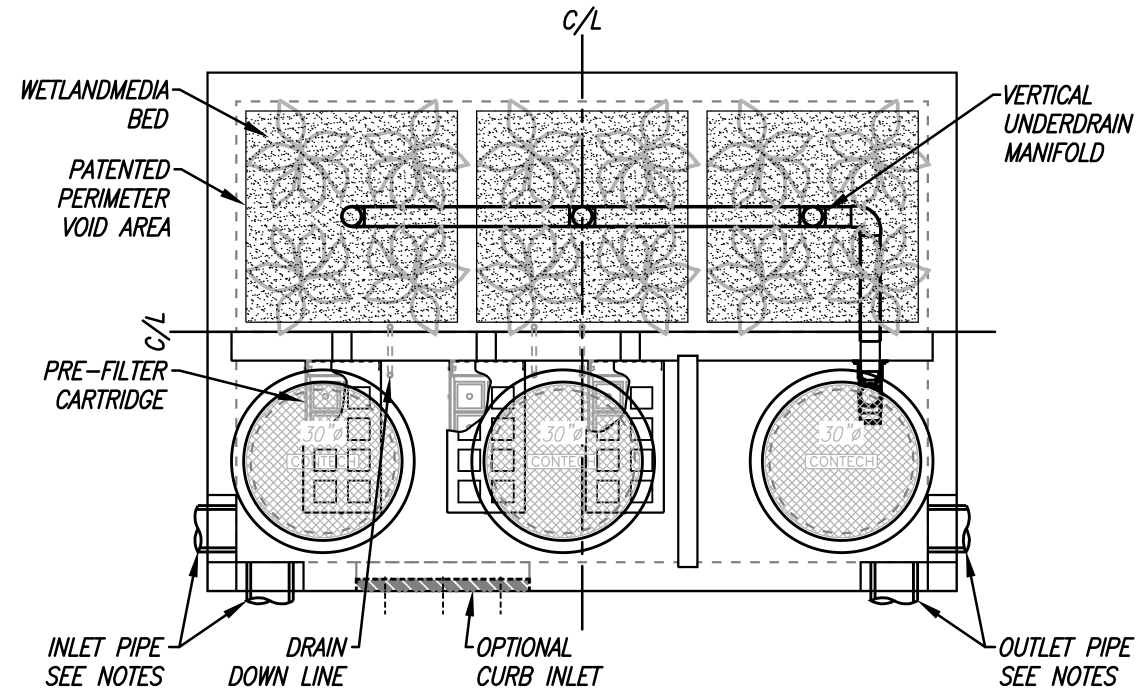
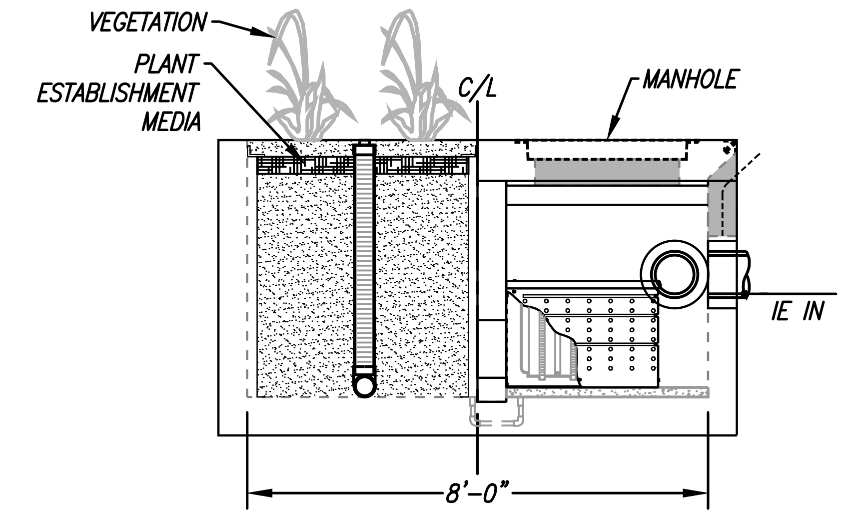
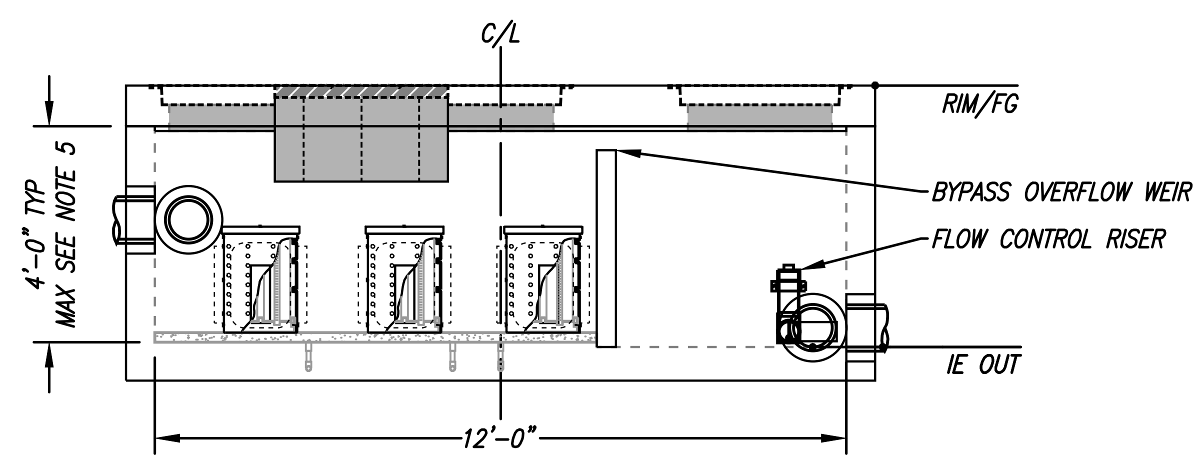


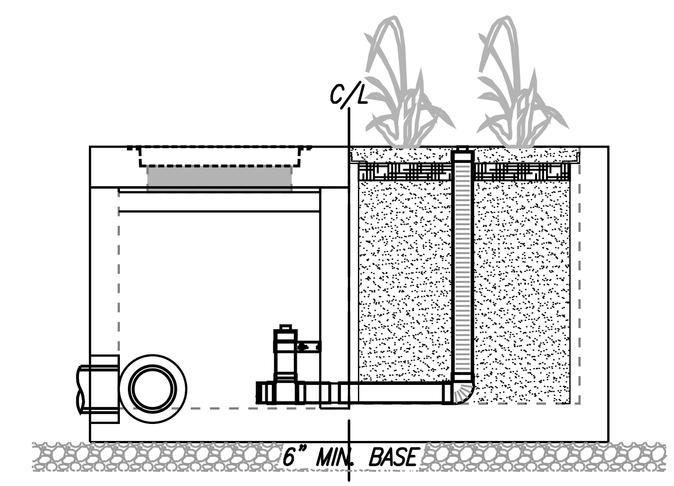
PLAN VIEW



LEFT END VIEW



ELEVATION VIEW



RIGHT END VIEW

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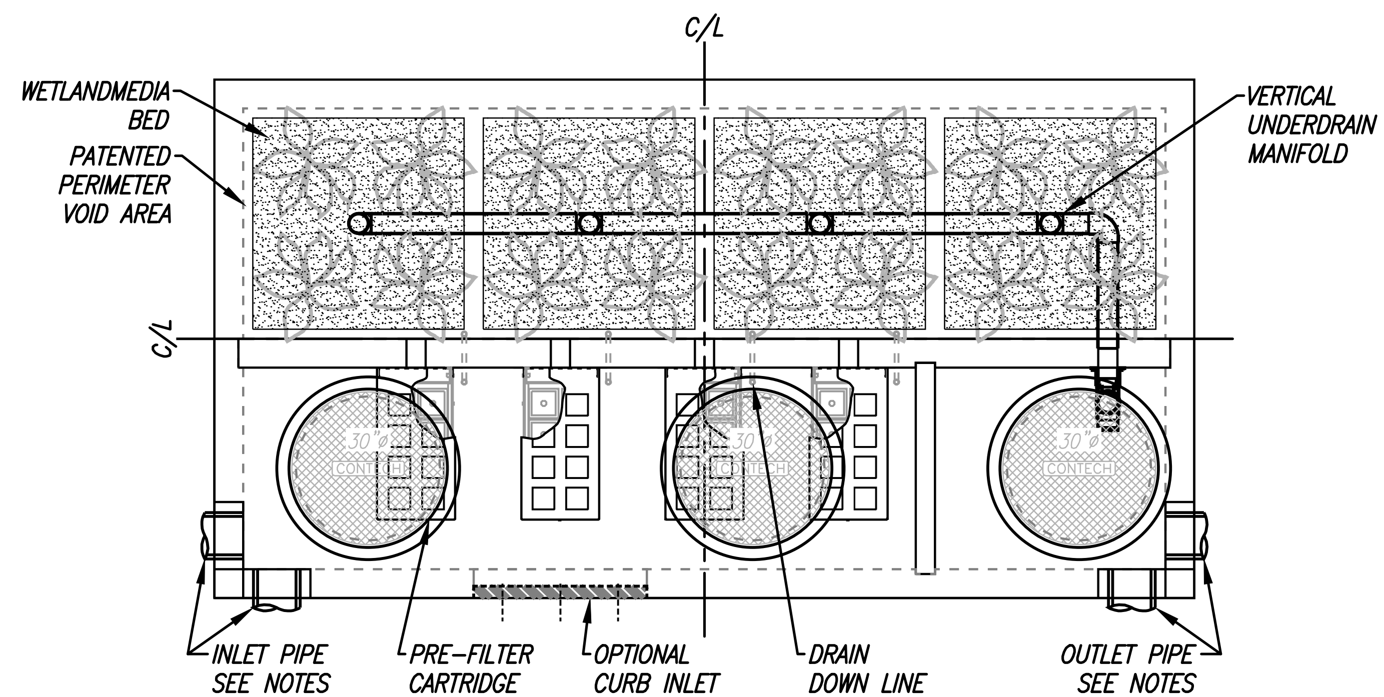
MWS-L-8-12-V
STORMWATER BIOFILTRATION SYSTEM STANDARD DETAIL

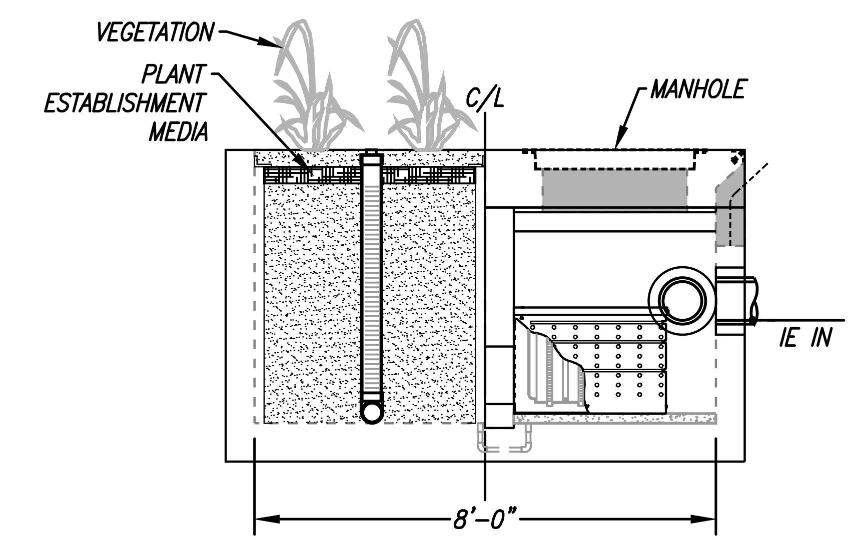
SITE SPECIFIC DATA

PROJECT NUMBER			
PROJECT NAME			
PROJECT LOCATION			
STRUCTURE ID			
TREATMENT REQUIRED			
TREATMENT FLOW (CFS)			
PRETREATMENT LOADING RATE (GPM/SF)			2.1 GPM/SF
WETLAND MEDIA LOADING RATE (GPM/SF)			1.0
PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE			____ (CFS)
PIPE DATA	*I.E.*	*MATERIAL*	*DIAMETER*
INLET PIPE 1			
INLET PIPE 2			
OUTLET PIPE			
	PRETREATMENT	*BIOFILTRATION*	*DISCHARGE*
RIM ELEVATION			
SURFACE LOAD	PEDESTRIAN		
NOTES:			

* PRELIMINARY ONLY - NOT FOR CONSTRUCTION



PLAN VIEW



LEFT END VIEW

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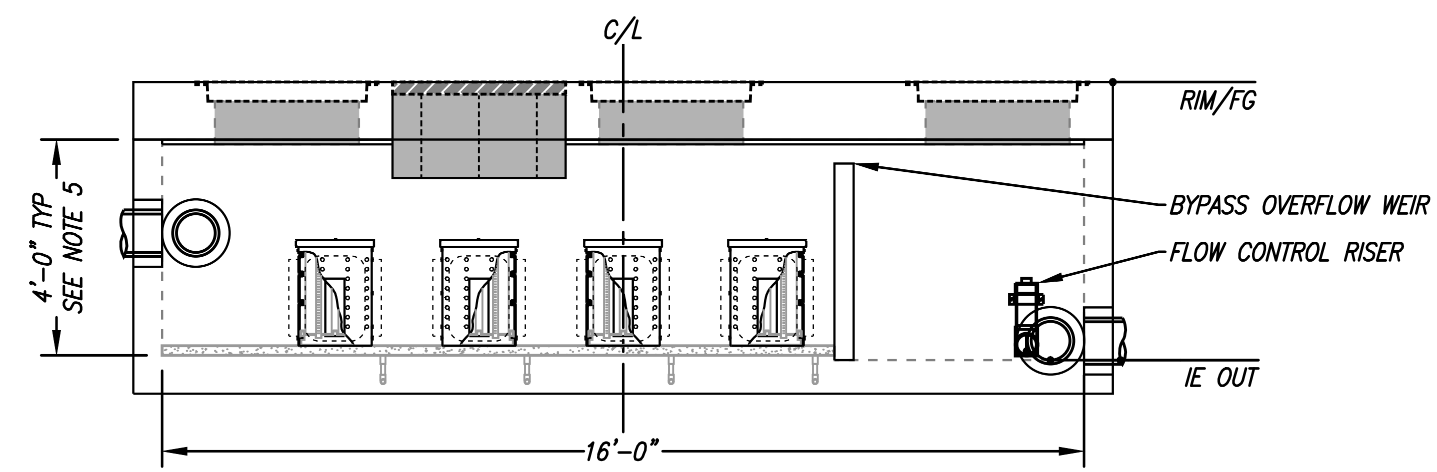
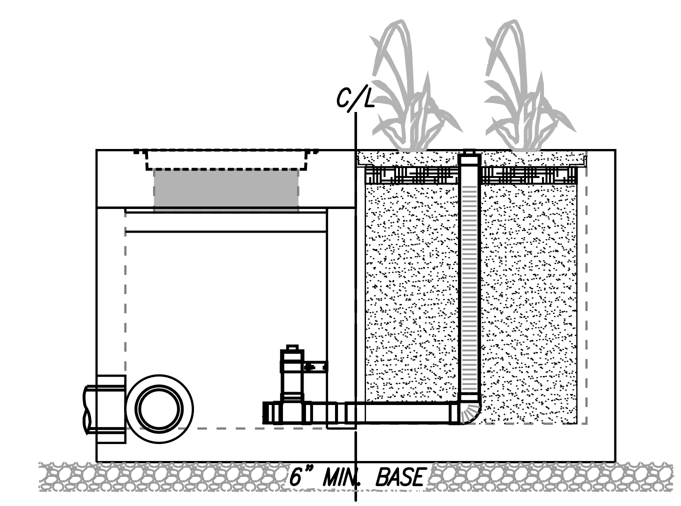


ELEVATION VIEW



RIGHT END VIEW

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SITE SPECIFIC DATA

PROJECT NUMBER			
PROJECT NAME			
PROJECT LOCATION			
STRUCTURE ID			
TREATMENT REQUIRED			
TREATMENT FLOW (CFS)			
PRETREATMENT LOADING RATE (GPM/SF)			2.1 GPM/SF
WETLAND MEDIA LOADING RATE (GPM/SF)			1.0
PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE			_____ (CFS)
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE 1			
INLET PIPE 2			
OUTLET PIPE			
	PRETREATMENT	BIOFILTRATION	DISCHARGE
RIM ELEVATION			
SURFACE LOAD	PEDESTRIAN		
NOTES:			

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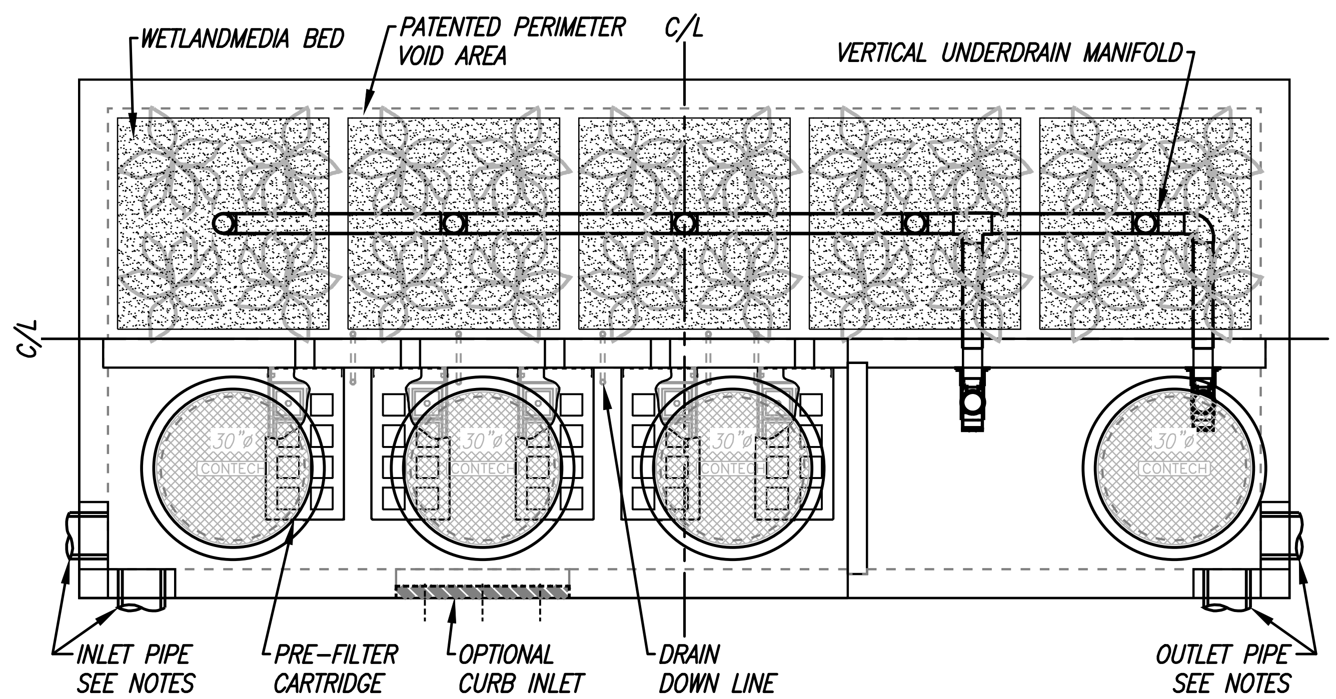
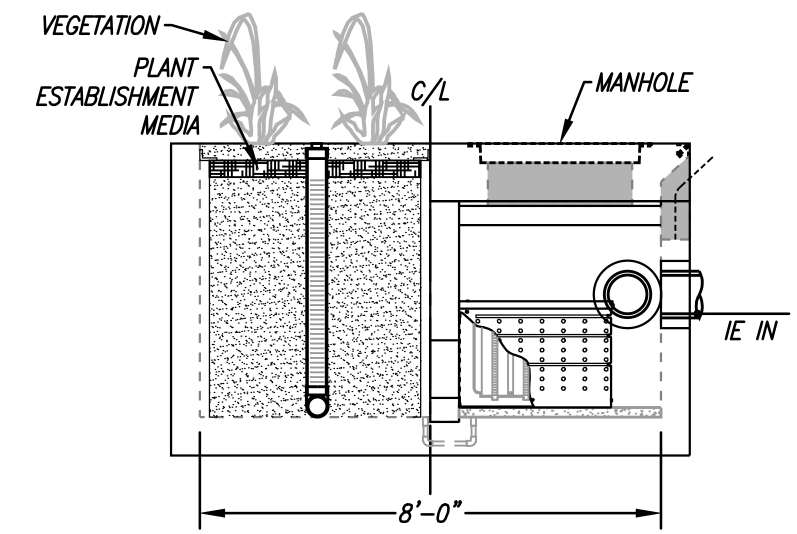
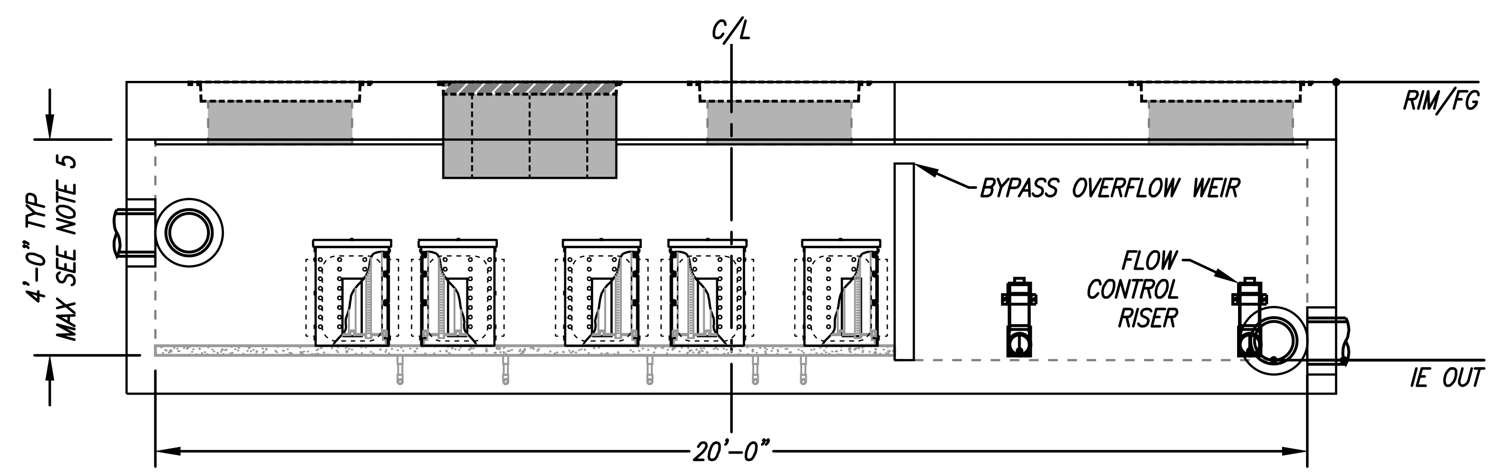


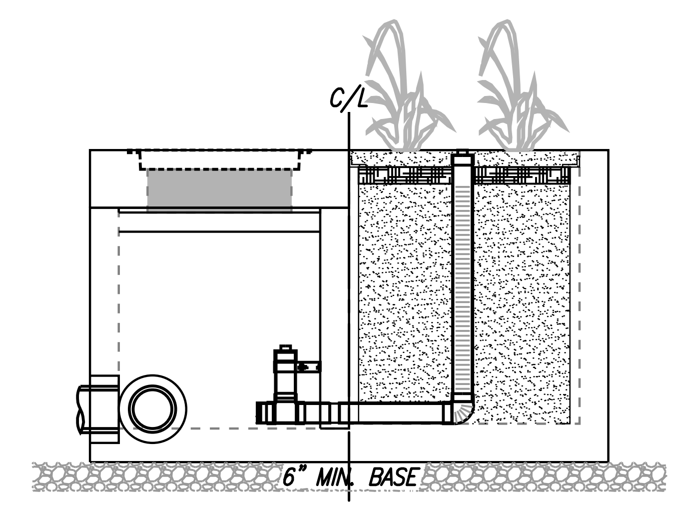
PLAN VIEW



LEFT END VIEW



ELEVATION VIEW



RIGHT END VIEW

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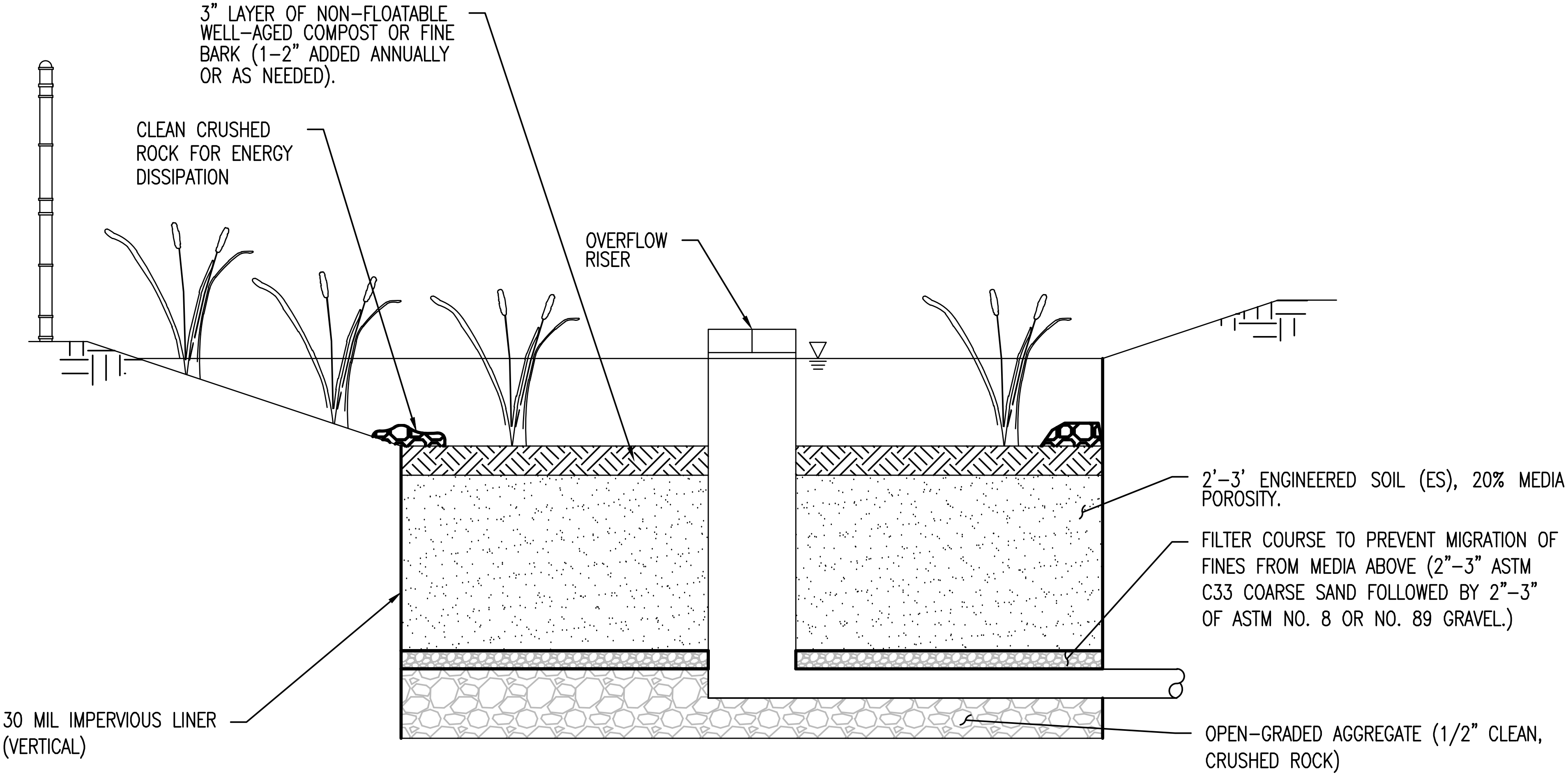
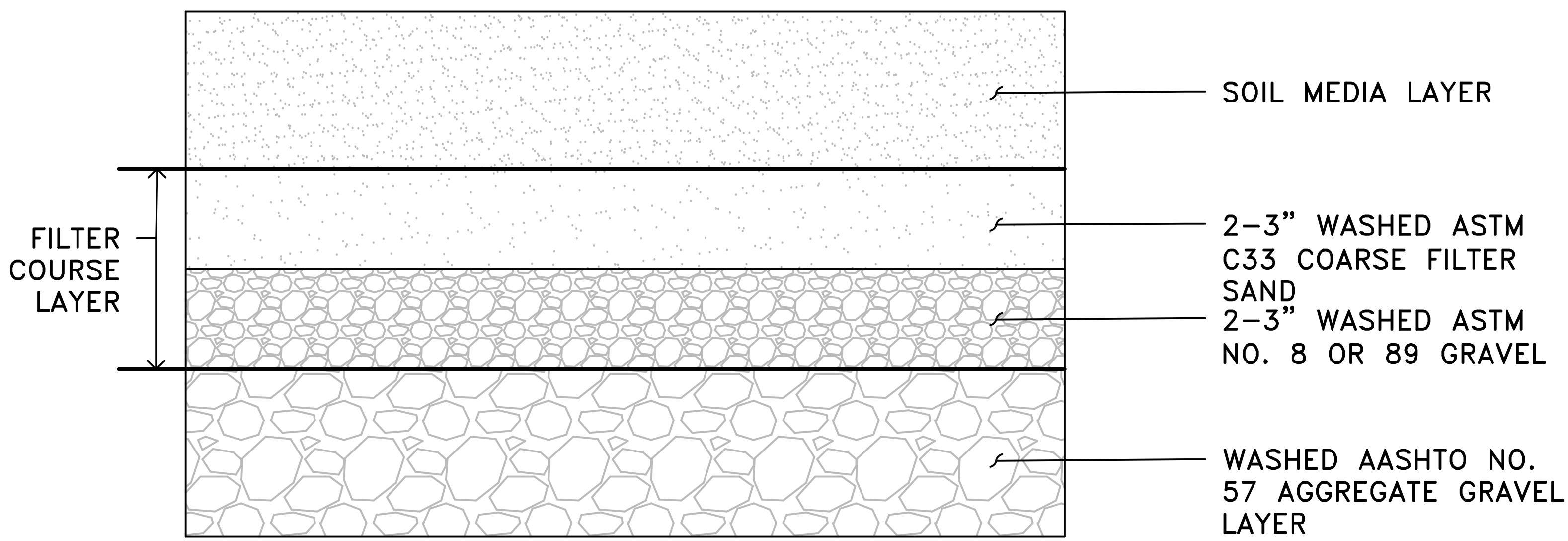
STANDARD DETAIL



2 BMP LOCATED IN VEHICLE NON-ACCESSIBLE AREAS

N.T.S.



3 FILTER COURSE

N.T.S.

XIV.5. Biotreatment BMP Fact Sheets (BIO)

Conceptual criteria for biotreatment BMP selection, design, and maintenance are contained in **Appendix XII**. These criteria are generally applicable to the design of biotreatment BMPs in Orange County and BMP-specific guidance is provided in the following fact sheets.

*Note: Biotreatment BMPs shall be designed to provide the maximum feasible infiltration and ET based on criteria contained in **Appendix** XI.2.*

BIO-1: Bioretention with Underdrains

Also known as:

- *Rain gardens with underdrains*
- *Vegetated media filter*
- *Downspout planter boxes*

Bioretention
Source: Geosyntec Consultants

Bioretention stormwater treatment facilities are landscaped shallow depressions that capture and filter stormwater runoff. These facilities function as a soil and plant-based filtration device that removes pollutants through a variety of physical, biological, and chemical treatment processes. The facilities normally consist of a ponding area, mulch layer, planting soils, and plants. As stormwater passes down through the planting soil, pollutants are filtered, adsorbed, biodegraded, and sequestered by the soil and plants. Bioretention with an underdrain are utilized for areas with low permeability native soils or steep slopes where the underdrain system that routes the treated runoff to the storm drain system rather than depending entirely on infiltration. **Bioretention must be designed without an underdrain** in areas of high soil permeability.

Feasibility Screening Considerations

- If there are no hazards associated with infiltration (such as groundwater concerns, contaminant plumes or geotechnical concerns), **bioinfiltration facilities**, which achieve partial infiltration, should be used to maximize infiltration.
- Bioretention with underdrain facilities should be lined if contaminant plumes or geotechnical concerns exist. If high groundwater is the reason for infiltration infeasibility, bioretention facilities with underdrains do not need to be lined.

Opportunity Criteria

- Land use may include commercial, residential, mixed use, institutional, and subdivisions. Bioretention may also be applied in parking lot islands, cul-de-sacs, traffic circles, road shoulders, road medians, and next to buildings in planter boxes.
- Drainage area is ≤ 5 acres.
- Area is available for infiltration.

- Site must have adequate relief between land surface and the stormwater conveyance system to permit vertical percolation through the soil media and collection and conveyance in underdrain to stormwater conveyance system.

OC-Specific Design Criteria and Considerations

- ☐ Ponding depth should not exceed 18 inches; fencing may be required if ponding depth is greater than 6 inches to mitigate drowning.
- ☐ The minimum soil depth is 2 feet (3 feet is preferred).
- ☐ The maximum drawdown time of the bioretention ponding area is 48 hours. The maximum drawdown time of the planting media and gravel drainage layer is 96 hours, if applicable.
- ☐ Infiltration pathways may need to be restricted due to the close proximity of roads, foundations, or other infrastructure. A geomembrane liner, or other equivalent water proofing, may be placed along the vertical walls to reduce lateral flows. This liner should have a minimum thickness of 30 mils.
- ☐ If infiltration in bioretention location is hazardous due to groundwater or geotechnical concerns, a geomembrane liner must be installed at the base of the bioretention facility. This liner should have a minimum thickness of 30 mils.
- ☐ The planting media placed in the cell shall be designed per the recommendations contained in MISC-1: Planting/Storage Media
- ☐ Plant materials should be tolerant of summer drought, ponding fluctuations, and saturated soil conditions for 48 hours; native place species and/or hardy cultivars that are not invasive and do not require chemical inputs should be used to the maximum extent feasible
- ☐ The bioretention area should be covered with 2-4 inches (average 3 inches) or mulch at the start and an additional placement of 1-2 inches of mulch should be added annually.
- ☐ Underdrain should be sized with a 6 inch minimum diameter and have a 0.5% minimum slope. Underdrain should be slotted polyvinyl chloride (PVC) pipe; underdrain pipe should be more than 5 feet from tree locations (if space allows).
- ☐ A gravel blanket or bedding is required for the underdrain pipe(s). At least 0.5 feet of washed aggregate must be placed below, to the top, and to the sides of the underdrain pipe(s).
- ☐ An overflow device is required at the top of the bioretention area ponding depth.
- ☐ Dispersed flow or energy dissipation (i.e. splash rocks) for piped inlets should be provided at basin inlet to prevent erosion.
- ☐ Ponding area side slopes shall be no steeper than 3:1 (H:V) unless designed as a planter box BMP with appropriate consideration for trip and fall hazards.

Simple Sizing Method for Bioretention with Underdrain

If the Simple Design Capture Volume Sizing Method described in **Appendix** III.3.1 is used to size a bioretention with underdrain facility, the user selects the basin depth and then determines the appropriate surface area to capture the DCV. The sizing steps are as follows:

Step 1: Determine DCV

Calculate the DCV using the Simple Design Capture Volume Sizing Method described in **Appendix** III.3.1.

Step 2: Verify that the Ponding Depth will Draw Down within 48 Hours

The ponding area drawdown time can be calculated using the following equation:

$DD_P = (d_P / K_{MEDIA}) \times 12$ in/ft

Where:

DD_P = time to drain ponded water, hours

d_P = depth of ponding above bioretention area, ft (not to exceed 1.5 ft)

K_{MEDIA} = media design infiltration rate, in/hr (equivalent to the media hydraulic conductivity with a factor of safety of 2; K_{MEDIA} of 2.5 in/hr should be used unless other information is available)

If the drawdown time exceeds 48 hours, adjust ponding depth and/or media infiltration rate until 48 hour drawdown time is achieved.

Step 3: Determine the Depth of Water Filtered During Design Capture Storm

The depth of water filtered during the design capture storm can be estimated as the amount routed through the media during the storm, or the ponding depth, whichever is smaller.

$d_{FILTERED}$ = Minimum [(($K_{MEDIA} \times T_{ROUTING}$)/12), d_P]

Where:

$d_{FILTERED}$ = depth of water that may be considered to be filtered during the design storm event, ft

K_{MEDIA} = media design infiltration rate, in/hr (equivalent to the media hydraulic conductivity with a factor of safety of 2; K_{MEDIA} of 2.5 in/hr should be used unless other information is available)

$T_{ROUTING}$ = storm duration that may be assumed for routing calculations; this should be assumed to be no greater than 3 hours. If the designer desires to account for further routing effects, the Capture Efficiency Method for Volume-Based, Constant Drawdown BMPs (See **Appendix** III.3.2) should be used.

d_P = depth of ponding above bioretention area, ft (not to exceed 1.5 ft)

Step 4: Determine the Facility Surface Area

$A = DCV/ (d_P + d_{FILTERED})$

Where:

A = required area of bioretention facility, sq-ft

DCV = design capture volume, cu-ft

$d_{FILTERED}$ = depth of water that may be considered to be filtered during the design storm event, ft

d_P = depth of ponding above bioretention area, ft (not to exceed 1.5 ft)

Capture Efficiency Method for Bioretention with Underdrains

If the bioretention geometry has already been defined and the user wishes to account more explicitly for routing, the user can determine the required footprint area using the Capture Efficiency Method for Volume-Based, Constant Drawdown BMPs (See **Appendix** III.3.2) to determine the fraction of the DCV that must be provided to manage 80 percent of average annual runoff volume. This method accounts for drawdown time different than 48 hours.

Step 1: Determine the drawdown time associated with the selected basin geometry

$DD = (d_p / K_{DESIGN}) \times 12$ in/ft

Where:

DD = time to completely drain infiltration basin ponding depth, hours

d_P = bioretention ponding depth, ft (should be less than or equal to 1.5 ft)

K_{DESIGN} = design media infiltration rate, in/hr (assume 2.5 inches per hour unless otherwise proposed)

If drawdown is less than 3 hours, the drawdown time should be rounded to 3 hours or the Capture Efficiency Method for Flow-based BMPs (See **Appendix III.3.3**) shall be used.

Step 2: Determine the Required Adjusted DCV for this Drawdown Time

Use the Capture Efficiency Method for Volume-Based, Constant Drawdown BMPs (See **Appendix III.3.2**) to calculate the fraction of the DCV the basin must hold to achieve 80 percent capture of average annual stormwater runoff volume based on the basin drawdown time calculated above.

Step 3: Determine the Basin Infiltrating Area Needed

The required infiltrating area (i.e. the surface area of the top of the media layer) can be calculated using the following equation:

A = Design Volume / d_p

Where:

A = required infiltrating area, sq-ft (measured at the media surface)

Design Volume = fraction of DCV, adjusted for drawdown, cu-ft (see Step 2)

d_p = ponding depth of water stored in bioretention area, ft (from Step 1)

This does not include the side slopes, access roads, etc. which would increase bioretention footprint. If the area required is greater than the selected basin area, adjust surface area or adjust ponding depth and recalculate required area until the required area is achieved.

Configuration for Use in a Treatment Train

- Bioretention areas may be preceeded in a treatment train by HSCs in the drainage area, which would reduce the required design volume of the bioretention cell. For example, bioretention could be used to manage overflow from a cistern.
- Bioretention areas can be used to provide pretreatment for underground infiltration systems.

Additional References for Design Guidance

- CASQA BMP Handbook for New and Redevelopment: http://www.cabmphandbooks.com/Documents/Development/TC-32.pdf
- SMC LID Manual (pp 68): http://www.lowimpactdevelopment.org/guest75/pub/All_Projects/SoCal_LID_Manual/SoCalLID_Manual_FINAL_040910.pdf
- Los Angeles County Stormwater BMP Design and Maintenance Manual, Chapter 5: http://dpw.lacounty.gov/DES/design_manuals/StormwaterBMPDesignandMaintenance.pdf
- San Diego County LID Handbook Appendix 4 (Factsheet 7): http://www.sdcounty.ca.gov/dplu/docs/LID-Appendices.pdf

  Los Angeles Unified School District (LAUSD) Stormwater Technical Manual, Chapter 4: http://www.laschools.org/employee/design/fs-studies-and-reports/download/white_paper_report_material/Storm_Water_Technical_Manual_2009-opt-red.pdf?version_id=76975850
- County of Los Angeles Low Impact Development Standards Manual, Chapter 5: http://dpw.lacounty.gov/wmd/LA_County_LID_Manual.pdf

BIO-7: Proprietary Biotreatment

Proprietary biotreatment devices are devices that are manufactured to mimic natural systems such as bioretention areas by incorporating plants, soil, and microbes engineered to provide treatment at higher flow rates or volumes and with smaller footprints than their natural counterparts. Incoming flows are typically filtered through a planting media (mulch, compost, soil, plants, microbes, etc.) and either infiltrated or collected by an underdrain and delivered to the storm water conveyance system. Tree box filters are an increasingly common type of proprietary biotreatment device that are installed at curb level and filled with a bioretention type soil. For low to moderate flows they operate similarly to bioretention systems and are bypassed during high flows. Tree box filters are highly adaptable solutions that can be used in all types of development and in all types of soils but are especially applicable to dense urban parking lots, street, and roadways.

Also known as:

- *Catch basin planter box*
- *Bioretention vault*
- *Tree box filter*

Proprietary biotreatment
Source: http://www.americastusa.com /index.php/filterra/

Feasibility Screening Considerations

- Proprietary biotreatment devices that are unlined may cause incidental infiltration. Therefore, an evaluation of site conditions should be conducted to evaluate whether the BMP should include an impermeable liner to avoid infiltration into the subsurface.

Opportunity Criteria

- Drainage areas of 0.25 to 1.0 acres.
- Land use may include commercial, residential, mixed use, institutional, and subdivisions. Proprietary biotreatment facilities may also be applied in parking lot islands, traffic circles, road shoulders, and road medians.
- Must not adversely affect the level of flood protection provided by the drainage system.

OC-Specific Design Criteria and Considerations

- ☐ Frequent maintenance and the use of screens and grates to keep trash out may decrease the likelihood of clogging and prevent obstruction and bypass of incoming flows.
- ☐ Consult proprietors for specific criteria concerning the design and performance.
- ☐ Proprietary biotreatment may include specific media to address pollutants of concern. However, for proprietary device to be considered a biotreatment device the media must be capable of supporting rigorous growth of vegetation.
- ☐ Proprietary systems must be acceptable to the reviewing agency. Reviewing agencies shall have the discretion to request performance information. Reviewing agencies shall have the discretion to deny the use of a proprietary BMP on the grounds of performance, maintenance considerations, or other relevant factors.

☐ In right of way areas, plant selection should not impair traffic lines of site. Local jurisdictions may also limit plant selection in keeping with landscaping themes.

Computing Sizing Criteria for Proprietary Biotreatment Device

- Proprietary biotreatment devices can be volume based or flow-based BMPs.
- Volume-based proprietary devices should be sized using the Simple Design Capture Volume Sizing Method described in **Appendix III.3.1** or the Capture Efficiency Method for Volume-Based, Constant Drawdown BMPs described in **Appendix III.3.2**.
- The required design flowrate for flow-based proprietary devices should be computed using the Capture Efficiency Method for Flow-based BMPs described in **Appendix III.3.3**).

Additional References for Design Guidance

- Los Angeles Unified School District (LAUSD) Stormwater Technical Manual, Chapter 4: http://www.laschools.org/employee/design/fs-studies-and-reports/download/white_paper_report_material/Storm_Water_Technical_Manual_2009-opt-red.pdf?version_id=76975850
- Los Angeles County Stormwater BMP Design and Maintenance Manual, Chapter 9: http://dpw.lacounty.gov/DES/design_manuals/StormwaterBMPDesignandMaintenance.pdf
- Santa Barbara BMP Guidance Manual, Chapter 6: http://www.santabarbaraca.gov/NR/rdonlyres/91D1FA75-C185-491E-A882-49EE17789DF8/0/Manual_071008_Final.pdf

SECTION VII EDUCATIONAL MATERIALS

The educational materials included in this WQMP are provided to inform people involved in future uses, activities, or ownership of the site about the potential pitfalls associated with careless storm water management. "The Ocean Begins at Your Front Door" provides users with information about storm water that is/will be generated on site, what happens when water enters a storm drain, and its ultimate fate, discharging into the ocean. Also included are activities guidelines to educate anyone who is or will be associated with activities that have a potential to impact storm water runoff quality, and provide a menu of BMPs to effectively reduce the generation of storm water runoff pollutants from a variety of activities. The educational materials that may be used for the proposed project are included in Appendix C of this WQMP and are listed below.

EDUCATION MATERIALS			
Residential Materials (http://www.ocwatersheds.com)	Check If Attached	Business Materials (http://www.ocwatersheds.com)	Check If Attached
The Ocean Begins at Your Front Door	☒	Tips for the Automotive Industry	☐
Tips for Car Wash Fund-raisers	☐	Tips for Using Concrete and Mortar	☐
Tips for the Home Mechanic	☐	Tips for the Food Service Industry	☐
Homeowners Guide for Sustainable Water Use	☐	Proper Maintenance Practices for Your Business	☒
Household Tips	☐	Other Materials (http://www.ocwatersheds.com) (https://www.casqa.org/resources/bmp-handbooks)	Check If Attached
Proper Disposal of Household Hazardous Waste	☐		
Recycle at Your Local Used Oil Collection Center (North County)	☐	DF-1 Drainage System Operation & Maintenance	☒
Recycle at Your Local Used Oil Collection Center (Central County)	☐	SC-11 Spill Prevention, Control & Cleanup	☒
Recycle at Your Local Used Oil Collection Center (South County)	☐	SC-32 Outdoor Equipment Operations	☒
Tips for Maintaining Septic Tank Systems	☐	SC-43 Parking/Storage Area	☒
Responsible Pest Control	☐	SC-70 Road and Street Maintenance	☒
Sewer Spill	☐	SC-73 Landscape Maintenance	☒
Tips for the Home Improvement Projects	☐	SC-74 Drainage System Maintenance	☒
Tips for Horse Care	☐	SD-11 Roof Runoff Controls	☒
Tips for Landscaping and Gardening	☐	SD-12 Efficient Irrigation	☒
Tips for Pet Care	☐	SD-13 Storm Drain Signage	☒
Tips for Pool Maintenance	☐	SD-31 Maintenance Bays & Docs	☐
Tips for Residential Pool, Landscape and Hardscape Drains	☐	SD-32 Trash Storage Areas	☒
Tips for Projects Using Paint	☐	SD-35 Outdoor Work Areas	☒
Tips for Protecting Your Watershed	☐		☐
Other: Children's Brochure	☐		☐

APPENDICES

Appendix A

Supporting Calculations

Worksheet B: Simple Design Capture Volume Sizing Method

			DMA A	DMA B	DMA C	DMA D	DMA E	DMA F	DMA G	DMA H	DMA I	DMA J	DMA K	DMA L	DMA M	
Step 1: Determine the design capture storm depth used for calculating volume																
1	Enter design capture storm depth from Figure III.1, *d* (inches)	d=	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	inches
2	Enter the effect of provided HSCs, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	0	0	0	0	0	0	0	0	0	0	0	0	inches
3	Calculate the remainder of the design capture storm depth, $d_{remainder}$ (inches) (Line 1 – Line 2)	$d_{remainder}$=	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	inches
Step 2: Calculate the DCV																
1	Enter Project area tributary to BMP(s), *A* (acres)	A=	1.70	1.94	0.30	0.26	0.27	0.37	0.20	0.29	0.19	2.27	1.24	5.53	0.89	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	90%	90%	90%	100%	100%	0%	100%	100%	30%	100%	100%	100%	90%	%
3	Calculate runoff coefficient, *C= (0.75 x imp) + 0.15*	C=	0.825	0.825	0.825	0.900	0.900	0.150	0.900	0.900	0.375	0.900	0.900	0.900	0.900	
4	Calculate runoff volume, $V_{design} = (C \times d_{remainder} \times A \times 43560 \times (1/12))$	V_{design}=	3,818	4,357	674	637	662	151	490	711	194	5,562	3,038	13,550	2,181	cu-ft
Step 3: Design BMPs to ensure full retention of the DCV																
Step 3a: Determine design infiltration rate																
1	Enter measured infiltration rate, $K_{measured}$ (in/hr) (Appendix VII)	$K_{measured}$=														in/hr
2	Enter combined safety factor from Worksheet H, S_{final} (unitless)	S_{final}=	Not Applicable Infiltration infeasible per Geotech - see Appendix F													
3	Calculate design infiltration rate, $K_{design} = K_{measured} / S_{final}$	K_{design}=														in/hr
Step 3b: Determine minimum BMP footprint																
4	Enter drawdown time, *T* (max 48 hours)	T=														hours
5	Calculate max retention depth that can be drawn down within the drawdown time (feet), $D_{max} = K_{design} \times T \times (1/12)$	D_{max}=	Not Applicable Infiltration infeasible per Geotech - see Appendix F													feet
6	Calculate minimum area required for BMP (sq-ft), $A_{min} = V_{design} / d_{max}$	A_{min}=														sq-ft

Worksheet D: Capture Efficiency Method for Flow-Based BMPs

			DMA A	DMA C	DMA D	DMA E	DMA J	DMA K	DML M	
Step 1: Determine the design capture storm depth used for calculating volume										
1	Enter the time of concentration, T_c (min) (See Appendix IV.2)	T_c=	5.0	5.0	5.0	5.0	5.0	5.0	5.0	min
2	Using Figure III.4, determine the design intensity at which the estimated time of concentration (T_c) achieves 80% capture efficiency, I_1	I_1=	0.260	0.260	0.260	0.260	0.260	0.260	0.260	in/hr
3	Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	0	0	0	0	0	0	inches
4	Enter capture efficiency corresponding to d_{HSC}, Y_2 (Worksheet A)	Y_2=	0%	0%	0%	0%	0%	0%	0%	%
5	Using Figure III.4, determine the design intensity at which the time of concentration (T_c) achieves the upstream capture efficiency (Y_2), I_2	I_2=	0	0	0	0	0	0	0	in/hr
6	Determine the design intensity that must be provided by BMP, $I_{design} = I_1 - I_2$	I_{design}=	0.260	0.260	0.260	0.260	0.260	0.260	0.260	in/hr
Step 2: Calculate the design flowrate										
1	Enter Project area tributary to BMP(s), *A* (acres)	A=	1.70	0.30	0.26	0.27	2.27	1.24	0.89	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	90%	90%	100%	100%	100%	100%	100%	%
3	Calculate runoff coefficient, $C = (0.75 \times imp) + 0.15$	C=	0.825	0.825	0.900	0.900	0.900	0.900	0.900	
4	Calculate design flowrate, $Q_{design} = (C \times i_{design} \times A)$	Q_{design}=	0.365	0.064	0.061	0.063	0.531	0.290	0.208	cfs
Supporting Calculations										
Describe System:										
		Proprietary BioTreatment (BIO-7):								
		Unit Size / Model =	*MWS-L-8-16*	*MWS-L-4-8*	*MWS-L-4-8*	*MWS-L-4-8*	*MWS-L-8-20*	*MWS-L-8-12*	*MWS-L-8-8*	
		Unit Size / Model Treatment Capacity =	*0.462*	*0.115*	*1.115*	*0.115*	*0.577*	*0.346*	*0.231*	cfs
		Number of Units Needed =	*1*	*1*	*1*	*1*	*1*	*1*	*1*	
		Total Bio-treatment Provided =	*0.462*	*0.115*	*1.115*	*0.115*	*0.577*	*0.346*	*0.231*	cfs

Worksheet C: Capture Efficiency Method for Volume-Based, Constant Drawdown BMPs

			DMA B	DMA G	DMA H	
Step 1: Determine the design capture storm depth used for calculating volume						
1	Enter design capture storm depth from Figure III.1, *d* (inches)	d=	0.75	0.75	0.75	inches
2	Enter calculated drawdown time of the proposed BMP based on equation provided in applicable BMP Fact Sheet, *T* (hours)	T=	2.40	1.20	1.20	hours
3	Using Figure III.2, determine the "fraction of design capture storm depth" at which the BMP drawdown time (T) line achieves 80% capture efficiency, X_1	X_1=	0.25	0.20	0.20	
4	Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	0	0	inches
5	Enter capture efficiency corresponding to d_{HSC}, Y_2 (Worksheet A)	Y_2=	0%	0%	0%	%
6	Using Figure III.2, determine the fraction of "design capture storm depth" at which the drawdown time (T) achieves the equivalent of the upstream capture efficiency (Y_2), X_2	X_2=	0.00	0.00	0.00	
7	Calculate the fraction of design volume that must be provided by BMP, $fraction = X_1 - X_2$	fraction=	0.25	0.20	0.20	
8	Calculate the resultant design capture storm depth (inches), $d_{fraction} = fraction \times d$	$d_{fraction}$=	0.19	0.15	0.15	inches
Step 2: Calculate the DCV						
1	Enter Project area tributary to BMP(s), *A* (acres)	A=	1.94	0.20	0.29	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	90%	100%	100%	%
3	Calculate runoff coefficient, $C= (0.75 \times imp) + 0.15$	C=	0.825	0.900	0.900	
4	Calculate runoff volume, $V_{design} = (C \times d_{rfraction} \times A \times 43560 \times (1/12))$	V_{design}=	1,089	98	142	cu-ft
Supporting Calculations						
Describe System:						
	BMP Type: Bioretention with Underdrain					
		Ponding Depth (d_p) =	*0.50*	*0.25*	*0.25*	ft
		Design Infiltration Rate (K_{Design}) =	*2.50*	*2.50*	*2.50*	in/hr
		Minimum Surface Area Required (A_{Min}) =	*2,178.7*	*392.0*	*568.5*	ft^2
		Total Surface Area Provided =	*4,944.0*	*1,743.0*	*1,238.0*	ft^2
		Total Volume Stored =	*2,472.0*	*435.8*	*309.5*	ft^3
Provide drawdown time calculations per applicable BMP Fact Sheet:						
		Drawdown (DD or T) = (d_p / K_{Design}) x 12				
		Time to Drawdown Effective Depth (T) =	*2.4*	*1.2*	*1.2*	hours

Worksheet I: Summary of Groundwater-related Feasibility Criteria

1	Is project large or small? (as defined by Table VIII.2) circle one	Large Small		
2	What is the tributary area to the BMP?	A	**15.43**	acres
3	What type of BMP is proposed?	**Modular Wetland System (5)** **Bioretention w/ Underdrain (4)**		
4	What is the infiltrating surface area of the proposed BMP?	A_{BMP}	**N/A**	sq-ft
5	What land use activities are present in the tributary area (list all) **Roofs, drive aisles, parking lots, pedestrian walkways, water attactions, landscaping**			
6	What land use-based risk category is applicable?	L	M	H
7	If M or H, what pretreatment and source isolation BMPs have been considered and are proposed (describe all):			
8	What minimum separation to mounded seasonally high groundwater applies to the proposed BMP? See Section VIII.2 (circle one)	5 ft	10 ft	
9	Provide rationale for selection of applicable minimum separation to seasonally high mounded groundwater:			
10	What is separation from the infiltrating surface to seasonally high groundwater?	SHGWT	**N/A**	ft
11	What is separation from the infiltrating surface to mounded seasonally high groundwater?	Mounded SHGWT	**N/A**	ft
12	Describe assumptions and methods used for mounding analysis:			
13	Is the site within a plume protection boundary (See Figure VIII.2)?	Y	N	N/A

Worksheet I: Summary of Groundwater-related Feasibility Criteria

14	Is the site within a selenium source area or other natural plume area (See Figure VIII.2)?	Y	N	N/A
15	Is the site within 250 feet of a contaminated site?	Y	N	N/A
16	If site-specific study has been prepared, provide citation and briefly summarize relevant findings:			
17	Is the site within 100 feet of a water supply well, spring, septic system?	Y	N	N/A
18	Is infiltration feasible on the site relative to groundwater-related criteria?	Y	N	
Provide rationale for feasibility determination:				
Stormwater infiltration is infeasible due to the presence of thick clay layers underlying the site that would be expected to have very low to no permeability, presence of perched water, and evidence of pressurized aquifers below the site. Appendix F for further details				

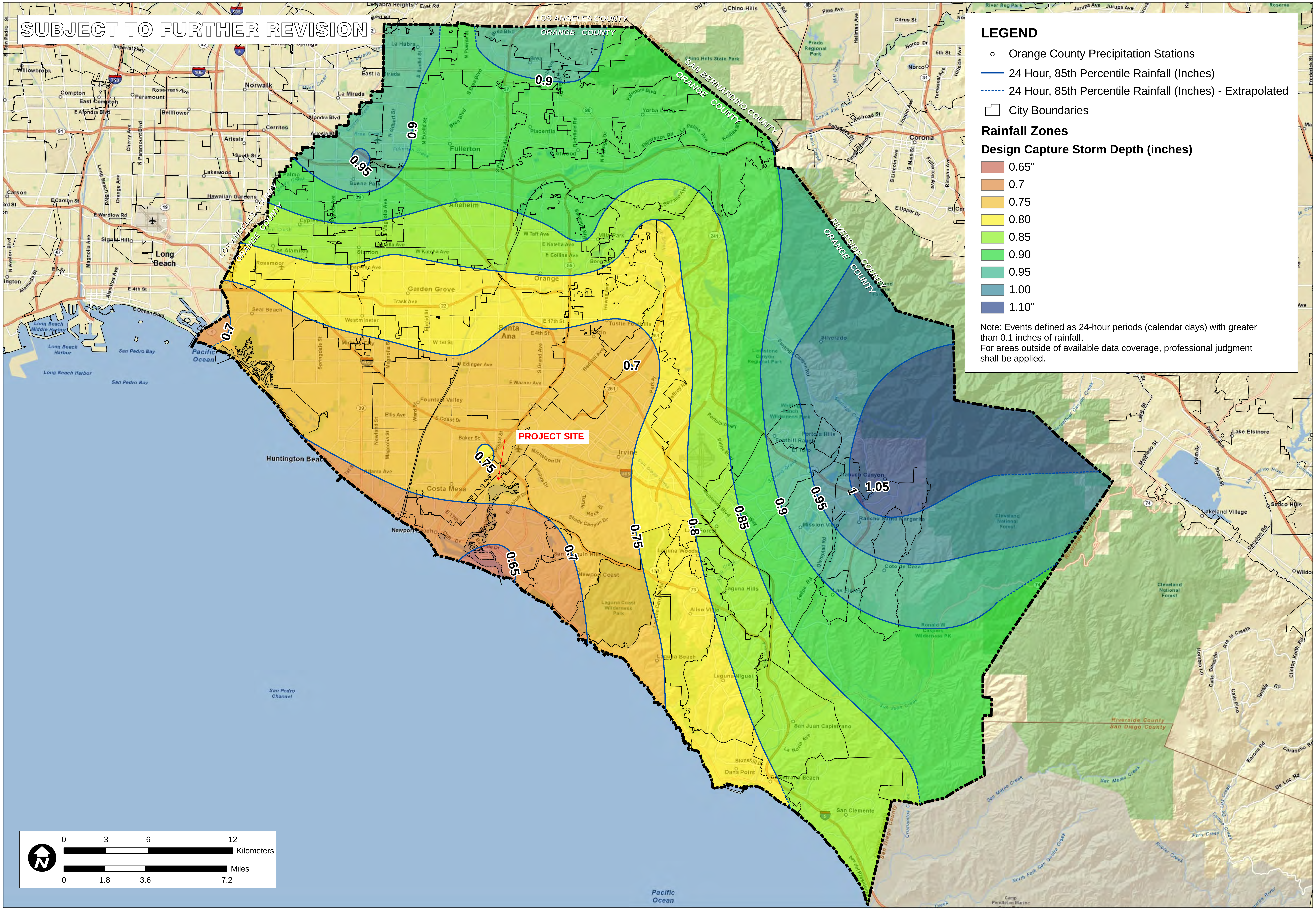
Note: if a single criterion or group of criteria would render infiltration infeasible, it is not necessary to evaluate every question in this worksheet.

Worksheet J: Summary of Harvested Water Demand and Feasibility

1	What demands for harvested water exist in the tributary area (check all that apply):			
2	Toilet and urinal flushing		**N/A**	
3	Landscape irrigation		**X**	
4	Other: ______________________________			
5	What is the design capture storm depth? (Figure III.1)	d	0.75	inches
6	What is the project size?	A	15.43	ac
7	What is the acreage of impervious area?	IA	13.89	ac
For projects with multiple types of demand (toilet flushing, irrigation demand, and/or other demand)				
8	What is the minimum use required for partial capture? (Table X.6)		N/A	gpd
9	What is the project estimated wet season total daily use (Section X.2)?		N/A	gpd
10	Is partial capture potentially feasible? (Line 9 > Line 8?)		N/A	
For projects with only toilet flushing demand				
11	What is the minimum TUTIA for partial capture? (Table X.7)		N/A	
12	What is the project estimated TUTIA?		N/A	
13	Is partial capture potentially feasible? (Line 12 > Line 11?)		N/A	
For projects with only irrigation demand				
14	What is the minimum irrigation area required based on conservation landscape design? (Table X.8)		16.73	ac
15	What is the proposed project irrigated area? (multiply conservation landscaping by 1; multiply active turf by 2)		4.62	ac
16	Is partial capture potentially feasible? (Line 15 > Line 14?)		No	

Provide supporing assumptions and citations for controlling demand calculation:

Minimum EIATA for Active Turf per Table X.8 =	*0.41*	*ac/ac*
Minimum EIATA for Conservation-Type Landscaping per Table X.8 =	*0.83*	*ac/ac*
Minimum Irrigated Area = Project Impervious Area ÷ EIATA	*16.73*	*ac*
Minimum Irrigated Area for 100% Active Turf Landscaping =	*33.88*	*ac*
Minimum Irrigated Area for 100% Conservation Landscaping =	*16.73*	*ac*
Proposed Landscaping Type =	*50% Turf; 50% Conservation*	
Total Proposed Irrigated Area for Active Turf Type =	*1.54*	*ac*
Total Proposed Irrigated Area for Conservation Type =	*1.54*	*ac*



TITLE

RAINFALL ZONES

JOB

ORANGE COUNTY TECHNICAL GUIDANCE DOCUMENT

ORANGE CO. CA

SCALE	1" = 1.8 miles
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	04/22/10
JOB NO.	9526-E

PACE Advanced Water Engineering

FIGURE

XVI-1

P:\9526E\6-GIS\Mxds\Reports\InfiltrationFeasability_20110215\9526E_FigureXVI-1_RainfallZones_20110215.mxd

APPENDIX B

NOTICE OF TRANSFER OF RESPONSIBILITY

NOTICE OF TRANSFER OF RESPONSIBILITY

WATER QUALITY MANAGEMENT PLAN

3100 Irvine Avenue, Newport Beach, CA 92660
GRADING PLANS: TBD

Submission of this Notice Of Transfer of Responsibility constitutes notice to the City of Newport Beach that responsibility for the Water Quality Management Plan ("WQMP") for the subject property identified below, and implementation of that plan, is being transferred from the Previous Owner (and his/her agent) of the site (or a portion thereof) to the New Owner, as further described below.

I. Previous Owner/ Previous Responsible Party Information

Company/ Individual Name:		Contact Person:	
Street Address:		Title:	
City:	State:	ZIP:	Phone:

II. Information about Site Transferred

Name of Project (if applicable):	
Title of WQMP Applicable to site:	
Street Address of Site (if applicable):	
Planning Area (PA) and/ or Tract Number(s) for Site:	Lot Numbers (if Site is a portion of a tract):
Date WQMP Prepared (and revised if applicable):	

III. New Owner/ New Responsible Party Information

Company/ Individual Name:		Contact Person:	
Street Address:		Title:	
City:	State:	ZIP:	Phone:

IV. Ownership Transfer Information

General Description of Site Transferred to New Owner:	General Description of Portion of Project/ Parcel Subject to WQMP Retained by Owner (if any):
Lot/ Tract Numbers of Site Transferred to New Owner:	
Remaining Lot/ Tract Numbers Subject to WQMP Still Held by Owner (if any):	
Date of Ownership Transfer:	

Note: When the Previous Owner is transferring a Site that is a portion of a larger project/ parcel addressed by the WQMP, as opposed to the entire project/parcel addressed by the WQMP, the General Description of the Site transferred and the remainder of the project/ parcel no transferred shall be set forth as maps attached to this notice. These maps shall show those portions of a project/ parcel addressed by the WQMP that are transferred to the New Owner (the Transferred Site), those portions retained by the Previous Owner, and those portions previously transferred by Previous Owner. Those portions retained by Previous Owner shall be labeled as "Previously Transferred".

V. Purpose of Notice of Transfer

The purposes of this Notice of Transfer of Responsibility are: 1) to track transfer of responsibility for implementation and amendment of the WQMP when property to which the WQMP is transferred from the Previous Owner to the New Owner, and 2) to facilitate notification to a transferee of property subject to a WQMP that such New Order is now the Responsible Party of record for the WQMP for those portions of the site that it owns.

VI. Certifications

A. Previous Owner

I certify under penalty of law that I am no longer the owner of the Transferred Site as described in Section II above. I have provided the New Owner with a copy of the WQMP applicable to the Transferred Site that the New Owner is acquiring from the Previous Owner.

Printed Name of Previous Owner Representative:	Title:
Signature of Previous Owner Representative:	Date:

B. New Owner

I certify under penalty of law that I am the owner of the Transferred Site, as described in Section II above, that I have been provided a copy of the WQMP, and that I have informed myself and understand the New Owner's responsibilities related to the WQMP, its implementation, and Best Management Practices associated with it. I understand that by signing this notice, the New Owner is accepting all ongoing responsibilities for implementation and amendment of the WQMP for the Transferred Site, which the New Owner has acquired from the Previous Owner.

Printed Name of New Owner Representative:	Title:
Signature:	Date:

APPENDIX C

EDUCATIONAL MATERIALS

Preventing water pollution at your commercial/industrial site

Clean beaches and healthy creeks, rivers, bays and ocean are important to Orange County. However, many landscape and building maintenance activities can lead to water pollution if you're not careful. Paint, chemicals, plant clippings and other materials can be blown or washed into storm drains that flow to the ocean. Unlike water in sanitary sewers (from sinks and toilets), water in storm drains is not treated before entering our waterways.

You would never pour soap or fertilizers into the ocean, so why would you let them enter the storm drains? Follow these easy tips to help prevent water pollution.

Some types of industrial facilities are required to obtain coverage under the State General Industrial Permit. For more information visit: **www.swrcb.ca.gov/stormwater/industrial.html**

For more information,
please call the
Orange County Stormwater Program
at **1-877-89-SPILL** (1-877-897-7455)
or visit
www.ocwatersheds.com

To report a spill,
call the
Orange County 24-Hour Water Pollution Problem Reporting Hotline
at **1-877-89-SPILL** (1-877-897-7455).

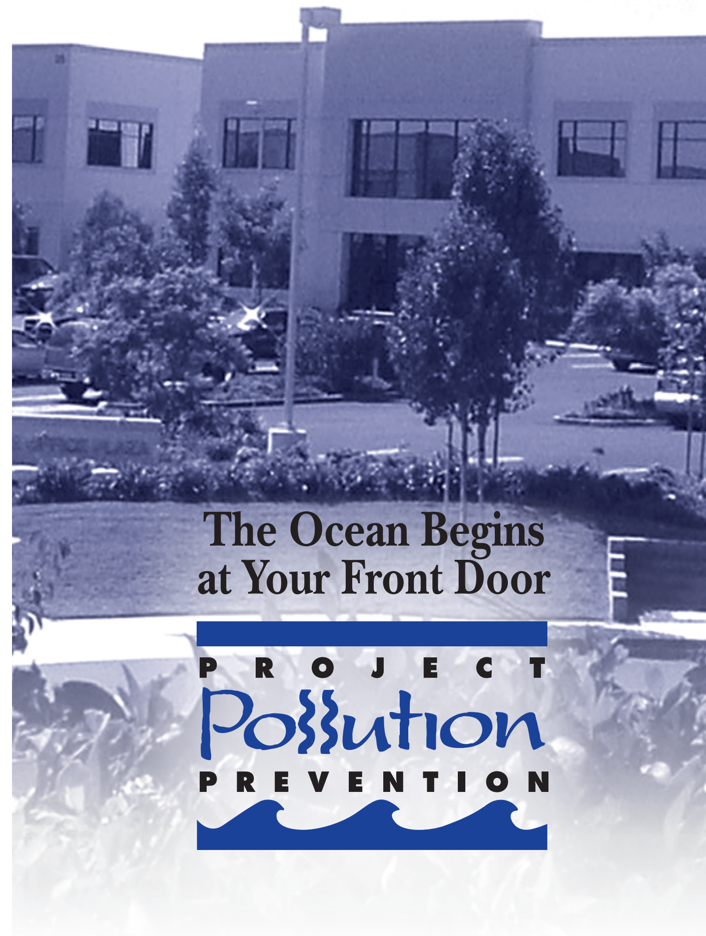
For emergencies, dial 911.

RECYCLE USED OIL

Printed on Recycled Paper

Help Prevent Ocean Pollution:

Proper Maintenance Practices for Your Business



The Ocean Begins at Your Front Door

PROJECT POLLUTION PREVENTION

Proper Maintenance Practices for your Business

Landscape Maintenance

- Compost grass clippings, leaves, sticks and other vegetation, or dispose of it at a permitted landfill or in green waste containers. Do not dispose of these materials in the street, gutter or storm drain.
- Irrigate slowly and inspect the system for leaks, overspraying and runoff. Adjust automatic timers to avoid overwatering.
- Follow label directions for the use and disposal of fertilizers and pesticides.
- Do not apply pesticides or fertilizers if rain is expected within 48 hours or if wind speeds are above 5 mph.
- Do not spray pesticides within 100 feet of waterways.
- Fertilizers should be worked into the soil rather than dumped onto the surface.
- If fertilizer is spilled on the pavement or sidewalk, sweep it up immediately and place it back in the container.

Building Maintenance

- Never allow washwater, sweepings or sediment to enter the storm drain.
- Sweep up dry spills and use cat litter, towels or similar materials to absorb wet spills. Dispose of it in the trash.
- If you wash your building, sidewalk or parking lot, you **must** contain the water. Use a shop vac to collect the water and contact your city or sanitation agency for proper disposal information. Do not let water enter the street, gutter or storm drain.
- Use drop cloths underneath outdoor painting, scraping, and sandblasting work, and properly dispose of materials in the trash.
- Use a ground cloth or oversized tub for mixing paint and cleaning tools.
- Use a damp mop or broom to clean floors.
- Cover dumpsters to keep insects, animals, rainwater and sand from entering. Keep the area around the dumpster clear of trash and debris. Do not overfill the dumpster.
- Call your trash hauler to replace leaking dumpsters.
- Do not dump any toxic substance or liquid waste on the pavement, the ground, or near a storm drain. Even materials that seem harmless such as latex paint or biodegradable cleaners can damage the environment.

NEVER DISPOSE OF ANYTHING IN THE STORM DRAIN.

- Recycle paints, solvents and other materials. For more information about recycling and collection centers, visit **www.oclandfills.com**.
- Store materials indoors or under cover and away from storm drains.
- Use a construction and demolition recycling company to recycle lumber, paper, cardboard, metals, masonry, carpet, plastic, pipes, drywall, rocks, dirt, and green waste. For a listing of construction and demolition recycling locations in your area, visit **www.ciwmb.ca.gov/recycle.**
- Properly label materials. Familiarize employees with Material Safety Data Sheets.

PROJECT Pollution PREVENTION

DF-1
DRAINAGE FACILITY OPERATION AND MAINTENANCE

As a consequence of its function, the stormwater conveyance system collects and transports urban runoff and storm water that may contain certain pollutants. Consequently these pollutants may accumulate in the system and must be removed periodically. In addition, the systems must also be maintained to function properly hydraulically to avoid flooding. Maintaining the system may involve the following activities:

1. Inspection and Cleaning of Stormwater Conveyance Structures
2. Controlling Illicit Connections and Discharges
3. Controlling Illegal Dumping

This list of Model Maintenance Procedures can be utilized as an inspection checklist to determine where better compliance with Designated Minimum Best Management Practices (notated with checkmarks and capital letters) is needed, and to recommend Additional Best Management Practices (notated with bullet points and lower case letters) that may be applicable under certain circumstances, especially where there are certain Pollutant Constituents of Concern. BMPs applicable to certain constituents are notated as:

Bacteria (BACT) *Sediment (SED)* *Nutrients (NUT)* *Oil and Grease (O&G)* *Pesticides (PEST)*
OtherToxic Compounds (TOX) *Trash (TRASH)* *Hydrological Impacts (HYD)* *Any/All or General (ANY)*

Program/Facility Being Inspected: ______________________________

Date: ____________________ Inspector Name: ______________________________

When completed, the checklist should be attached to the General Inspection Form Cover Sheet and copies should be provided to the Supervisor of the Facility/Program being inspected.

MAINTENANCE PROCEDURES:

1. Inspection and Cleaning of Drainage Facilities

Unsatisfactory / OK	General Guidelines
☐ ____________ ☐	T 1A. Annually inspect and clean drainage structures as needed.
☐ ____________ ☐	T 1B. Maintain appropriate records of cleaning and inspections.
☐ ____________ ☐	T 1C. Properly dispose of removed materials at a landfill or recycling facility.
☐ ____________ ☐	T 1D. Conduct intermittent supplemental visual inspections during the wet season to determine if there are problem inlets where sediment/trash or other pollutants accumulate, and provide for additional cleanouts as appropriate.
☐ ____________ ☐	T 1E. Prevent or clean up any discharges that may occur during the course of maintenance and cleaning procedures.
☐ ____________ ☐	T 1F. Verify that appropriate employees or subcontractors are trained in proper conductance of maintenance activities, including record keeping and disposal.
☐ ____________ ☐	T 1G. Annually inspect and clean v-ditches as needed, prior to the wet season. On shrub-covered slopes, vegetative debris may be placed on the downhill side of the ditch. Trash should be bagged and disposed at a landfill.

Unsatisfactory / OK	
☐ ☐	**General Guidelines (cont.)**
☐ ☐	• 1a. Remove trash or debris as needed from open channels. It should be noted that major vegetative debris removal may require other regulatory permits prior to completing the work. (TRASH)
☐ ☐	• 1b. Consider retrofitting energy dissipaters (e.g. riprap) below culvert outfalls to minimize potential for erosion. (SED)
☐ ☐	• 1c. Repair any v-ditches that have cracked or displaced in a manner that accelerates erosion. (SED)
☐ ☐	• 1d. If suspicious conditions appear to exist, test selected samples of the removed wastes for compliance with hazardous waste regulations prior to disposal. (TOX)
☐ ☐	• 1e. Consider more frequent regular cleaning of selected drainage structures to help address ongoing specific impairments. (SED, BACT, NUT, TRASH)
☐ ☐	• 1f. Consider structural retrofits to the MS4 to help address ongoing specific impairments (SED, BACT, NUT, TRASH, O&G)
☐ ☐	• 1g. Consider cleaning out pipes at gradient breaks or other in-pipe debris accumulation points as identified/needed. (ANY, BACT, NUT, TRASH)
	Storm Drain Flushing
☐ ☐	• 1h. Flushing of storm drains or storm drain inlets should only be done when critically necessary and no other solution is practical. (SED, BACT, TRASH).
☐ ☐	• 1i. If flushed, to the extent practical the material should be collected (vacuumed), treated with an appropriate filtering device to remove sand and debris and disposed of properly. (SED)
	Waste Management
☐ ☐	T 1H. Store wastes collected from cleaning activities of the drainage facilities in appropriate containers or temporary storage sites in a manner that prevents discharge to the storm drain.
☐ ☐	• 1j. Dewater the wastes if necessary with outflow into the sanitary sewer if permitted. Water should be treated with an appropriate filtering device to remove the sand and debris prior to discharge to the sanitary sewer. If discharge to the sanitary sewer is not permitted, water should be pumped or vacuumed to a tank and properly disposed of. Do not dewater near a storm drain or stream. (SED, TRASH)
☐ ☐	• 1k. Provide for laboratory analysis of at least one randomly collected sediment (less the debris) sample per year from the storm drain inlet leaning program to ensure that it does not meet the EPA criteria for hazardous waste. If the sample is determined to be hazardous, the sediment must be disposed of as hazardous waste and the source should be investigated. (TOX).

2. Controlling Illicit Connections and Discharges		
Unsatisfactory	**OK**	**General Guidelines**
☐	☐	T 2A. Report prohibited discharges such as dumping, paint spills, abandoned oil containers, etc. observed during the course of normal daily activities so they can be investigated, contained, and cleaned up.
☐	☐	T 2B. Where field observations and/or monitoring data indicate significant problems, conduct field investigations to detect and eliminate existing illicit connections and improper disposal of pollutants into the storm drain (i.e. identify problem areas where discharges or illegal connections may occur and follow up stream to determine the source(s)). (Refer to Appendices A-10 and A-11.)
☐	☐	T 2C. Report all observed illicit connections and discharges to the 24-hour water pollution problem reporting hotline (714) 567-6363.
☐	☐	T 2D. Encourage public reporting of improper waste disposal by distributing public education materials and advertising the 24-hour water pollution problem reporting hotline.
		Storm Drain Stenciling ("No Dumping—Drains to Ocean")
☐	☐	T 2E. Implement and maintain a storm drain stenciling program.
☐	☐	• 2a. Consider adding the hotline number to the storm drain stencils (BACT, TOX, TRASH).

3. Controlling Illegal Dumping		
		Field Investigation
☐	☐	T 3A. Report prohibited discharges such as dumpings observed during the course of normal daily activities so they can be investigated, contained and cleaned up.
☐	☐	T 3B. Conduct field investigations to detect and eliminate improper disposal of pollutants into the storm drain (i.e. identify problem areas where discharges or illegal connections may occur and follow up stream to determine the source(s)).
☐	☐	T 3C. Report all observed illegal dumping to the 24-hour water pollution problem reporting hotline (714) 567-6363.
☐	☐	T 3D. Encourage public reporting of improper waste disposal by distributing public education materials and advertising the 24-hour water pollution problem reporting hotline.
☐	☐	T 3E. If perpetrator can be identified, take appropriate enforcement action.
☐	☐	• 3a. Consider posting "No Dumping" signs in problem areas with a phone number for reporting dumping and disposal. Signs could also indicate fines and penalties for illegal dumping. (ANY)

Unsatisfactory OK	Training/Education/Outreach
☐ ______ ☐ ______ ______ ☐ ______ ☐ ______ ______ ☐ ______ ☐ ______ ______ ______ ______	T 3F. Verify that appropriate employees and subcontractors are trained to recognize and report illegal dumping. T 3G. Encourage public reporting of illegal dumping by advertising the 24-hour water pollution problem reporting hotline (714) 567-6363. • 3b. Take extra steps to educate the public in neighborhoods where illegal dumping has occurred to inform them why illegal dumping is a problem, and that illegal dumping carries a significant financial penalty. (ANY)

LIMITATIONS:

Clean-up activities may create a slight disturbance for local aquatic species. Access to items and material on private property may be limited. Trade-offs may exist between channel hydraulics and water quality/riparian habitat. If storm channels or basins are recognized as wetlands, many activities, including maintenance, may be subject to regulation and permitting.

Spill Prevention, Control & Cleanup SC-11

Photo Credit: Geoff Brosseau

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

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

Description

Many activities that occur at an industrial or commercial site have the potential to cause accidental or illegal spills. Preparation for accidental or illegal spills, with proper training and reporting systems implemented, can minimize the discharge of pollutants to the environment.

Spills and leaks are one of the largest contributors of stormwater pollutants. Spill prevention and control plans are applicable to any site at which hazardous materials are stored or used. An effective plan should have spill prevention and response procedures that identify potential spill areas, specify material handling procedures, describe spill response procedures, and provide spill clean-up equipment. The plan should take steps to identify and characterize potential spills, eliminate and reduce spill potential, respond to spills when they occur in an effort to prevent pollutants from entering the stormwater drainage system, and train personnel to prevent and control future spills.

Approach

Pollution Prevention

- Develop procedures to prevent/mitigate spills to storm drain systems. Develop and standardize reporting procedures, containment, storage, and disposal activities, documentation, and follow-up procedures.

- Develop a Spill Prevention Control and Countermeasure (SPCC) Plan. The plan should include:

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CALIFORNIA STORMWATER QUALITY ASSOCIATION

- Description of the facility, owner and address, activities and chemicals present
- Facility map
- Notification and evacuation procedures
- Cleanup instructions
- Identification of responsible departments
- Identify key spill response personnel

■ Recycle, reclaim, or reuse materials whenever possible. This will reduce the amount of process materials that are brought into the facility.

Suggested Protocols (including equipment needs)
Spill Prevention

■ Develop procedures to prevent/mitigate spills to storm drain systems. Develop and standardize reporting procedures, containment, storage, and disposal activities, documentation, and follow-up procedures.

■ If consistent illegal dumping is observed at the facility:

- Post "No Dumping" signs with a phone number for reporting illegal dumping and disposal. Signs should also indicate fines and penalties applicable for illegal dumping.
- Landscaping and beautification efforts may also discourage illegal dumping.
- Bright lighting and/or entrance barriers may also be needed to discourage illegal dumping.

■ Store and contain liquid materials in such a manner that if the tank is ruptured, the contents will not discharge, flow, or be washed into the storm drainage system, surface waters, or groundwater.

■ If the liquid is oil, gas, or other material that separates from and floats on water, install a spill control device (such as a tee section) in the catch basins that collects runoff from the storage tank area.

■ Routine maintenance:

- Place drip pans or absorbent materials beneath all mounted taps, and at all potential drip and spill locations during filling and unloading of tanks. Any collected liquids or soiled absorbent materials must be reused/recycled or properly disposed.
- Store and maintain appropriate spill cleanup materials in a location known to all near the tank storage area; and ensure that employees are familiar with the site's spill control plan and/or proper spill cleanup procedures.
- Sweep and clean the storage area monthly if it is paved, *do not hose down the area to a storm drain.*

- Check tanks (and any containment sumps) daily for leaks and spills. Replace tanks that are leaking, corroded, or otherwise deteriorating with tanks in good condition. Collect all spilled liquids and properly dispose of them.

- Label all containers according to their contents (e.g., solvent, gasoline).

- Label hazardous substances regarding the potential hazard (corrosive, radioactive, flammable, explosive, poisonous).

- Prominently display required labels on transported hazardous and toxic materials (per US DOT regulations).

- Identify key spill response personnel.

Spill Control and Cleanup Activities

- Follow the Spill Prevention Control and Countermeasure Plan.

- Clean up leaks and spills immediately.

- Place a stockpile of spill cleanup materials where it will be readily accessible (e.g., near storage and maintenance areas).

- On paved surfaces, clean up spills with as little water as possible. Use a rag for small spills, a damp mop for general cleanup, and absorbent material for larger spills. If the spilled material is hazardous, then the used cleanup materials are also hazardous and must be sent to a certified laundry (rags) or disposed of as hazardous waste. Physical methods for the cleanup of dry chemicals include the use of brooms, shovels, sweepers, or plows.

- Never hose down or bury dry material spills. Sweep up the material and dispose of properly.

- Chemical cleanups of material can be achieved with the use of adsorbents, gels, and foams. Use adsorbent materials on small spills rather than hosing down the spill. Remove the adsorbent materials promptly and dispose of properly.

- For larger spills, a private spill cleanup company or Hazmat team may be necessary.

Reporting

- Report spills that pose an immediate threat to human health or the environment to the Regional Water Quality Control Board.

- Federal regulations require that any oil spill into a water body or onto an adjoining shoreline be reported to the National Response Center (NRC) at 800-424-8802 (24 hour).

- Report spills to local agencies, such as the fire department; they can assist in cleanup.

- Establish a system for tracking incidents. The system should be designed to identify the following:

  - 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

Training

- Educate employees about spill prevention and cleanup.

- Well-trained employees can reduce human errors that lead to accidental releases or spills:

  - The employee should have the tools and knowledge to immediately begin cleaning up a spill should one occur.

  - Employees should be familiar with the Spill Prevention Control and Countermeasure Plan.

- Employees should be educated about aboveground storage tank requirements. Employees responsible for aboveground storage tanks and liquid transfers should be thoroughly familiar with the Spill Prevention Control and Countermeasure Plan and the plan should be readily available.

- Train employees to recognize and report illegal dumping incidents.

Other Considerations (Limitations and Regulations)

- A Spill Prevention Control and Countermeasure Plan (SPCC) is required for facilities that are subject to the oil pollution regulations specified in Part 112 of Title 40 of the Code of Federal Regulations or if they have a storage capacity of 10,000 gallons or more of petroleum. (Health and Safety Code 6.67)

- State regulations also exist for storage of hazardous materials (Health & Safety Code Chapter 6.95), including the preparation of area and business plans for emergency response to the releases or threatened releases.

- Consider requiring smaller secondary containment areas (less than 200 sq. ft.) to be connected to the sanitary sewer, prohibiting any hard connections to the storm drain.

Requirements

Costs (including capital and operation & maintenance)

- Will vary depending on the size of the facility and the necessary controls.

- Prevention of leaks and spills is inexpensive. Treatment and/or disposal of contaminated soil or water can be quite expensive.

Maintenance (including administrative and staffing)

- This BMP has no major administrative or staffing requirements. However, extra time is needed to properly handle and dispose of spills, which results in increased labor costs.

Supplemental Information

Further Detail of the BMP

Reporting

Record keeping and internal reporting represent good operating practices because they can increase the efficiency of the facility and the effectiveness of BMPs. A good record keeping system helps the facility minimize incident recurrence, correctly respond with appropriate cleanup activities, and comply with legal requirements. A record keeping and reporting system should be set up for documenting spills, leaks, and other discharges, including discharges of hazardous substances in reportable quantities. Incident records describe the quality and quantity of non-stormwater discharges to the storm sewer. These records should contain the following information:

- Date and time of the incident
- Weather conditions
- Duration of the spill/leak/discharge
- Cause of the spill/leak/discharge
- Response procedures implemented
- Persons notified
- Environmental problems associated with the spill/leak/discharge

Separate record keeping systems should be established to document housekeeping and preventive maintenance inspections, and training activities. All housekeeping and preventive maintenance inspections should be documented. Inspection documentation should contain the following information:

- The date and time the inspection was performed
- Name of the inspector
- Items inspected
- Problems noted
- Corrective action required
- Date corrective action was taken

Other means to document and record inspection results are field notes, timed and dated photographs, videotapes, and drawings and maps.

Aboveground Tank Leak and Spill Control

Accidental releases of materials from aboveground liquid storage tanks present the potential for contaminating stormwater with many different pollutants. Materials spilled, leaked, or lost from tanks may accumulate in soils or on impervious surfaces and be carried away by stormwater runoff.

The most common causes of unintentional releases are:

- Installation problems
- Failure of piping systems (pipes, pumps, flanges, couplings, hoses, and valves)
- External corrosion and structural failure
- Spills and overfills due to operator error
- Leaks during pumping of liquids or gases from truck or rail car to a storage tank or vice versa

Storage of reactive, ignitable, or flammable liquids should comply with the Uniform Fire Code and the National Electric Code. Practices listed below should be employed to enhance the code requirements:

- Tanks should be placed in a designated area.
- Tanks located in areas where firearms are discharged should be encapsulated in concrete or the equivalent.
- Designated areas should be impervious and paved with Portland cement concrete, free of cracks and gaps, in order to contain leaks and spills.
- Liquid materials should be stored in UL approved double walled tanks or surrounded by a curb or dike to provide the volume to contain 10 percent of the volume of all of the containers or 110 percent of the volume of the largest container, whichever is greater. The area inside the curb should slope to a drain.
- For used oil or dangerous waste, a dead-end sump should be installed in the drain.
- All other liquids should be drained to the sanitary sewer if available. The drain must have a positive control such as a lock, valve, or plug to prevent release of contaminated liquids.
- Accumulated stormwater in petroleum storage areas should be passed through an oil/water separator.

Maintenance is critical to preventing leaks and spills. Conduct routine inspections and:

- Check for external corrosion and structural failure.
- Check for spills and overfills due to operator error.
- Check for failure of piping system (pipes, pumps, flanger, coupling, hoses, and valves).
- Check for leaks or spills during pumping of liquids or gases from truck or rail car to a storage facility or vice versa.

- Visually inspect new tank or container installation for loose fittings, poor welding, and improper or poorly fitted gaskets.
- Inspect tank foundations, connections, coatings, and tank walls and piping system. Look for corrosion, leaks, cracks, scratches, and other physical damage that may weaken the tank or container system.
- Frequently relocate accumulated stormwater during the wet season.
- Periodically conduct integrity testing by a qualified professional.

Vehicle Leak and Spill Control

Major spills on roadways and other public areas are generally handled by highly trained Hazmat teams from local fire departments or environmental health departments. The measures listed below pertain to leaks and smaller spills at vehicle maintenance shops.

In addition to implementing the spill prevention, control, and clean up practices above, use the following measures related to specific activities:

Vehicle and Equipment Maintenance

- Perform all vehicle fluid removal or changing inside or under cover to prevent the run-on of stormwater and the runoff of spills.
- Regularly inspect vehicles and equipment for leaks, and repair immediately.
- Check incoming vehicles and equipment (including delivery trucks, and employee and subcontractor vehicles) for leaking oil and fluids. Do not allow leaking vehicles or equipment onsite.
- Always use secondary containment, such as a drain pan or drop cloth, to catch spills or leaks when removing or changing fluids.
- Immediately drain all fluids from wrecked vehicles.
- Store wrecked vehicles or damaged equipment under cover.
- Place drip pans or absorbent materials under heavy equipment when not in use.
- Use adsorbent materials on small spills rather than hosing down the spill.
- Remove the adsorbent materials promptly and dispose of properly.
- Promptly transfer used fluids to the proper waste or recycling drums. Don't leave full drip pans or other open containers lying around.
- Oil filters disposed of in trashcans or dumpsters can leak oil and contaminate stormwater. Place the oil filter in a funnel over a waste oil recycling drum to drain excess oil before disposal. Oil filters can also be recycled. Ask your oil supplier or recycler about recycling oil filters.

- Store cracked batteries in a non-leaking secondary container. Do this with all cracked batteries, even if you think all the acid has drained out. If you drop a battery, treat it as if it is cracked. Put it into the containment area until you are sure it is not leaking.

Vehicle and Equipment Fueling

- Design the fueling area to prevent the run-on of stormwater and the runoff of spills:
  - Cover fueling area if possible.
  - Use a perimeter drain or slope pavement inward with drainage to a sump.
  - Pave fueling area with concrete rather than asphalt.
- If dead-end sump is not used to collect spills, install an oil/water separator.
- Install vapor recovery nozzles to help control drips as well as air pollution.
- Discourage "topping-off' of fuel tanks.
- Use secondary containment when transferring fuel from the tank truck to the fuel tank.
- Use adsorbent materials on small spills and general cleaning rather than hosing down the area. Remove the adsorbent materials promptly.
- Carry out all Federal and State requirements regarding underground storage tanks, or install above ground tanks.
- Do not use mobile fueling of mobile industrial equipment around the facility; rather, transport the equipment to designated fueling areas.
- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Train employees in proper fueling and cleanup procedures.

Industrial Spill Prevention Response

For the purposes of developing a spill prevention and response program to meet the stormwater regulations, facility managers should use information provided in this fact sheet and the spill prevention/response portions of the fact sheets in this handbook, for specific activities. The program should:

- Integrate with existing emergency response/hazardous materials programs (e.g., Fire Department)
- Develop procedures to prevent/mitigate spills to storm drain systems
- Identify responsible departments
- Develop and standardize reporting procedures, containment, storage, and disposal activities, documentation, and follow-up procedures
- Address spills at municipal facilities, as well as public areas

- Provide training concerning spill prevention, response and cleanup to all appropriate personnel

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

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Stormwater Managers Resource Center http://www.stormwatercenter.net/

Outdoor Equipment Maintenance SC-32

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	☑
Nutrients	
Trash	☑
Metals	☑
Bacteria	
Oil and Grease	☑
Organics	☑
Oxygen Demanding	

Description

Outside process equipment operations and maintenance can contaminate stormwater runoff. Activities, such as grinding, painting, coating, sanding, degreasing or parts cleaning, landfills and waste piles, solid waste treatment and disposal, are examples of process operations that can lead to contamination of stormwater runoff. Source controls for outdoor process equipment operations and maintenance include reducing the amount of waste created, enclosing or covering all or some of the equipment, installing secondary containment, and training employees.

Approach

Pollution Prevention

- Perform the activity during dry periods.
- Use non-toxic chemicals for maintenance and minimize or eliminate the use of solvents.

Suggested Protocols

- Consider enclosing the activity in a building and connecting the floor drains to the sanitary sewer.
- Cover the work area with a permanent roof.
- Minimize contact of stormwater with outside process equipment operations through berming and drainage routing (runon prevention). If allowed, connect process equipment area to public sewer.
- Dry clean the work area regularly.

Training

- Train employees to perform the activity during dry periods only and to use less or non-toxic materials.
- Train employee and contractors in proper techniques for spill containment and cleanup. The employee should have the tools and knowledge to immediately begin cleaning up a spill if one should occur.

Spill Response and Prevention

- Refer to SC-11, Spill Prevention, Control & Cleanup
- Keep your spill prevention control and countermeasure (SPCC) plan up-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

- Space limitations may preclude enclosing some equipment.
- Storage sheds often must meet building and fire code requirements.

Requirements

Costs

- Costs vary depending on the complexity of the operation and the amount of control necessary for stormwater pollution control.
- Providing cover may be expensive.

Maintenance

- Conduct routine preventive maintenance, including checking process equipment for leaks.
- Clean the storm drain system regularly.

Supplemental Information

Further Detail of the BMP

Hydraulic/Treatment Modifications

In some cases it may be necessary to capture and treat polluted stormwater. If the municipality does not have its own process wastewater treatment system, consider discharging to the public sewer system. Use of the public sewer might be allowed under the following conditions:

- If the activity area is very small (less than a few hundred square feet), the local sewer authority may be willing to allow the area to remain uncovered with the drain connected to the public sewer.
- It may be possible under unusual circumstances to connect a much larger area to the public sewer, as long as the rate of stormwater discharges does not exceed the capacity of the wastewater treatment plant. The stormwater could be stored during the storm and then transferred to the public sewer when the normal flow is low, such as at night.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Stormwater Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Stormwater Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Stormwater Managers Resource Center http://www.stormwatercenter.net/

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	☑
Oxygen Demanding	☑

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 following protocols 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

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.

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 concentrations.

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- Arrange rooftop drains to prevent drainage directly onto paved surfaces.
- Design lot to include semi-permeable hardscape.

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 or vacuuming) to prevent the discharge of pollutants into the stormwater conveyance system.
- 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.
- If water is used follow the procedures below:
  - Block the storm drain or contain runoff.
  - Wash water should be collected and pumped to the sanitary sewer or discharged to a pervious surface, do not allow wash water to enter storm drains.
  - Dispose of parking lot sweeping debris and dirt at a landfill.
- When cleaning heavy oily deposits:
  - Use absorbent materials on oily spots prior to sweeping or washing.
  - Dispose of used absorbents appropriately.

Surface Repair

- Pre-heat, transfer or load hot bituminous material away from storm drain inlets.
- Apply concrete, asphalt, and seal coat during dry weather to prevent contamination form contacting stormwater runoff.
- Cover and seal nearby storm drain inlets (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc., where applicable. Leave covers in place until job is complete and until 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 the parking facilities and stormwater conveyance systems associated with them 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

- Refer to SC-11, Spill Prevention, Control & Cleanup.
- Keep your Spill Prevention Control and countermeasure (SPCC) plan up-to-date, nad 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

- Limitations related to sweeping activities at large parking facilities may include high equipment costs, the need for sweeper operator training, and the inability of current sweeper technology to remove oil and grease.

Requirements

Costs

Cleaning/sweeping costs can be quite large, construction and maintenance of stormwater structural controls can be quite expensive as well.

Maintenance

- Sweep parking lot to minimize cleaning with water.
- Clean out oil/water/sand separators regularly, especially after heavy storms.
- Clean parking facilities on a regular basis to prevent accumulated wastes and pollutants from being discharged into conveyance systems during rainy conditions.

SC-43 Parking/Storage Area Maintenance

Supplemental Information

Further Detail of the BMP

Surface Repair

Apply concrete, asphalt, and seal coat during dry weather to prevent contamination form 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 until 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.

References and Resources

http://www.stormwatercenter.net/

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Model Urban Runoff Program: A How-To Guide for Developing Urban Runoff Programs for Small Municipalities. Prepared by City of Monterey, City of Santa Cruz, California Coastal Commission, Monterey Bay National Marine Sanctuary, Association of Monterey Bay Area Governments, Woodward-Clyde, Central Coast Regional Water Quality control Board. July 1998 (Revised February 2002 by the California Coastal Commission).

Orange County Stormwater Program
http://www.ocwatersheds.com/StormWater/swp_introduction.asp

Oregon Association of Clean Water Agencies. Oregon Municipal Stormwater Toolbox for Maintenance Practices. June 1998.

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA) http://www.basma.org

San Diego Stormwater Co-permittees Jurisdictional Urban Runoff Management Program (URMP)
http://www.projectcleanwater.org/pdf/Model%20Program%20Municipal%20Facilities.pdf

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	☑
Nutrients	
Trash	☑
Metals	☑
Bacteria	
Oil and Grease	☑
Organics	☑
Oxygen Demanding	☑

Description

Streets, roads, and highways are significant sources of pollutants in stormwater discharges, and operation and maintenance (O&M) practices, if not conducted properly, can contribute to the problem. Stormwater pollution from roadway and bridge maintenance should be addressed on a site-specific basis. Use of the procedures outlined below, that address street sweeping and repair, bridge and structure maintenance, and unpaved roads will reduce pollutants in stormwater.

Approach

Pollution Prevention

- Use the least toxic materials available (e.g. water based paints, gels or sprays for graffiti removal)
- Recycle paint and other materials whenever possible.
- Enlist the help of citizens to keep yard waste, used oil, and other wastes out of the gutter.

Suggested Protocols

Street Sweeping and Cleaning

- Maintain a consistent sweeping schedule. Provide minimum monthly sweeping of curbed streets.
- Perform street cleaning during dry weather if possible.

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- Avoid wet cleaning or flushing of street, and utilize dry methods where possible.
- Consider increasing sweeping frequency based on factors such as traffic volume, land use, field observations of sediment and trash accumulation, proximity to water courses, etc. For example:
  - Increase the sweeping frequency for streets with high pollutant loadings, especially in high traffic and industrial areas.
  - Increase the sweeping frequency just before the wet season to remove sediments accumulated during the summer.
  - Increase the sweeping frequency for streets in special problem areas such as special events, high litter or erosion zones.
- Maintain cleaning equipment in good working condition and purchase replacement equipment as needed. Old sweepers should be replaced with new technologically advanced sweepers (preferably regenerative air sweepers) that maximize pollutant removal.
- Operate sweepers at manufacturer requested optimal speed levels to increase effectiveness.
- To increase sweeping effectiveness consider the following:
  - Institute a parking policy to restrict parking in problematic areas during periods of street sweeping.
  - Post permanent street sweeping signs in problematic areas; use temporary signs if installation of permanent signs is not possible.
  - Develop and distribute flyers notifying residents of street sweeping schedules.
- Regularly inspect vehicles and equipment for leaks, and repair immediately.
- If available use vacuum or regenerative air sweepers in the high sediment and trash areas (typically industrial/commercial).
- Keep accurate logs of the number of curb-miles swept and the amount of waste collected.
- Dispose of street sweeping debris and dirt at a landfill.
- Do not store swept material along the side of the street or near a storm drain inlet.
- Keep debris storage to a minimum during the wet season or make sure debris piles are contained (e.g. by berming the area) or covered (e.g. with tarps or permanent covers).

Street Repair and Maintenance

Pavement marking

- Schedule pavement marking activities for dry weather.

- Develop paint handling procedures for proper use, storage, and disposal of paints.
- Transfer and load paint and hot thermoplastic away from storm drain inlets.
- Provide drop cloths and drip pans in paint mixing areas.
- Properly maintain application equipment.
- Street sweep thermoplastic grindings. Yellow thermoplastic grindings may require special handling as they may contain lead.
- Paints containing lead or tributyltin are considered a hazardous waste and must be disposed of properly.
- Use water based paints whenever possible. If using water based paints, clean the application equipment in a sink that is connected to the sanitary sewer.
- Properly store leftover paints if they are to be kept for the next job, or dispose of properly.

Concrete installation and repair

- Schedule asphalt and concrete activities for dry weather.
- Take measures to protect any nearby storm drain inlets and adjacent watercourses, prior to breaking up asphalt or concrete (e.g. place san bags around inlets or work areas).
- Limit the amount of fresh concrete or cement mortar mixed, mix only what is needed for the job.
- Store concrete materials under cover, away from drainage areas. Secure bags of cement after they are open. Be sure to keep wind-blown cement powder away from streets, gutters, storm drains, rainfall, and runoff.
- Return leftover materials to the transit mixer. Dispose of small amounts of hardened excess concrete, grout, and mortar in the trash.
- Do not wash sweepings from exposed aggregate concrete into the street or storm drain. Collect and return sweepings to aggregate base stockpile, or dispose in the trash.
- When making saw cuts in pavement, use as little water as possible and perform during dry weather. Cover each storm drain inlet completely with filter fabric or plastic during the sawing operation and contain the slurry by placing straw bales, sandbags, or gravel dams around the inlets. After the liquid drains or evaporates, shovel or vacuum the slurry residue from the pavement or gutter and remove from site. Alternatively, a small onsite vacuum may be used to pick up the slurry as this will prohibit slurry from reaching storm drain inlets.
- Wash concrete trucks off site or in designated areas on site designed to preclude discharge of wash water to drainage system.

Patching, resurfacing, and surface sealing

- Schedule patching, resurfacing and surface sealing for dry weather.
- Stockpile materials away from streets, gutter areas, storm drain inlets or watercourses. During wet weather, cover stockpiles with plastic tarps or berm around them if necessary to prevent transport of materials in runoff.
- Pre-heat, transfer or load hot bituminous material away from drainage systems or watercourses.
- Where applicable, cover and seal nearby storm drain inlets (with waterproof material or mesh) and maintenance holes before applying seal coat, slurry seal, etc. Leave covers in place until job is complete and until all water from emulsified oil sealants has drained or evaporated. Clean any debris from covered maintenance holes and storm drain inlets when the job is complete.
- Prevent excess material from exposed aggregate concrete or similar treatments from entering streets or storm drain inlets. Designate an area for clean up and proper disposal of excess materials.
- Use only as much water as necessary for dust control, to avoid runoff.
- Sweep, never hose down streets to clean up tracked dirt. Use a street sweeper or vacuum truck. Do not dump vacuumed liquid in storm drains.
- 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.

Equipment cleaning maintenance and storage

- Inspect equipment daily and repair any leaks. Place drip pans or absorbent materials under heavy equipment when not in use.
- Perform major equipment repairs at the corporation yard, when practical.
- If refueling or repairing vehicles and equipment must be done onsite, use a location away from storm drain inlets and watercourses.
- Clean equipment including sprayers, sprayer paint supply lines, patch and paving equipment, and mud jacking equipment at the end of each day. Clean in a sink or other area (e.g. vehicle wash area) that is connected to the sanitary sewer.

Bridge and Structure Maintenance

Paint and Paint Removal

- Transport paint and materials to and from job sites in containers with secure lids and tied down to the transport vehicle.
- Do not transfer or load paint near storm drain inlets or watercourses.

- Test and inspect spray equipment prior to starting to paint. Tighten all hoses and connections and do not overfill paint container.
- Plug nearby storm drain inlets prior to starting painting where there is significant risk of a spill reaching storm drains. Remove plugs when job is completed.
- If sand blasting is used to remove paint, cover nearby storm drain inlets prior to starting work.
- Perform work on a maintenance traveler or platform, or use suspended netting or tarps to capture paint, rust, paint removing agents, or other materials, to prevent discharge of materials to surface waters if the bridge crosses a watercourse. If sanding, use a sander with a vacuum filter bag.
- Capture all clean-up water, and dispose of properly.
- Recycle paint when possible (e.g. paint may be used for graffiti removal activities). Dispose of unused paint at an appropriate household hazardous waste facility.

Graffiti Removal

- Schedule graffiti removal activities for dry weather.
- Protect nearby storm drain inlets prior to removing graffiti from walls, signs, sidewalks, or other structures needing graffiti abatement. Clean up afterwards by sweeping or vacuuming thoroughly, and/or by using absorbent and properly disposing of the absorbent.
- When graffiti is removed by painting over, implement the procedures under Painting and Paint Removal above.
- Direct runoff from sand blasting and high pressure washing (with no cleaning agents) into a landscaped or dirt area. If such an area is not available, filter runoff through an appropriate filtering device (e.g. filter fabric) to keep sand, particles, and debris out of storm drains.
- If a graffiti abatement method generates wash water containing a cleaning compound (such as high pressure washing with a cleaning compound), plug nearby storm drains and vacuum/pump wash water to the sanitary sewer.
- Consider using a waterless and non-toxic chemical cleaning method for graffiti removal (e.g. gels or spray compounds).

Repair Work

- Prevent concrete, steel, wood, metal parts, tools, or other work materials from entering storm drains or watercourses.
- Thoroughly clean up the job site when the repair work is completed.
- When cleaning guardrails or fences follow the appropriate surface cleaning methods (depending on the type of surface) outlined in SC-71 Plaza & Sidewalk Cleaning fact sheet.

- If painting is conducted, follow the painting and paint removal procedures above.
- If graffiti removal is conducted, follow the graffiti removal procedures above.
- If construction takes place, see the Construction Activity BMP Handbook.
- Recycle materials whenever possible.

Unpaved Roads and Trails

- Stabilize exposed soil areas to prevent soil from eroding during rain events. This is particularly important on steep slopes.
- For roadside areas with exposed soils, the most cost-effective choice is to vegetate the area, preferably with a mulch or binder that will hold the soils in place while the vegetation is establishing. Native vegetation should be used if possible.
- If vegetation cannot be established immediately, apply temporary erosion control mats/blankets; a comma straw, or gravel as appropriate.
- If sediment is already eroded and mobilized in roadside areas, temporary controls should be installed. These may include: sediment control fences, fabric-covered triangular dikes, gravel-filled burlap bags, biobags, or hay bales staked in place.

Non-Stormwater Discharges

Field crews should be aware of non-stormwater discharges as part of their ongoing street maintenance efforts.

- Refer to SC-10 Non-Stormwater Discharges
- Identify location, time and estimated quantity of discharges.
- Notify appropriate personnel.

Training

- Train employees regarding proper street sweeping operation and street repair and maintenance.
- Instruct employees and subcontractors to ensure that measures to reduce the stormwater impacts of roadway/bridge maintenance are being followed.
- Require engineering staff and/or consulting A/E firms to address stormwater quality in new bridge designs or existing bridge retrofits.
- Use a training log or similar method to document training.
- Train employees on proper spill containment and clean up, and in identifying non-stormwater discharges.

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

- Densely populated areas or heavily used streets may require parking regulations to clear streets for cleaning.
- No currently available conventional sweeper is effective at removing oil and grease. Mechanical sweepers are not effective at removing finer sediments.
- Limitations may arise in the location of new bridges. The availability and cost of land and other economic and political factors may dictate where the placement of a new bridge will occur. Better design of the bridge to control runoff is required if it is being placed near sensitive waters.

Requirements

Costs

- The maintenance of local roads and bridges is already a consideration of most community public works or transportation departments. Therefore, the cost of pollutant reducing management practices will involve the training and equipment required to implement these new practices.
- The largest expenditures for street sweeping programs are in staffing and equipment. The capital cost for a conventional street sweeper is between $60,000 and $120,000. Newer technologies might have prices approaching $180,000. The average useful life of a conventional sweeper is about four years, and programs must budget for equipment replacement. Sweeping frequencies will determine equipment life, so programs that sweep more often should expect to have a higher cost of replacement.
- A street sweeping program may require the following.
  - Sweeper operators, maintenance, supervisory, and administrative personnel are required.
  - Traffic control officers may be required to enforce parking restrictions.
  - Skillful design of cleaning routes is required for program to be productive.
  - Arrangements must be made for disposal of collected wastes.

- If investing in newer technologies, training for operators must be included in operation and maintenance budgets. Costs for public education are small, and mostly deal with the need to obey parking restrictions and litter control. Parking tickets are an effective reminder to obey parking rules, as well as being a source of revenue.

Maintenance

- Not applicable

Supplemental Information

Further Detail of the BMP

Street sweeping

There are advantages and disadvantages to the two common types of sweepers. The best choice depends on your specific conditions. Many communities find it useful to have a compliment of both types in their fleet.

Mechanical Broom Sweepers - More effective at picking up large debris and cleaning wet streets. Less costly to purchase and operate. Create more airborne dust.

Vacuum Sweepers - More effective at removing fine particles and associated heavy metals. Ineffective at cleaning wet streets. Noisier than mechanical broom sweepers which may restrict areas or times of operation. May require an advance vehicle to remove large debris.

Street Flushers - Not affected by biggest interference to cleaning, parked cars. May remove finer sediments, moving them toward the gutter and stormwater inlets. For this reason, flushing fell out of favor and is now used primarily after sweeping. Flushing may be effective for combined sewer systems. Presently street flushing is not allowed under most NPDES permits.

Cross-Media Transfer of Pollutants

The California Air Resources Board (ARB) has established state ambient air quality standards including a standard for respirable particulate matter (less than or equal to 10 microns in diameter, symbolized as PM10). In the effort to sweep up finer sediments to remove attached heavy metals, municipalities should be aware that fine dust, that cannot be captured by the sweeping equipment and becomes airborne, could lead to issues of worker and public safety.

Bridges

Bridges that carry vehicular traffic generate some of the more direct discharges of runoff to surface waters. Bridge scupper drains cause a direct discharge of stormwater into receiving waters and have been shown to carry relatively high concentrations of pollutants. Bridge maintenance also generates wastes that may be either directly deposited to the water below or carried to the receiving water by stormwater. The following steps will help reduce the stormwater impacts of bridge maintenance:

- Site new bridges so that significant adverse impacts to wetlands, sensitive areas, critical habitat, and riparian vegetation are minimized.

- Design new bridges to avoid the use of scupper drains and route runoff to land for treatment control. Existing scupper drains should be cleaned on a regular basis to avoid sediment/debris accumulation.
- Reduce the discharge of pollutants to surface waters during maintenance by using suspended traps, vacuums, or booms in the water to capture paint, rust, and paint removing agents. Many of these wastes may be hazardous. Properly dispose of this waste by referring to CA21 (Hazardous Waste Management) in the Construction Handbook.
- Train employees and subcontractors to reduce the discharge of wastes during bridge maintenance.

De-icing

- Do not over-apply deicing salt and sand, and routinely calibrate spreaders.
- Near reservoirs, restrict the application of deicing salt and redirect any runoff away from reservoirs.
- Consider using alternative deicing agents (less toxic, biodegradable, etc.).

References and Resources

Model Urban Runoff Program: A How-To Guide for Developing Urban Runoff Programs for Small Municipalities. Prepared by City of Monterey, City of Santa Cruz, California Coastal Commission, Monterey Bay National Marine Sanctuary, Association of Monterey Bay Area Governments, Woodward-Clyde, Central Coast Regional Water Quality Control Board. July. 1998.

Orange County Stormwater Program
http://www.ocwatersheds.com/stormwater/swp_introduction.asp

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Santa Clara Valley Urban Runoff Pollution Prevention Program. 2001. Fresh Concrete and Mortar Application Best Management Practices for the Construction Industry. June.

Santa Clara Valley Urban Runoff Pollution Prevention Program. 2001. Roadwork and Paving Best Management Practices for the Construction Industry. June.

United States Environmental Protection Agency (USEPA). 2002. Pollution Prevention/Good Housekeeping for Municipal Operations Roadway and Bridge Maintenance. On-line http://www.epa.gov/npdes/menuofbmps/poll_13.htm

Objectives

- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	☑
Nutrients	☑
Trash	☑
Metals	
Bacteria	
Oil and Grease	
Organics	
Oxygen Demanding	☑

Description

Landscape maintenance activities include vegetation removal; herbicide and insecticide application; fertilizer application; watering; and other gardening and lawn care practices. Vegetation control typically involves a combination of chemical (herbicide) application and mechanical methods. All of these maintenance practices have the potential to contribute pollutants to the storm drain system. The major objectives of this BMP are to minimize the discharge of pesticides, herbicides and fertilizers to the storm drain system and receiving waters; prevent the disposal of landscape waste into the storm drain system by collecting and properly disposing of clippings and cuttings, and educating employees and the public.

Approach

Pollution Prevention

- Implement an integrated pest management (IPM) program. IPM is a sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools.

- Choose low water using flowers, trees, shrubs, and groundcover.

- Consider alternative landscaping techniques such as naturescaping and xeriscaping.

- Conduct appropriate maintenance (i.e. properly timed fertilizing, weeding, pest control, and pruning) to help preserve the landscapes water efficiency.

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- Consider grass cycling (grass cycling is the natural recycling of grass by leaving the clippings on the lawn when mowing. Grass clippings decompose quickly and release valuable nutrients back into the lawn).

Suggested Protocols

Mowing, Trimming, and Weeding

- Whenever possible use mechanical methods of vegetation removal (e.g mowing with tractor-type or push mowers, hand cutting with gas or electric powered weed trimmers) rather than applying herbicides. Use hand weeding where practical.

- Avoid loosening the soil when conducting mechanical or manual weed control, this could lead to erosion. Use mulch or other erosion control measures when soils are exposed.

- Performing mowing at optimal times. Mowing should not be performed if significant rain events are predicted.

- Mulching mowers may be recommended for certain flat areas. Other techniques may be employed to minimize mowing such as selective vegetative planting using low maintenance grasses and shrubs.

- Collect lawn and garden clippings, pruning waste, tree trimmings, and weeds. Chip if necessary, and compost or dispose of at a landfill (see waste management section of this fact sheet).

- Place temporarily stockpiled material away from watercourses, and berm or cover stockpiles to prevent material releases to storm drains.

Planting

- Determine existing native vegetation features (location, species, size, function, importance) and consider the feasibility of protecting them. Consider elements such as their effect on drainage and erosion, hardiness, maintenance requirements, and possible conflicts between preserving vegetation and the resulting maintenance needs.

- Retain and/or plant selected native vegetation whose features are determined to be beneficial, where feasible. Native vegetation usually requires less maintenance (e.g., irrigation, fertilizer) than planting new vegetation.

- Consider using low water use groundcovers when planting or replanting.

Waste Management

- Compost leaves, sticks, or other collected vegetation or dispose of at a permitted landfill. Do not dispose of collected vegetation into waterways or storm drainage systems.

- Place temporarily stockpiled material away from watercourses and storm drain inlets, and berm or cover stockpiles to prevent material releases to the storm drain system.

- Reduce the use of high nitrogen fertilizers that produce excess growth requiring more frequent mowing or trimming.

- Avoid landscape wastes in and around storm drain inlets by either using bagging equipment or by manually picking up the material.

Irrigation

- Where practical, use automatic timers to minimize runoff.
- Use popup sprinkler heads in areas with a lot of activity or where there is a chance the pipes may be broken. Consider the use of mechanisms that reduce water flow to sprinkler heads if broken.
- Ensure that there is no runoff from the landscaped area(s) if re-claimed water is used for irrigation.
- If bailing of muddy water is required (e.g. when repairing a water line leak), do not put it in the storm drain; pour over landscaped areas.
- Irrigate slowly or pulse irrigate to prevent runoff and then only irrigate as much as is needed.
- Apply water at rates that do not exceed the infiltration rate of the soil.

Fertilizer and Pesticide Management

- Utilize a comprehensive management system that incorporates integrated pest management (IPM) techniques. There are many methods and types of IPM, including the following:
  - Mulching can be used to prevent weeds where turf is absent, fencing installed to keep rodents out, and netting used to keep birds and insects away from leaves and fruit.
  - Visible insects can be removed by hand (with gloves or tweezers) and placed in soapy water or vegetable oil. Alternatively, insects can be sprayed off the plant with water or in some cases vacuumed off of larger plants.
  - Store-bought traps, such as species-specific, pheromone-based traps or colored sticky cards, can be used.
  - Slugs can be trapped in small cups filled with beer that are set in the ground so the slugs can get in easily.
  - In cases where microscopic parasites, such as bacteria and fungi, are causing damage to plants, the affected plant material can be removed and disposed of (pruning equipment should be disinfected with bleach to prevent spreading the disease organism).
  - Small mammals and birds can be excluded using fences, netting, tree trunk guards.
  - Beneficial organisms, such as bats, birds, green lacewings, ladybugs, praying mantis, ground beetles, parasitic nematodes, trichogramma wasps, seed head weevils, and spiders that prey on detrimental pest species can be promoted.
- Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of fertilizers and pesticides and training of applicators and pest control advisors.

- Use pesticides only if there is an actual pest problem (not on a regular preventative schedule).
- Do not use pesticides if rain is expected. Apply pesticides only when wind speeds are low (less than 5 mph).
- Do not mix or prepare pesticides for application near storm drains.
- Prepare the minimum amount of pesticide needed for the job and use the lowest rate that will effectively control the pest.
- Employ techniques to minimize off-target application (e.g. spray drift) of pesticides, including consideration of alternative application techniques.
- Fertilizers should be worked into the soil rather than dumped or broadcast onto the surface.
- Calibrate fertilizer and pesticide application equipment to avoid excessive application.
- Periodically test soils for determining proper fertilizer use.
- Sweep pavement and sidewalk if fertilizer is spilled on these surfaces before applying irrigation water.
- Purchase only the amount of pesticide that you can reasonably use in a given time period (month or year depending on the product).
- Triple rinse containers, and use rinse water as product. Dispose of unused pesticide as hazardous waste.
- Dispose of empty pesticide containers according to the instructions on the container label.

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.
- Inspect pesticide/fertilizer equipment and transportation vehicles daily.

Training

- Educate and train employees on use of pesticides and in pesticide application techniques to prevent pollution. Pesticide application must be under the supervision of a California qualified pesticide applicator.
- Train/encourage municipal maintenance crews to use IPM techniques for managing public green areas.
- Annually train employees within departments responsible for pesticide application on the appropriate portions of the agency's IPM Policy, SOPs, and BMPs, and the latest IPM techniques.

- Employees who are not authorized and trained to apply pesticides should be periodically (at least annually) informed that they cannot use over-the-counter pesticides in or around the workplace.
- Use a training log or similar method to document training.

Spill Response and Prevention

- Refer to SC-11, Spill Prevention, Control & Cleanup
- Have spill cleanup materials readily available and in a know in location
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

Other Considerations

- The Federal Pesticide, Fungicide, and Rodenticide Act and California Title 3, Division 6, Pesticides and Pest Control Operations place strict controls over pesticide application and handling and specify training, annual refresher, and testing requirements. The regulations generally cover: a list of approved pesticides and selected uses, updated regularly; general application information; equipment use and maintenance procedures; and record keeping. The California Department of Pesticide Regulations and the County Agricultural Commission coordinate and maintain the licensing and certification programs. All public agency employees who apply pesticides and herbicides in "agricultural use" areas such as parks, golf courses, rights-of-way and recreation areas should be properly certified in accordance with state regulations. Contracts for landscape maintenance should include similar requirements.
- All employees who handle pesticides should be familiar with the most recent material safety data sheet (MSDS) files.
- Municipalities do not have the authority to regulate the use of pesticides by school districts, however the California Healthy Schools Act of 2000 (AB 2260) has imposed requirements on California school districts regarding pesticide use in schools. Posting of notification prior to the application of pesticides is now required, and IPM is stated as the preferred approach to pest management in schools.

Requirements

Costs

Additional training of municipal employees will be required to address IPM techniques and BMPs. IPM methods will likely increase labor cost for pest control which may be offset by lower chemical costs.

Maintenance

Not applicable

Supplemental Information

Further Detail of the BMP

Waste Management

Composting is one of the better disposal alternatives if locally available. Most municipalities either have or are planning yard waste composting facilities as a means of reducing the amount of waste going to the landfill. Lawn clippings from municipal maintenance programs as well as private sources would probably be compatible with most composting facilities

Contractors and Other Pesticide Users

Municipal agencies should develop and implement a process to ensure that any contractor employed to conduct pest control and pesticide application on municipal property engages in pest control methods consistent with the IPM Policy adopted by the agency. Specifically, municipalities should require contractors to follow the agency's IPM policy, SOPs, and BMPs; provide evidence to the agency of having received training on current IPM techniques when feasible; provide documentation of pesticide use on agency property to the agency in a timely manner.

References and Resources

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Los Angeles County Stormwater Quality Model Programs. Public Agency Activities http://ladpw.org/wmd/npdes/model_links.cfm

Model Urban Runoff Program: A How-To Guide for Developing Urban Runoff Programs for Small Municipalities. Prepared by City of Monterey, City of Santa Cruz, California Coastal Commission, Monterey Bay National Marine Sanctuary, Association of Monterey Bay Area Governments, Woodward-Clyde, Central Coast Regional Water Quality Control Board. July. 1998.

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Santa Clara Valley Urban Runoff Pollution Prevention Program. 1997 Urban Runoff Management Plan. September 1997, updated October 2000.

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Drainage System Maintenance SC-74

Photo Credit: Geoff Brosseau

Objectives

- Contain
- Educate
- Reduce/Minimize

Targeted Constituents

Sediment	☑
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	☑
Oil and Grease	☑
Organics	☑
Oxygen Demanding	☑

Description

As a consequence of its function, the stormwater conveyance system collects and transports urban runoff that may contain certain pollutants. Maintaining catch basins, stormwater inlets, and other stormwater conveyance structures on a regular basis will remove pollutants, prevent clogging of the downstream conveyance system, restore catch basins' sediment trapping capacity, and ensure the system functions properly hydraulically to avoid flooding.

Approach

Suggested Protocols

Catch Basins/Inlet Structures

- Municipal staff should regularly inspect facilities to ensure the following:
  - Immediate repair of any deterioration threatening structural integrity.
  - Cleaning before the sump is 40% full. Catch basins should be cleaned as frequently as needed to meet this standard.
  - Stenciling of catch basins and inlets (see SC-75 Waste Handling and Disposal).
- Clean catch basins, storm drain inlets, and other conveyance structures in high pollutant load areas just before the wet season to remove sediments and debris accumulated during the summer.

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- Conduct inspections more frequently during the wet season for problem areas where sediment or trash accumulates more often. Clean and repair as needed.
- Keep accurate logs of the number of catch basins cleaned.
- Record the amount of waste collected.
- 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 with outflow into the sanitary sewer if permitted. Water should be treated with an appropriate filtering device prior to discharge to the sanitary sewer. If discharge to the sanitary sewer is not allowed, water should be pumped or vacuumed to a tank and properly disposed of. Do not dewater near a storm drain or stream.
- Except for small communities with relatively few catch basins that may be cleaned manually, most municipalities will require mechanical cleaners such as eductors, vacuums, or bucket loaders.

Storm Drain Conveyance System

- Locate reaches of storm drain with deposit problems and develop a flushing schedule that keeps the pipe clear of excessive buildup.
- Collect flushed effluent and pump to the sanitary sewer for treatment.

Pump Stations

- Clean all storm drain pump stations prior to the wet season to remove silt and trash.
- Do not allow discharge from cleaning a storm drain pump station or other facility to reach the storm drain system.
- Conduct quarterly routine maintenance at each pump station.
- Inspect, clean, and repair as necessary all outlet structures prior to the wet season.
- Sample collected sediments to determine if landfill disposal is possible, or illegal discharges in the watershed are occurring.

Open Channel

- Consider modification of storm channel characteristics to improve channel hydraulics, to increase pollutant removals, and to enhance channel/creek aesthetic and habitat value.
- Conduct channel modification/improvement in accordance with existing laws. Any person, government agency, or public utility proposing an activity that will change the natural (emphasis added) state of any river, stream, or lake in California, must enter into a steam or Lake Alteration Agreement with the Department of Fish and Game. The developer-applicant should also contact local governments (city, county, special districts), other state agencies

(SWRCB, RWQCB, Department of Forestry, Department of Water Resources), and Federal Corps of Engineers and USFWS

Illicit Connections and Discharges

- During routine maintenance of conveyance system and drainage structures field staff should look for evidence of illegal discharges or illicit connections:
  - Is there evidence of spills such as paints, discoloring, etc.
  - Are there any odors associated with the drainage system
  - Record locations of apparent illegal discharges/illicit connections
  - Track flows back to potential dischargers and conduct aboveground inspections. This can be done through visual inspection of up gradient manholes or alternate techniques including zinc chloride smoke testing, fluorometric dye testing, physical inspection testing, or television camera inspection.
  - Once the origin of flow is established, require illicit discharger to eliminate the discharge.
- Stencil storm drains, where applicable, to prevent illegal disposal of pollutants. Storm drain inlets should have messages such as “Dump No Waste Drains to Stream” stenciled next to them to warn against ignorant or intentional dumping of pollutants into the storm drainage system.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

Illegal Dumping

- Regularly inspect 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.

- The State Department of Fish and Game has a hotline for reporting violations called Cal TIP (1-800-952-5400). The phone number may be used to report any violation of a Fish and Game code (illegal dumping, poaching, etc.).

- The California Department of Toxic Substances Control's Waste Alert Hotline, 1-800-69TOXIC, can be used to report hazardous waste violations.

Training

- Train crews in proper maintenance activities, including record keeping and disposal.

- Only properly trained individuals are allowed to handle hazardous materials/wastes.

- Train municipal employees from all departments (public works, utilities, street cleaning, parks and recreation, industrial waste inspection, hazardous waste inspection, sewer maintenance) to recognize and report illegal dumping.

- Train municipal employees and educate businesses, contractors, and the general public in proper and consistent methods for disposal.

- Train municipal staff regarding non-stormwater discharges (See SC-10 Non-Stormwater Discharges).

Spill Response and Prevention

- Refer to SC-11, Prevention, Control & Cleanup

- 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

- Cleanup activities may create a slight disturbance for local aquatic species. Access to items and material on private property may be limited. Trade-offs may exist between channel hydraulics and water quality/riparian habitat. If storm channels or basins are recognized as wetlands, many activities, including maintenance, may be subject to regulation and permitting.

- Storm drain flushing is most effective in small diameter pipes (36-inch diameter pipe or less, depending on water supply and sediment collection capacity). Other considerations associated with storm drain flushing may include the availability of a water source, finding a downstream area to collect sediments, liquid/sediment disposal, and disposal of flushed effluent to sanitary sewer may be prohibited in some areas.

- Regulations may include adoption of substantial penalties for illegal dumping and disposal.

- Municipal codes should include sections prohibiting the discharge of soil, debris, refuse, hazardous wastes, and other pollutants into the storm drain system.

- Private property access rights may be needed to track illegal discharges up gradient.

- Requirements of municipal ordinance authority for suspected source verification testing for illicit connections necessary for guaranteed rights of entry.

Requirements

Costs

- An aggressive catch basin cleaning program could require a significant capital and O&M budget. A careful study of cleaning effectiveness should be undertaken before increased cleaning is implemented. Catch basin cleaning costs are less expensive if vacuum street sweepers are available; cleaning catch basins manually can cost approximately twice as much as cleaning the basins with a vacuum attached to a sweeper.

- Methods used for illicit connection detection (smoke testing, dye testing, visual inspection, and flow monitoring) can be costly and time-consuming. Site-specific factors, such as the level of impervious area, the density and ages of buildings, and type of land use will determine the level of investigation necessary. Encouraging reporting of illicit discharges by employees can offset costs by saving expense on inspectors and directing resources more efficiently. Some programs have used funds available from "environmental fees" or special assessment districts to fund their illicit connection elimination programs.

Maintenance

- Two-person teams may be required to clean catch basins with vactor trucks.

- Identifying illicit discharges requires teams of at least two people (volunteers can be used), plus administrative personnel, depending on the complexity of the storm sewer system.

- Arrangements must be made for proper disposal of collected wastes.

- Requires technical staff to detect and investigate illegal dumping violations, and to coordinate public education.

Supplemental Information

Further Detail of the BMP

Storm Drain flushing

Sanitary sewer flushing is a common maintenance activity used to improve pipe hydraulics and to remove pollutants in sanitary sewer systems. The same principles that make sanitary sewer flushing effective can be used to flush storm drains. Flushing may be designed to hydraulically convey accumulated material to strategic locations, such as to an open channel, to another point where flushing will be initiated, or over to the sanitary sewer and on to the treatment facilities, thus preventing re-suspension and overflow of a portion of the solids during storm events. Flushing prevents "plug flow" discharges of concentrated pollutant loadings and sediments. The deposits can hinder the designed conveyance capacity of the storm drain system and potentially cause backwater conditions in severe cases of clogging.

Storm drain flushing usually takes place along segments of pipe with grades that are too flat to maintain adequate velocity to keep particles in suspension. An upstream manhole is selected to place an inflatable device that temporarily plugs the pipe. Further upstream, water is pumped into the line to create a flushing wave. When the upstream reach of pipe is sufficiently full to cause a flushing wave, the inflated device is rapidly deflated with the assistance of a vacuum pump, releasing the backed up water and resulting in the cleaning of the storm drain segment.

To further reduce the impacts of stormwater pollution, a second inflatable device, placed well downstream, may be used to re-collect the water after the force of the flushing wave has dissipated. A pump may then be used to transfer the water and accumulated material to the sanitary sewer for treatment. In some cases, an interceptor structure may be more practical or required to re-collect the flushed waters.

It has been found that cleansing efficiency of periodic flush waves is dependent upon flush volume, flush discharge rate, sewer slope, sewer length, sewer flow rate, sewer diameter, and population density. As a rule of thumb, the length of line to be flushed should not exceed 700 feet. At this maximum recommended length, the percent removal efficiency ranges between 65-75 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 or that fire hydrant line flushing coincide with storm drain flushing.

Flow Management

Flow management has been one of the principal motivations for designing urban stream corridors in the past. Such needs may or may not be compatible with the stormwater quality goals in the stream corridor.

Downstream flood peaks can be suppressed by reducing through flow velocity. This can be accomplished by reducing gradient with grade control structures or increasing roughness with boulders, dense vegetation, or complex banks forms. Reducing velocity correspondingly increases flood height, so all such measures have a natural association with floodplain open space. Flood elevations laterally adjacent to the stream can be lowered by increasing through flow velocity.

However, increasing velocity increases flooding downstream and inherently conflicts with channel stability and human safety. Where topography permits, another way to lower flood elevation is to lower the level of the floodway with drop structures into a large but subtly excavated bowl where flood flows we allowed to spread out.

Stream Corridor Planning

Urban streams receive and convey stormwater flows from developed or developing watersheds. Planning of stream corridors thus interacts with urban stormwater management programs. If local programs are intended to control or protect downstream environments by managing flows delivered to the channels, then it is logical that such programs should be supplemented by management of the materials, forms, and uses of the downstream riparian corridor. Any proposal for steam alteration or management should be investigated for its potential flow and stability effects on upstream, downstream, and laterally adjacent areas. The timing and rate of flow from various tributaries can combine in complex ways to alter flood hazards. Each section of channel is unique, influenced by its own distribution of roughness elements, management activities, and stream responses.

Flexibility to adapt to stream features and behaviors as they evolve must be included in stream reclamation planning. The amenity and ecology of streams may be enhanced through the landscape design options of 1) corridor reservation, 2) bank treatment, 3) geomorphic restoration, and 4) grade control.

Corridor reservation - Reserving stream corridors and valleys to accommodate natural stream meandering, aggradation, degradation, and over bank flows allows streams to find their own form and generate less ongoing erosion. In California, open stream corridors in recent urban developments have produced recreational open space, irrigation of streamside plantings, and the aesthetic amenity of flowing water.

Bank treatment - The use of armoring, vegetative cover, and flow deflection may be used to influence a channel's form, stability, and biotic habitat. To prevent bank erosion, armoring can be done with rigid construction materials, such as concrete, masonry, wood planks and logs, riprap, and gabions. Concrete linings have been criticized because of their lack of provision of biotic habitat. In contrast, riprap and gabions make relatively porous and flexible linings. Boulders, placed in the bed reduce velocity and erosive power.

Riparian vegetation can stabilize the banks of streams that are at or near a condition of equilibrium. Binding networks of roots increase bank shear strength. During flood flows, resilient vegetation is forced into erosion-inhibiting mats. The roughness of vegetation leads to lower velocity, further reducing erosive effects. Structural flow deflection can protect banks from erosion or alter fish habitat. By concentrating flow, a deflector causes a pool to be scoured in the bed.

Geomorphic restoration – Restoration refers to alteration of disturbed streams so their form and behavior emulate those of undisturbed streams. Natural meanders are retained, with grading to gentle slopes on the inside of curves to allow point bars and riffle-pool sequences to develop. Trees are retained to provide scenic quality, biotic productivity, and roots for bank stabilization, supplemented by plantings where necessary.

A restorative approach can be successful where the stream is already approaching equilibrium. However, if upstream urbanization continues new flow regimes will be generated that could disrupt the equilibrium of the treated system.

Grade Control - A grade control structure is a level shelf of a permanent material, such as stone, masonry, or concrete, over which stream water flows. A grade control structure is called a sill, weir, or drop structure, depending on the relation of its invert elevation to upstream and downstream channels.

A sill is installed at the preexisting channel bed elevation to prevent upstream migration of nick points. It establishes a firm base level below which the upstream channel can not erode.

A weir or check dam is installed with invert above the preexisting bed elevation. A weir raises the local base level of the stream and causes aggradation upstream. The gradient, velocity, and erosive potential of the stream channel are reduced. A drop structure lowers the downstream invert below its preexisting elevation, reducing downstream gradient and velocity. Weirs and drop structure control erosion by dissipating energy and reducing slope velocity.

When carefully applied, grade control structures can be highly versatile in establishing human and environmental benefits in stabilized channels. To be successful, application of grade control structures should be guided by analysis of the stream system both upstream and downstream from the area to he reclaimed.

Examples

The California Department of Water Resources began the Urban Stream Restoration Program in 1985. The program provides grant funds to municipalities and community groups to implement stream restoration projects. The projects reduce damages from streambank aid watershed instability arid floods while restoring streams' aesthetic, recreational, and fish and wildlife values.

In Buena Vista Park, upper floodway slopes are gentle and grassed to achieve continuity of usable park land across the channel of small boulders at the base of the slopes.

The San Diego River is a large, vegetative lined channel, which was planted in a variety of species to support riparian wildlife while stabilizing the steep banks of the floodway.

References and Resources

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San Diego Stormwater Co-permittees Jurisdictional Urban Runoff Management Program (URMP) Municipal Activities Model Program Guidance. 2001. Project Clean Water. November.

United States Environmental Protection Agency (USEPA). 1999. Stormwater Management Fact Sheet Non-stormwater Discharges to Storm Sewers. EPA 832-F-99-022. Office of Water, Washington, D.C. September.

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United States Environmental Protection Agency (USEPA). 2002. Pollution Prevention/Good Housekeeping for Municipal Operations Illegal Dumping Control. On line: http://www.epa.gov/npdes/menuofbmps/poll_7.htm

United States Environmental Protection Agency (USEPA). 2002. Pollution Prevention/Good Housekeeping for Municipal Operations Storm Drain System Cleaning. On line: http://www.epa.gov/npdes/menuofbmps/poll_16.htm

Rain Garden

Design Objectives

- ☑ Maximize Infiltration
- ☑ Provide Retention
- ☑ Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- ☑ Contain Pollutants
- Collect and Convey

Description

Various roof runoff controls are available to address stormwater that drains off rooftops. The objective is to reduce the total volume and rate of runoff from individual lots, and retain the pollutants on site that may be picked up from roofing materials and atmospheric deposition. Roof runoff controls consist of directing the roof runoff away from paved areas and mitigating flow to the storm drain system through one of several general approaches: cisterns or rain barrels; dry wells or infiltration trenches; pop-up emitters, and foundation planting. The first three approaches require the roof runoff to be contained in a gutter and downspout system. Foundation planting provides a vegetated strip under the drip line of the roof.

Approach

Design of individual lots for single-family homes as well as lots for higher density residential and commercial structures should consider site design provisions for containing and infiltrating roof runoff or directing roof runoff to vegetative swales or buffer areas. Retained water can be reused for watering gardens, lawns, and trees. Benefits to the environment include reduced demand for potable water used for irrigation, improved stormwater quality, increased groundwater recharge, decreased runoff volume and peak flows, and decreased flooding potential.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment.

Design Considerations

Designing New Installations

Cisterns or Rain Barrels

One method of addressing roof runoff is to direct roof downspouts to cisterns or rain barrels. A cistern is an above ground storage vessel with either a manually operated valve or a permanently open outlet. Roof runoff is temporarily stored and then released for irrigation or infiltration between storms. The number of rain

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barrels needed is a function of the rooftop area. Some low impact developers recommend that every house have at least 2 rain barrels, with a minimum storage capacity of 1000 liters. Roof barrels serve several purposes including mitigating the first flush from the roof which has a high volume, amount of contaminants, and thermal load. Several types of rain barrels are commercially available. Consideration must be given to selecting rain barrels that are vector proof and childproof. In addition, some barrels are designed with a bypass valve that filters out grit and other contaminants and routes overflow to a soak-away pit or rain garden.

If the cistern has an operable valve, the valve can be closed to store stormwater for irrigation or infiltration between storms. This system requires continual monitoring by the resident or grounds crews, but provides greater flexibility in water storage and metering. If a cistern is provided with an operable valve and water is stored inside for long periods, the cistern must be covered to prevent mosquitoes from breeding.

A cistern system with a permanently open outlet can also provide for metering stormwater runoff. If the cistern outlet is significantly smaller than the size of the downspout inlet (say ¼ to ½ inch diameter), runoff will build up inside the cistern during storms, and will empty out slowly after peak intensities subside. This is a feasible way to mitigate the peak flow increases caused by rooftop impervious land coverage, especially for the frequent, small storms.

Dry wells and Infiltration Trenches

Roof downspouts can be directed to dry wells or infiltration trenches. A dry well is constructed by excavating a hole in the ground and filling it with an open graded aggregate, and allowing the water to fill the dry well and infiltrate after the storm event. An underground connection from the downspout conveys water into the dry well, allowing it to be stored in the voids. To minimize sedimentation from lateral soil movement, the sides and top of the stone storage matrix can be wrapped in a permeable filter fabric, though the bottom may remain open. A perforated observation pipe can be inserted vertically into the dry well to allow for inspection and maintenance.

In practice, dry wells receiving runoff from single roof downspouts have been successful over long periods because they contain very little sediment. They must be sized according to the amount of rooftop runoff received, but are typically 4 to 5 feet square, and 2 to 3 feet deep, with a minimum of 1-foot soil cover over the top (maximum depth of 10 feet).

To protect the foundation, dry wells must be set away from the building at least 10 feet. They must be installed in solids that accommodate infiltration. In poorly drained soils, dry wells have very limited feasibility.

Infiltration trenches function in a similar manner and would be particularly effective for larger roof areas. An infiltration trench is a long, narrow, rock-filled trench with no outlet that receives stormwater runoff. These are described under Treatment Controls.

Pop-up Drainage Emitter

Roof downspouts can be directed to an underground pipe that daylights some distance from the building foundation, releasing the roof runoff through a pop-up emitter. Similar to a pop-up irrigation head, the emitter only opens when there is flow from the roof. The emitter remains flush to the ground during dry periods, for ease of lawn or landscape maintenance.

Foundation Planting

Landscape planting can be provided around the base to allow increased opportunities for stormwater infiltration and protect the soil from erosion caused by concentrated sheet flow coming off the roof. Foundation plantings can reduce the physical impact of water on the soil and provide a subsurface matrix of roots that encourage infiltration. These plantings must be sturdy enough to tolerate the heavy runoff sheet flows, and periodic soil saturation.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Supplemental Information

Examples

- City of Ottawa's Water Links Surface –Water Quality Protection Program
- City of Toronto Downspout Disconnection Program
- City of Boston, MA, Rain Barrel Demonstration Program

Other Resources

Hager, Marty Catherine, Stormwater, "Low-Impact Development", January/February 2003. www.stormh2o.com

Low Impact Urban Design Tools, Low Impact Development Design Center, Beltsville, MD. www.lid-stormwater.net

Start at the Source, Bay Area Stormwater Management Agencies Association, 1999 Edition

Efficient Irrigation SD-12

Design Objectives

☑ Maximize Infiltration
☑ Provide Retention
☑ Slow Runoff
Minimize Impervious Land Coverage
Prohibit Dumping of Improper Materials
Contain Pollutants
Collect and Convey

Description

Irrigation water provided to landscaped areas may result in excess irrigation water being conveyed into stormwater drainage systems.

Approach

Project plan designs for development and redevelopment should include application methods of irrigation water that minimize runoff of excess irrigation water into the stormwater conveyance system.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment. (Detached residential single-family homes are typically excluded from this requirement.)

Design Considerations

Designing New Installations

The following methods to reduce excessive irrigation runoff should be considered, and incorporated and implemented where determined applicable and feasible by the Permittee:

- Employ rain-triggered shutoff devices to prevent irrigation after precipitation.
- Design irrigation systems to each landscape area's specific water requirements.
- Include design featuring flow reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines.
- Implement landscape plans consistent with County or City water conservation resolutions, which may include provision of water sensors, programmable irrigation times (for short cycles), etc.

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- Design timing and application methods of irrigation water to minimize the runoff of excess irrigation water into the storm water drainage system.
- Group plants with similar water requirements in order to reduce excess irrigation runoff and promote surface filtration. Choose plants with low irrigation requirements (for example, native or drought tolerant species). Consider design features such as:
  - Using mulches (such as wood chips or bar) in planter areas without ground cover to minimize sediment in runoff
  - Installing appropriate plant materials for the location, in accordance with amount of sunlight and climate, and use native plant materials where possible and/or as recommended by the landscape architect
  - Leaving a vegetative barrier along the property boundary and interior watercourses, to act as a pollutant filter, where appropriate and feasible
  - Choosing plants that minimize or eliminate the use of fertilizer or pesticides to sustain growth
- Employ other comparable, equally effective methods to reduce irrigation water runoff.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Storm Drain Signage SD-13

Design Objectives

- Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- ☑ Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Waste materials dumped into storm drain inlets can have severe impacts on receiving and ground waters. Posting notices regarding discharge prohibitions at storm drain inlets can prevent waste dumping. Storm drain signs and stencils are highly visible source controls that are typically placed directly adjacent to storm drain inlets.

Approach

The stencil or affixed sign contains a brief statement that prohibits dumping of improper materials into the urban runoff conveyance system. Storm drain messages have become a popular method of alerting the public about the effects of and the prohibitions against waste disposal.

Suitable Applications

Stencils and signs alert the public to the destination of pollutants discharged to the storm drain. Signs are appropriate in residential, commercial, and industrial areas, as well as any other area where contributions or dumping to storm drains is likely.

Design Considerations

Storm drain message markers or placards are recommended at all storm drain inlets within the boundary of a development project. The marker should be placed in clear sight facing toward anyone approaching the inlet from either side. All storm drain inlet locations should be identified on the development site map.

Designing New Installations

The following methods should be considered for inclusion in the project design and show on project plans:

- Provide stenciling or labeling of all storm drain inlets and catch basins, constructed or modified, within the project area with prohibitive language. Examples include "NO DUMPING

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– DRAINS TO OCEAN" and/or other graphical icons to discourage illegal dumping.

- Post signs with prohibitive language and/or graphical icons, which prohibit illegal dumping at public access points along channels and creeks within the project area.

Note - Some local agencies have approved specific signage and/or storm drain message placards for use. Consult local agency stormwater staff to determine specific requirements for placard types and methods of application.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. If the project meets the definition of "redevelopment", then the requirements stated under " designing new installations" above should be included in all project design plans.

Additional Information

Maintenance Considerations

- Legibility of markers and signs should be maintained. If required by the agency with jurisdiction over the project, the owner/operator or homeowner's association should enter into a maintenance agreement with the agency or record a deed restriction upon the property title to maintain the legibility of placards or signs.

Placement

- Signage on top of curbs tends to weather and fade.

- Signage on face of curbs tends to be worn by contact with vehicle tires and sweeper brooms.

Supplemental Information

Examples

- Most MS4 programs have storm drain signage programs. Some MS4 programs will provide stencils, or arrange for volunteers to stencil storm drains as part of their outreach program.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Trash Storage Areas SD-32

Design Objectives

Maximize Infiltration

Provide Retention

Slow Runoff

Minimize Impervious Land Coverage

Prohibit Dumping of Improper Materials

☑ Contain Pollutants

Collect and Convey

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.

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

- Use lined bins or dumpsters to reduce leaking of liquid waste.
- Provide roofs, awnings, or attached lids on all trash containers to minimize direct precipitation and prevent rainfall from entering containers.
- Pave trash storage areas with an impervious surface to mitigate spills.
- Do not locate storm drains in immediate vicinity of the trash storage area.
- Post signs on all dumpsters informing users that hazardous materials are not to be disposed of therein.

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

Maintenance Considerations

The integrity of structural elements that are subject to damage (i.e., screens, covers, and signs) must be maintained by the owner/operator. Maintenance agreements between the local agency and the owner/operator may be required. Some agencies will require maintenance deed restrictions to be recorded of the property title. If required by the local agency, maintenance agreements or deed restrictions must be executed by the owner/operator before improvement plans are approved.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Outdoor Work Areas SD-35

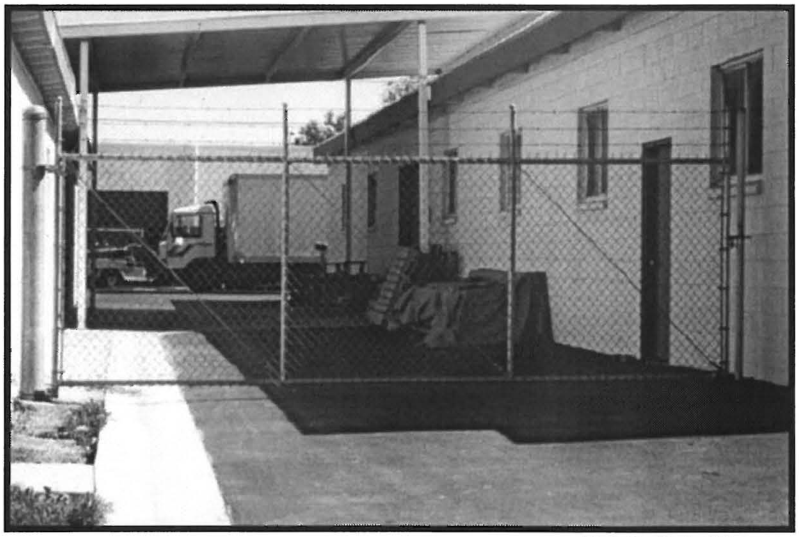

Photo Credit: Geoff Brosseau

Design Objectives

- ☐ Maximize Infiltration
- ☐ Provide Retention
- ☐ Slow Runoff
- ☐ Minimize Impervious Land Coverage
- ☐ Prohibit Dumping of Improper Materials
- ☑ Contain Pollutant
- ☑ Collect and Convey

Description

Proper design of outdoor work areas for materials reduces opportunity for toxic compounds, oil and grease, heavy metals, nutrients, suspended solids, and other pollutants to enter the stormwater conveyance system.

Approach

Outdoor work areas require a drainage approach different from the typical infiltration/detention strategy. In outdoor work areas, infiltration is discouraged; collection and conveyance are encouraged. In outdoor work areas, infiltration is discouraged and runoff is often routed directly to the sanitary sewer, not the storm drain. Because this runoff is being added to the loads normally received by the wastewater treatment plants, municipal stormwater programs and/or private developers must work with the local plant to develop solutions that minimize effects on the treatment facility. These concerns are best addressed in the planning and design stage of the outdoor work area.

Suitable Applications

Appropriate applications include residential, commercial, and industrial areas planned for development or redevelopment.

Design Considerations

Design requirements for outdoor work areas are governed by Building and Fire Codes, and by current local agency ordinances, and zoning requirements.

Designing New Installations

Outdoor work areas can be designed in particular ways to reduce impacts on both stormwater quality and sewage treatment plants.

- Create an impermeable surface such as concrete or asphalt, or a prefabricated metal drip pan, depending on the use.

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CALIFORNIA STORMWATER QUALITY ASSOCIATION

- Cover the area with a roof. This prevents rain from falling on the work area and becoming polluted runoff.

- Berm or perform mounding around the perimeter of the area to prevent water from adjacent areas from flowing on to the surface of the work area.

- Directly connect runoff. Unlike other areas, runoff from work areas is directly connected to the sanitary sewer or other specialized containment system(s). This allows the more highly concentrated pollutants from these areas to receive special treatment that removes particular constituents. Approval for this connection must be obtained from the appropriate sanitary sewer agency.

- Locate the work area away from storm drains or catch basins.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

APPENDIX D

BMP MAINTENANCE SUPPLEMENT / O&M PLAN

OPERATIONS AND MAINTENANCE (O&M) PLAN

Water Quality Management Plan

For

Snug Harbor Surf Camp

3100 Irvine Avenue, Newport Beach, CA 92660, County of Orange

APN 119-200-38 & 119-200-41

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BMP INSPECTION & MAINTENANCE RESPONSIBILITY MATRIX			
BMP Applicable? Yes/No	**BMP Name and BMP Implementation, Maintenance and Inspection Procedures**	**Implementation, Maintenance, and Inspection Frequency and Schedule**	**Person or Entity with Operation & Maintenance Responsibility**
NON-STRUCTURAL SOURCE CONTROL BMPs			
No	N1. Education for Property Owners, Tenants and Occupants	Not Applicable	
Yes	N2. Activity Restrictions The Owner shall develop ongoing activity restrictions that include those that have the potential to create adverse impacts on water quality. Activities include, but are not limited to: handling and disposal of contaminants, fertilizer and pesticide application restrictions, litter control and pick-up, and vehicle or equipment repair and maintenance in non-designated areas, as well as any other activities that may potentially contribute to water pollution.	The Owner will prescribe activity restrictions to protect surface water quality, through lease terms or other equally effective measure, for the property. Frequency: Ongoing	Back Bay Barrels, LLC.

BMP INSPECTION & MAINTENANCE RESPONSIBILITY MATRIX			
BMP Applicable? Yes/No	**BMP Name and BMP Implementation, Maintenance and Inspection Procedures**	**Implementation, Maintenance, and Inspection Frequency and Schedule**	**Person or Entity with Operation & Maintenance Responsibility**
Yes	N3. Common Area Landscape Management Management programs will be designed and implemented by the Owner to maintain all the common areas within the project site. These programs will cover how to reduce the potential pollutant sources of fertilizer and pesticide uses, utilization of water-efficient landscaping practices and proper disposal of landscape wastes by the owner/developer and/or contractors.	Maintenance shall be consistent with City requirements. Fertilizer and/or pesticide usage shall be consistent with County Management Guidelines for Use of Fertilizers (OC DAMP Section 5.5). Maintenance includes mowing, weeding, and debris removal on a weekly basis. Trimming, replanting, and replacement of mulch shall be performed on an as-needed basis to prevent exposure of erodible surfaces. Trimmings, clippings, and other landscape wastes shall be properly disposed of in accordance with local regulations. Materials temporarily stockpiled during maintenance activities shall be placed away from water courses and storm drains inlets. Frequency: Monthly	Back Bay Barrels, LLC.
Yes	N4. BMP Maintenance The Owner will be responsible for the implementation and maintenance of each applicable non-structural BMP, as well as scheduling inspections and maintenance of all applicable structural BMP facilities through its staff, landscape contractor, and/or any other necessary maintenance contractors.	Maintenance of structural BMPs implemented at the project site shall be performed at the frequency prescribed in the O&M Plan. Records of inspections and BMP maintenance shall be kept by the owner/developer and shall be available for review upon request. Frequency: Ongoing	Back Bay Barrels, LLC.

BMP INSPECTION & MAINTENANCE RESPONSIBILITY MATRIX			
BMP Applicable? Yes/No	**BMP Name and BMP Implementation, Maintenance and Inspection Procedures**	**Implementation, Maintenance, and Inspection Frequency and Schedule**	**Person or Entity with Operation & Maintenance Responsibility**
Yes	N5. Title 22 CCR Compliance (How development will comply) Where applicable, the proposed project shall comply with Title 22 of the California Code of Regulations and relevant sections of the California Health and Safety Code regarding hazardous waste management, which will be enforced by County Environmental Health on behalf of the State. Compliance shall be maintained on an ongoing basis.	Frequency: Ongoing	Back Bay Barrels, LLC.
No	N6. Local Industrial Permit Compliance	Not Applicable	

BMP INSPECTION & MAINTENANCE RESPONSIBILITY MATRIX			
BMP Applicable? Yes/No	**BMP Name and BMP Implementation, Maintenance and Inspection Procedures**	**Implementation, Maintenance, and Inspection Frequency and Schedule**	**Person or Entity with Operation & Maintenance Responsibility**
Yes	N7. Spill Contingency Plan Any facilities that store liquid materials or wastes shall maintain procedures for spill response and cleanup activities. Emergency spill kits shall be kept on-site at all times. Spill kits shall include, at a minimum, dry adsorbent material such as kitty litter, mats or pillows, containment booms, wipes, goggles, gloves and disposal bags. Minor spills shall be cleaned up immediately using dry methods, consistent with measures identified in the fact sheets attached to this WQMP. Activities will be coordinated between the respective departments and the Police and Fire departments in the event of a spill.	Frequency: Ongoing	Back Bay Barrels, LLC.
No	N8. Underground Storage Tank Compliance	Not Applicable	
Yes	N9. Hazardous Materials Disclosure Compliance Any storage or utilization of hazardous wastes, where applicable, shall comply with the County of Orange Fire Authority hazardous material disclosure requirements. Compliance shall be maintained on an ongoing basis.	Frequency: Ongoing	Back Bay Barrels, LLC.

BMP INSPECTION & MAINTENANCE RESPONSIBILITY MATRIX			
BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Yes	N10. Uniform Fire Code Implementation The Owner shall ensure all structures comply with Article 80 of the Uniform Fire Code, City of Newport Beach Municipal Code, County of Orange Fire Authority, and Orange City Fire Department. Compliance shall be maintained on an ongoing basis.	Frequency: Ongoing	Back Bay Barrels, LLC.
Yes	N11. Common Area Litter Control The Owner will be responsible for performing trash pickup and sweeping of littered common areas on a weekly basis or whenever necessary. Responsibilities will also include noting improper disposal materials by the public and reporting such violations for investigation.	Litter patrol, violations investigations, reporting and other litter control activities shall be performed on a weekly basis and in conjunction with routine maintenance activities. Frequency: Weekly	Back Bay Barrels, LLC.
Yes	N12. Employee Training All employees of the Owner and any contractors will require training to ensure that employees are aware of maintenance activities that may result in pollutants reaching the storm drain. Training will include, but not be limited to, spill cleanup procedures, proper waste disposal, housekeeping practices, etc.	Educate all new employees/ managers on storm water pollution prevention, particularly good housekeeping practices, prior to the start of the rainy season (October 1). Refresher courses shall be conducted on an as needed basis. Frequency: Annually	Back Bay Barrels, LLC.
No	N13. Housekeeping of Loading Docks	Not Applicable	

BMP INSPECTION & MAINTENANCE RESPONSIBILITY MATRIX			
BMP Applicable? Yes/No	**BMP Name and BMP Implementation, Maintenance and Inspection Procedures**	**Implementation, Maintenance, and Inspection Frequency and Schedule**	**Person or Entity with Operation & Maintenance Responsibility**
Yes	N14. Common Area Catch Basin Inspection All on-site catch basin inlets and drainage facilities shall be inspected and maintained by the Owner at least once a year, prior to the rainy season, no later than October 1st of each year. The City of Newport Beach shall be responsible for inspection and maintenance of all public catch basins and drainage facilities associated with the project.	Catch basin inlets and other drainage facilities shall be inspected after each storm event and once per year. Storm drain inlets and other drainage facilities shall be cleaned prior to the rainy season, by October 1 each year. Frequency: 2x per year and after large storm event	Back Bay Barrels, LLC.
Yes	N15. Street Sweeping Private Streets and Parking Lots The Owner shall be responsible for sweeping all on-site streets, drive aisles, and/or uncovered parking areas within the project on a quarterly basis. The applicant shall not spray down or wash down the parking lot or surrounding sidewalks unless the water used is directed through the sanitary sewer system or a filtered drain. No car washing shall be permitted in the parking lot.	Drive aisles and parking areas must be swept at least quarterly (every 3 months), including prior to the start of the rainy season (October 1). The applicant shall not spray down or wash down the parking lot or surrounding sidewalks unless the water used is directed through the sanitary sewer system or a filtered drain. No car washing shall be permitted in the parking lot. Frequency: Monthly	Back Bay Barrels, LLC.
No	N16. Retail Gasoline Outlets	Not Applicable	
STRUCTURAL SOURCE CONTROL BMPs			

BMP INSPECTION & MAINTENANCE RESPONSIBILITY MATRIX			
BMP Applicable? Yes/No	**BMP Name and BMP Implementation, Maintenance and Inspection Procedures**	**Implementation, Maintenance, and Inspection Frequency and Schedule**	**Person or Entity with Operation & Maintenance Responsibility**
Yes	**S1. Provide storm drain system stenciling and signage** The phrase "NO DUMPING! DRAINS TO OCEAN", or an equally effective phrase approved by the City, will be stenciled on all major storm drain inlets within the project site to alert the public to the destination of pollutants discharged into storm water. Stencils shall be in place prior to release of certificate of occupancy. Stencils shall be inspected for legibility on an annual basis and re-stenciled as necessary.	Storm drain stencils shall be inspected for legibility, at minimum, once prior to the storm season, no later than October 1 each year. Those determined to be illegible will be re-stenciled as soon as possible. Frequency: Annually	Back Bay Barrels, LLC.
No	**S2. Design and construct outdoor material storage areas to reduce pollution introduction**	Not Applicable	
Yes	**S3. Design and construct trash and waste storage areas to reduce pollution introduction** All trash and waste shall be stored in containers that have lids or tarps to minimize direct precipitation into the containers. One (1) trash enclosures will be located in the Clubhouse Building. The trash storage areas will be designed to City standards, and will be walled, roofed, have gates and proper drainage per City standards.	Sweep trash area at least once per week and before October 1st each year. Maintain area clean of trash and debris at all times. Frequency: Weekly	Back Bay Barrels, LLC.

BMP INSPECTION & MAINTENANCE RESPONSIBILITY MATRIX			
BMP Applicable? Yes/No	**BMP Name and BMP Implementation, Maintenance and Inspection Procedures**	**Implementation, Maintenance, and Inspection Frequency and Schedule**	**Person or Entity with Operation & Maintenance Responsibility**
Yes	S4. Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control The Owner will be responsible for the installation and maintenance of all common landscape areas utilizing similar planting materials with similar water requirements to reduce excess irrigation runoff. The Owner will be responsible for implementing all efficient irrigation systems for common area landscaping including, but not limited to, provisions for water sensors and programmable irrigation cycles. This includes smart timers, rain sensors, and moisture shut-off valves. The irrigation systems shall be in conformance with water efficiency guidelines. Systems shall be tested twice per year, and water used during testing/flushing shall not be discharged to the storm drain system.	In conjunction with routine maintenance activities, verify that landscape design continues to function properly by adjusting properly to eliminate overspray to hardscape areas, and to verify that irrigation timing and cycle lengths are adjusted in accordance with water demands, given time of year, weather, and day or night time temperatures. System testing shall occur twice per year. Water from testing/flushing shall be collected and properly disposed to the sewer system and shall not discharge to the storm drain system. Frequency: 2x per year	Back Bay Barrels, LLC.

BMP INSPECTION & MAINTENANCE RESPONSIBILITY MATRIX			
BMP Applicable? Yes/No	**BMP Name and BMP Implementation, Maintenance and Inspection Procedures**	**Implementation, Maintenance, and Inspection Frequency and Schedule**	**Person or Entity with Operation & Maintenance Responsibility**
Yes	S5. Protect slopes and channels and provide energy dissipation The site drainage design shall include appropriate BMPs to decrease the potential for erosion of slopes and/or channels. The design shall be consistent with Federal, State, and local standards (e.g., RWQCB, ACOE, CDFG). Where feasible, the following principles shall be considered: 1) convey runoff safely from the tops of slopes, 2) avoid disturbing steep or unstable slopes, as well as natural channels, 3) implement a permanent stabilization BMP on disturbed slopes and channels as quickly as possible, such as native vegetation, and 4) install energy dissipaters at the outlets of new storm drains, culverts, or channels.	Frequency:	Back Bay Barrels, LLC.
No	S6. Dock areas	Not Applicable	
No	S7. Maintenance bays	Not Applicable	
No	S8. Vehicle wash areas	Not Applicable	
No	S9. Outdoor processing areas	Not Applicable	

BMP INSPECTION & MAINTENANCE RESPONSIBILITY MATRIX			
BMP Applicable? Yes/No	**BMP Name and BMP Implementation, Maintenance and Inspection Procedures**	**Implementation, Maintenance, and Inspection Frequency and Schedule**	**Person or Entity with Operation & Maintenance Responsibility**
No	S10. Equipment wash areas	Not Applicable	
No	S11. Fueling areas	Not Applicable	
No	S12. Hillside landscaping	Not Applicable	
No	S13. Wash water control for food preparation areas	Not Applicable	
No	S14. Community car wash racks	Not Applicable	

BMP INSPECTION & MAINTENANCE RESPONSIBILITY MATRIX		
BMP Name and BMP Implementation, Maintenance and Inspection Procedures	**Implementation, Maintenance, and Inspection Frequency and Schedule**	**Person or Entity with Operation & Maintenance Responsibility**
LOW IMPACT DEVELOPMENT BMPs		

BMP INSPECTION & MAINTENANCE RESPONSIBILITY MATRIX		
BMP Name and BMP Implementation, Maintenance and Inspection Procedures	**Implementation, Maintenance, and Inspection Frequency and Schedule**	**Person or Entity with Operation & Maintenance Responsibility**
Biotreatment BMP # 1: Modular Wetland System (MWS) Modular Wetlands by Modular Wetlands Systems, Inc. are proprietary biotreatment systems that utilize multi-stage treatment processes. The pre-treatment chamber contains the first three stages of treatment and includes a catch basin inlet filter to capture trash, debris, gross solids and sediments, a settling chamber for separating out larger solids, and a media filter cartridge for capturing fine TSS, metals, nutrients, and bacteria. Runoff then flows through the wetland chamber where treatment is achieved through a variety of physical, chemical, and biological processes. As storm water passes down through the planting soil, pollutants are filtered, adsorbed, biodegraded and sequestered by the soil and plants, functioning similar to bioretention systems. The discharge chamber at the end of the unit collects treated flows and discharges back into the storm drain system.	Typical maintenance includes removing trash & debris from the catch basin screening filter (by hand), removal of sediment and solids in the settlement chamber (vacuum truck), replacement of the BioMediaGREENTM filter cartridge, and replacement of the BioMediaGREENTM drain down filter. In the Separation Chamber, spray down pollutants accumulated on walls and cartridge filters. Vacuum out Separation Chamber and remove all accumulated pollutants. Replace the screening device, grate, or manhole cover when complete. In addition, plants within the wetland chamber will require trimming in conjunction with landscape maintenance activities. See attached manufacturer's specifications for additional requirements. Frequency: Inspect system at a minimum of once every six months, prior to the start of the rainy season (October 1), and after major storm events.	Back Bay Barrels, LLC.

BMP INSPECTION & MAINTENANCE RESPONSIBILITY MATRIX		
BMP Name and BMP Implementation, Maintenance and Inspection Procedures	**Implementation, Maintenance, and Inspection Frequency and Schedule**	**Person or Entity with Operation & Maintenance Responsibility**
Biotreatment BMP # 2: Bioretention Planters with Underdrains Bioretention planters with underdrains are plant-based biotreatment systems that typically consist of a ponding area, mulch layer, planting soils and plants. As storm water passes down through the planting soil, pollutants are filtered, adsorbed, biodegraded and sequestered by the soil and plants. Underdrains collect the treated water and return it back into the storm drain system.	Inspections should occur semi-annually or after major storm events to check for the following and remove accordingly: standing water, sediment, and trash & debris. Inspections should also look for potential clogging and clean planters or, if necessary, replace the entire filter bed. Inspect for weeds, and prune and/or replace plants in accordance with routine landscape maintenance activities. Replace mulch and prune shrubs as necessary. Frequency: 2x per year	Back Bay Barrels, LLC.

Required Permits

Permits are not required for the implementation, operation, and maintenance of the BMPs.

Forms to Record BMP Implementation, Maintenance, and Inspection

The form that will be used to record implementation, maintenance, and inspection of BMPs is attached.

Recordkeeping

All records must be maintained for at least five (5) years and must be made available for review upon request.

Waste Management

Any waste generated from maintenance activities will be disposed of properly. Wash water and other waste from maintenance activities is not to be discharged or disposed of into the storm drain system. Clippings from landscape maintenance (i.e. prunings) will be collected and disposed of properly off-site, and will not be washed into the streets, local area drains/conveyances, or catch basin inlets.

RECORD OF BMP IMPLEMENTATION, MAINTENANCE, AND INSPECTION

Today's Date: ______________________________

Name of Person Performing Activity (Printed): ______________________________

Signature: ______________________________

BMP Name (As Shown in O&M Plan)	Brief Description of Implementation, Maintenance, and Inspection Activity Performed

RECORD OF BMP IMPLEMENTATION, MAINTENANCE, AND INSPECTION

Today's Date: ______________________________

Name of Person Performing Activity (Printed): ______________________________

Signature: ______________________________

BMP Name (As Shown in O&M Plan)	Brief Description of Implementation, Maintenance, and Inspection Activity Performed

APPENDIX E

CONDITIONS OF APPROVAL (PENDING)

Appendix F

Geotechnical Investigation

GEOTECHNICAL EXPLORATION
PROPOSED WAVEGARDEN COVE
3100 IRVINE AVENUE
NEWPORT BEACH, CALIFORNIA

Prepared For:

Back Barrels, LLC.

1940 Continental Avenue
Costa Mesa, CA 92627

Project No. PWAS_20240507

June 28, 2024

CARL KIM GEOTECHNICAL, INC.
945 Baileyana Road
Hillsborough, CA 94010
949-441-8143
carlkimgeo@gmail.com

June 28, 2024

Project No. PWAS_20240507

Back Bay Barrels, LLC.
1940 Continental Avenue
Costa Mesa, CA 92627

Attention: Mr. Adam Cleary

Subject: **Geotechnical Exploration**
Proposed Wavegarden Cove
3100 Irvine Avenue
Newport Beach, California

Per your request, Carl Kim Geotechnical, Inc. (Carl Kim Geo) has performed a geotechnical exploration for the subject project. The purpose of this study was to review and verify engineering properties of onsite soils, identify geologic and seismic hazards that may impact the site, and develop foundation and earthwork recommendations for the project that are in general conformance with the 2022 California Building Code (CBC).

Based on plans prepared by X Engineering and 52nd Street Consultants LLC and a "geotechnical brief" prepared by LPC, Carl Kim Geo understands that the proposed Snug Harbor project will include construction of a 13-foot-deep surf lagoon, a 3-story 50,000-square-foot clubhouse building with one subterranean level, a building for athlete lodging, two additional pools, parking lots with solar panel canopies, a service yard, pavement, landscaping, and utilities. Retaining walls are planned to achieve design grades.

The project site is located at the Newport Beach Golf Course, east of the intersection of Irvine Avenue and Mesa Drive. The project site is an irregularly shaped parcel that includes three holes, a driving range, pro shop, clubhouse, restaurant, and parking areas. The site generally slopes toward the northwest. An existing 15- to 20-foot-high slope descends from the southeast edge of the property from about Elevation (El.) +58 feet mean sea level (msl). The rest of the site generally slopes gently from about El. +50 feet msl to about El. +15 feet msl near the west corner of the property. Based on review of aerial photos, the golf course was constructed between 1972 and 1980. The site is bounded by the Santa Ana-Delhi channel and Irvine Avenue from the north, Mesa Drive from the south, and commercial properties from the southeast.

Carl Kim Geo reviewed and incorporated subsurface geotechnical data previously collected by Moore Twining and performed additional subsurface explorations. Current explorations included two hand-auger borings and seven (7) cone penetration test soundings.

This site is located in the Santa Ana Heights area adjacent to the Delhi Channel approximately ¾ mile north of Upper Newport Bay. Santa Ana Heights is located northwest of the San Joaquin Hills and is mapped as covered by coastal terrace deposits.

The project site is underlain by engineered fill (thickness ranging from 0 to about 15 feet) described clayey sand, sandy lean clay, silty sand, and clay. The fill is underlain by late Quaternary to recent alluvium, which is underlain by Quaternary marine terrace deposits consisting primarily of lean clay with interlayers of fine to medium sand, silty sand, and silt layers.

Groundwater below the site has been encountered in temporary piezometers at approximately El. +4 to +15 feet msl. However, this water level is likely the result of a pressurized confined or semiconfined aquifer. The recommended design groundwater level for the site is at El. +8 feet msl, which is approximately two feet above the adjacent concrete-lined Delhi Channel. Widespread dewatering or lowering of a water table is not anticipated to be required. However, isolated seepage zones may be encountered in excavations.

Based on results of our study, it is our opinion that the proposed development is feasible from a geotechnical standpoint provided that the recommendations presented herein are implemented in the design and construction of the project. No evidence of extraordinarily adverse geological or geotechnical hazards at the site were noted that will preclude the development of the project as currently planned.

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

Respectfully submitted,

Carl Kim Geotechnical, Inc.

Carl C. Kim
Senior Principal Engineer

Andrew Hillstrand
Consulting Engineering Geologist

ARH/CCK

Distribution: (4) Addressee

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1.0 INTRODUCTION

1.1 SITE LOCATION AND PROJECT DESCRIPTION

The project site (latitude + 33.6585°, longitude -117.8819°) is located within a portion of the Newport Beach Golf Course located at 3100 Irvine Avenue in Newport Beach (Figure 1 – Site Location) (Figure 2 – Aerial Photos). The irregularly shaped property includes three holes, a driving range, pro shop, clubhouse, restaurant, and parking areas. The site generally slopes toward the northwest. An existing 15- to 20-foot-high slope descends from the southeast edge of the property from about Elevation (El.) +58 feet mean sea level (msl). The rest of the site generally slopes gently from about El. +50 feet msl to about El. +15 feet msl near the west corner of the property. Based on review of aerial photos, the golf course was constructed between 1972 and 1980. The site is bounded by the Santa Ana-Delhi channel and Irvine Avenue from the north, Mesa Drive from the south, and commercial properties from the southeast.

Based on preliminary plans and specifications for the project, Carl Kim Geo understands that the proposed Snug Harbor project will include construction of a 13-foot-deep surf lagoon, a 3-story 50,000-square-foot clubhouse building with one subterranean level, a building for athlete lodging, two additional pools, parking lots with solar panel canopies, a service yard, pavement, landscaping, and utilities. Segmental and conventional retaining walls are planned to achieve design grades. A plinth structure approximately 40 feet wide by 350 feet long will be constructed along the central axis of the lagoon to generate waves. The plinth structure will be tied in with a continuous footing that will span the remaining length of the lagoon. The proposed project elements are shown on Plate 1, Explorations.

1.2 PURPOSE AND SCOPE

The purpose of this study was to characterize engineering properties of onsite soils, identify geologic and seismic hazards impacting the site, and develop geotechnical recommendations for foundations and earthwork. The tasks completed as part of this study are described below in more detail.

TASK 1 - DOCUMENT REVIEW

Carl Kim Geo reviewed preliminary plans and specifications prepared by X Engineering, 52nd Street Consultants LLC, and La Playa Consulting Inc. (LPC). In addition, previous geotechnical data gathered by Moore Twining Associates (2019, 2020) were reviewed and incorporated into this report. The documents reviewed are referenced in Appendix A.

TASK 2 –SUBSURFACE EXPLORATION AND LABORATORY TESTING

Current exploration included seven (7) cone penetration test (CPT) soundings, sampling of the near-surface hand excavations for each of the CPTs, and two (2) hand-auger borings advanced to obtain representative subsurface data for grading and foundation design in addition to prior explorations conducted by others. Prior exploration data by Moore Twining included logs from 26 hollow stem auger borings and four CPT soundings. Six (6) of the hollow-stem-auger borings were converted to temporary piezometers. Explorations ranged in depth from 4 to 75 feet below ground surface (bgs). Exploration locations are shown on Plate 1 and logs of current and prior explorations are attached in Appendix B, Explorations.

Laboratory test results from current and prior explorations are attached in Appendix C, Laboratory Tests. The testing included:

- Soil classification (ASTM D2488);
- Moisture and density (ASTM D 2216 and D 2937);
- Expansion Index (ASTM D 4829);
- Direct Shear (ASTM D3080);
- Consolidation (ASTM D 2435);
- Compaction (ASTM D 1557); and
- R-value (CTM 301).

TASK 3 –GEOLOGIC/SEISMIC HAZARDS EVALUATION

Using available geologic data, we have developed information on the general geologic conditions beneath the project including the locations of documented active and potentially active faults near the site. This study addresses the potential for primary earthquake hazards (ground shaking and surface rupture) and secondary earthquake hazards (liquefaction, seismic settlement, seiches, and earthquake-induced landsliding) impacting the site. Seismic design parameters are attached in Appendix D.

TASK 4 - ENGINEERING ANALYSIS AND REPORT

The results of subsurface exploration, laboratory testing, geologic-seismic hazards, and geotechnical design recommendations are summarized below.

2.0 GEOLOGIC CONDITIONS

2.1 GEOLOGIC SETTING

The property is located in the Peninsular Ranges physiographic province of California. This geomorphic province is characterized by north-northwest trending geologic grain, meaning that its primary faults, folds, mountains and valleys are all aligned in north-northwest direction.

The site is located northwest of the pediment of the San Juaquin Hills in the Santa Ana Heights area, approximately ¾-mile north of Upper Newport Bay. According to regional geologic mapping by Douglas M. Morton and others of the United States Geological Survey (USGS, 2006), the Santa Ana Heights area consists of "old paralic deposits overlain by alluvial-fan deposits". A regional scale geologic map compiled by the indicates the site is underlain by Quaternary-age marine terrace deposits that may or may not be covered by river-derived alluvium in places. The older rock units underlying the region (e.g. Monterey, Topanga Formations, etc.) are generally folded into a series of anticlines and synclines with axes that trend and plunge toward the northwest roughly parallel to the Newport-Inglewood Fault Zone and Whittier-Elsinore Fault system to the north (Yerkes, 1965) (USGS, 2006).

The regional geologic conditions of the site and vicinity are shown on Figure 3, *Geology*.

2.2 SITE GEOLOGY

An improved concrete culvert known as the Santa Ana-Delhi Channel traverses the northwest and west edges of the site. The drainage course was known as the Delhi Drainage Ditch for some time prior to improvements (USGS, 1932). This drainage system locally formed the topographically lowest portion of the site as it meanders and drains from north to south generally toward the Upper Newport Bay (aka upper Back Bay). Aerial photos and geomorphology indicate the active channel and lowest fluvial flood plain (where Holocene to recent alluvial deposits would be deposited) was 250 to 300 feet wide extending from roughly the present Santa Ana-Delhi Channel southeastward (Figure 2 – Aerial Photos).

Based on aerial photos reviewed (Appendix A) the site appears to have been used historically for agriculture and was fallow for several decades before it was developed into the Newport Beach Golf Course around or just before 1980. It appears that grading was performed along the periphery of the site and for construction of onsite infrastructure.

Based on subsurface explorations, field mapping, and review of historic maps and aerials photos, earth materials at the site consist of man-made fill, alluvium, and older terrace deposits. The identified and interpreted limits of the earth materials are shown on Plates 1 and 2. The materials underlying the site are described below and in Appendix B.

Undocumented Artificial Fill (afu): The site is mantled by variable thicknesses of man-made fill. Fill was identified in B-3, B-5, B-11, and B-19. A maximum of approximately 15 feet of fill was identified in B-11. Note that fill is expected to occur in other areas explored but was not specifically labeled in many of the explorations. As encountered, fill soils vary from soft to stiff sandy lean clay, and loose to dense and silty sand and clayey sand that is generally moist.

Quaternary Alluvium (Map Symbol - Qal): Quaternary to recent age alluvium encountered in site explorations consisted of layers of lean clay, sandy lean clay, clayey sand, silty sand, and poorly graded sands. Soils with notable organic content were logged in B-3, B-5, B-16, and CKG CPT-2. The materials were generally slightly moist to moist. Fine-grained soils varied from soft to stiff while granular soils encountered were logged as medium dense.

Quaternary Terrace Deposits (Map Symbol - Qt): Quaternary-age terrace deposits encountered in site explorations consisted of layers of lean clay, sandy lean clay, and fat clay with interlayers or intermixed zones of silty sand, poorly graded sand, and silt. The materials were generally moist. Fine-grained soils varied from soft to hard while granular soils encountered were logged as medium dense to very dense.

2.3 GROUNDWATER

According to the California Geological Survey (CGS, 1997a), the historic high groundwater level in the vicinity of the site is approximately 10 bgs (Figure 4 – Historic High Groundwater Level).

Free water was encountered/detected in 7 of 26 hollow stem auger borings and not detected at 19 locations. The highest first encountered water was in boring B-9 at a depth of 18 feet bgs (El. +14 feet msl).

Six temporary piezometers were constructed in 2020 at B-17, B-18, B-19, B-22, B-23, and B-24 (Moore Twining, 2020a,b). Available well construction details and depth to water measurements in wells and borings are tabulated in Appendix B.

The water level measured in B-9 appears to be a localized perched water zone. Water levels below the site vary from unobserved to El. +15 feet msl. Given the variability of water levels across the site and the presence of the adjacent Delhi Channel with a flow line at approximately El. +6 feet msl, the recommended design groundwater level is 15 feet bgs.

Perched water and groundwater would be expected to occur where granular soils are encountered. Fluctuation of the groundwater level and localized zones of perched water should be anticipated below grade. Irrigation of landscaped areas can also impact local groundwater levels or likelihood of perched water or seepage to be encountered in excavations.

3.0 GEOLOGIC HAZARDS

Geologic hazards include surface faulting, ground lurching, seismic shaking, landslides, liquefaction, seismically-induced settlement, lateral spreading, seismically-induced landslides, flooding, expansive soils, corrosive soils, and soil gas. The following sections discuss these hazards and their potential impacts at the site in more detail.

3.1 FAULTING AND SEISMICITY

In general, the primary seismic hazards for sites in the region include strong ground shaking and surface fault rupture. Our discussion of faults potentially impacting the site is prefaced with a discussion of California legislation and state policies concerning the classification and land-use criteria associated with faults. By definition of the California Geological Survey (CGS), an active fault is a fault which has had surface displacement within Holocene time (about the last 11,000 years). Similarly, a fault whose recency of past movement is older than 11,700 years is a pre-Holocene fault, and does not meet State criteria as "active." Age-undetermined faults are those whose age of most recent movement is not known and is unconstrained. These updated definitions were necessary to eliminate agency and practitioner confusion for fault investigation reports as mandated by the Alquist-Priolo Earthquake Faulting Zones Act of 1972 (AP Act) and recently revised Special Publication 42 (CGS, 2018). The intent of this act is to prevent siting of habitable structures across traces of "active" faults.

3.1.1 SURFACE RUPTURE HAZARD

According to the State of California Earthquake Fault Zones maps), the site is not located within a currently established Alquist-Priolo Earthquake Fault Zone. Therefore, a surface fault rupture hazard evaluation is not mandated for this site.

The closest zoned active fault is a segment of the Newport-Inglewood-Rose Canyon Fault Zone approximately 5.6 miles to the west (CGS, 1997a,b). Inferred/buried strands of the Newport-Inglewood-Rose Canyon Fault Zone are mapped trending south of the site but are not currently zoned as active. The closest mapped trace is approximately 0.9 mile south of the site. No photo lineaments or other geomorphic evidence of active or potentially active faults intersecting the site were observed or recognized as part of our review of aerial photos and historic topographic maps; therefore, potential for surface fault rupture at the site is expected to be low.

Major active and potentially active faults in the site vicinity are shown on Figure 5, *Regional Faults*.

3.1.2 HISTORICAL SEISMICITY

Although Southern California has been seismically active during the past 200 years, written accounts of only the strongest shocks survive the early part of this period. Early descriptions of earthquakes are rarely specific enough to allow an association with any particular fault zone. It is also not possible to precisely locate epicenters of earthquakes that have occurred prior to the twentieth century.

A search of historical earthquakes was performed using the USGS database (https://earthquake.usgs.gov/earthquakes/search/) for the time period between 1769 and the present. Within that time frame, 353 earthquakes of magnitude 4 or greater were found within a 100-kilometer radius of the site (Figure 6, *Historical Seismicity*).

3.1.3 SEISMICITY

The principal seismic hazard to the site is ground shaking resulting from an earthquake occurring along any of several major active and potentially active faults in southern California (Figure 5). The intensity of ground shaking at a given location depends primarily upon the earthquake magnitude, the distance from the source, and the site response characteristics. Accordingly, design of the project should be performed in accordance with all applicable current codes and standards utilizing the appropriate seismic design parameters to reduce seismic risk as defined by California Geological Survey (CGS) Chapter 2 of Special Publication 117A (CGS, 2008). The 2022 edition of the California Building Code (CBC) is the current edition of the code. Through compliance with these regulatory requirements and the utilization of appropriate seismic design parameters selected by the design professionals, potential effects relating to seismic shaking can be reduced.

The following code-based seismic parameters should be considered for design under the 2022 CBC:

2022 CBC Map Based Ground Motion Parameters

Categorization/Coefficient	Code-Based
Site Latitude	+33.6587°
Site Longitude	-117.8826°
Site Class	D
Mapped Spectral Response Acceleration at Short Period (0.2 sec), S_S	1.311 g
Mapped Spectral Response Acceleration at Long Period (1 sec), S_1	0.468 g
Short Period (0.2 sec) Site Coefficient, F_a	1.0
Long Period (1 sec) Site Coefficient, F_v	1.832[1]
Adjusted Spectral Response Acceleration at Short Period (0.2 sec), S_{MS}	1.311 g
Adjusted Spectral Response Acceleration at Long Period (1 sec), S_{M1}	0.858[1] g
Design Spectral Response Acceleration at Short Period (0.2 sec), S_{DS}	0.874 g
Design Spectral Response Acceleration at Long Period (1 sec), S_{D1}	0.572[1] g
Site Amplification Factor, F_{PGA}	1.1
Site Modified Peak Ground Acceleration, PGA_M	0.620 g

[1] See Section 11.4.8 of ASCE 7-16. A site-specific ground motion hazard analysis in accordance with Section 21.2 of ASCE 7-16 is required for this site. Per Supplement 3 to ASCE 7-16, a site-specific ground motion hazard analysis is not required where the value of the parameters S_{M1} and S_{D1} in the table are increased by 50%.

The site is located within a seismically active region, as is all of Southern California. Based on the available subsurface information for the site, the site was designated as Site Class D. Details are presented in Appendix D.

3.2 SECONDARY SEISMIC HAZARDS

In general, secondary seismic hazards for sites in the region could include soil liquefaction, seismically-induced settlement, lateral spreading, landsliding, seiches and tsunamis. These potential secondary seismic hazards are discussed below.

3.2.1 LIQUEFACTION

Liquefaction is a seismic phenomenon in which loose, saturated, fine-grained granular soils behave similarly to a fluid when subjected to high-intensity ground shaking. Liquefaction occurs when three general conditions exist: 1) shallow groundwater; 2) low density, fine, clean sandy soils; and 3) high-intensity ground motion. Studies indicate that saturated, loose and medium dense, near-surface cohesionless soils exhibit the highest liquefaction potential, while dry, dense, cohesionless soils and cohesive soils exhibit low to negligible liquefaction potential.

As shown on Figure 7, *Seismic Hazards*, a liquefaction hazard zone is delineated by the State of California (CGS, 1997a) along the northwest edge of the site. Based on our site-specific evaluation using a design high groundwater at 15 feet bgs, PGA_M, and a mean magnitude of 6.7, liquefaction hazard is deemed low. The results are presented in Appendix E.

3.2.2 SEISMICALLY-INDUCED SETTLEMENT

Seismically-induced settlement consists of dynamic settlement of unsaturated soil (above groundwater) and liquefaction-induced settlement (below groundwater). These settlements occur primarily within low density sandy soil due to reduction in volume during and shortly after an earthquake event.

Based on our evaluation using the historic high groundwater level of 15 feet bgs, PGA_M, and a mean magnitude of 6.7, the potential total earthquake-induced settlement is estimated to be less than ½ inch (Appendix E). Moore Twining's CPT-3 indicated over 1 inch of seismically-induced settlement but most of the settlement occurred within the undocumented fill in the upper 10 feet, which will be removed and replaced as engineered fill during grading. The differential settlement can be taken as half the total settlement over a horizontal distance of 30 feet.

3.2.3 LATERAL SPREADING OR FLOW FAILURE

Liquefaction may also cause lateral spreading. For lateral spreading to occur, the liquefiable zone must be continuous, unconstrained laterally, and free to move along gently sloping ground toward an unconfined area. Because liquefaction hazard is low, the potential for lateral spreading is deemed low.

3.2.4 SEISMICALLY-INDUCED LANDSLIDES

As shown on Figure 7, *Seismic Hazards*, the site is not mapped within a seismically-induced landslide hazard zone identified by the State of California (CGS, 1999). In addition, due to project site lacking significant slopes, it is our opinion that the potential for seismically-induced landslide hazard at the site is low.

3.2.5 SEICHES AND TSUNAMIS

Seiches are large waves generated in enclosed bodies of water in response to ground shaking. Tsunamis are waves generated in large bodies of water by fault displacement or major ground movement. Once built, the Wavegarden lagoon will be an enclosed body of water subject to accelerations from ground movements. An area immediately south of Mesa Drive is within a tsunami hazard Zone (Figure 8, *Tsunami Hazard*). As such, the site and periphery are subject to seiche and/or tsunami hazards should strong ground motions or significant displacement of earth occur offshore.

3.3 FLOODING HAZARDS

According to a Federal Emergency Management Agency (FEMA) flood insurance rate map (FEMA, 2008), the project site is located within a flood hazard area identified as “Zone X”, which is defined as an area of minimal flood hazard. Regionally, storm runoff flow is generally directed to the south toward Upper Newport Bay. As shown on Figure 9, *Flood Hazards*, the site is **not** located within a flood hazard zone.

Earthquake-induced flooding can be caused by failure of dams or other water-retaining structures as a result of earthquakes. The site is not mapped within modeled inundation zone associated with proximal reservoirs (Figure 10). Therefore, the risk of seismically-induced flooding due to dam failure is considered very low.

3.4 EXPANSIVE SOILS

Expansive soils contain significant amounts of clay particles that swell considerably when wetted and which shrink when dried. Foundations constructed on these soils are subject to uplifting forces caused by the swelling. Without proper mitigation measures, heaving and cracking of both building foundations and slabs-on-grade could result.

Prior laboratory testing indicates that site soils have very low to medium expansion potential. Low to medium plasticity clays were encountered in explorations. Expansion Index test results range from 0 to 74 and are included in Appendix C.

3.5 CORROSIVE SOILS

Results of corrosion testing are included in Appendix C. The underlying soil should be assumed to be severely corrosive to buried ferrous metals per ASTM STP 1013. Concrete in contact with the soil is expected to have moderate (S1) exposure to sulfate attack per ACI 318 (ACI, 2014). An exposure class of C1 may be assumed for concrete in contact with soil exposed to moisture per ACI 318 but not to external sources of chlorides.

3.6 SUBSURFACE GASES

Based on review of State of California Geologic Energy Management Division (CalGEM, formerly DOGGR) records, the project site is not located within an oil field boundary (CalGEM, 2024). Accordingly, the potential for methane hazards to affect the site is low.

3.7 SUBSIDENCE

Based on review of referenced reports the site is not within an area of known significant subsidence associated with groundwater or petroleum withdrawal, peat oxidation, or hydro-compaction.

4.0 CONCLUSIONS

Based on the results of our study, it is our opinion that the proposed project is feasible from a geotechnical standpoint. In our opinion, the following geotechnical factors should be considered:

- The project site is underlain by variable thicknesses of fill in areas up to 15 feet in thickness. The fill is described as sandy clay and silty sand. The fill is underlain by Quaternary age and younger alluvium and Quaternary age marine terrace deposits consisting of low plasticity clay, sandy clay, silt, and some sand layers.
- Our review of the geologic literature (Appendix A) indicates there are no known active faults that intersect the site. In addition, site-specific data does not indicate the presence of faulting at the site.
- The main seismic hazard that may affect the site is strong ground shaking.
- Groundwater appears to occur in discrete confined layers at different elevations across the site. Perched water may occur at the site at approximately El. +15 feet msl. Design groundwater may be assumed at 15 feet below the existing ground surface.
- The expansion potential of near-surface onsite soils is expected to be low to medium.
- The onsite soils are expected to be severely corrosive to buried ferrous metals and have moderate sulfate exposure to concrete.
- Due to the presence of thick clay layers underlying the site that would be expected to have very low to no permeability, presence of perched water, evidence of pressurized aquifers below the site, stormwater infiltration is deemed infeasible.
- The planned grading will place up to 20 feet of new fill to establish design elevations along the north side of the site. Raising the ground surface elevation at the site will induce settlement. We estimate about an inch of settlement per foot of new fill placed to raise site grades. Accordingly, we recommend that the rough site grading be performed as far in advance as possible before construction of the proposed improvements.

5.0 RECOMMENDATIONS

The proposed development is feasible from a geotechnical standpoint, provided that the recommendations presented in this report are properly incorporated in design and construction.

The recommendations presented below are based upon the exhibited geotechnical engineering properties of the soils and their anticipated response both during and after construction. The recommendations are also based upon proper field observation and testing during construction. The project geotechnical engineer should be notified of suspected variances in field conditions to determine the effect upon the recommendations subsequently presented. These recommendations are considered minimal and may be superseded by more restrictive requirements of the civil and structural engineers, the City of Newport Beach, and other governing agencies.

Carl Kim Geo should review the grading and foundation plans and project specifications as they become available to verify that the recommendations presented in this report have been incorporated into the plans for this project.

5.1 EARTHWORK AND GRADING

We recommend that earthwork on the site be performed in accordance with the recommendations presented in this report and the project specifications as prepared by others. The *Earthwork and Grading Guide Specifications* included in Appendix F may be used for guidance in developing the project specifications. If conflict arises, the recommendations in Appendix F shall be superseded by the project specifications, recommendations contained in this report and/or the City of Newport Beach requirements, whichever is more stringent.

All site grading should be performed in accordance with the applicable local codes and in accordance with the project specifications that are prepared by the appropriate design professional.

5.1.1 SITE PREPARATION

After the site is cleared, the soils should be carefully observed for the removal of all unsuitable deposits. We recommend that after removal of pavements and hardscape, and complete demolition of existing structures within the proposed improvement footprints, all undocumented fill soils should be excavated from these proposed improvement footprints, which is expected to occur over most of the northern half of the site. Undocumented fill was encountered as deep as 15 feet bgs in the borings. Deeper fill may be encountered between boring locations.

Overexcavation is not required for footings established directly on undisturbed natural soils. Any underground obstructions encountered should be removed. Those lines should be removed or rerouted where interfering with proposed construction. *It is essential that excavation does not undermine foundations of any existing infrastructure that will remain in place along the boundaries of the project. As-built details of any structure to remain should be provided to Carl Kim Geo and the structural engineer prior to incorporation into the new design.*

Areas outside the structure footprint limits, planned for new asphalt and/or concrete pavement or pavers, should be over-excavated to a minimum depth of 24 inches below existing or finish grade or 18 inches below proposed pavement sections, whichever is deeper.

5.1.2 SUBGRADE PREPARATION

Excavation bottoms should be observed by Carl Kim Geo prior to placement of any backfill or new construction. After overexcavations are completed, and prior to fill placement, exposed surfaces should be scarified to a minimum depth of 6 inches, moisture-conditioned to 2 to 4 percent above optimum moisture content, and recompacted to a minimum 90 percent relative compaction as determined by ASTM D1557 standard test method (modified Proctor compaction curve).

Based on the explorations (Appendix B) saturated subgrade conditions are expected in deep excavations for undocumented fill removal and the planned basement for the 3-story building, which will require stabilization for support of engineered fill or new structures. Adjustment to the stabilization limits should be anticipated based on observed performance during stabilization. The stabilization methodology may vary and it is the contractor's responsibility to achieve a non-yielding compacted subgrade prior to fill placement or foundation construction. While the laboratory-indicated moisture contents alone may not cause subgrade instability, the exposed moisture conditions may vary from what is currently reported. As such, we provide this information for planning purposes. The following proven geotechnical solution may be considered should subgrade instability occur during grading.

Rock Stabilization*:* If saturated subgrade conditions exist at the bottom of excavation, a 4- to 6-inch layer of 2- to 3-inch crushed rock should be placed in the excavation. Rock should be mechanically compacted under the weight of the equipment to push the rock into the underlying clay soils. Vibratory equipment should <u>not be used</u> to work in the rock blanket as the vibrations may aggravate locally soft saturated clays causing pumping conditions to expand laterally and destabilize the subgrade further. Clay soils removed from the excavation will require drying prior to reuse and are not considered suitable for use behind retaining walls.

Depending upon the degree of subgrade instability, should it occur, the initial lift may completely penetrate the subgrade, and additional lifts will be necessary. Alternatively, the quantity of material may be reduced if a geogrid or geotextile fabric is considered to provide additional reinforcement effect after the placement of the initial lift. Geogrid or geotextile reinforcement should be placed with a minimum 3 feet of overlap between adjacent panels extending a distance of at least 5 feet beyond the footprint on all sides.

5.1.3 FILL MATERIALS

On-site soil that is free of construction debris, organics, or rock larger than 4 inches in largest dimension is suitable to be used as fill for support of structures. Onsite clayey soils with an Expansion Index greater than 20 should not be used within 2 feet of concrete slabs-on-grade to avoid potential for lightly loaded concrete slabs to heave. Any imported fill soil should be approved by the geotechnical engineer prior to import or use onsite. Import soils should be uncontaminated, granular in nature, free of organic material (loss on ignition less than 2 percent), have a very low expansion potential (with an EI of 20 or lower) and have a low corrosion impact to the proposed improvements.

Because of the medium expansive nature of some onsite clay soils, precautions should be taken to reduce the potential heaving of concrete slabs on grade if clay soil is exposed in the subgrade. A 24-inch-thick layer of relatively non-expansive, predominantly granular soils is recommended immediately beneath concrete walks and slabs on grade, including Portland cement concrete paving. This select, non-expansive granular soil should contain sufficient fines as to be relatively impermeable when compacted. Material of this type was observed onsite within the undocumented fill encountered at the boring locations. This granular undocumented fill material may be reused onsite.

5.1.4 FILL PLACEMENT AND COMPACTION

All fill soil should be placed in thin, loose lifts, moisture-conditioned, as necessary, to 2 to 4 percent above optimum moisture content, and compacted to a minimum 90% relative compaction as determined by ASTM D 1557 standard test method (modified Proctor compaction curve) within building footprints. Aggregate base for pavement sections should be compacted to a minimum of 95% relative compaction. At least the upper 12 inches of the exposed soils in roadways and access drives, parking and (concrete –paver) flatwork areas, should be compacted to at least 95 percent relative compaction based on ASTM Test Method D 1557.

5.1.5 REUSE OF CONCRETE AND ASPHALT IN FILL

Pulverized demolition concrete free of rebar and other materials and demolished asphalt pavement can be pulverized to particles no-larger-than (≤) 3-inches and mixed with site soils for use in compacted fill. Blended pulverized concrete and asphalt should be mixed with at least 25% soils by weight. Such materials must be free of and segregated from any hazardous materials and/or organic material of any kind.

5.2 FOUNDATIONS

Because structural loading information for the proposed buildings is not yet available, we assumed a maximum dead plus live column load of 450 kips in our evaluation. The design of the plinth structure is anticipated to be governed by dynamic loading with relatively small dead loads. The proposed new structures may be supported on a shallow spread footing foundation system established on engineered fill or undisturbed natural soils.

5.2.1 SPREAD FOOTINGS

Footings for proposed structures should have a minimum embedment of 2 feet and have a minimum width of 24 inches. Footings for proposed temporary structures may be supported directly on grade.

Bearing Value: Footings or post-tensioned concrete slabs with thickened edges established on engineered fill or undisturbed natural soils may be designed to impose an allowable bearing pressure of 2,000 pounds per square foot (psf). The excavations should be deepened as necessary to extend into satisfactory soils.

A 50 percent increase in the bearing value for short duration loading, such as wind or seismic forces, may be used.

The ultimate bearing capacity can be taken as 9,000 psf. This value does not incorporate a factor of safety and may only be used for an ultimate bearing capacity check with appropriate factored loads. A resistance factor of 0.45 may be used for initial bearing capacity evaluation with factored loads.

The recommended bearing value is a net value, and the weight of concrete in the footings can be taken as 50 pounds per cubic foot (pcf); the weight of soil backfill can be neglected when determining the downward loads.

Settlement: The above recommended allowable bearing capacities are generally based on a total post-construction settlement of about 1 inch for column loads not exceeding 450 kips in dead plus live loads.

Differential settlement due to static loading is generally estimated at ½ inch over a horizontal distance of 40 feet. Once developed by the structural engineer, we should review total dead and sustained live loads for each column including plan location and span distance, to evaluate if differential settlements between dissimilarly loaded columns will be tolerable. Excessive differential settlement can be mitigated with the use of reduced bearing pressures, deeper footing embedment, possibly changing overexcavation schemes and using imported base material under spread footings, or possibly other methods.

Lateral Resistance: Soil resistance available to withstand lateral loads on a shallow foundation is a function of the frictional resistance along the base of the footing and the passive resistance that may develop as the face of the structure tends to move into the soil. The frictional resistance between the base of the foundation and the subgrade soil may be computed using a coefficient of friction of 0.3. The passive resistance may be computed using an equivalent fluid pressure of 250 pounds-per-cubic-foot (pcf) up to a maximum of 2,500 psf, assuming there is constant contact between the footing and undisturbed soil. The passive resistance can be increased by one-third when considering short-duration wind or seismic loads. The friction resistance and the passive resistance of the soils can be combined without reduction in determining the total lateral resistance.

5.2.2 MODULUS OF SUBGRADE REACTION

For static loading, 20 pounds per cubic inch (pci) may be assumed as the modulus of subgrade reaction (*k*) for shallow foundations supported on engineered fill or undisturbed natural soils. For seismic loading, a *k* value of 100 pci may be assumed.

5.2.3 FLAGPOLE TYPE FOUNDATIONS

Canopy structures, light poles, and fencing may be supported on flagpole-type foundations. Flagpole-type foundations may be designed to impose an allowable vertical bearing pressure of 2,000 psf and an allowable lateral bearing pressure of 500 psf per foot below grade. The allowable vertical and lateral bearing pressures may be increased by one-third for short-duration loading such as wind or seismic loading. The recommended bearing value is a net value, and the weight of concrete in the flagpole footings can be taken as 50 pounds per cubic foot.

5.2.4 MICROPILES

Micropiles should be designed and detailed in accordance with Sections 1810.3.10 of the 2022 CBC. Axial capacities of 6- and 8-inch diameter micropiles, at least 40 feet long, should be calculated based on the bonded length of grout to ground bond adhesion presented in the following table:

Axial Capacities of 6- and 8-inch-diameter Micropiles

Pile Diameter (inches)	Bond Adhesion (kips-per-foot)	Construction Type
6-inch	0.9	Gravity
8-inch	1.1	Gravity

The grout to ground bond adhesion capacity can be increased to 150% for pressure grouting using Type B Construction (pressure grouted through the casing during casing withdrawal). The bond adhesion values are considered ultimate values. Ultimate pile capacities can be used if micropiles are proof tested to design capacities. Uplift capacity can be taken as 50 percent of the downward capacity.

A resistance factor of 0.5 should be used for downward and uplift capacity evaluation with factored loads.

Micropiles should have a maximum total length of 100 feet including cased length with a minimum edge distance of 2 times the pile diameter from center of the pile. To avoid group effects, the pile on-center spacing should be at least three times its largest diameter.

The specialty contractor may be able to attain higher bond capacities by pressure grouting or secondary grouting. The micropile casing should be designed to transfer vertical loads to soils below an imaginary 1:1.5 (horizontal:vertical) plane extending down buried structures. Structural constraints and lateral load analysis may dictate longer casing.

Micropiles should not be designed to carry lateral loads.

Micropile installation should be performed by a specialty contractor experienced with the types of soils encountered at this site. We recommend that Carl Kim Geo review the final foundation plans and specifications to assure that the intent of the recommendations presented in this report have been incorporated into the contract documents.

Project-specific micropile testing should be performed before and over the course of construction to verify design capacities. We recommend testing include the following:

At least two pre-production tests performed per ASTM D1143 or D3689. At least one proof test at each pile group performed per ASTM D1143 or D3689.

It is understood that micropile foundations are to be designed to resist seismic forces utilizing ultimate geotechnical capacity. For this case, pre-production and proof testing should be performed to 100 percent of the design axial load governing individual pile capacity. Results of pre-production and proof test should be evaluated for acceptance using a 0.025 in/kip load-displacement curve slope at the maximum test load.

5.3 SLABS-ON-GRADE

Concrete slabs-on-grade should be designed by the structural engineer in accordance with 2022 CBC requirements for soils with a high expansion potential. More stringent requirements may be required by the structural engineer and/or architect; however, slabs-on-grade should have the following minimum recommended components:

- **Subgrade:** The near-surface soils can be expansive and will shrink and swell with changes in the moisture content. Therefore, floor slabs-on-grade and adjacent concrete flatwork should be underlain by at least 24 inches of non-expansive fill (EI<21). Existing clay soils at planned basement levels are anticipated to be expansive. Accordingly, removal and replacement with non-expansive fill is recommended at the basement level.

Slab-on-grade subgrade soil should be moisture conditioned to within 2% of optimum moisture content, to a minimum depth of 18 inches within building footprints and compacted to 90% of the modified proctor (ASTM D 1557) laboratory maximum density prior to placing either a moisture barrier, steel and/or concrete. Onsite soil may be suitable for this use; however additional expansion testing should be performed upon completion of grading to verify expansive properties of onsite soil.

- **Moisture Barrier:** A moisture barrier consisting of at least 15-mil-thick Stego-wrap vapor barriers (see: http://www.stegoindustries.com/products/stego_wrap_vapor_barrier.php), or equivalent, should then be placed below slabs where moisture-sensitive floor coverings or equipment will be placed.

- **Reinforced Concrete**: A conventionally reinforced concrete slab-on-grade with a thickness of at least 5 inches within the building footprint and 6 inches for exterior SOG in pedestrian areas without heavy loads may be used. Reinforcing steel should be designed by the structural engineer, but as a minimum should be No. 3 rebar placed at 18 inches on-center, each direction (perpendicularly), mid-depth in the slab. A modulus of subgrade reaction (k) as a linear spring constant, of 75 pounds-per-square-inch per inch deflection (pci) can be used for design of heavily loaded slabs-on-grade, assuming a linear response up to deflections on the order of ¾ inch.

Minor cracking of concrete after curing due to expansion, drying and shrinkage is normal and will occur. However, cracking is often aggravated by a high water-to-cement ratio, high concrete temperature at the time of placement, small nominal aggregate size, and rapid moisture loss due to hot, dry, and/or windy weather conditions during placement and curing. Cracking due to temperature and moisture fluctuations can also be expected. The use of low-slump concrete or low water/cement ratios can reduce the potential for shrinkage.

5.4 CEMENT TYPE AND CORROSION PROTECTION

Based on the results of laboratory testing, concrete structures in contact with the onsite soil are expected to have moderate (S1) exposure to water-soluble sulfates in the soil. Type II/V cement plus pozzolan may be used for concrete construction onsite and the concrete should be designed in accordance with 2022 CBC requirements.

The onsite soil may be considered severely corrosive to ferrous metals. Ferrous pipe should be avoided by using high-density polyethylene (HDPE) or other non-ferrous pipe when possible. Ferrous pipe, if used, should be protected by polyethylene bags, tap or coatings, di-electric fittings or other means to separate the pipe from onsite soils.

5.6 LATERAL EARTH PRESSURES

Recommended lateral earth pressures are provided as equivalent fluid unit weights, in psf/ft. or pcf., for retaining walls in drained conditions using onsite sandy soils as backfill.

Condition	Equivalent Fluid Unit Weight (psf/ft) Level Backfill, Static Condition
Active	45
At-Rest	65
Passive	250
Coefficient of Friction	0.35

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

Cantilever walls that are designed for a deflection at the top of the wall of at least 0.001H, where H is equal to the wall height, may be designed using the active earth pressure condition. Rigid walls that are not free to rotate, walls that are braced at the top, and walls that provide indirect support for foundations should be designed using the at-rest condition. A seismic increment of 20 pcf may be added to the active earth pressure above to evaluate seismic loading on walls.

The above lateral earth pressures are based on fully drained conditions. Infiltrating surface water may build-up behind proposed basement walls. Therefore, walls below grade should be designed to resist hydrostatic pressures (additional fluid pressure of 45 pounds per cubic foot) or be provided with positive drainage behind the wall.

Lateral load resistance will be provided by the sliding resistance at the base of the foundation and the passive pressure developed along the front of the foundation. A frictional resistance coefficient of 0.3 may be used at the concrete and soil interface.

In addition to the above lateral forces due to retained earth, the appropriate loads due to surcharges should be considered in the design of retaining structures.

5.7 PAVEMENT DESIGN

5.7.1 ASPHALT CONCRETE PAVING

The paving thicknesses presented in the table below are based on our review of available subsurface data. We assumed an R-value of 8 for design (laboratory test results ranged from 8 to 10). The required paving and base thicknesses will depend on the expected wheel loads and volume of traffic (Traffic Index or TI). Assuming that the paving subgrade will consist of the on-site or comparable soils compacted to at least 95% of the maximum dry density obtainable by the ASTM Designation D1557 method of compaction as recommended, the minimum recommended paving thicknesses are presented in the following table.

Area	Traffic Index	Asphalt Concrete (inches)	Base Course (inches)
Parking Areas	4	3	6
Light Truck	5	4	7
Heavy Truck	6	5	9
Main Drives	7	6	11

The asphalt paving sections were determined using the Caltrans design method. We can determine the recommended paving and base course thicknesses for other Traffic Indices if required. Careful inspection is recommended to verify that the recommended thicknesses or greater are achieved, and that proper construction procedures are followed.

5.7.2 PORTLAND CEMENT CONCRETE PAVING

We have assumed that the subgrade consisting of a layer of non-expansive fill below Portland cement concrete paving will have an R-value of at least 20, which will need to be verified during grading. Portland cement concrete paving sections were determined in accordance with procedures developed by the Portland Cement Association. Concrete paving sections for a range of Traffic Indices are presented in the following table. We have assumed that the Portland Cement Concrete will have a compressive strength of at least 4,000 pounds per square inch.

Area	Traffic Index	PCC (inches)	Base Course (inches)
Parking Areas	4	5½	4
Light Truck	5	6	4
Heavy Truck	6	6½	4
Main Drives	7	7½	4

The paving should be provided with expansion joints at regular intervals no more than 15 feet in each direction. Load transfer devices, such as dowels or keys, are recommended at joints in the paving to reduce possible offsets. The paving sections in the above table have been developed based on the strength of unreinforced concrete. Steel reinforcing may be added to the paving to reduce cracking and to prolong the life of the paving.

5.7.3 SPECIFICATIONS

The base course should conform to requirements of Section 26 of State of California Department of Transportation Standard Specifications (Caltrans), latest edition, or meet the specifications for untreated base as defined in Section 200-2 of the latest edition of the Standard Specifications for Public Works Construction (Green Book). The existing asphalt paving may be used for base course if it is crushed and processed to meet the requirements of crushed miscellaneous base per the Green Book. The base course should be compacted to at least 95 percent relative compaction. The asphalt concrete should conform to the specifications outlined in Section 203-6 of the Green Book, and asphalt concrete construction methods should meet the requirements of Section 302-5 of the Green Book.

5.8 TEMPORARY EXCAVATIONS

All temporary excavations, including utility trenches, retaining wall excavations, and foundation excavations should be performed in accordance with project plans, specifications, and all OSHA requirements. Excavations 4 feet or deeper should be laid back or shored in accordance with OSHA requirements before personnel are allowed to enter.

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

Temporary excavations should be treated in accordance with the State of California version of OSHA excavation regulations, Construction Safety Orders for Excavation General Requirements, Article 6, Section 1541, effective October 1, 1995. The sides of excavations should be shored or sloped in accordance with OSHA regulations. OSHA allows the sides of unbraced excavations, up to a maximum height of 20 feet, to be cut to a ¾H:1V (horizontal:vertical) slope for Type A soils, 1H:1V for Type B soils, and 1½H:1V for Type C soils. Onsite soils are to be considered Type C soils which are subject to collapse in shallow unbraced excavations (i.e. approximately 3 feet in vertical height).

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

5.9 TRENCH BACKFILL

Utility trenches should be backfilled with compacted fill in accordance with Sections 306-1 and 306-6 of the Standard Specifications for Public Works Construction, ("Greenbook"), 2018 Edition. Utility trenches can be backfilled with onsite sandy material free of rubble, debris, organic and oversized material up to (≤) 3-inches in largest dimension. Prior to backfilling trenches, pipes should be bedded in and covered with either:

(1) **Sand:** A uniform, sand material that has a Sand Equivalent (SE) greater-than-or-equal-to (≥) 30, passing the No. 4 U.S. Standard Sieve (or as specified by the pipe manufacturer), water densified in place, or

(2) **CLSM:** Controlled Low Strength Material (CLSM) conforming to Section 201-6 of the *Standard Specifications for Public Works Construction,* ("Greenbook"), 2018 Edition.

Pipe bedding should extend at least 4 inches below the pipeline invert and at least 12 inches over the top of the pipeline. Native and clean fill soils can be used as backfill over the pipe bedding zone, and should be placed in thin lifts, moisture conditioned above optimum, and mechanically compacted to at least 95 percent relative compaction, relative to the ASTM D 1557 laboratory maximum density.

5.10 DRAINAGE AND LANDSCAPING

Building walls below grade should be waterproofed or at least damp proofed, depending upon the degree of moisture protection desired. Surface drainage should be designed to direct water away from foundations and toward approved drainage devices. Irrigation of landscaping should be controlled to maintain, as much as possible, consistent moisture content sufficient to provide healthy plant growth without overwatering.

5.11 ADDITIONAL GEOTECHNICAL SERVICES

The geotechnical recommendations presented in this report are based on subsurface conditions as interpreted from limited subsurface explorations and limited laboratory testing. Our conclusions and recommendations presented in this report should be reviewed and verified by Carl Kim Geo during site construction and revised accordingly if exposed geotechnical conditions vary from our preliminary findings and interpretations. The recommendations presented in this report are only valid if Carl Kim Geo verifies the site conditions during construction. Geotechnical observation and testing should be provided during the following activities:

- Grading and excavation of the site;
- Overexcavation and compaction;
- Compaction of all fill materials;
- Excavation and installation of foundations;
- After excavation of all slabs and footings and prior to placement of steel or concrete to confirm the slabs and footings are founded in firm, compacted fill;
- Utility trench backfilling and compaction; and
- When any conditions are encountered that varies significantly from the conditions described in this report.

Carl Kim Geo should review the final grading and foundation plans and specifications, when available, to comment on the geotechnical aspects. Our recommendations should be revised, as necessary, based on future plans and incorporated into the final design plans and specifications.

7.0 LIMITATIONS

The geotechnical engineering analyses presented in this geotechnical exploration report have been conducted in general accordance with current practice and the standard of care exercised by geotechnical consultants performing similar tasks in the project area. No other warranty, express or implied, is made regarding the conclusions, recommendations, and opinions presented in this report.

Please also note that our evaluation was limited to assessment of the geologic and seismic aspects of the site, and did not include evaluation of structural issues, environmental concerns or the presence of hazardous materials. Our conclusions, recommendations and opinions are based on an analysis of the observed site conditions, engineering characteristics of the observed site soils and our review of the referenced geologic literature and reports. If geologic conditions different from those described in this report are encountered, our office should be notified and additional recommendations, if warranted, will be provided upon request.

FIGURES AND PLATES

0 1,000 2,000 4,000 Feet

1 inch =2,000 feet

N

June 2024

Legend

Site Boundary

Imagery Source: California F&W. 2022.

CKGEO

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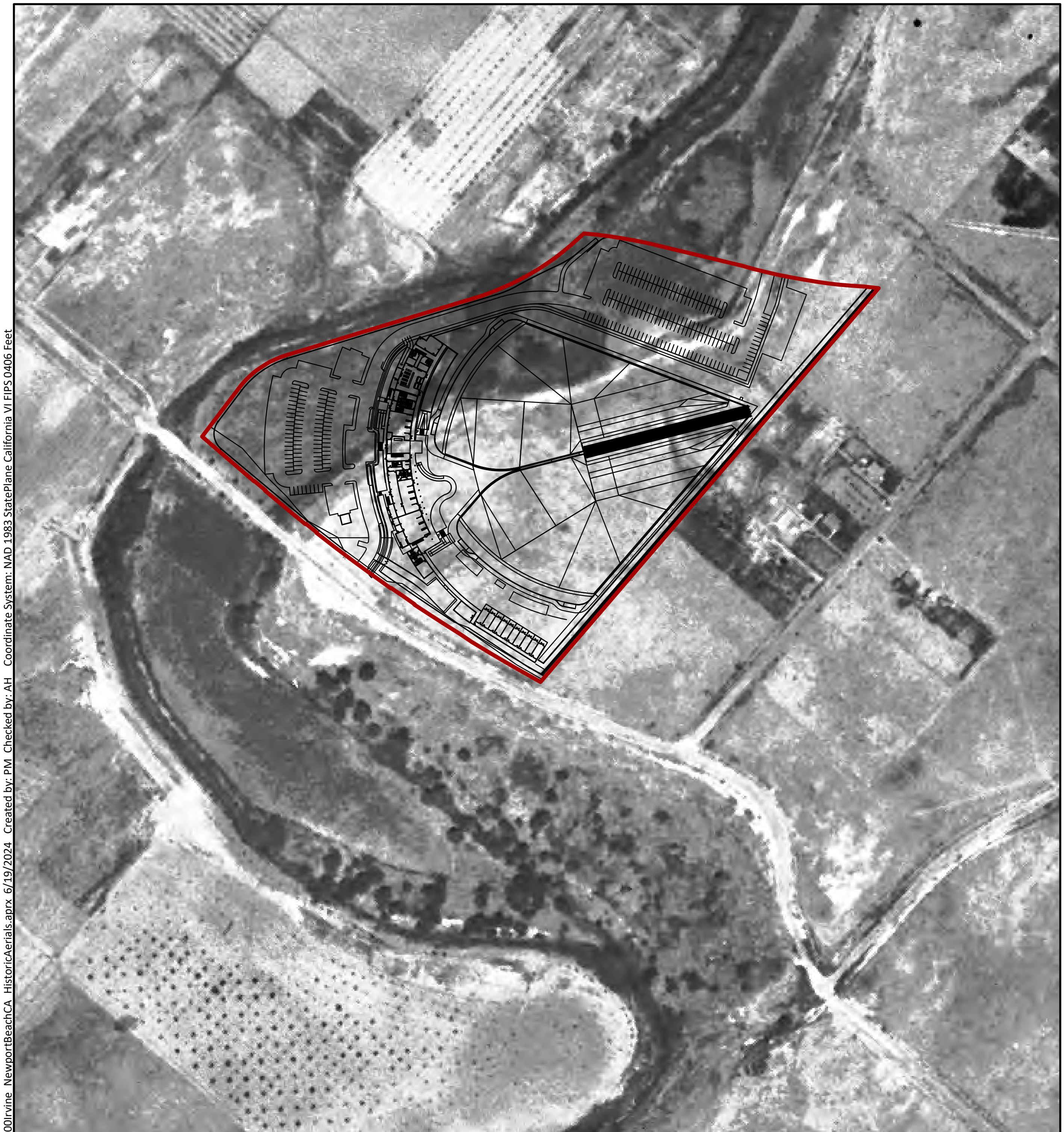
CLIENT:	Back Bay Barrels, LLC
PROJECT:	Wavegarden Cove 3100 Irvine Avenue Newport Beach, CA
PROJECT NUMBER:	PWAS_20240507

Site Location

FIGURE 1

File: X:\CarlKim\California\NewportBeach CA\3100IrvineAve\3100Irvine NewportBeachCA.aprx 6/21/2024 Created by: PM Checked by: AH Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet



0 150 300 600 Feet

1 inch =300 feet

June 2024

N

Legend

Site Boundary (approximate)

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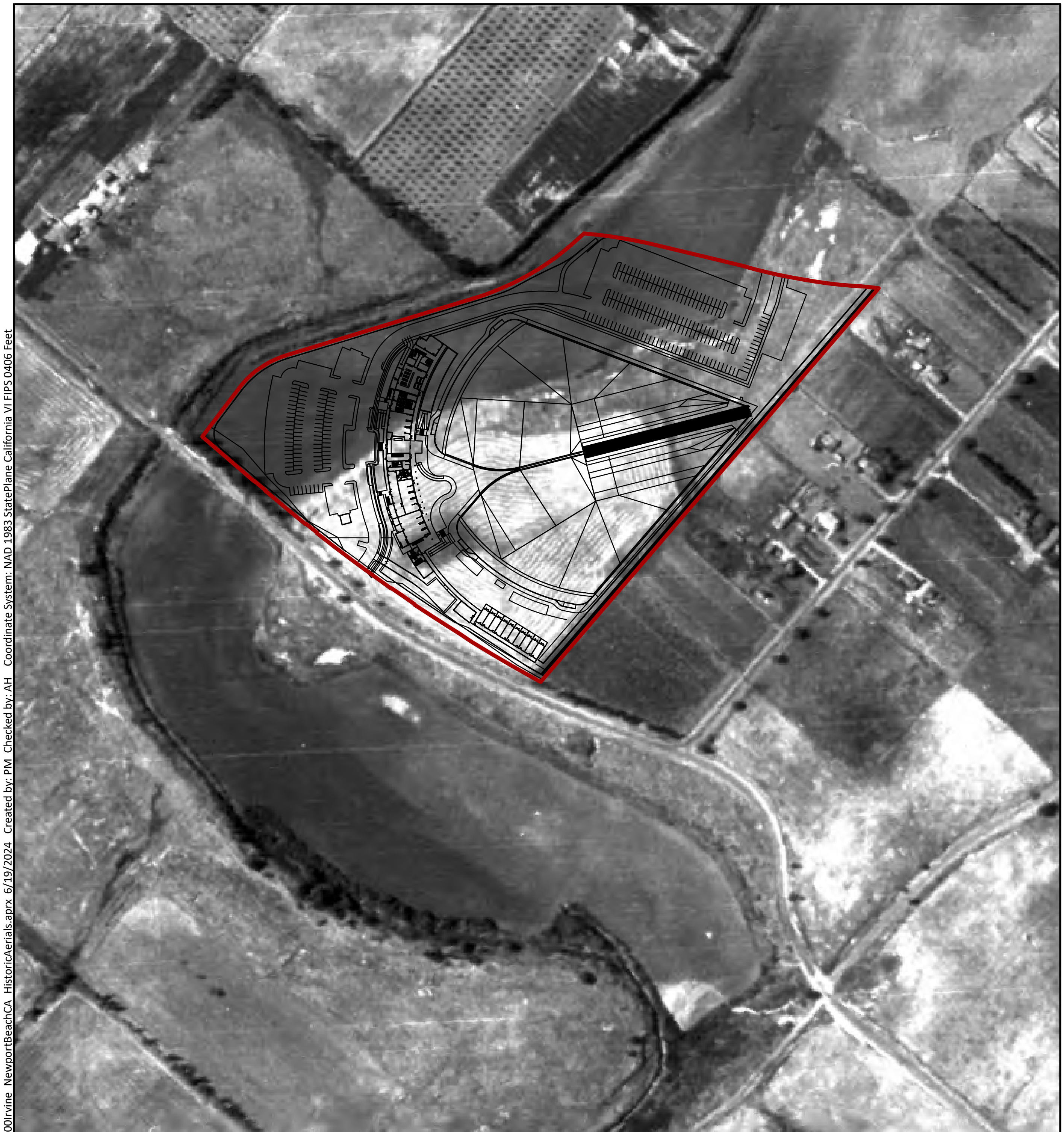
Historic Aerial (1927)

FIGURE 2A

File: X:\CarlKim\California\NewportBeach_CA\3100IrvineAve\3100Irvine_NewportBeachCA_HistoricAerials.aprx 6/19/2024 Created by: PM Checked by: AH Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet



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0 150 300 600 Feet

1 inch =300 feet

June 2024

N

Legend

Site Boundary (approximate)

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Historic Aerial (1938)

FIGURE 2B

0 150 300 600 Feet

1 inch =300 feet

June 2024

N

Legend

Site Boundary (approximate)

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Historic Aerial (1963)

FIGURE 2C

File: X:\CarlKim\California\NewportBeach_CA\3100IrvineAve\3100Irvine_NewportBeachCA_HistoricAerials.aprx 6/19/2024 Created by: PM Checked by: AH Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet

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0 150 300 600 Feet

1 inch =300 feet

June 2024

N

Legend

Site Boundary (approximate)

CKGEO	CLIENT: Back Bay Barrels, LLC	Historic Aerial (1968)
Carl Kim Geotechnical, Inc. 945 Baileyana Road Hillsborough, CA 94010 949-441-8143 *CARLKIMGEO@GMAIL.COM*	PROJECT: Wavegarden Cove 3100 Irvine Avenue Newport Beach, CA	
	PROJECT NUMBER: PWAS_20240507	**FIGURE 2D**

File: X:\CarlKim\California\NewportBeach_CA\3100IrvineAve\3100Irvine_NewportBeachCA_HistoricAerials.aprx 6/19/2024 Created by: PM Checked by: AH Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet

0 150 300 600 Feet

1 inch =300 feet

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N

Legend

Site Boundary (approximate)

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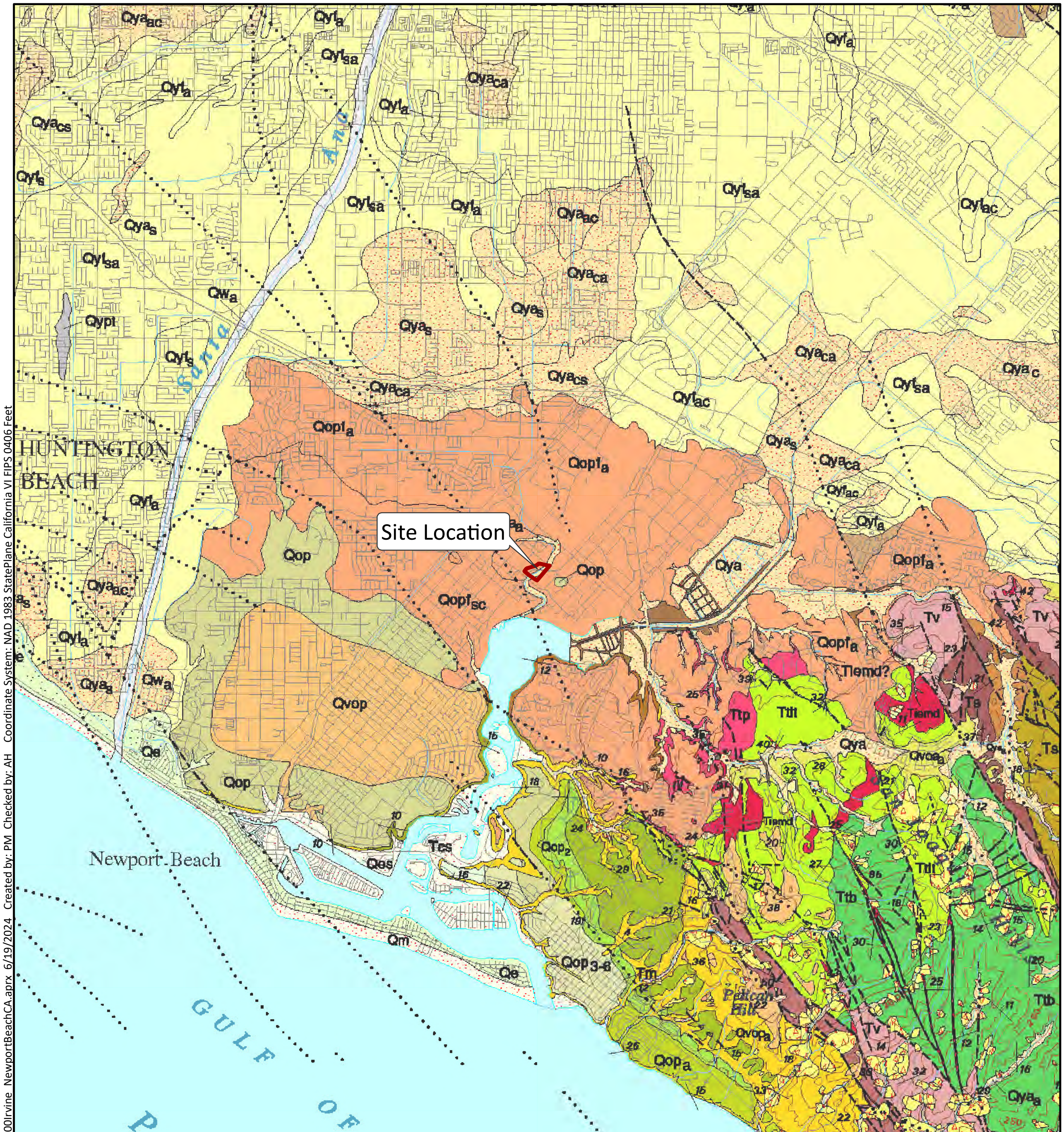
PROJECT:	Wavegarden Cove 3100 Irvine Avenue Newport Beach, CA
PROJECT NUMBER:	PWAS_20240507

Historic Aerial (2001)

FIGURE 2E



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0 4,000 8,000 16,000 Feet

1 inch =8,000 feet

June 2024

N

Legend

Site Boundary

Geologic Map of the San Bernardino and Santa Ana 30' x 60' Quadrangles, California, Douglas M. Morton and Fred K. Miller, 2006, USGS Open File report 2006-1217

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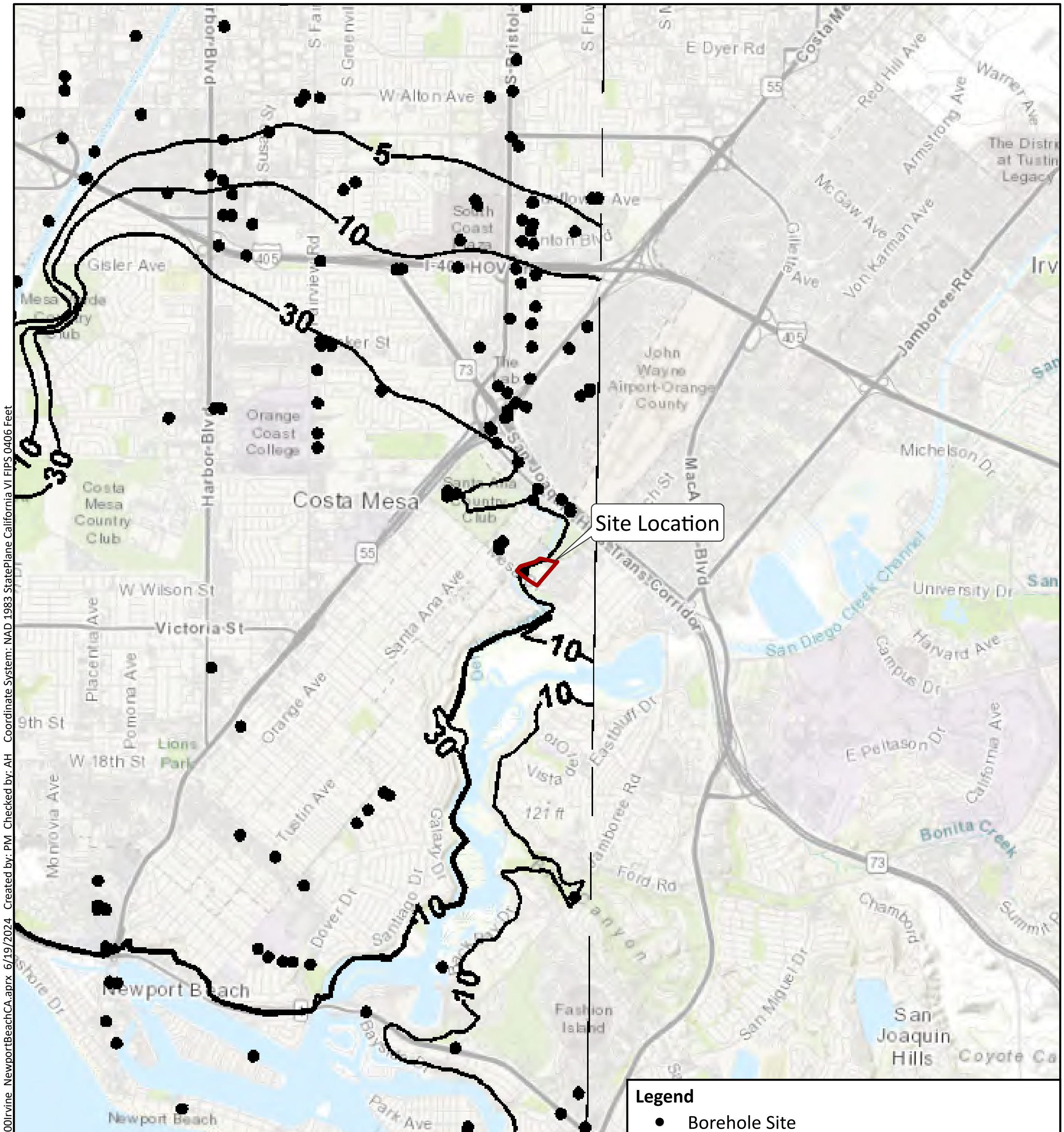
PROJECT:	Wavegarden Cove 3100 Irvine Avenue Newport Beach, CA
PROJECT NUMBER:	PWAS_20240507

Geologic Map

FIGURE 3



Legend

- Borehole Site
- Estimated depth to historic high groundwater level in feet
- Site Boundary

Base Map: Seismic Hazard Zone Report for the Newport Beach 7.5 Quadrangle, Plate 1.2 Historically Highest Ground Water Contours and Borehole Log Data Locations

0 2,500 5,000 10,000 Feet

1 inch =5,000 feet

N

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Historic High Groundwater Level

FIGURE 4

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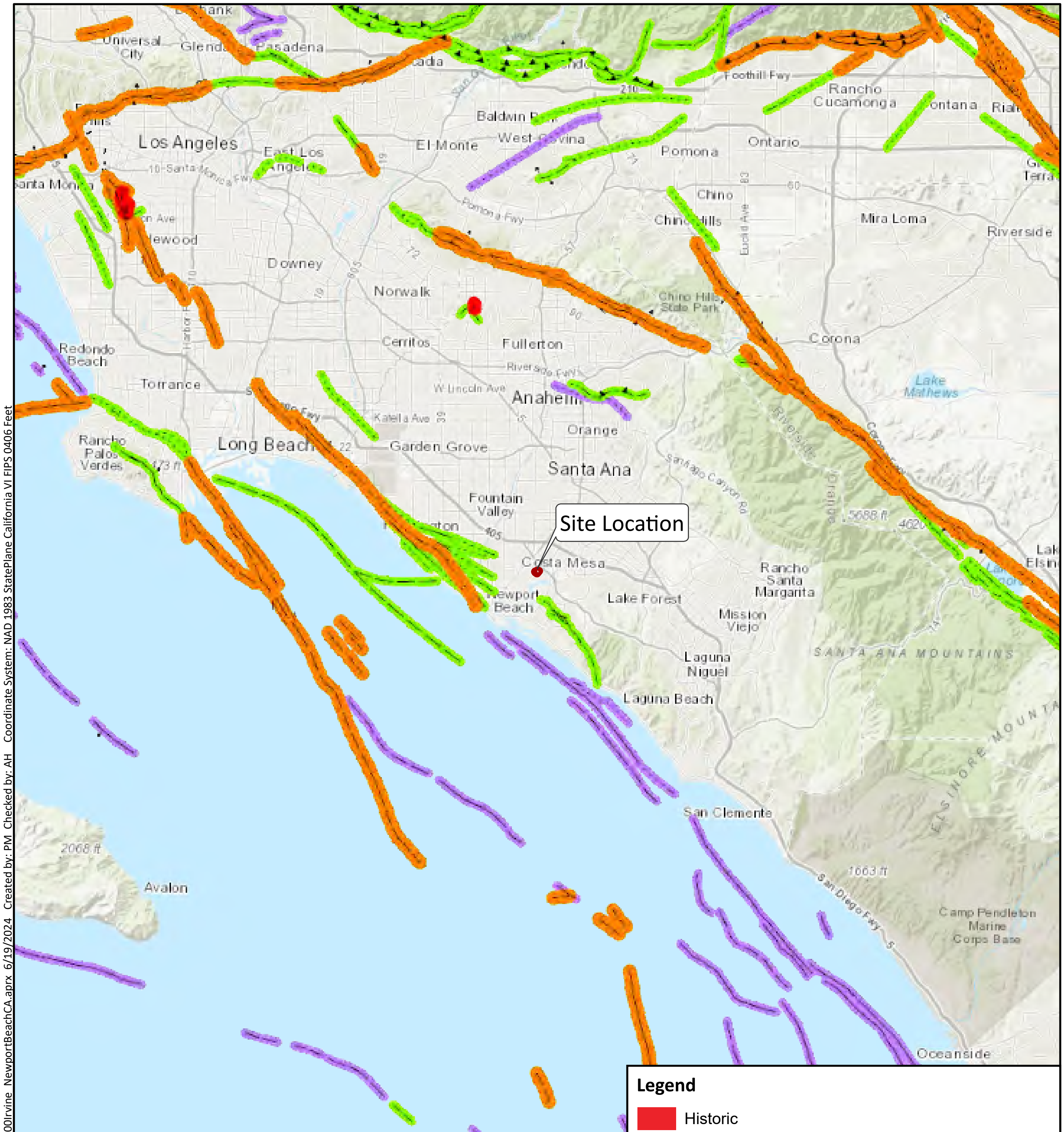
Holocene



Legend

- Historic
- Holocene
- Late Quaternary
- Quaternary

Base Map: Fault Activity Map of California, California Department of Conservation

0 25,000 50,000 100,000 Feet

1 inch =50,000 feet

N

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Regional Faults

FIGURE 5

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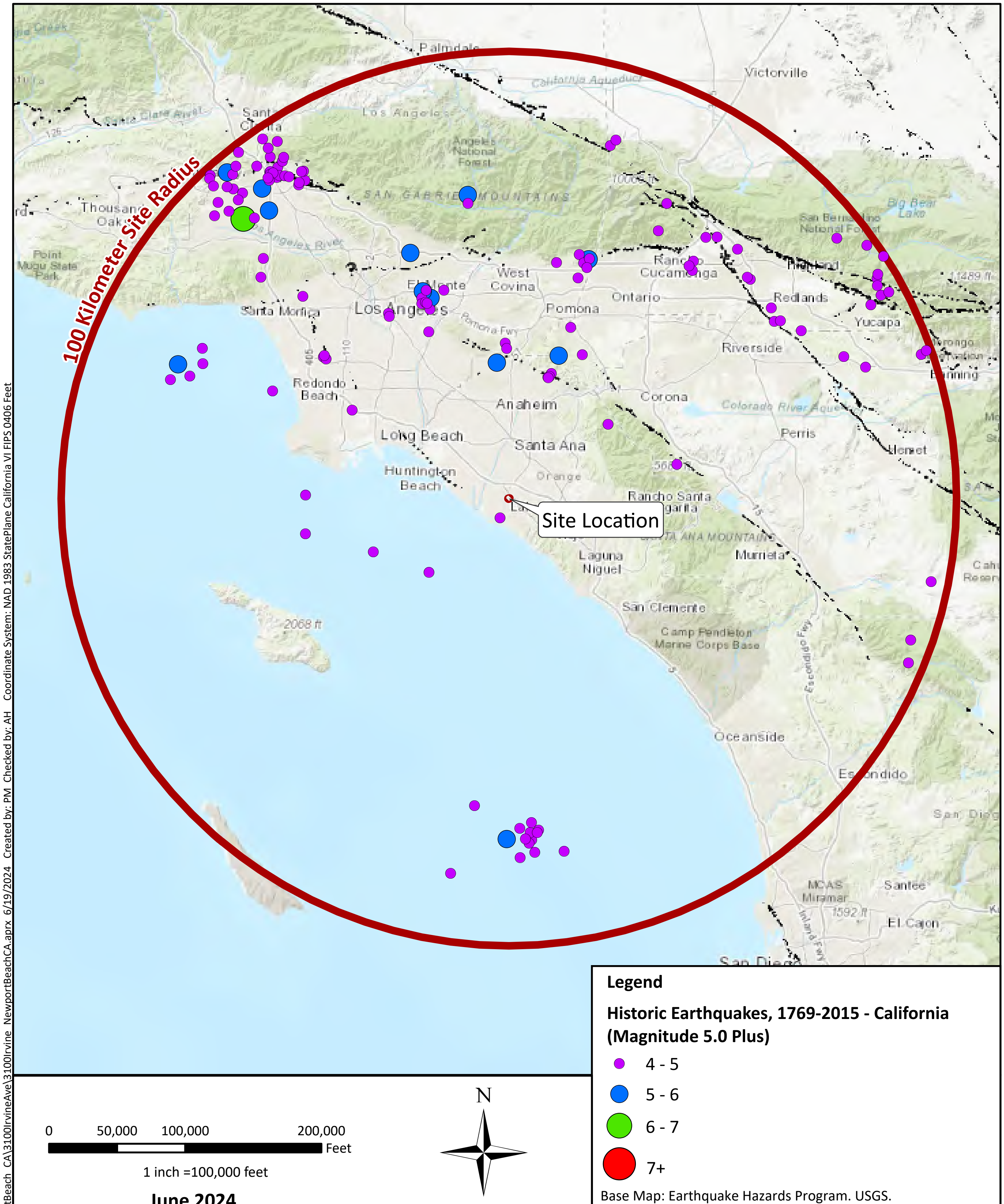

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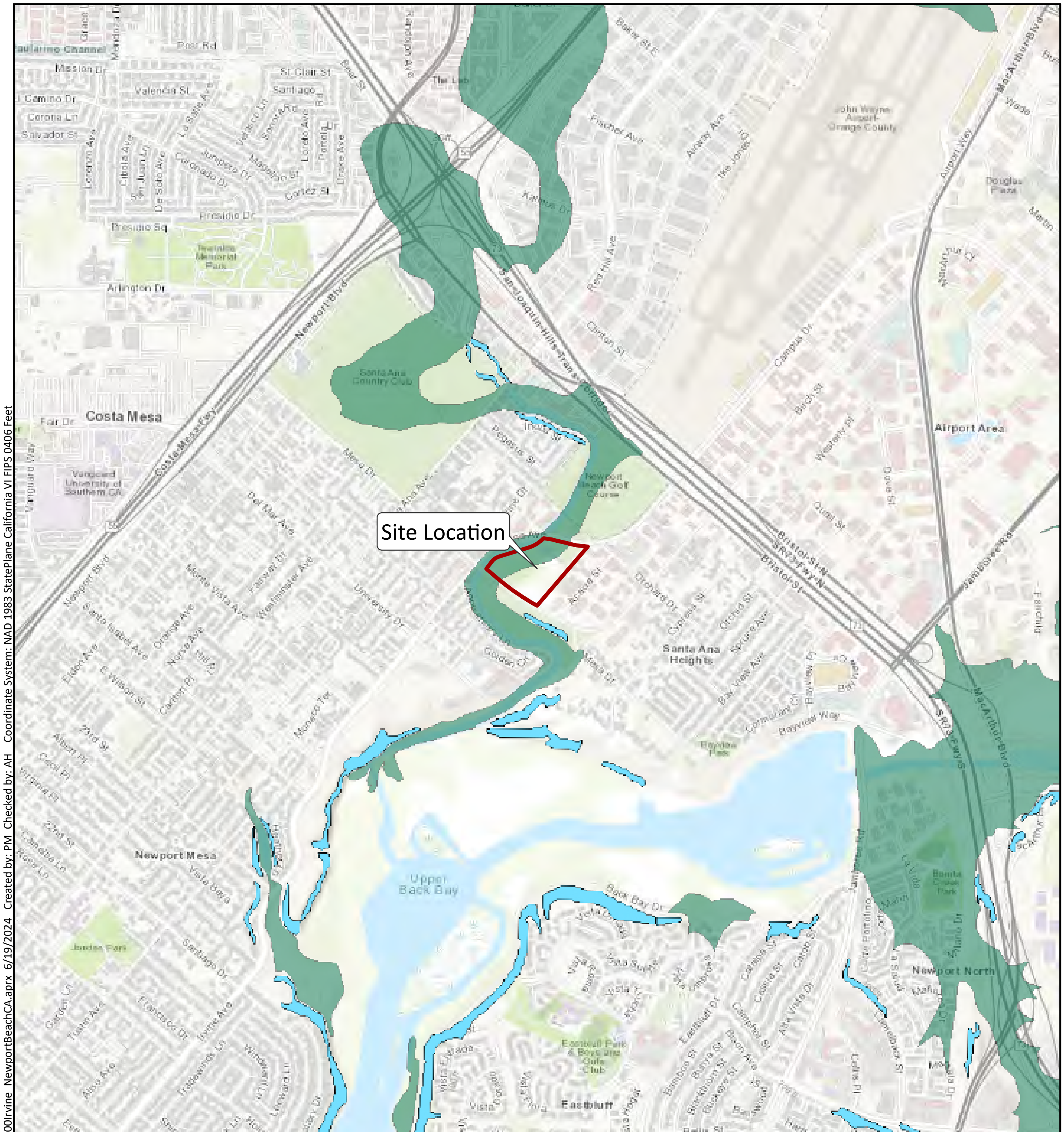
CKGEO	CLIENT: Back Bay Barrels, LLC	**Historic Seismicity**
Carl Kim Geotechnical, Inc. 945 Baileyana Road Hillsborough, CA 94010 949-441-8143 *CARLKIMGEO@GMAIL.COM*	PROJECT: Wavegarden Cove 3100 Irvine Avenue Newport Beach, CA	
	PROJECT NUMBER: PWAS_20240507	**FIGURE 6**



0 1,000 2,000 4,000 Feet

1 inch =2,000 feet

June 2024

N

Legend

Site Boundary

Liquefaction Zones

Landslide Zones

Base Map: CGS Seismic Hazards Program: Liquefaction and Landslide Zones, California Department of Conservation

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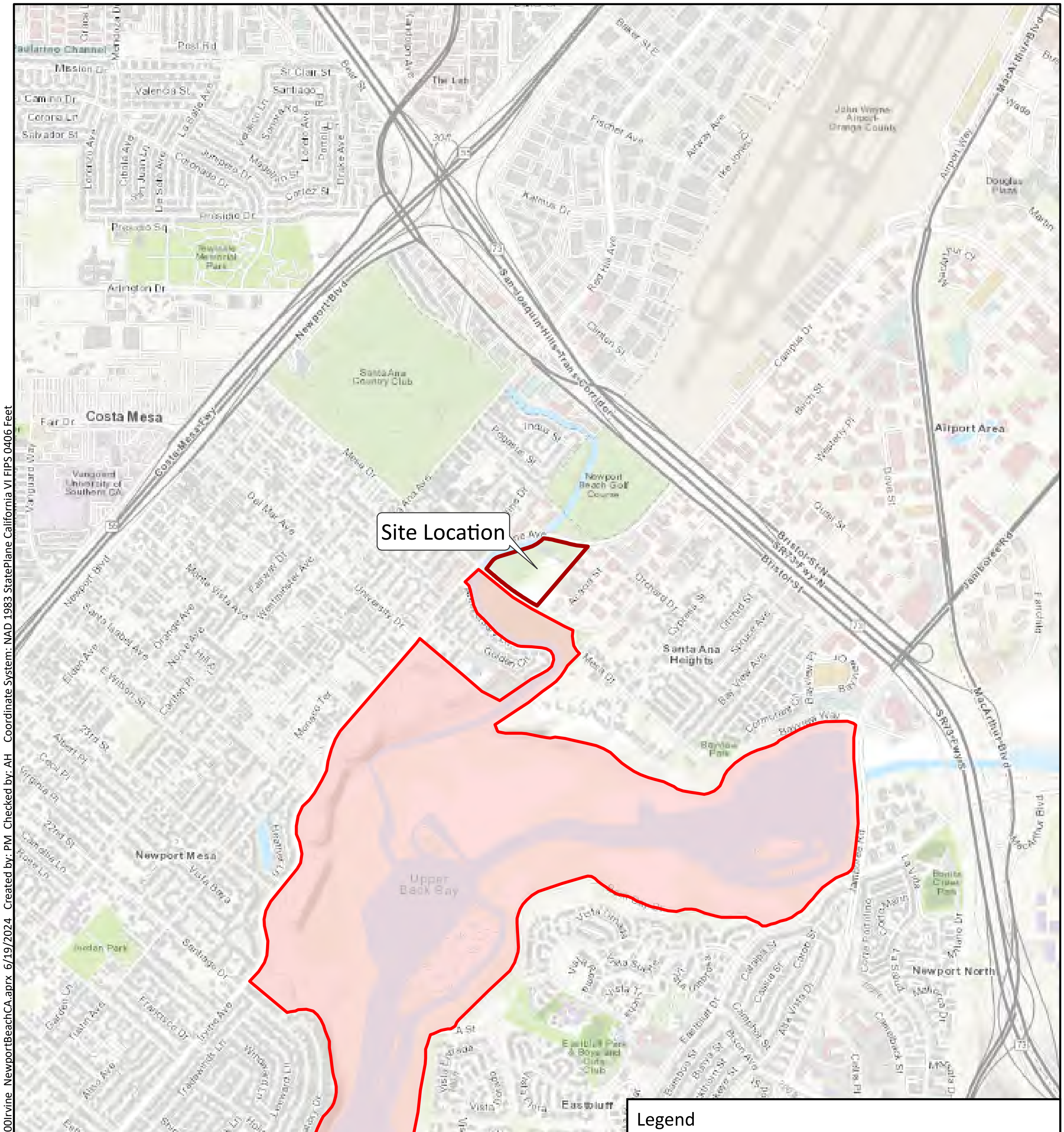
PROJECT NUMBER:	PWAS_20240507

Seismic Hazards

FIGURE 7

File: X:\CarlKim\California\NewportBeach_CA\3100IrvineAve\3100Irvine_NewportBeachCA.aprx 6/19/2024 Created by: PM Checked by: AH Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet



Legend

Site Boundary

Tsunami Hazard Area

Tsunami Inundation Source: California Department of Conservation. California Tsunami Maps.
https://www.conservation.ca.gov/cgs/tsunami/maps

0 1,000 2,000 4,000 Feet

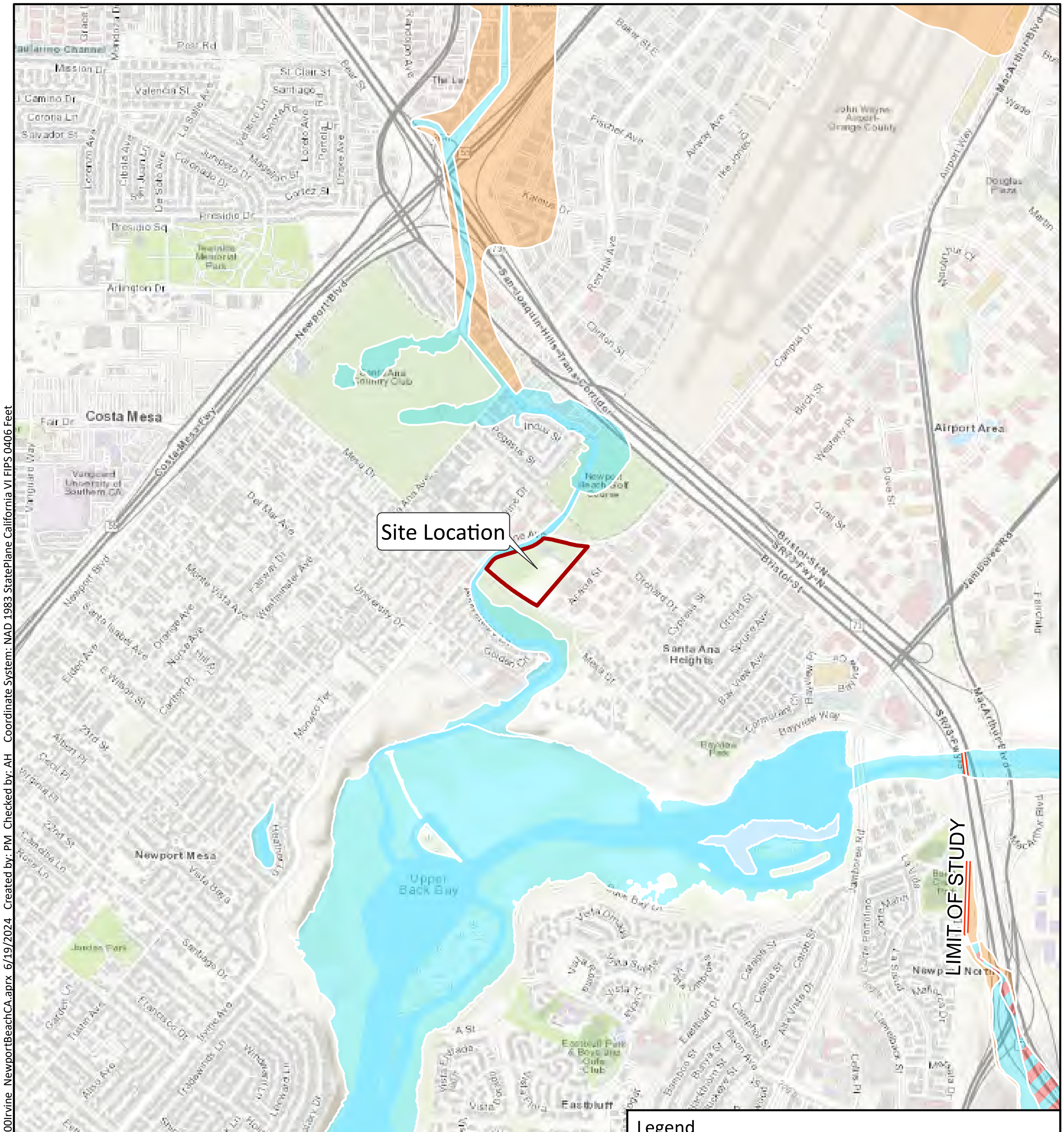
1 inch =2,000 feet

N

June 2024

CKGEO	CLIENT:	Back Bay Barrels, LLC	**Tsunami Hazard**
Carl Kim Geotechnical, Inc. 945 Baileyana Road Hillsborough, CA 94010 949-441-8143 *CARLKIMGEO@GMAIL.COM*	PROJECT:	Wavegarden Cove 3100 Irvine Avenue Newport Beach, CA	
	PROJECT NUMBER:	PWAS_20240507	**FIGURE 8**

File: X:\CarlKim\California\NewportBeach_CA\3100IrvineAve\3100Irvine_NewportBeachCA.aprx 6/19/2024 Created by: PM Checked by: AH Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet



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0 1,000 2,000 4,000 Feet

1 inch =2,000 feet

N

June 2024

Legend

Site Boundary

1% Annual Chance Flood Hazard

0.2% Annual Chance Flood Hazard

Flood Layer Source: FEMA's National Flood Hazard Layer

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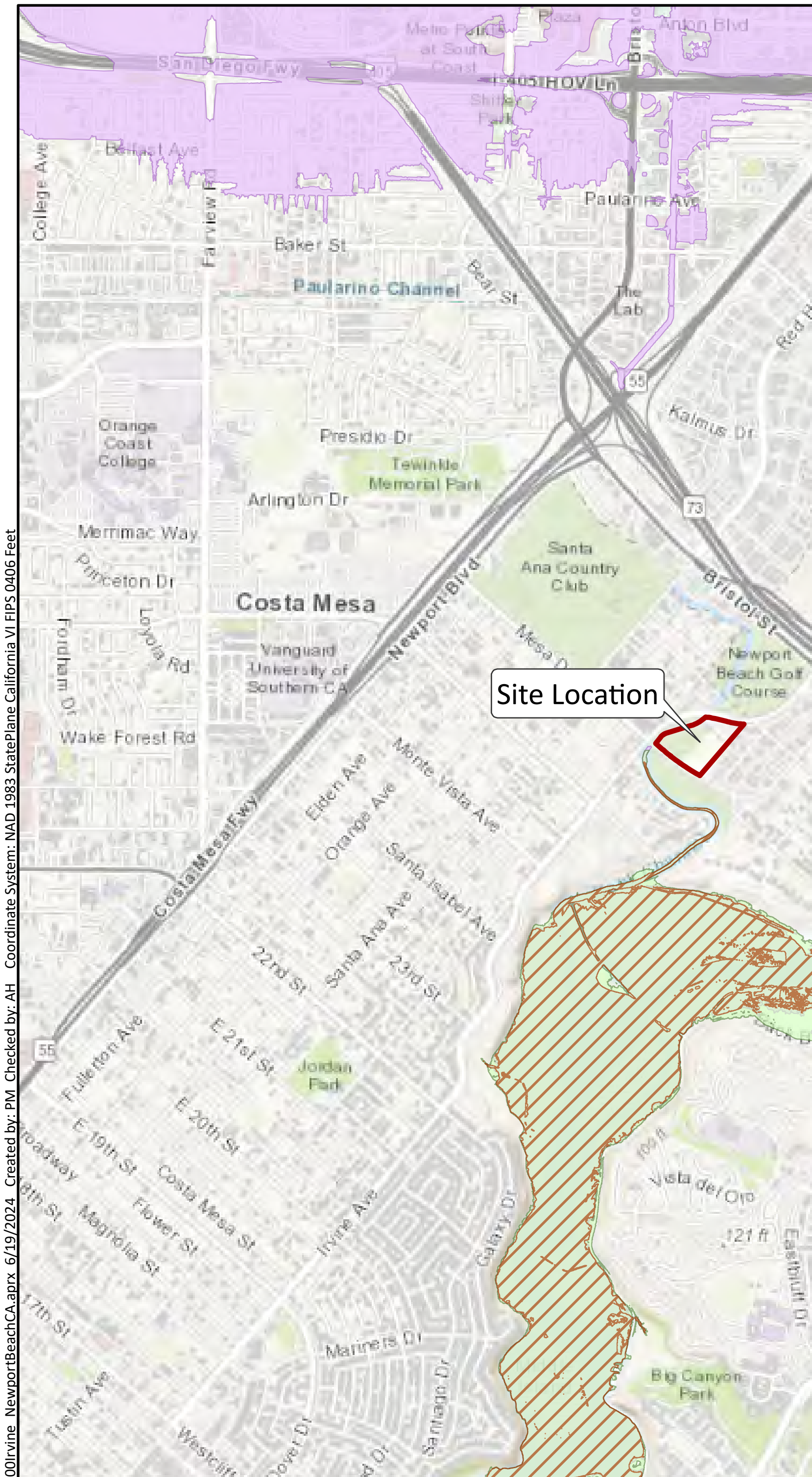
PROJECT NUMBER:	PWAS_20240507

Flood Hazards

FIGURE 9



Legend
Site Boundary
Dam Breach Inundation Scenario (Santiago Creek, No. 75-0)
Dam Breach Inundation Scenario (Sand Canyon, No. 1029-2)
Dam Breach Inundation Scenario (San Juaquin Reservoir, No. 1029-0)

Dam Inundation Source: California Department of Water Resources, Division of Safety of Dams (DSOD). California Dam Breach Inundation Maps.

0 1,500 3,000 6,000 Feet

1 inch =3,000 feet

N

June 2024

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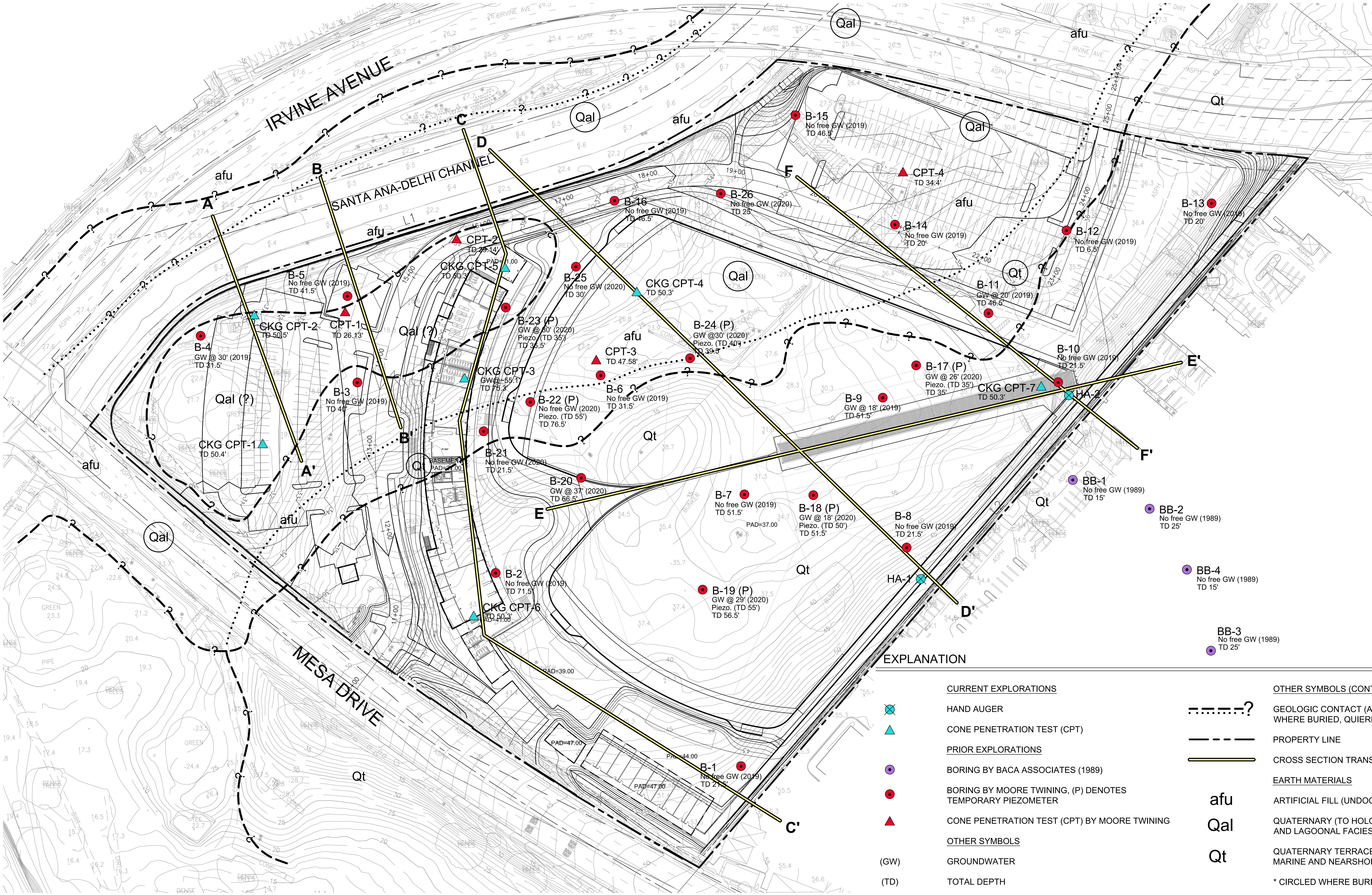
CLIENT:	Back Bay Barrels, LLC
PROJECT:	Wavegarden Cove 3100 Irvine Avenue Newport Beach, CA
PROJECT NUMBER:	PWAS_20240507

Dam Inundation

FIGURE 10

File: X:\CarlKim\California\NewportBeach_CA\3100IrvineAve\3100Irvine_NewportBeachCA.aprx 6/19/2024 Created by: PM Checked by: AH Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet



EXPLANATION

CURRENT EXPLORATIONS

- HAND AUGER
- CONE PENETRATION TEST (CPT)

PRIOR EXPLORATIONS

- BORING BY BACA ASSOCIATES (1989)
- BORING BY MOORE TWINING, (P) DENOTES TEMPORARY PIEZOMETER
- CONE PENETRATION TEST (CPT) BY MOORE TWINING

OTHER SYMBOLS

- (GW) GROUNDWATER
- (TD) TOTAL DEPTH

OTHER SYMBOLS (CONTINUED)

- ? GEOLOGIC CONTACT (APPROXIMATE, DOTTED WHERE BURIED, QUIERRIED WHERE UNCERTAIN)
- PROPERTY LINE
- CROSS SECTION TRANSECT

EARTH MATERIALS

- afu ARTIFICIAL FILL (UNDOCUMENTED)
- Qal QUATERNARY (TO HOLOCENE) ALLUVIUM (RIVERINE AND LAGOONAL FACIES)
- Qt QUATERNARY TERRACE DEPOSITS (UPLIFTED MARINE AND NEARSHORE)

* CIRCLED WHERE BURIED

June 2024

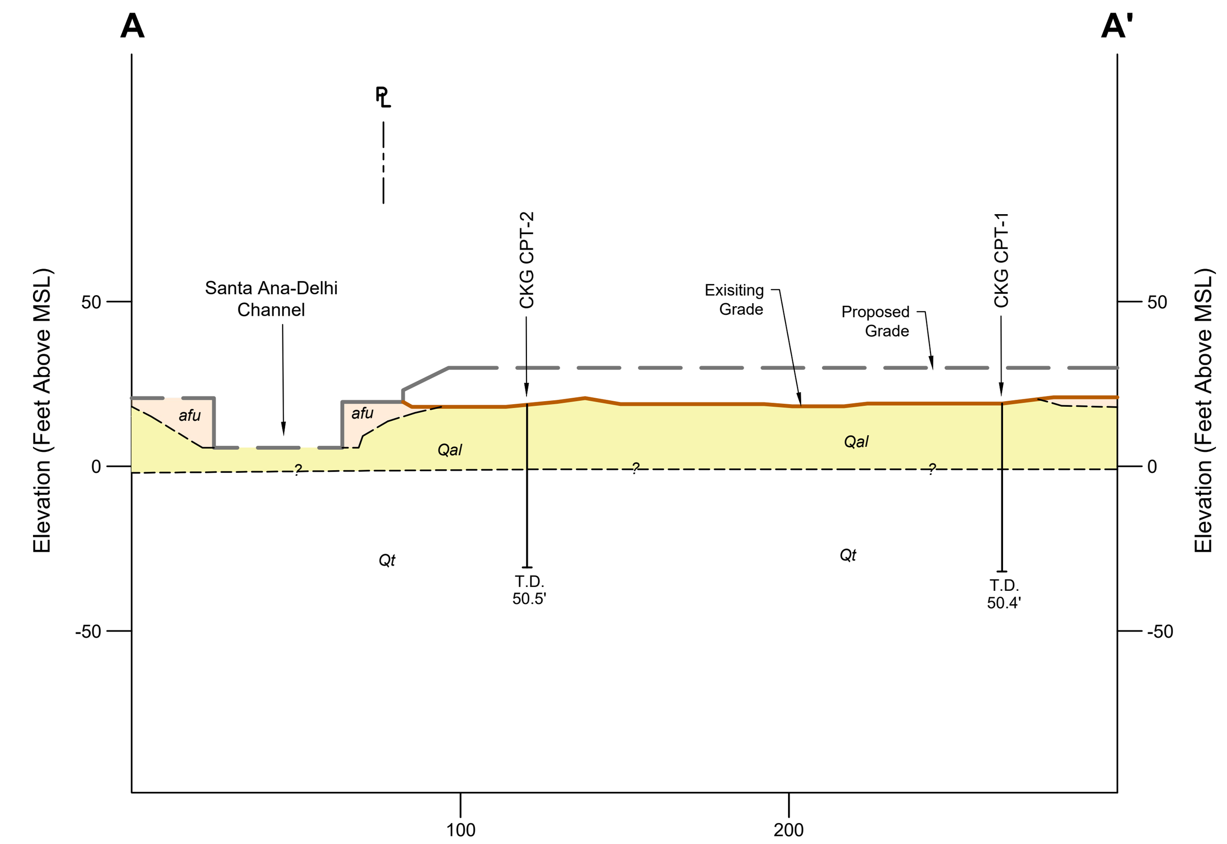
Aerial Imagery Source: ©2024. Microsoft Corporation.

CKGEO
Carl Kim Geotechnical, Inc.
945 Baileyana Road
Hillsborough, CA 94010
949-441-8143
CARLKIMGEO@GMAIL.COM

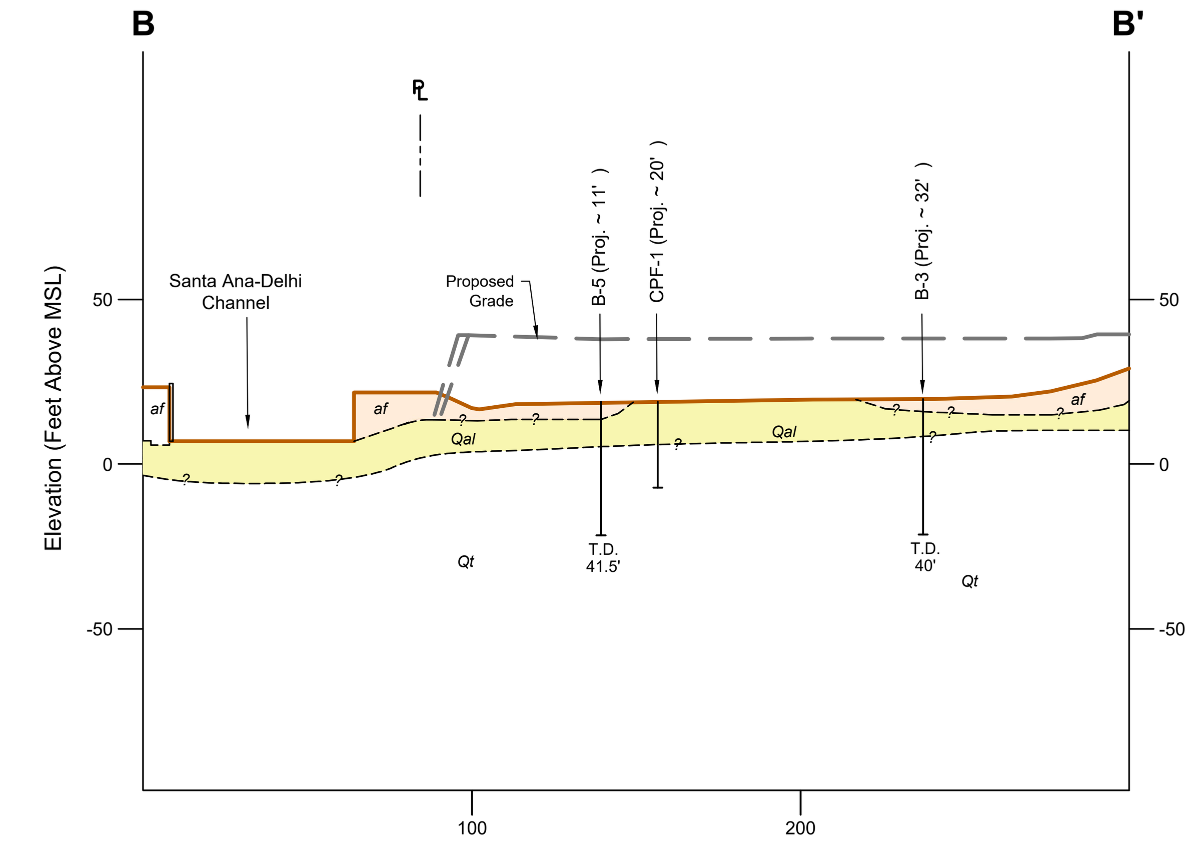
CLIENT:	Back Bay Barrels, LLC
PROJECT:	Wavegarden Cove 3100 Irvine Avenue Newport Beach, CA
PROJECT NUMBER:	PWAS_20240507

EXPLORATIONS

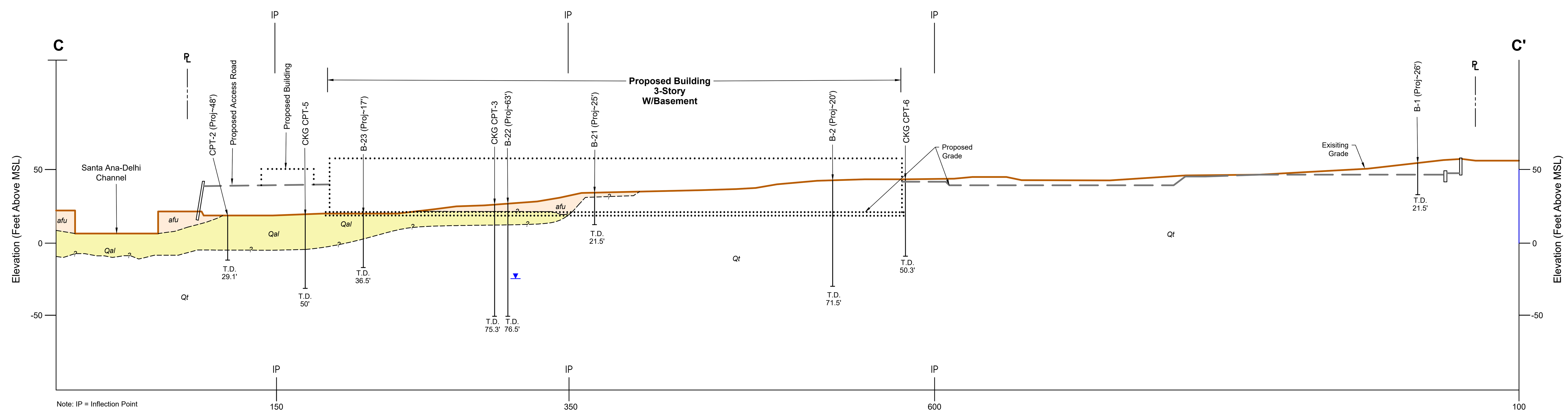
PLATE 1



CROSS SECTION A-A'

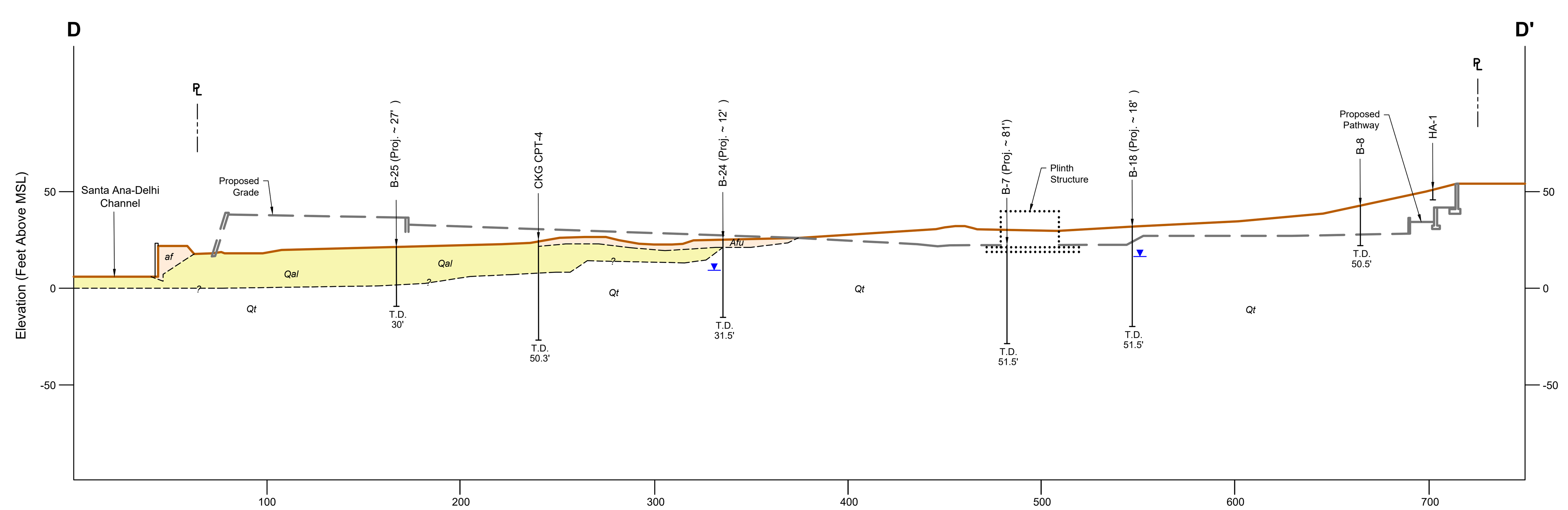


CROSS SECTION B-B'



Note: IP = Inflection Point

CROSS SECTION C-C'

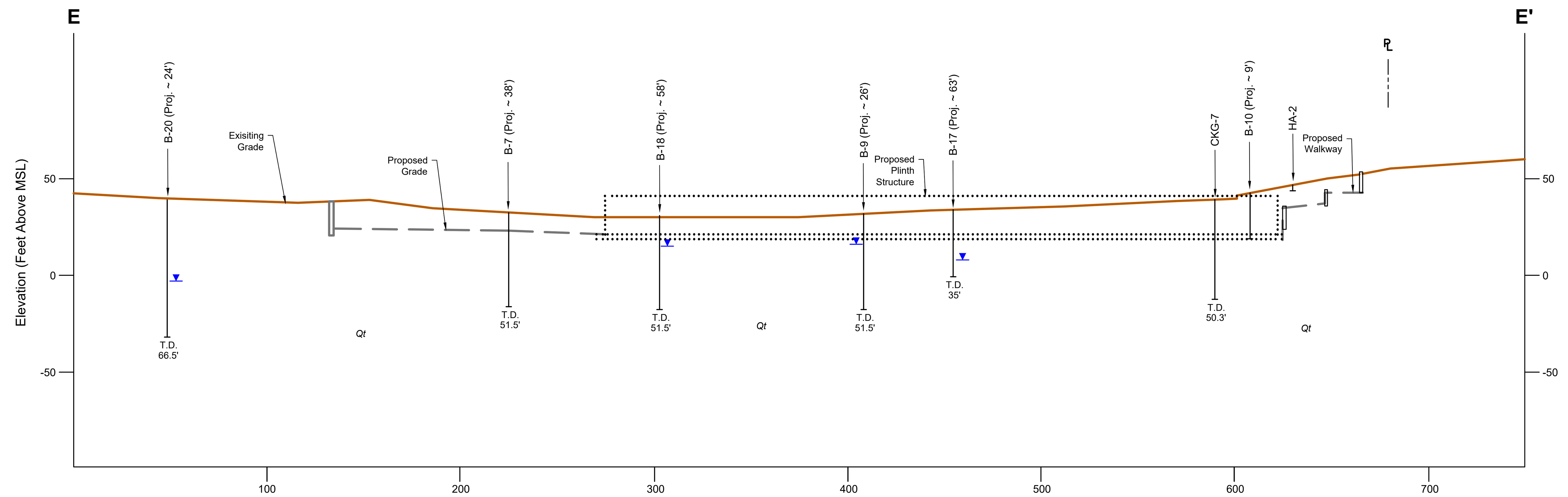


CROSS SECTION D-D'

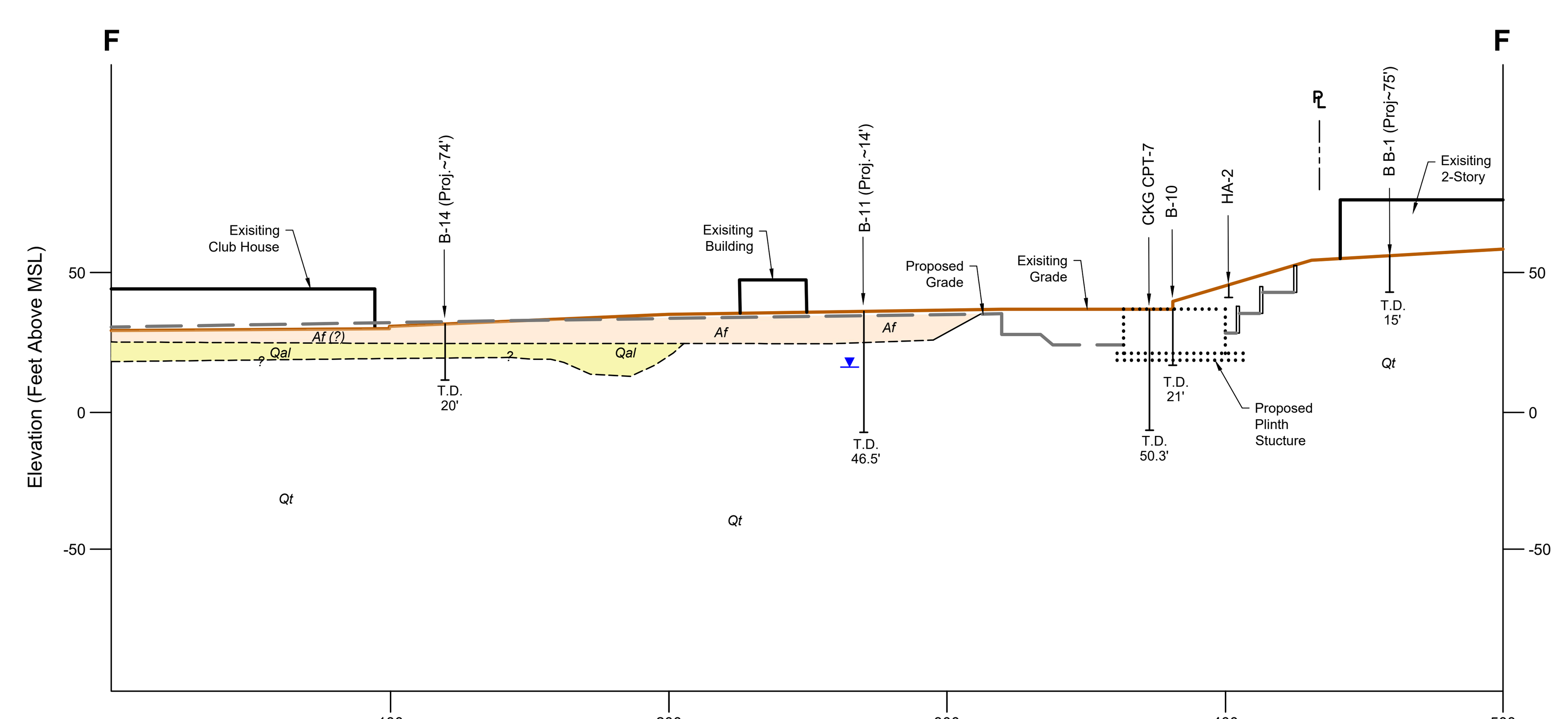
EXPLANATION

- BORING
- EXISTING GRADE
- PROPOSED GRADE
- PROPERTY LINE
- afu — ARTIFICIAL FILL, UNDOCUMENTED/ DOCUMENTED
- Qal — ALLUVIUM
- Qr — TERRACE DEPOSIT
- MSL — MEAN SEA LEVEL
- GROUNDWATER LEVEL

VERTICAL SCALE (IN FEET) 50; HORIZONTAL SCALE (IN FEET) 50	June 2024	CLIENT: Back Bay Barrels, LLC	CROSS SECTIONS
	CKGEO Carl Kim Geotechnical, Inc. 945 Baileyana Road Hillsborough, CA 94010 949-441-8143 CARLKIMGEO@GMAIL.COM	PROJECT: Wavegarden Cove, 3100 Irvine Avenue, Newport Beach, CA	
		PROJECT NUMBER: PWAS_20240507	PLATE 2A



CROSS SECTION E-E'



CROSS SECTION F-F'

EXPLANATION

⊥	BORING
	EXISTING GRADE
	PROPOSED GRADE
PL	PROPERTY LINE
afu	ARTIFICIAL FILL, UNDOCUMENTED/ DOCUMENTED
Qal	ALLUVIUM
Qt	TERRACE DEPOSIT
MSL	MEAN SEA LEVEL
▼	GROUNDWATER LEVEL

VERTICAL SCALE (IN FEET) 50; HORIZONTAL SCALE (IN FEET) 50	June 2024	CLIENT: Back Bay Barrels, LLC	CROSS SECTIONS
	CKGEO Carl Kim Geotechnical, Inc. 945 Baileyana Road Hillsborough, CA 94010 949-441-8143 *CARLKIMGEO@GMAIL.COM*	PROJECT: Wavegarden Cove, 3100 Irvine Avenue, Newport Beach, CA	
		PROJECT NUMBER: PWAS_20240507	PLATE 2B

APPENDIX A

REFERENCES

APPENDIX A

REFERENCES

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AERIAL PHOTOGRAPHS REVIEWED

Date	***Photograph***	***Source***
10-14-1939	5925-112	Continental Aerial Photo
11-18-1952	AXK-1K-43	Continental Aerial Photo
1-13-75	157 7-23	Continental Aerial Photo
1-20-1992	C85-13-20	Continental Aerial Photo

APPENDIX B

EXPLORATIONS

APPENDIX B

FIELD EXPLORATIONS

General
This appendix collates available relevant subsurface information from recent investigations by Carl Kim Geotechnical, Inc (Carl Kim Geo) and from prior explorations by others. The bullet points below summarize the data attached in this appendix.

Carl Kim Geo (2024)
- Seven (7) cone penetration test soundings (CKG CPT-1 through CKG CPT-7)
- Two (2) hand auger borings (HA-1 and HA-2)

Moore Twining Associates, Inc. (Moore Twining) (2019-2020)
- 4 CPT soundings (CPT-1 through CPT-4)
- 26 hollow stem auger borings (B-1 through B-26)
  - Six (6) of the 26 borings listed above were converted to temporary piezometers (B-17, B-18, B-19, B-22, B-23, and B-24)

Baca Associates, Inc. (Off site work 1989) (20351 SW Acacia Street)
- Four (4) hollow stem auger borings (BB-1 through BB-4)

Current Investigation
Current geotechnical investigations by Carl Kim Geotechnical, Inc. consisted of cone penetration test (CPT) soundings. As applicable, explorations were supervised and logged by qualified representatives. Earth materials encountered in hand-augered excavations for utility clearance were visually classified in accordance with the Unified Soil Classification System (USCS). Interpreted stratigraphic boundaries are indicated on the logs. Some soil/material types transition gradually.

Reconnaissance and Logistics
Locations of the CPT soundings and hand auger borings were chosen to obtain subsurface information at locations appropriate for the objective of this report. Prior to conducting the subsurface explorations, Carl Kim Geotechnical personnel evaluated each drill site for equipment access and marked proposed locations. Locations were reviewed by Newport Beach Golf Course representatives.

Prior to field explorations an exploration permit was obtained from the County of Orange Environmental Health Division and Underground Service Alert (USA) was contacted greater than 48 hours in advance of subsurface work. USA contacted members (i.e. utility infrastructure owners) to provide clearance for drilling with respect to underground utility lines. No underground utilities were encountered with drilling equipment during the current investigation.

<u>Subsurface Exploration</u>
7 CPT soundings and two hand auger borings were advanced May 28, 2024. Shear wave measurements and a pore dissipation test was conducted at CKG CPT-3. Shallow soils were logged and sampled from each location. Soil descriptions are tabulated below and CPT interpretations are included in this appendix.

Temporary piezometers installed by Moore Twining were sounded using an a Solinst electric well sounder. The accessible wells included B-17, B-18, and B-19. The remaining wells (B-22, B-23, and B-24) were not located because they are located within the artificial turf covered driving range. Each well sounded appeared to be constructed with nominal 1-inch polyvinyl chloride (PVC) casing covered by a metal flush mount surface completion. Each well was outfitted with a compression cap. Depth to water (DTW) below top of casing (BTOC) was measured and recorded to the nearest hundredth of a foot (0.01 feet).

<u>Borehole Sealing</u>
Each borehole was abandoned using cement-bentonite grout emplaced via tremie pipe. Asphalt cold patch/soil was placed as needed to match the existing surface.

<u>Sampling by Carl Kim Geo</u>
Representative bulk (bag) samples of fill and native soils were obtained from CKG CPT-1 through CKG CPT-7 and HA-1 and HA-2. Samples were logged, labeled, and retained for laboratory testing. Bulk samples are designated with a B-[number] and California modified split spoon samples (ring samples) are designated with R-[number] below. No free groundwater was encountered in hand excavations.

Table B-1 - LOG OF HAND AUGER EXCAVATIONS, MAY 28, 2024

EXCAVATION DESIGNATION	SAMPLE IDENTIFIERS.	SOIL DESCRIPTION
CKG CPT-1	B-1 at 0-5.0’	APPROXIMATE SURFACE ELEVATION +19 FEET ABOVE MEAN SEAL LEVEL (MSL) lean clay with sand (CL), soft to stiff, dark yellowish brown (10YR 3/6), moist, low plasticity, high dry strength, slow dilatancy; estimate 25-35% fine to coarse sand, trace gravel, few thin black organic-rich zones, trace rootlets TOTAL DEPTH OF HAND AUGER 5 FEET
CKG CPT-2	B-1 at 0-5.0’	APPROXIMATE SURFACE ELEVATION +20 MSL organic soil (OL/CL), soft under hand auger, black (10YR 2/1), dry to slightly moist, low to medium plasticity, low toughness, no dilatancy, medium dry strength; feels low density, no odor, micaceous, estimate 10% fine sand TOTAL DEPTH OF HAND AUGER 5 FEET
CKG CPT-3	B-1 at 0-5.0’	APPROXIMATE SURFACE ELEVATION +25 MSL silt with sand (ML), soft, dark yellow brown (10YR 3/6), dry to slightly moist, low plasticity, rapid dilatancy, low dry strength, estimate 15 to 20% fine to medium grained sand TOTAL DEPTH OF HAND AUGER 5 FEET
CKG CPT-4	B-1 at 0-5.0’	APPROXIMATE SURFACE ELEVATION +24 MSL organic soil (OL/CL), soft under hand auger, black (5YR 2.5/1), slightly moist, low to medium plasticity, low toughness, no dilatancy, high dry strength; micaceous TOTAL DEPTH OF HAND AUGER 5 FEET
CKG CPT-5	B-1 at 0-5.0’	APPROXIMATE SURFACE ELEVATION +19 MSL organic soil/ fat clay (OH/CH), soft under hand auger, black (5YR 2.5/1) with few light gray zones, slightly moist, high plasticity, low toughness, no dilatancy, high dry strength TOTAL DEPTH OF HAND AUGER 5 FEET
CKG CPT-6	B-1 at 0-5.0’	APPROXIMATE SURFACE ELEVATION +43 MSL lean clay with sand (CL), soft to medium stiff under hand auger, dark yellowish brown (10YR 3/4), nonplastic, slow to rapid dilatancy (rapid, but faint reaction to test), high dry strength; estimate 40% fine to medium sand TOTAL DEPTH OF HAND AUGER 5 FEET

Table B-1 - LOG OF HAND AUGER EXCAVATIONS, MAY 28, 2024

EXCAVATION DESIGNATION	SAMPLE IDENTIFIERS.	SOIL DESCRIPTION
CKG CPT-7	B-1 at 0-5.0’	APPROXIMATE SURFACE ELEVATION +37 MSL Asphalt (0-3”); Base (GW)(0.25’ to 1’) @1’ to 5’: well graded sand with gravel (SW), loose to dense under hand auger, yellowish brown (10YR 5/4), dry, fine to coarse sand, angular to subangular, estimate 15% subrounded fine gravel, estimate 5% fines; noncohesive – easy to excavate with hand auger; mostly “clean” sand TOTAL DEPTH OF HAND AUGER 5 FEET
HA-1	B-1 at 0-5.0’ R-1 at 5.5’	APPROXIMATE SURFACE ELEVATION +45 lean clay/ silt with clay (CL/ML), very stiff under hand auger (difficult to excavate; appears to bulk considerably), dark yellowish brown (10YR 3/4), dry from 0 to 2.2’, moist below, low to medium plasticity, slow dilatancy, medium dry strength, micaceous; estimate 10% fine sand, massive, orange paleosol appearance TOTAL DEPTH SAMPLED ~5.8 FEET BACKFILLED WITH FILL SAND
HA-2	B-1 at 0-4.0’	APPROXIMATE SURFACE ELEVATION +46 fat clay (CH), soft to 1.8’, medium stiff below, dry to slightly moist, light gray, high plasticity, no dilatancy, medium tough, high dry strength TOTAL DEPTH SAMPLED 4 FEET BACKFILLED WITH FILL SAND

Groundwater

The highest reported saturated soils observed at the site were encountered at boring B-9 at a depth of 18 feet bgs (~EL +14 feet msl).

Of the 26 hollow-stem auger borings drilled and logged by Moore Twining, free groundwater was observed in seven (7) of the points. Table B-2 below summarizes groundwater levels where encountered. Note that first encountered groundwater is shown in bold on Table B-2, which differs from subsequent water level measurements. In most cases it appears that free water was encountered in granular strata that is confined by clayey layers and under some pressure (confined/semi-confined conditions).

Similarly, a pore dissipation test was conducted in CKG CPT-3 at 55.92 feet BGS. The pore pressure in that zone was attenuating slowly when the test was concluded. The last pressure of 16 pounds per square inch was recorded suggesting that water in that zone could potentially rise to about EL +6 feet if overlying confining layers were not present.

TABLE B-2 - GROUNDWATER MEASUREMENTS IN BORINGS

FIELD POINT	DTW (FEET BTOC)	APPROX. SURFACE EL (FEET MSL)	CALC. GW EL (FEET MSL)	BORING TD (FEET)	MEASURE DATE
B-4	30	18	-12	31.5	7/22/2019
B-9	18	32	14	51.5	7/29/2019
B-17	**-**	**34**	**-**	**35**	**2/24/2020**
B-17	26	34	8	35	2/25/2020
B-18	**35**	**33**	**-2**	**51.5**	**2/24/2020**
B-18	18	33	15	51.5	2/25/2020
B-19	**38.5**	**36**	**-2.5**	**55.5**	**2/24/2020**
B-19	29	36	7	55.5	2/25/2020
B-20	**42.5**	**34**	**-8.5**	**66.5**	**2/25/2020**
B-20	37	34	-3	66.5	2/26/2020
B-22	-	30	-	55	2/28/2020
B-23	-	20	-	55	2/27/2020
B-24	**30**	**28**	**-2**	**39.5**	**2/26/2020**
B-24	24	28	4	39.5	2/27/2020

NOTES:
TD = TOTAL DEPTH EL = ELEVATION DTW = DEPTH TO WATER
MSL = MEAN SEA LEVEL

1. DEPTH TO 'FIRST ENCOUNTERED GROUNDWATER' IN BOLD.
2. B-22 AND B-23 COMPLETED AS PEIZOMETERS IN DRY HOLES.

Table B-3 summarizes all available groundwater level measurements from temporary piezometers constructed at the direction of Moore Twining.

TABLE B-3 - PIEZOMETER MEASUREMENTS

FIELD POINT	WELL TD (FEET)	APPROX. DATUM EL (FEET MSL)	GEOL./ TECH	DTW MEASURE DATE	DTW (FEET BTOC)	CALC. GW EL (FEET MSL)	NOTES
B-17	35	34		2/28/2020	28	6	
B-17	35	34		4/17/2020	27.7	6.3	
B-18	50	33		2/28/2020	18	15	
B-18	50	33		4/17/2020	19	14	
B-19	55	36		2/28/2020	24	12	
B-19	55	36		4/17/2020	22.2	13.8	
B-22	55	30		2/28/2020	dry	-	
B-22	55	30		4/17/2020	dry	-	
B-22	55	30	**ARH**	**5/28/2024**	**55.26**	-25.3	**WELL TD 55.40'**
B-23	35	20		2/28/2020	dry	-	
B-23	35	20		4/17/2020	dry	-	
B-23	35	20	**ARH**	**5/28/2024**	**34.77**	-14.77	**WELL TD 34.96'**
B-24	40	28		2/28/2020	24	4	
B-24	40	28		4/17/2020	18.4	9.6	
B-24	40	28	**ARH**	**5/28/2024**	**18.52**	9.5	**WELL TD 40.12' (soft)**

NOTES:
TD = TOTAL DEPTH EL = ELEVATION DTW = DEPTH TO WATER MSL = MEAN SEA LEVEL
BTOC = BELOW TOP OF CASING

1. DATA OBTAINED BY CARL KIM GEO IS IN BOLD.
2. SURFACE AND DATUM ELEVATIONS ESTIMATED BASED ON MAPS.
3. THE DATUM IS A MEASURING POINT AT TOP OF PIEZOMETER CASING.

APPENDIX B - ATTACHMENTS

EXPLORATION LOGS (Current Investigation)

CKG CPT-1 through CKG CPT-7
Well Permit

EXPLORATION LOGS (Prior Investigation - Moore Twining Associates, Inc. (2019, 2020)

Borings B-1 through B-26
CPT-1 through CPT-4
Piezometer Sounding Data
Well Permit for Temporary Piezometer Installation

EXPLORATION LOGS (Off-Site – Baca Associates (1989)

Borings BB-1 through BB-4

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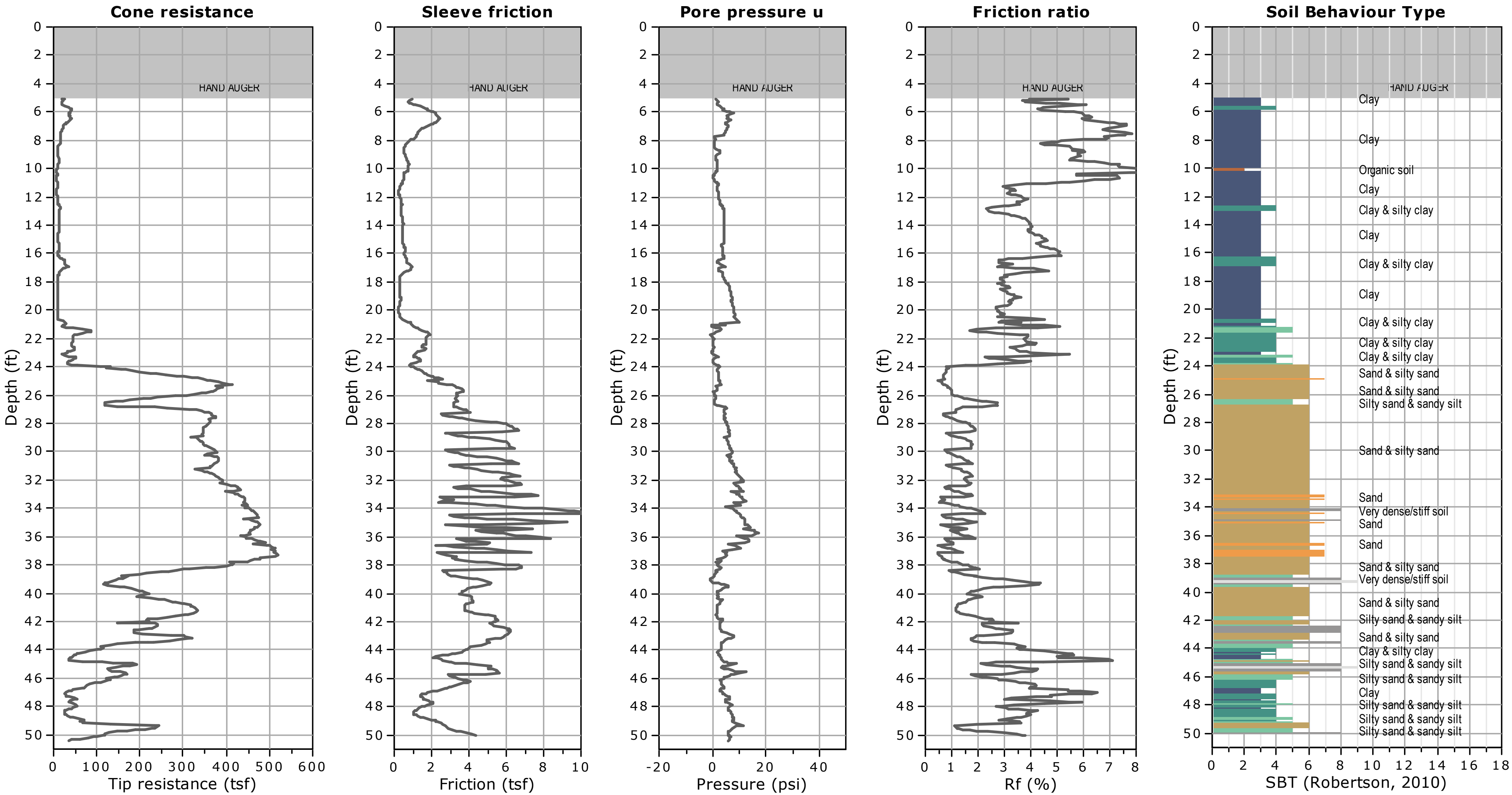
Project: Carl Kim Geotechnical
Location: 3100 Irvine Ave, Newport Beach, CA

CKG CPT-1
Total depth: 50.42 ft, Date: 5/28/2024



Project file: C:\Users\stevek\OneDrive - Kehoe Testing and Engineering Inc\Documents\CPT Current Data\CarlKim-NewportBeach5-24\CPT Report\CPeT.cpt

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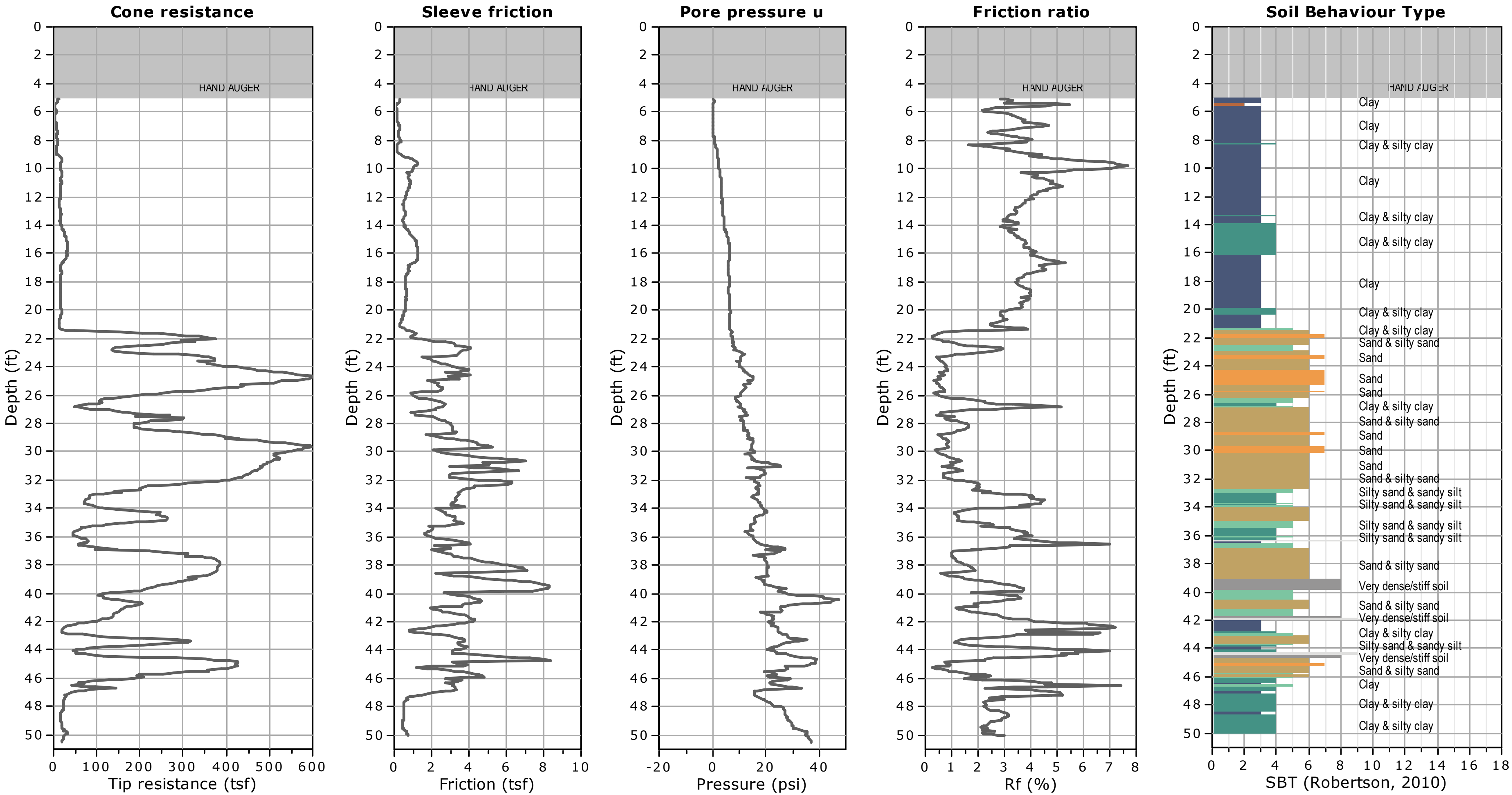
Project: Carl Kim Geotechnical
Location: 3100 Irvine Ave, Newport Beach, CA

CKG CPT-2
Total depth: 50.48 ft, Date: 5/28/2024



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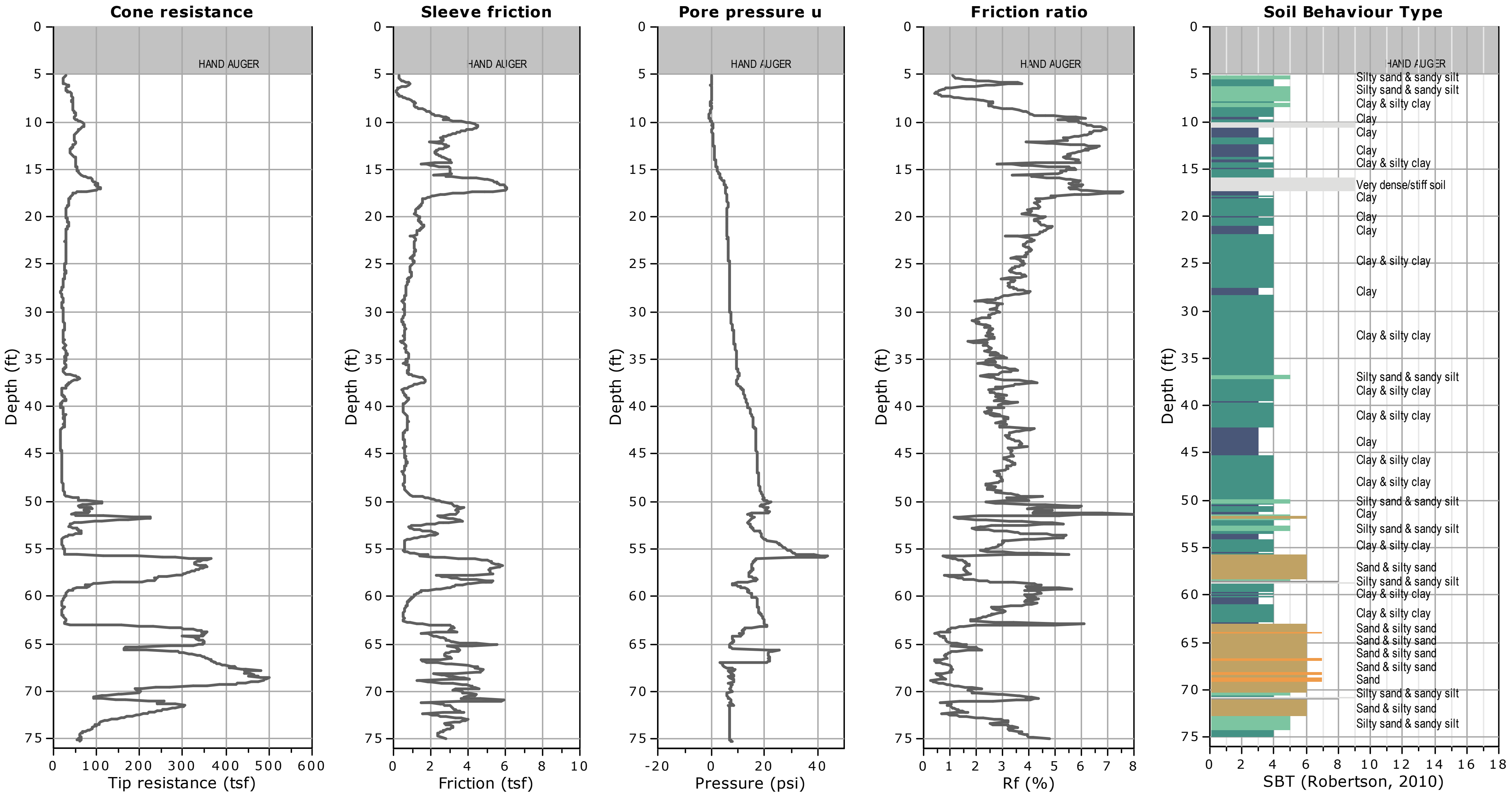
Project: **Carl Kim Geotechnical**
Location: **3100 Irvine Ave, Newport Beach, CA**

CKG CPT-3
Total depth: 75.29 ft, Date: 5/28/2024



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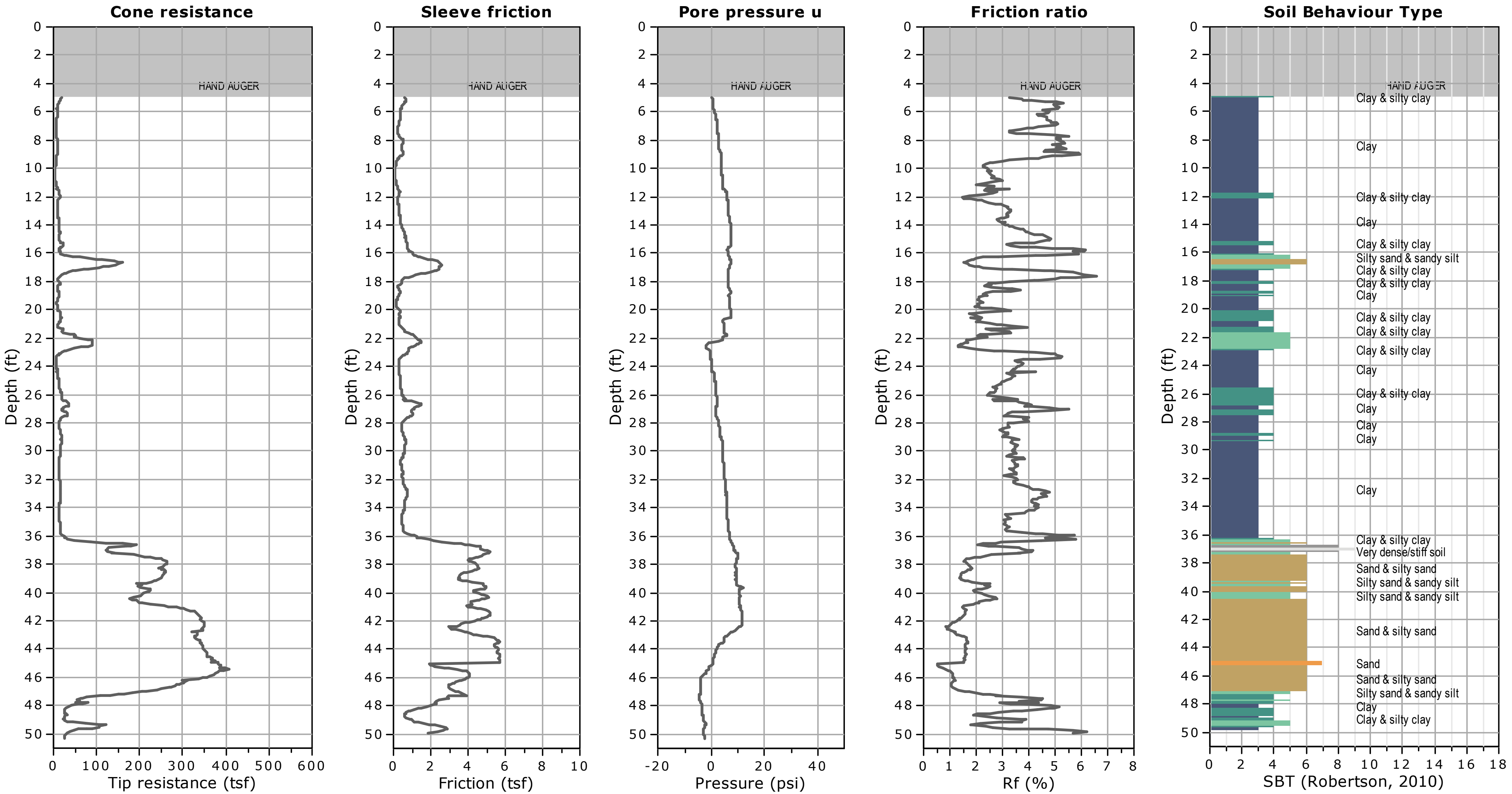
Project: Carl Kim Geotechnical
Location: 3100 Irvine Ave, Newport Beach, CA

CKG CPT-4
Total depth: 50.27 ft, Date: 5/28/2024



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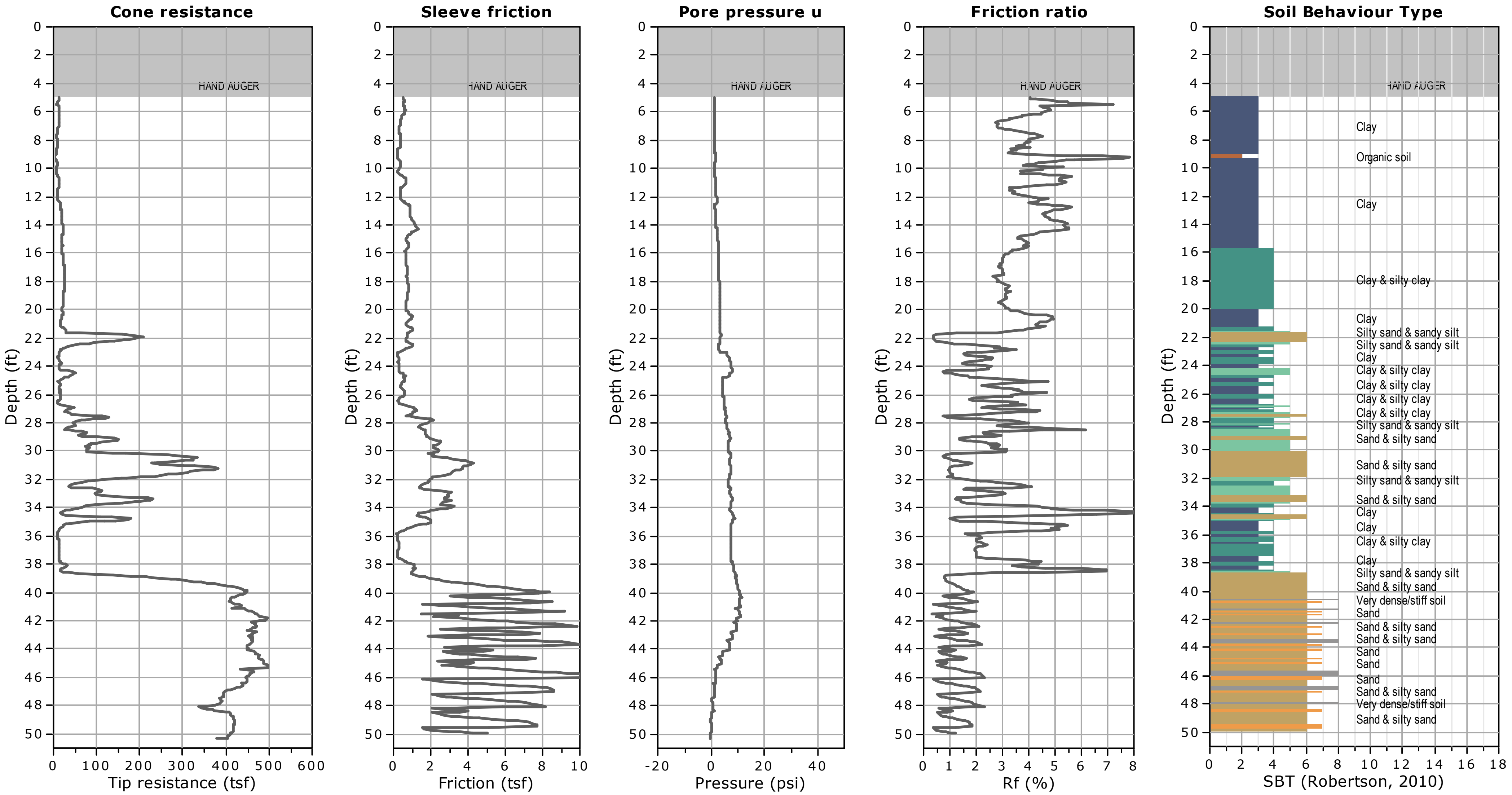
Project: Carl Kim Geotechnical
Location: 3100 Irvine Ave, Newport Beach, CA

CKG CPT-5
Total depth: 50.34 ft, Date: 5/28/2024



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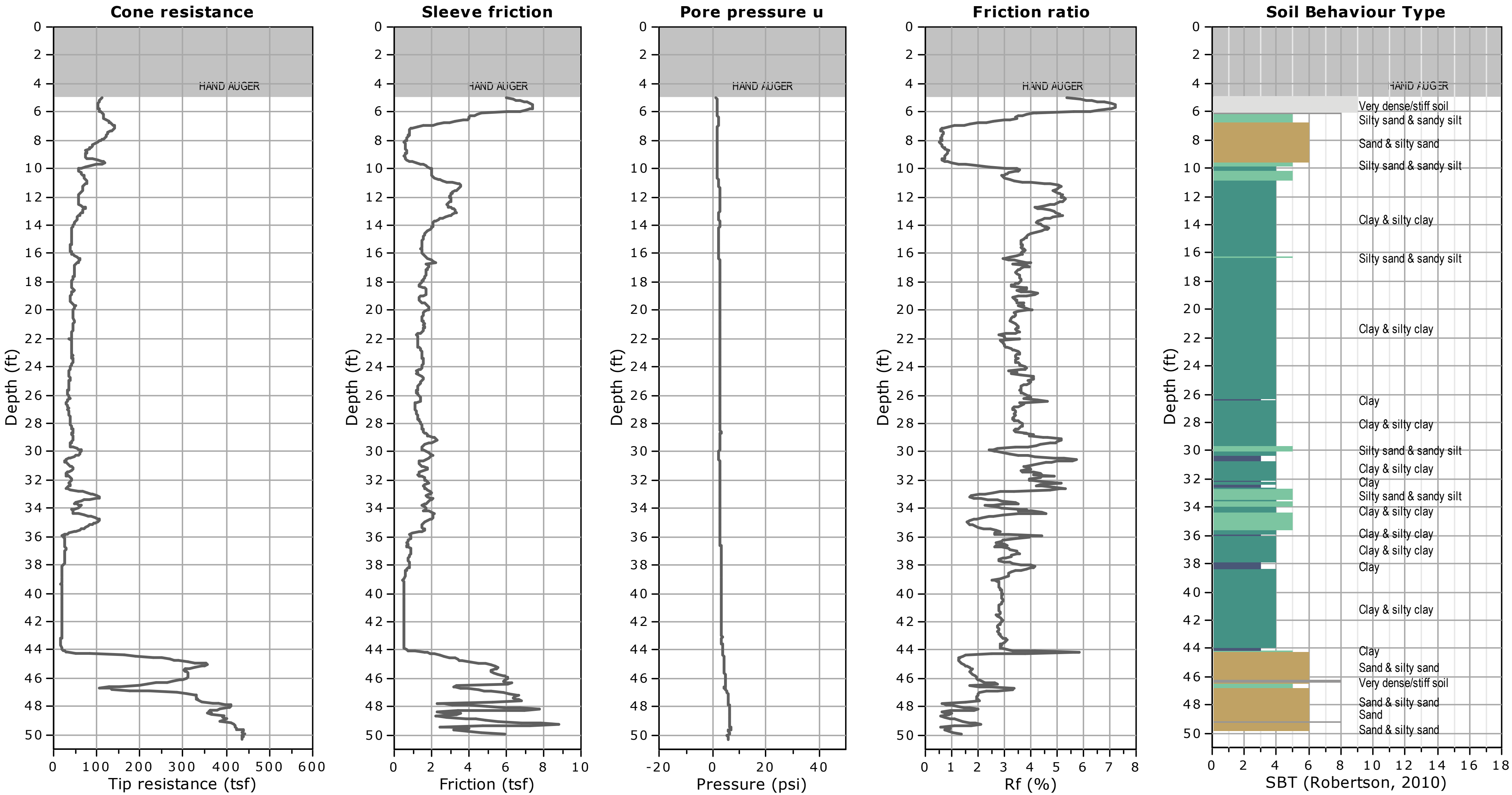
Project: Carl Kim Geotechnical
Location: 3100 Irvine Ave, Newport Beach, CA

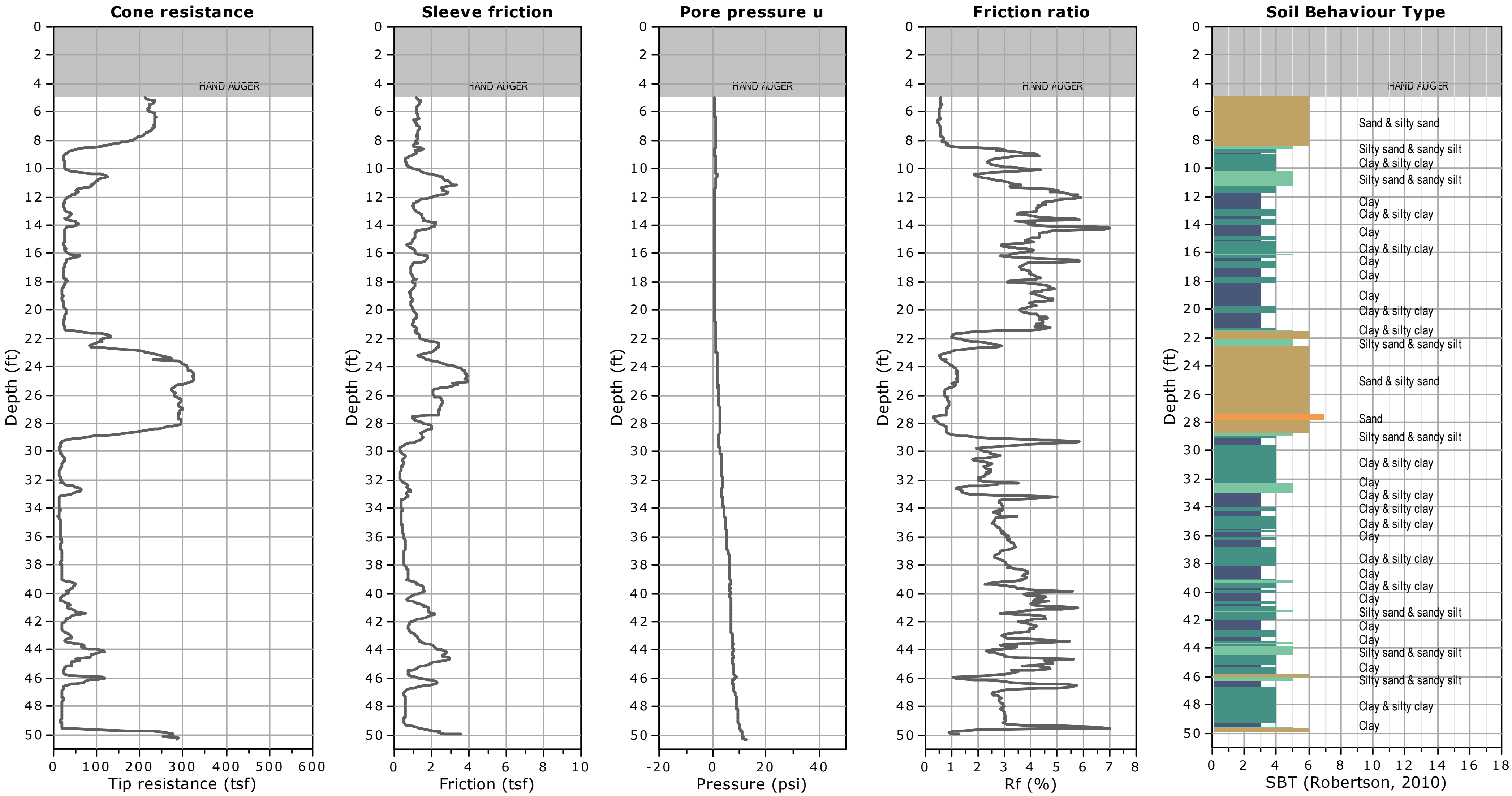
CKG CPT-6
Total depth: 50.27 ft, Date: 5/28/2024



Kehoe Testing and Engineering
714-901-7270
steve@kehoetesting.com
www.kehoetesting.com

Project: **Carl Kim Geotechnical**
Location: **3100 Irvine Ave, Newport Beach, CA**

CKG CPT-7
Total depth: 50.34 ft, Date: 5/28/2024



Carl Kim Geotechnical
3100 Irvine Ave.
Newport Beach, CA

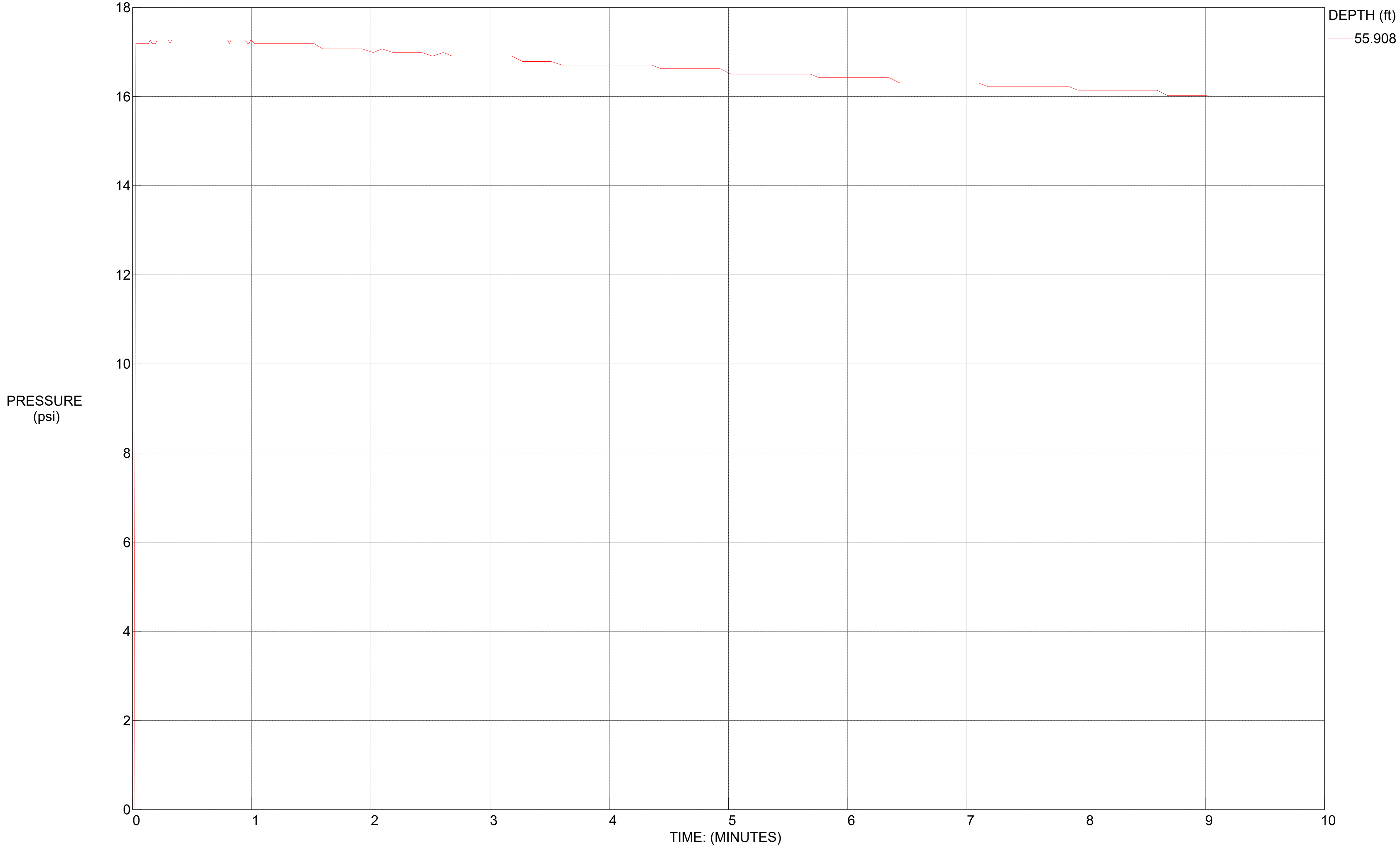
CPT Shear Wave Measurements

Location	Tip Depth (ft)	Geophone Depth (ft)	Travel Distance (ft)	S-Wave Arrival (msec)	S-Wave Velocity from Surface (ft/sec)	Interval S-Wave Velocity (ft/sec)
CKG CPT-3	9.97	8.97	9.19	11.04	832	
	20.05	19.05	19.15	22.48	852	871
	30.02	29.02	29.09	34.56	842	822
	40.06	39.06	39.11	46.76	836	822
	50.03	49.03	49.07	61.24	801	688
	60.04	59.04	59.07	72.98	809	852
	70.05	69.05	69.08	82.64	836	1036
	75.07	74.07	74.10	87.46	847	1041

Shear Wave Source Offset - 2 ft

S-Wave Velocity from Surface = Travel Distance/S-Wave Arrival
Interval S-Wave Velocity = (Travel Dist2-Travel Dist1)/(Time2-Time1)

TEST ID: CKG CPT-3



APPLICATION FOR WELL/EXPLORATORY BORING PERMIT

ORANGE COUNTY HEALTH CARE AGENCY
ENVIRONMENTAL HEALTH DIVISION

1241 E. DYER ROAD, SUITE 120
SANTA ANA, CA 92705-5611

EHOCWELLS@OCHCA.COM
714-433-6000

WELL PERMIT NO. **24-05-22**

For multiple cities, addresses, or locations, complete a separate permit application. **PROPOSED START DATE**

CITY	WELL LOCATION / STREET INTERSECTION
Newport Beach	**NEWPORT BEACH GOLF COURSE 3100 IRVINE AVE.** 3100 Irvine Avenue **APN 119-200-41**

LONGTITUDE (DECIMAL)	LATITUDE (DECIMAL)	OVERSIGHT AGENCY (if applicable)
33.6588578 33.658857 **33.658857**	-117.881136°	

EMAIL PERMIT TO: geoandy@gmail.com

■ Consultant ☐ Driller ☐ Well Owner

SERVICE ■ **Construction** ☐ **Destruction (Fee is per well)**

WATER WELLS (complete one permit application for per water well)

☐ Public Domestic/Municipal ☐ Private Domestic & No. of connections ___ ☐ Irrigation

☐ CATHODIC WELL (complete one permit application for per cathodic well)

NON-PRODUCTION WELLS (fee is the same as monitoring well construction) Total No. of Wells ______

☐ Monitoring ____ ☐ Air Sparge ____ ☐ Soil Vapor Extraction ___ ☐ Electrical Grounding Well __

☐ Water Extraction ____ ☐ Inclinometer ____ ☐ Injection/Recharge ____ ☐ Geothermal Heat Exchange __

☐ Piezometer ____ ☐ Horizontal ____ ☐ Soil Vapor Probes ____ ☐ Other ____________

EXPLORATORY BORINGS
(complete separate permits for probe survey and soil boring. Also complete the WELL & EXPLORATORY BORING DESTRUCTION section on the next page.)

■ Probe Survey (CPT or Direct Push Only) ~9
☐ Probe Survey Soil Vapor Probes (Direct Push) ___
☐ Soil Boring (hollow stem auger, mud rotary, sonic, or bucket auger, etc...) ___

FOR ACCOUNTING USE ONLY

HSO NO ________ CHECK NO. ________

DATE ________ AMOUNT **$382.00**

INTL ________

APPROVAL BY OTHER AGENCIES

JURISDICTION **CA WELL STANDARDS & OC WELL ORDINANCE**

REMARKS

USE A TREMIE PIPE OR EQUIVALENT TO BACKFILL THE PROBES WITH AN APPROVED SEALING MATERIAL FROM BOTTOM TO WITHIN 5 FEET B.G.S.:

- FREEFALL IS PROHIBITED.
- SOIL CUTTINGS AND UNAPPROVED SEALING MIXTURES ARE PROHIBITED TO BE USED AS BACKFILL.

AUTHORIZED SIGNATURE DATE

FOR OFFICE USE ONLY
NO PERMIT IS DEEMED COMPLETED UNTIL THE FOLLOWING ARE MARKED AND SIGNED OFF:

☐ NOTIFICATION OF COMPLETION RECEIVED
☐ FINAL INSPECTION
☐ ALL REQUIRED DOCUMENTS RECEIVED

PRINT NAME PHONE NUMBER

DISPOSITION OF PERMIT (FOR OFFICE USE ONLY)

X APPROVAL IS SUBJECT TO THE FOLLOWING CONDITIONS:

NOTIFY THIS AGENCY AT LEAST 48 HOURS:

- X PRIOR TO ANY CHANGES OF THE WORK PLAN.
- ☐ PRIOR TO SEALING THE ANNULAR SPACE.
- ☐ PRIOR TO FILLING OF CONDUCTOR CASING.

X SUBMIT TO THIS AGENCY, WITHIN 30 DAYS OF COMPLETION OF WORK, A COPY OF THE WELL COMPLETION REPORT(S) AND/OR DRILLING LOG(S). PLEASE REFERENCE PERMIT NO.

☐ SECURE ALL WELLS TO PREVENT TAMPERING.

X NOTIFY WHEN ALL WORK IS COMPLETED AND INCLUDE THE DEPTH TO FIRST ENCOUNTERED WATER, PHOTO DOCUMENTATION, AND/OR COPIES OF CEMENT TICKETS/CALCULATIONS.

☐ WORK COMPLETED PRIOR TO SUBMITTING PERMIT APPLICATION TO THIS AGENCY

X OTHER **PERMIT EXPIRES ON 05-10-2025**

Juan Anzora **05-09-2024**

PERMIT ISSUED BY DATE

JUAN ANZORA **714-433-6287**

PRINT NAME PHONE NUMBER

WHEN SIGNED BY AN ORANGE COUNTY HEALTH CARE AGENCY REPRESENTATIVE, THIS APPLICATION IS A VALID PERMIT.

(R10/21)

I hereby agree to comply with all applicable requirements of the Health Care Agency and with all ordinances and laws of the County of Orange and of the State of California pertaining to well construction, reconstruction and destruction, including the requirements to maintain the integrity of all significant confining zones. A violation of the California Well Standards and the local Well Ordinances may constitute a misdemeanor (County Well Ordinance Sec. 4-5-31).

WELL OWNER

WELL OWNER'S NAME	EMAIL ADDRESS
Back Bay Barrels LLC BACK BAY BARRELS, LLC	Adam@surffarm.com

WELL OWNER'S ADDRESS / CITY / STATE/ ZIP CODE	TELEPHONE NUMBER
1940 Continental Ave Costa Mesa, Ca 92627	(949) 836-3055

WELL OWNER'S SIGNATURE	DATE
	5-9-24

CONSULTING FIRM

NAME OF CONSULTING FIRM	BUSINESS ADDRESS/CITY/STATE/ZIP CODE	PROFESSIONAL LICENSE NUMBER
Carl Kim Geotechnical, Inc. CARL KIM GEOTECHNICAL, INC.	945 Baileyana Road Hillsborough, CA 94010	PG 7720; CEG 2366

CONSULTANT'S SIGNATURE	DATE	EMAIL ADDRESS
Andrew R. Hillstrand Digitally signed by Andrew R. Hillstrand Date: 2024.05.09 09:43:42 -07'00'	5/8/2024	geoandy@gmail.com

DRILLING CONTRACTOR

NAME OF DRILLER	EMAIL ADDRESS	C-57 LICENSE NUMBER
Kehoe Testing & Engineering, Inc.	kte3@kehoetesting.com	786163 786163

DRILLER'S SIGNATURE	DATE
Digitally signed by Steven P. Kehoe Date: 2024.05.09 10:09:15-07'00'	05/09/2024

REQUIRED DOCUMENTS

WATER & STORMWATER DRY INJECTION WELL CONSTRUCTION

☐ An approval from the Division of Drinking Water (DDW) for public or municipal water wells.

☐ A cross-section well diagram detailing total depth, borehole diameter, depth and thickness of the sanitary seal(s), type(s) of casing(s), and length(s) of screen(s) / slotting. A top view is required for nested wells that demonstrate the radial thickness separation.

☐ Indicate the number of water aquifers the well will be screened through.

☐ A site map using a 250-foot radius from the proposed water well location that includes locations and distances to:

- All existing, active, inactive, and/or abandoned water wells.
- All existing, abandoned, and/or proposed sewer lines, recycled water lines, and storm drain lines.
- All active and/or abandoned leach fields, cesspits, and septic tanks.
- All animal enclosures (e.g., stables, coops, kennels, etc.).
- All water courses and/or bodies of water, including, but not limited to: rivers, creeks, ponds, retention ponds, and/or swimming pools.
- All other underground storage tanks and open (regulated) remediation sites.
- All nearby structures (e.g., commercial and residential buildings, houses, storage sheds) sanitary hazards and their locations.

NON-PRODUCTION WELL CONSTRUCTION

☐ Written work plan. For regulated sites, an approved work plan by the overseeing regulatory agency must be included for the installation of any type of nested well.

☐ Site map(s) showing the locations of the proposed wells (no topographical maps).

☐ A cross-section well diagram detailing total depth, borehole diameter, depth and thickness of the sanitary seal(s), type(s) of casing(s), and length(s) of screen(s) / slotting. A top view is required for nested wells that demonstrates a 2-inch radial thickness separation between casings and casing and wall of the borehole.

WELL & EXPLORATORY BORING DESTRUCTION

■ Written work plan. For regulated sites, an approval of the work plan by the overseeing regulatory agency must be included.

■ Site map(s) showing the locations of the wells to be destroyed (no topographical maps).

■ Type and amount of sealant (show calculations for water wells):

Total depth 40-70 feet Borehole diameter 1.44 inches Sealing material BENTONITE-CEMENT

■ Method of destruction:

☐ Pressure grout / removal of top 5 feet casing / removal of well boxes ☐ Overdrill ☐ Excavation

■ Other Approved sealing materials will be place via tremie from total depth to ground surface.

(R10/21)

May 8, 2024 Project No. PWAS_20240507

Orange County Health Care Agency
1241 East Dyer Road, Suite 120
Santa Ana, CA 92705-5611

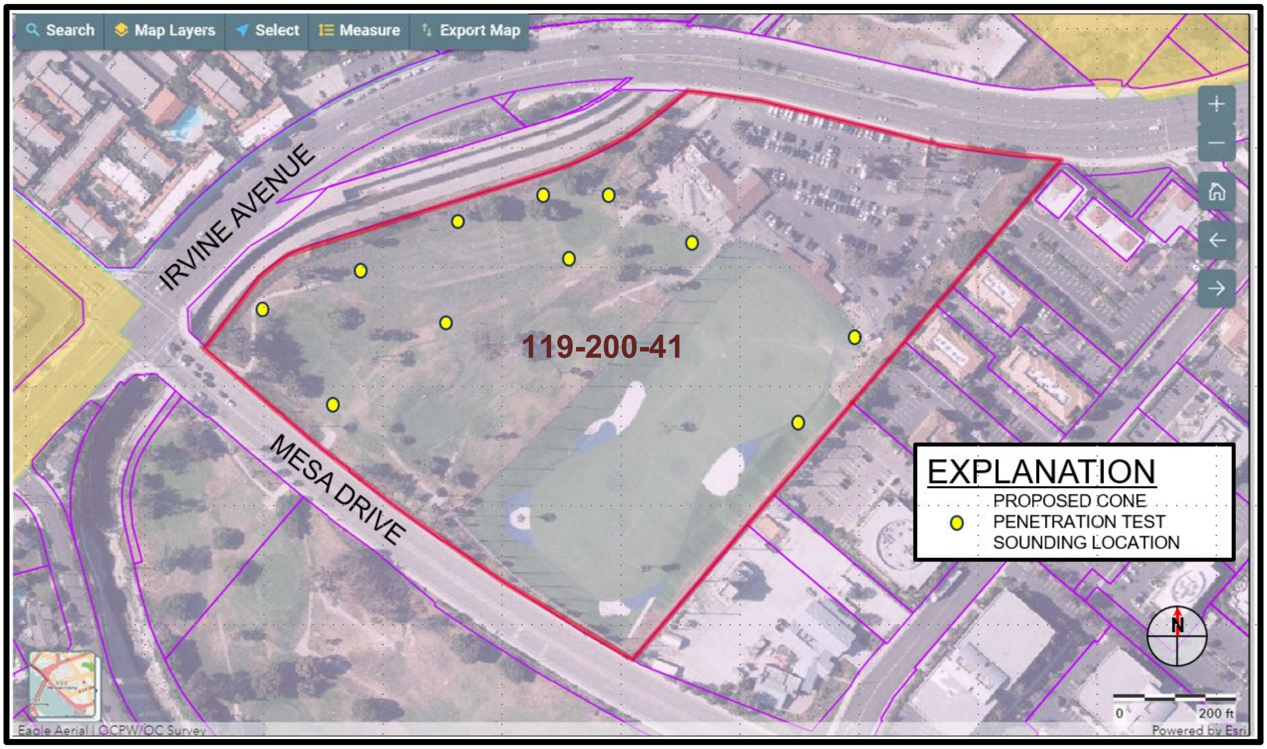
Attn.: Water Quality, Wells Section (EHOCWells@ochca.com)

RE: "Work Plan" for Geotechnical Boring Permit, 3100 Irvine Avenue, Newport Beach, California, Assessor's Parcel Number (APN) 119-200-41

Dear Sir or Madam,

Carl Kim Geotechnical, Inc. (Carl Kim Geo) is planning geotechnical explorations that will include approximately nine (9) cone penetration test soundings to depths of 40 to 70 below ground surface (BGS). The CPT subcontractor is currently scheduled to commence the work on or about May 20, 2024. Carl Kim Geo's staff and subcontractors will use industry standard techniques to seal boreholes to surface. We will adhere to the requirements of the Orange County Well/Boring Permit and California Well Standards. As such, borings will be sealed with neat cement (Portland cement-bentonite grout) using positive displacement methods (tremie pipe) across the intervals explored.

For convenience, the map below was excerpted from https://www.ocgis.com/ocpw/landrecords/ and includes the approximate locations of the proposed explorations, all of which are within parcel number 119-200-41. Note that depths and locations will be adjusted based on field conditions and other technical factors.



The proposed work will be observed and documented by qualified staff or directly by the undersigned.

If you have any questions, please do not hesitate to contact me at 805-573-0315 or geoandy@gmail.com.

Respectfully submitted,

Andrew R. Hillstrand PG 7720, CEG 2366
Senior Engineering Geologist

Enclosure

APPENDIX B

LOGS OF BORINGS

This appendix contains the final logs of borings. These logs represent our interpretation of the contents of the field logs and the results of the field and laboratory tests.

The logs and related information depict subsurface conditions only at these locations and at the particular time designated on the logs. Soil conditions at other locations may differ from conditions occurring at these test boring locations. Also, the passage of time may result in changes in the soil conditions at these test boring locations.

In addition, an explanation of the abbreviations used in the preparation of the logs and a description of the Unified Soil Classification System are provided at the end of Appendix B.

MOORE TWINING ASSOCIATES, INC.

Test Boring: B-1

Project: Proposed Drive Shack - Restaurant and Golf Driving Range

Project Number: E40550.01

Drilled By: Pacific Drilling

Drill Type: CME 75

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

Logged By: Jovany C.

Date: July 29, 2019

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: N/E

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
0	4/6 4/6 3/6	SM	SILTY SAND; loose, moist, fine, dark-brown		7	
	7/6 7/6 7/6		Medium dense, fine to medium grained, trace fine gravel		14	
5	5/6 8/6 12/6		Weakly cemented		20	
10	9/6 13/6 15/6	SP	POORLY GRADED SAND; medium dense, moist, fine to coarse grained, red-brown, trace fine gravel	DD = 100.7 pcf	28	3.9
15	8/6 11/6 12/6		Iron oxide staining		23	
20	9/6 7/6 10/6	CL	SANDY LEAN CLAY; stiff, moist, low to medium plasticity, blue and brown	DD = 85.5 pcf	17	33.7
			Bottom of boring			
25						

DRAFT

Notes:

Figure Number

MOORE TWINING ASSOCIATES, INC.

Since 1898

Test Boring: B-2

Project: Proposed Drive Shack - Restaurant and Golf Driving Range

Project Number: E40550.01

Drilled By: Pacific Drilling

Drill Type: CME 75

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

Logged By: Jovany C.

Date: July 30, 2019

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: N/E

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
0	11/6 10/6 7/6	SM	SIITY SAND; medium dense, damp, fine to medium grained, brown, with rootlets, some clay		17	3.3
	7/6 12/6 8/6		Moist, weakly cemented		20	6.0
5	8/6 10/6 9/6		Increase in sand content, decrease in fines, trace fine gravel		19	6.8
10	1/6 2/6 10/6	CL	SANDY LEAN CLAY; medium stiff, moist, low plasticity, olive- green	DD = 92.6 pcf	12	21.8
15	3/6 6/6 8/6		Stiff, low to medium plasticity, iron oxide staining		14	22.3
20	2/6 4/6 8/6		Dark-brown staining		12	25.3
25	2/6 5/6 9/6				14	24.5

Notes:

Figure Number

MOORE TWINING ASSOCIATES, INC.

Since 1898

Test Boring: B-2

Project: Proposed Drive Shack - Restaurant and Golf Driving Range

Project Number: E40550.01

Drilled By: Pacific Drilling

Drill Type: CME 75

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

Logged By: Jovany C.

Date: July 30, 2019

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: N/E

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
30	2/6 5/6 8/6		With sea shells		13	
35	2/6 7/6 10/6		Slight increase in moisture content, blue	DD = 91.7 pcf LL =42 PI = 25	17	26.1
40	2/6 3/6 4/6		Medium stiff		7	35.6
45	15/6 24/6 40/6	SP	POORLY GRADED SAND; dense, moist, fine to medium grained, gray		65	
50	15/6 27/6 27/6		Very dense, fine sand		54	1.6
55	15/6 20/6 28/6		Dense		48	

Notes:

Figure Number

MOORE TWINING ASSOCIATES, INC.

Test Boring: B-2

Project: Proposed Drive Shack - Restaurant and Golf Driving Range

Project Number: E40550.01

Logged By: Jovany C.

Drilled By: Pacific Drilling

Date: July 30, 2019

Drill Type: CME 75

Elevation: N/A

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

Depth to Groundwater First Encountered During Drilling: N/E

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
60	3/6 4/6 4/6	CL	LEAN CLAY; medium stiff, moist, low to medium plasticity, dark-gray	Sand = 2.0% -#200 = 98.0% LL = 40 PI = 17	8	
65	3/6 5/6 5/6		Stiff, black, 2 inch sandy silt lens		10	
70	3/6 3/6 6/6				9	35.7
			Bottom of boring			
75						
80						
85						

Notes:

Figure Number

MOORE TWINING ASSOCIATES, INC.

Since 1898

Test Boring: B-3

Project: Proposed Drive Shack - Restaurant and Golf Driving Range

Project Number: E40550.01

Drilled By: Allen B.

Drill Type: CME 75

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

Logged By: Jovany C.

Date: July 22, 2019

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: N/E

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
0	3/6 8/6 10/6	FIII	SANDY LEAN CLAY; very stiff, moist, low to medium plasticity, dark-brown, with rootlets, trace fine gravel, weak to moderate cementation		18	6.5
	6/6 7/6 7/6		Stiff, brown to black		14	9.1
5	2/6 1/6 1/6	CL	SANDY LEAN CLAY; Soft, moist, low plasticity, black, organics		2	60.5
10	4/6 7/6 9/6		Gray to black, iron oxide stains	DD = 87.8 pcf	16	34.6
	3/6 4/6 5/6		Tan-brown, iron oxide stains		9	23
15	5/6 10/6 12/6		Stiff, bluish-gray to black, with seams of black	DD = 96.6 pcf	22	35.7
	4/6 5/6 6/6		Bluish-gray		11	20.4
20	0/6 2/6 3/6		Medium stiff, dark-brown		5	46.0
25	5/6 14/6 14/6	SM	SILTY SAND with Clay; very stiff, moist, fine to medium grained, dark-gray	DD = 92.5 pcf Gravel= 11.0% Sand = 76.9% -#200 = 12.1% c = 380 psf ø = 36°	28	20.3

Notes:

Figure Number

MOORE TWINING ASSOCIATES, INC.

Test Boring: B-3

Project: Proposed Drive Shack - Restaurant and Golf Driving Range

Project Number: E40550.01

Drilled By: Allen B.

Drill Type: CME 75

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

Logged By: Jovany C.

Date: July 22, 2019

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: N/E

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
30	4/6 6/6 12/6	SM	SILTY SAND; medium dense, moist, fine sand, dark- gray, 2 inch clay lens	Sand = 82.9% -#200 =17.1%	18	
	11/6 33/6 50/5		Very dense, trace clay, trace gravel	DD = 107.4 pcf	>83	10.5
35						
	7/6 7/6 11/6	CL	SANDY LEAN CLAY; very stiff, moist, low to medium plasticity, dark-gray		18	
40						24.4
			Bottom of boring			
45						
50						
55						

Notes:

Figure Number

MOORE TWINING ASSOCIATES, INC.

Test Boring: B-4

Project: Proposed Drive Shack - Restaurant and Golf Driving Range

Project Number: E40550.01

Drilled By: Allen B.

Drill Type: CME 75

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

Logged By: Jovany C.

Date: July 22, 2019

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: 30 feet

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
0	7/6 9/6 11/6	CL	SANDY LEAN CLAY; very stiff, moist, low plasticity, dark-brown, weak to moderate cementation		20	6.4
5	4/6 4/6 4/6		Soft, with rootlets, iron oxide staining		8	18.8
10	9/6 11/6 14/6		Very stiff, low to medium plasticity, gray to black	DD = 102.0 pcf	25	21.0
15	3/6 4/6 5/6		Stiff, bluish-gray, iron oxide stains		9	27.2
20	8/6 12/6 16/6	SP	POORLY GRADED SANDS; medium dense, moist, fine sand, bluish-gray		28	10.5
25	5/6 8/6 10/6	CL	LEAN CLAY; very stiff, very moist, low plasticity, dark-gray		18	24.7

Notes:

Figure Number

MOORE TWINING ASSOCIATES, INC.

Since 1898

Test Boring: B-4

Project: Proposed Drive Shack - Restaurant and Golf Driving Range

Project Number: E40550.01

Drilled By: Allen B.

Drill Type: CME 75

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

Logged By: Jovany C.

Date: July 22, 2019

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: 30 feet

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
30	9/6 17/6 23/6	SP	POORLY GRADED SAND; dense, wet, fine to medium grained, dark-gray		40	21.4
			Bottom of boring			
35						
40						
45						
50						
55						

DRAFT

Notes:

Figure Number

MOORE TWINING ASSOCIATES, INC.

Test Boring: B-5

Project: Proposed Drive Shack - Restaurant and Golf Driving Range

Project Number: E40550.01

Drilled By: Allen B.

Drill Type: CME 75

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

Logged By: Jovany C.

Date: July 22, 2019

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: N/E

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
0	3/6 4/6 3/6	FILL	SANDY LEAN CLAY; medium stiff, moist, low to medium plasticity, brown to black		7	
5	2/6 2/6 4/6		Soft, black, with rootlets, organics	DD = 69.0 pcf LOI=14.1%	6	43.4
	4/6 4/6 4/6	CL	SANDY LEAN CLAY: medium stiff, low plasticity, olive green		8	
10						
	4/6 4/6 5/6		Stiff, brown to blue		9	
15						
	4/6 6/6 10/6	SM	SILTY SAND; loose, moist, fine to medium grained, dark gray	DD = 95.2 pcf Sand = 72.7% -#200 = 27.3% c = 350 psf ø = 30° LL = NV PI = NP	16	21.1
20						
25	5/6 11/6 14/6	SP	POORLY GRADED SAND; medium dense, moist, fine to medium grained, dark-gray, trace coarse gravel, 2 inch clay lens		25	

Notes:

Figure Number

MOORE TWINING ASSOCIATES, INC.

Since 1898

Test Boring: B-5

Project: Proposed Drive Shack - Restaurant and Golf Driving Range

Project Number: E40550.01

Drilled By: Allen B.

Drill Type: CME 75

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

Logged By: Jovany C.

Date: July 22, 2019

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: N/E

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
30	8/6 15/6 36/6		Dense, 2 inch clay lens	DD = 112.5 pcf	51	9.1
35	9/6 13/6 7/6		Medium dense		20	2.9
40	2/6 6/6 4/6	CL	SANDY LEAN CLAY; stiff, moist, low to medium plasticity, dark-gray, 2 inch sandy silt lens		10	35.8
			Bottom of boring			
45						
50						
55						

Notes:

Figure Number

MOORE TWINING ASSOCIATES, INC.

Since 1898

Test Boring: B-6

Project: Proposed Drive Shack - Restaurant and Golf Driving Range

Project Number: E40550.01

Drilled By: Allen B.

Drill Type: CME 75

Auger Type: 6-5/8" Hollow Stem Augers

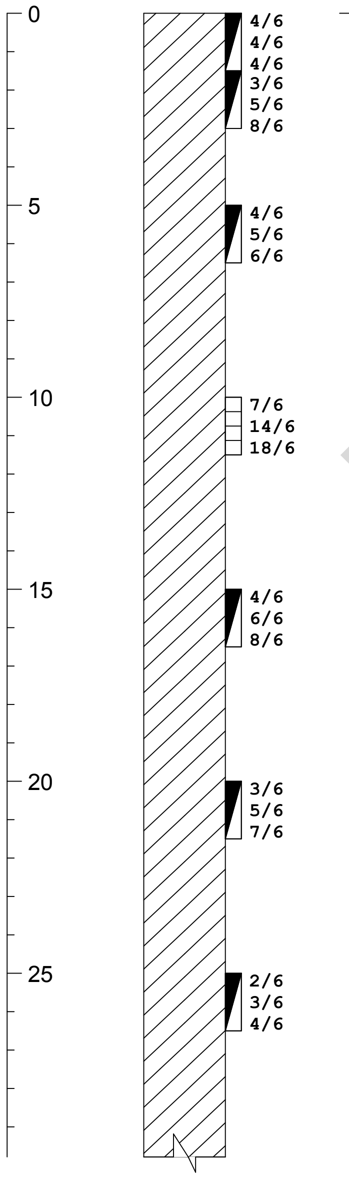
Hammer Type: 140 LB Auto Trip Hammer

Logged By: Jovany C.

Date: July 23, 2019

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: N/E



ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
0	4/6 4/6 4/6	CL	SANDY LEAN CLAY; medium stiff, moist, low to medium plasticity, dark-brown, weakly cemented, with rootlets		8	
	3/6 5/6 8/6		Stiff, trace gravel, increase in sand content,		13	
5	4/6 5/6 6/6		Stiff, trace fine to coarse gravel, 1 inch poorly graded sand lens		11	
10	7/6 14/6 18/6		Very stiff, brown, iron oxide stains	DD = 95.6 pcf	32	25.9
15	4/6 6/6 8/6		Stiff, light-brown to brown, iron oxide staining		14	
20	3/6 5/6 7/6		Bluish-brown		12	
25	2/6 3/6 4/6		Medium stiff, blue, interbedded mica		7	

Notes:

Figure Number

MOORE TWINING ASSOCIATES, INC.

Since 1898

Test Boring: B-6

Project: Proposed Drive Shack - Restaurant and Golf Driving Range

Project Number: E40550.01

Drilled By: Allen B.

Drill Type: CME 75

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

Logged By: Jovany C.

Date: July 23, 2019

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: N/E

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
30	2/6 2/6 2/6		Soft, dark-gray		4	
			Bottom of boring			
35						
40						
45						
50						
55						

Notes:

Figure Number

MOORE TWINING ASSOCIATES, INC.

Test Boring: B-7

Project: Proposed Drive Shack - Restaurant and Golf Driving Range

Project Number: E40550.01

Drilled By: Pacific Drilling

Drill Type: CME 75

Auger Type: 6-5/8" Hollow Stem Augers

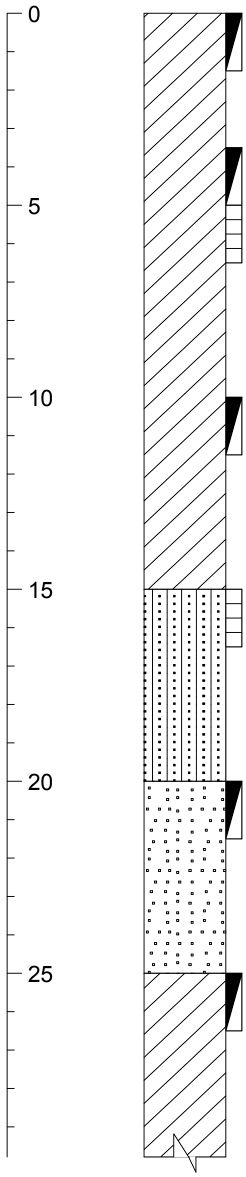
Hammer Type: 140 LB Auto Trip Hammer

Logged By: Jovany C.

Date: July 29, 2019

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: N/E



ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
0	2/6 2/6 4/6	CL	LEAN CLAY; medium stiff, moist, low to medium plasticity, olive-brown, iron oxide staining		6	
	3/6 5/6 5/6		Stiff, low plasticity, bluish- grown, iron oxide stains		10	
5	4/6 6/6 9/6		Low plasticity, gray to dark-gray	DD = 86.8pcf LL = 47 PI = 23	15	25.5
10	2/6 5/6 6/6		Low to medium plasticity, blue, iron oxide staining		11	
15	11/6 22/6 35/6	SM	SILTY SAND; dense, moist, fine to medium grained, olive- brown, trace clay	DD =105.6 pcf Sand = 81.3% -#200 = 18.7%	57	7.8
20	10/6 15/6 16/6	SP	POORLY GRADED SAND; dense, moist, fine to medium, brown		31	
25	2/6 2/6 4/6	CL	SANDY LEAN CLAY; medium stiff, moist, low to medium plasticity, blue, iron oxide staining		6	

Notes:

Figure Number

MOORE TWINING ASSOCIATES, INC.

Test Boring: B-7

Project: Proposed Drive Shack - Restaurant and Golf Driving Range

Project Number: E40550.01

Drilled By: Pacific Drilling

Drill Type: CME 75

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

Logged By: Jovany C.

Date: July 29, 2019

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: N/E

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
30	3/6 6/6 5/6		Stiff, very moist, 3 inches of interbedded muscovite		11	
35	1/6 2/6 3/6		Medium stiff, low to medium plasticity, dark-gray		5	
40	4/6 6/6 6/6		Stiff, 2 inches of interbedded sandy silt		12	
45	5/6 6/6 8/6	ML	SANDY SILT; stiff, moist, non-plastic, dark-gray		14	
50	3/6 5/6 6/6	CL	SANDY LEAN CLAY; stiff, moist, low plasticity, dark-gray, with organics		11	
			Bottom of boring			
55						

Notes:

Figure Number

MOORE TWINING ASSOCIATES, INC.

Test Boring: B-8

Project: Proposed Drive Shack - Restaurant and Golf Driving Range

Project Number: E40550.01

Drilled By: Pacific Drilling

Drill Type: CME 75

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

Logged By: Jovany C.

Date: July 29, 2019

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: N/E

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
0	4/6 4/6 4/6	CL	SANDY LEAN CLAY; medium stiff, moist, low to medium plasticity, dark-brown		8	
	4/6 7/6 7/6		Stiff		14	
5	4/6 8/6 7/6		Red-brown, trace fine gravel	DD = 109.2 pcf	15	11.8
10	2/6 3/6 5/6	SP	POORLY GRADED SAND; loose, moist, fine to coarse grained, red-brown		8	
15	5/6 11/6 13/6	CL	SANDY LEAN CLAY; very stiff, moist, low plasticity, olive brown, iron oxide staining	DD = 94.2 pcf	24	28.8
20	3/6 5/6 8/6		Stiff, low to medium plasticity, brown, iron oxide staining, seams of sand		13	
			Bottom of boring			
25						

Notes:

Figure Number

MOORE TWINING ASSOCIATES, INC.

Since 1898

Test Boring: B-9

Project: Proposed Drive Shack - Restaurant and Golf Driving Range

Project Number: E40550.01

Drilled By: Pacific Drilling

Drill Type: CME 75

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

Logged By: Jovany C.

Date: July 29, 2019

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: 18 feet

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
0	3/6 4/6 7/6	SM	SILTY SAND; medium dense, moist, fine to medium dense, brown		11	
	2/6 5/6 5/6		Trace gravel, 2 inch thick clay lens in sample		10	
5	3/6 5/6 7/6	ML	Sandy Silt; stiff, moist, slight plasticity, red-brown, iron oxide staining	Sand = 49.6% -#200 = 50.4%	12	
10	6/6 9/6 12/6	SM	SILTY SAND; medium dense, moist, fine to medium grained, red-brown	DD = 96.7 pcf	21	4.2
15	6/6 10/6 13/6	SP	POORLY GRADED SAND; moist, medium dense, fine to medium	Sand = 96.8% -#200 = 3.2% LL = NV PI = NP	23	
			2 feet of heave at 18 feet			
20	3/6 9/6 17/6		Wet, bluish-gray		26	
25	2/6 3/6 2/6	CL	SANDY LEAN CLAY; medium stiff, wet, low plasticity, grayish- blue, with weathered interbedded muscovite		5	

Notes:

Figure Number

MOORE TWINING ASSOCIATES, INC.

Test Boring: B-9

Project: Proposed Drive Shack - Restaurant and Golf Driving Range

Project Number: E40550.01

Drilled By: Pacific Drilling

Drill Type: CME 75

Auger Type: 6-5/8" Hollow Stem Augers

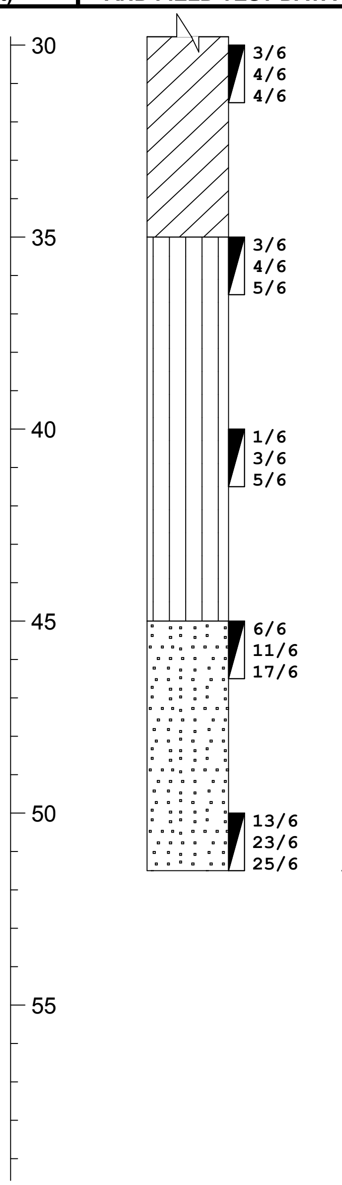
Hammer Type: 140 LB Auto Trip Hammer

Logged By: Jovany C.

Date: July 29, 2019

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: 18 feet



ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
30	3/6 4/6 4/6		Low to medium plasticity, dark-gray		8	
35	3/6 4/6 5/6	ML	SANDY SILT; stiff, moist, low plasticity, dark-gray, organic odor, some clay		9	
40	1/6 3/6 5/6		Medium stiff, low plasticity, increase in clay content		8	
45	6/6 11/6 17/6	SP	POORLY GRADED SAND; medium dense, wet, fine to medium grained, dark gray, trace organics		28	
50	13/6 23/6 25/6		Dense		48	
			Bottom of boring			
55						

Notes:

Figure Number

MOORE TWINING ASSOCIATES, INC.

Test Boring: B-10

Project: Proposed Drive Shack - Restaurant and Golf Driving Range

Project Number: E40550.01

Drilled By: Allen B.

Drill Type: CME 75

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

Logged By: Jovany C.

Date: July 16, 2019

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: N/E

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
0	8/6 10/6 12/6	AC	2.0 inches of Asphaltic CONCRETE over 6.5 inches of AGGREGATE BASE		22	
	11/6 14/6 17/6	SP	POORLY GRADED SAND; medium dense, moist, fine to coarse grained, light-brown		31	
5	13/6 20/6 29/6		Dense	DD = 108.0 pcf	49	2.4
10	3/6 9/6 12/6	CL	LEAN CLAY; hard, moist, low plasticity, brown		21	
15	4/6 8/6 8/6		Very stiff, low to medium plasticity, bluish-brown, moderately cemented, iron oxide staining		16	
20	4/6 8/6 12/6				20	
			Bottom of boring			
25						

Notes:

Figure Number

MOORE TWINING ASSOCIATES, INC.

Test Boring: B-11

Project: Proposed Drive Shack - Restaurant and Golf Driving Range

Project Number: E40550.01

Drilled By: Allen B.

Drill Type: CME 75

Auger Type: 6-5/8" Hollow Stem Augers

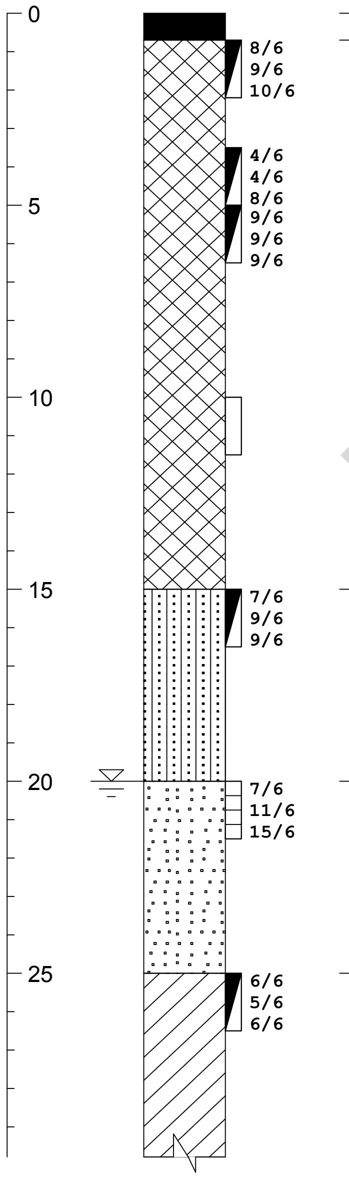
Hammer Type: 140 LB Auto Trip Hammer

Logged By: Jovany C.

Date: July 16, 2019

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: 20 Feet



ELEVATION/ DEPTH (feet)	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
0	AC	2.0 inches of ASPHALTIC			
	FILL	CONCRETE over 6 inches of AGGREGATE BASE		19	
	FILL	CLAYEY SAND; medium dense, moist, fine to medium grained, brown		12	
5		SANDY LEAN CLAY; stiff, moist, low to medium plasticity, red-brown to black Very stiff		18	
10	FILL	SANDY LEAN CLAY; stiff, moist, low plasticity, bluish-gray, iron oxide staining			
15	SM	SILTY SAND; medium dense, moist, fine to medium grained, brown, trace clay		18	
20	SP	POORLY GRADED SAND; medium dense, wet, fine to coarse, bluish-gray	DD =104.5 pcf Sand = 95.5% -#200 = 4.5% LL = NV PI = NP	26	20.6
25	CL	SANDY LEAN CLAY; stiff, wet, low to medium plasticity, blue, sea shells		11	

DRAFT

Notes:

Figure Number

MOORE TWINING ASSOCIATES, INC.

Test Boring: B-11

Project: Proposed Drive Shack - Restaurant and Golf Driving Range

Project Number: E40550.01

Drilled By: Allen B.

Drill Type: CME 75

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

Logged By: Jovany C.

Date: July 16, 2019

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: 20 Feet

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
30	3/6 4/6 4/6		LEAN CLAY; medium stiff, wet, low to medium plasticity, bluish-gray, 1 inch poorly graded sand lens		8	
35	4/6 6/6 8/6	CL	SANDY LEAN CLAY; stiff, moist, low to medium plasticity, bluish-gray (3 feet of heave during drilling)		14	
40	20/6 24/6 22/6	CL	Seam of poorly graded sand SANDY LEAN CLAY; hard, moist, low to medium plasticity, bluish-gray		46	
45	6/6 12/6 29/6	ML	SANDY SILT; hard, moist, non plastic, gray, 1" clay lens		41	
			Bottom of boring			
50						
55						

Notes:

Figure Number

MOORE TWINING ASSOCIATES, INC.
Since 1898

Test Boring: B-12

Project: Proposed Drive Shack - Restaurant and Golf Driving Range

Project Number: E40550.01

Drilled By: Allen B.

Drill Type: CME 75

Auger Type: 6-5/8" Hollow Stem Augers

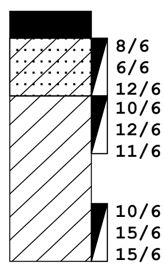
Hammer Type: 140 LB Auto Trip Hammer

Logged By: Jovany C.

Date: July 15, 2019

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: N/E



ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
0		AC	2.5 inches of ASPHALTIC CONCRETE over 6.0 inches of AGGREGATE BASE			
	8/6 6/6 12/6	SC	CLAYEY SAND; medium dense, moist, fine to medium grained, red-brown to brown, weakly cemented		20	
	10/6 12/6 11/6	CL	SANDY LEAN CLAY; very stiff, moist, low to medium plasticity, brown, moderate cementation With 1" clayey sand lens		23	
5	10/6 15/6 15/6				30	
			Bottom of boring			
10						
15						
20						
25						

Notes:

Figure Number

MOORE TWINING ASSOCIATES, INC.

Since 1898

Test Boring: B-13

Project: Proposed Drive Shack - Restaurant and Golf Driving Range

Project Number: E40550.01

Drilled By: Allen B.

Drill Type: CME 75

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

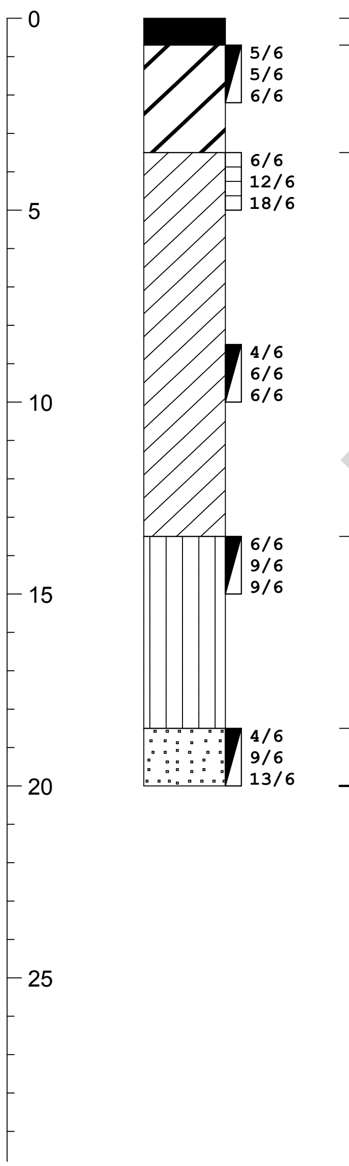
Logged By: Jovany C.

Date: July 15, 2019

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: N/E

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
0		AC	2.3 inches of ASPHALTIC CONCRETE over 6.0 inches of AGGREGATE BASE			
	5/6, 5/6, 6/6	CH	FAT CLAY; stiff, moist, medium to high plasticity, light-brown		11	
	6/6, 12/6, 18/6	CL	LEAN CLAY; very stiff, moist, low plasticity, light-brown		30	
5–10	4/6, 6/6, 6/6		Stiff, decrease in plasticity, olive		12	
	6/6, 9/6, 9/6	ML	SILT; very stiff, moist, non plastic, red-brown		18	
15–20	4/6, 9/6, 13/6	SP	POORLY GRADED SAND; medium dense, moist, fine to medium grained, trace coarse sand, brown, iron oxide staining		22	
20			Bottom of boring			



Notes:

Figure Number

MOORE TWINING ASSOCIATES, INC.

Test Boring: B-14

Project: Proposed Drive Shack - Restaurant and Golf Driving Range

Project Number: E40550.01

Drilled By: Allen B.

Drill Type: CME 75

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

Logged By: Jovany C.

Date: July 15, 2019

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: N/E

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
0		AC	2.1 inches of ASPHALTIC CONCRETE over 7.5 inches of AGGREGATE BASE			
	5/6 5/6 5/6	SC	CLAYEY SAND; loose, moist, fine to medium grained, dark brown to red-brown, gravel noted in cuttings		10	
5	7/6 8/6 11/6		Medium dense, slight increase in fines content		19	
		SP	POORLY GRADED SAND; loose, moist, fine to coarse, tan brown, trace clay fragments			
10	3/6 4/6 6/6	CL	SANDY LEAN CLAY; stiff, moist, low to medium plasticity, dark-brown, 1 inch clayey sand lens		10	
15	5/6 16/6 21/6	CL	LEAN CLAY; Very stiff, moist, low to medium plasticity, dark-brown to red-brown, trace sand	DD = 124.3 pcf	37	11.0
20	4/6 6/6 8/6		Stiff, gray to brown		14	
			Bottom of boring			
25						

Notes:

Figure Number

MOORE TWINING ASSOCIATES, INC. Since 1898

Test Boring: B-15

Project: Proposed Drive Shack - Restaurant and Golf Driving Range

Project Number: E40550.01

Drilled By: Allen B.

Drill Type: CME 75

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

Logged By: Jovany C.

Date: July 15, 2019

Elevation:

Depth to Groundwater First Encountered During Drilling: N/E

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
0	3/6 4/6 5/6	AC SC	2.8 inches of ASPHALTIC CONCRETE over 5.0 inches of AGGREGATE BASE		9	
	5/6 6/6 7/6	CL	CLAYEY SAND; loose, moist, fine to medium grained, dark- brown to black		13	
5	6/6 13/6 26/6		SANDY LEAN CLAY; stiff, moist, low plasticity, dark-brown Very stiff, increase in sand content, 2" clayey sand lens	DD = 112.0 pcf	39	11.6
10	5/6 6/6 7/6		Very stiff, low plasticity, dark-brown		13	
15			Low to medium plasticity			
20	2/6 2/6 3/6		Medium stiff, moist, low to medium plasticity, light-gray to light-green		5	
25	2/6 2/6 4/6	CH	FAT CLAY; stiff, moist, medium to high plasticity, bluish-green, interbedded tan, sea shells		6	

Notes:

Figure Number

MOORE TWINING ASSOCIATES, INC.

Test Boring: B-15

Project: Proposed Drive Shack - Restaurant and Golf Driving Range

Project Number: E40550.01

Drilled By: Allen B.

Drill Type: CME 75

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

Logged By: Jovany C.

Date: July 15, 2019

Elevation:

Depth to Groundwater First Encountered During Drilling: N/E

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
30	4/6 6/6 8/6	CL	SANDY LEAN CLAY; stiff, moist, low to medium plasticity, dark-blue	DD = 84.5 pcf	14	33.2
35	10/6 17/6 21/6	SP	POORLY GRADED SAND; dense, moist, fine sand, gray		38	
40	5/6 7/6 9/6	ML	SANDY SILT; very stiff, moist, non-plastic, dark-gray		16	
45	5/6 7/6 9/6	SP	POORLY GRADED SAND; medium dense, moist, fine, gray		16	
			Bottom of boring			
50						
55						

Notes:

Figure Number

MOORE TWINING ASSOCIATES, INC.

Since 1898

Test Boring: B-16

Project: Proposed Drive Shack - Restaurant and Golf Driving Range

Project Number: E40550.01

Drilled By: Allen B.

Drill Type: CME 75

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

Logged By: Jovany C.

Date: July 23, 2019

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: N/E

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
0	2/6 4/6 4/6	CL	SANDY LEAN CLAY; medium stiff, moist, low to medium plasticity, black, with rootlets, weak to moderate cementation		8	13.8
	6/6 8/6 10/6		Stiff	DD = 83.2 pcf c = 230 psf ø = 30°	18	29.5
5	3/6 4/6 5/6		Increase in sand content		9	28.7
10	2/6 1/6 2/6		Soft, decrease in plasticity		3	60.2
15	2/6 6/6 8/6	CL	SANDY LEAN CLAY; stiff, moist, low plasticity, black, organics		14	37.7
20	7/6 11/6 13/6	ML	SANDY SILT; very stiff, moist, non-plastic, brown		24	7.9
25	3/6 4/6 5/6	CL	SANDY LEAN CLAY; stiff, moist, low to medium plasticity, bluish-gray		9	20.0

Notes:

Figure Number

MOORE TWINING ASSOCIATES, INC.

Test Boring: B-16

Project: Proposed Drive Shack - Restaurant and Golf Driving Range

Project Number: E40550.01

Drilled By: Allen B.

Drill Type: CME 75

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

Logged By: Jovany C.

Date: July 23, 2019

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: N/E

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
30	0/6 2/6 2/6		Soft, trace gravel		4	29.0
35	2/6 4/6 4/6		Medium stiff, bluish-gray		8	20.5
40	4/6 6/6 8/6	SM	SILTY SAND; medium dense, moist, fine to medium grained, bluish-gray, with trace clay		14	15.8
45	5/6 6/6 7/6				13	9.7
			Bottom of boring			
50						
55						

DRAFT

Notes:

Figure Number

MOORE TWINING ASSOCIATES, INC.

Since 1898

Test Boring: B-17

Project: Proposed Drive Shack - Restaurant and Golf Driving Range

Project Number: E40550.01

Drilled By: Pac Drill

Drill Type: Fraste L.A.R.

Auger Type: 6-5/8" Hollow Stem Augers

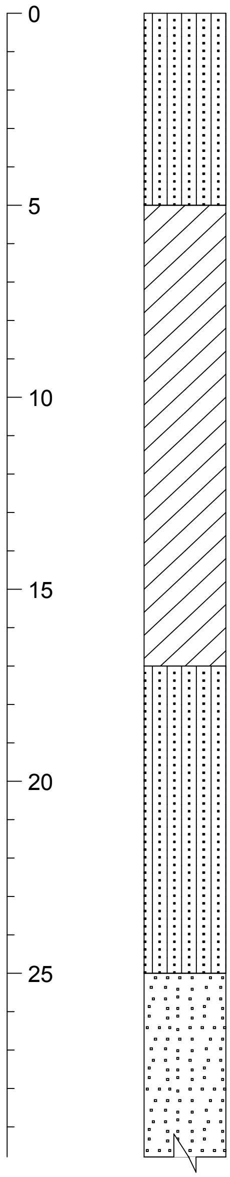
Hammer Type: 140 LB Auto Trip Hammer

Logged By: Jovany C.

Date: February 24, 2020

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: N/E



ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
0		SM	SILTY SAND; moist, fine to medium grained, brown Dark-brown			
5		CL	SANDY LEAN CLAY; moist, low plasticity, dark-brown Increase in sand content Grayish-blue, low to medium plasticity Greenish-blue, slight increase in moisture			
		SM	SILTY SAND; moist, fine to medium grained, red-brown			
25		SP	POORLY GRADED SAND; moist, fine to medium grained, red-brown			

Notes: *Groundwater not encountered during drilling on February 24, 2020. Groundwater was measured at 26 feet BSG on February 25, 2020.*

Figure Number

MOORE TWINING ASSOCIATES, INC.

Test Boring: B-17

Project: Proposed Drive Shack - Restaurant and Golf Driving Range

Project Number: E40550.01

Drilled By: Pac Drill

Drill Type: Fraste L.A.R.

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

Logged By: Jovany C.

Date: February 24, 2020

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: N/E

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
30						
		CL	LEAN CLAY; moist, low plasticity, grayish-blue			
35			Slight increase in moisture, Bottom of boring B-17 at 35 feet BSG			
40						
45						
50						
55						

DRAFT

Notes: *Groundwater not encountered during drilling on February 24, 2020. Groundwater was measured at 26 feet BSG on February 25, 2020.*

Figure Number

MOORE TWINING ASSOCIATES, INC.

Since 1898

Test Boring: B-18

Project: Proposed Drive Shack - Restaurant and Golf Driving Range

Project Number: E40550.01

Drilled By: Pac Drill

Drill Type: Fraste L.A.R.

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

Logged By: Jovany C.

Date: February 24, 2020

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: 35 Feet

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
0	3/6 4/6 5/6	SP-SM	POORLY GRADED SAND WITH SILT; loose, moist, fine to coarse grained, brown		9	
5	6/6 4/6 3/6	CL	LEAN CLAY; medium stiff, moist, low plasticity, brown		7	
		SP-SM	POORLY GRADED SAND WITH SILT; loose, moist, fine to coarse grained, brown, some fine subangular gravel			
10	4/6 4/6 5/6	CL	SANDY LEAN CLAY; stiff, moist, low to medium plasticity, grayish-blue		9	
15	7/6 8/6 10/6	SP-SM	POORLY GRADED SAND with Silt; medium dense, moist, fine to medium grained, brown	Sand=92.2% -#200=7.8%	18	
20	4/6 6/6 8/6	CL	LEAN CLAY; stiff, very moist, low to medium plasticity, grayish-blue, iron oxide staining	DD=88.1 pcf	14	34.8
25	3/6 3/6 3/6		Medium stiff, with shells		6	

Notes: *Groundwater encountered at about 35 feet BSG during drilling on February 24, 2020. Groundwater was measured at 18 feet BSG on February 25, 2020.*

Figure Number

MOORE TWINING ASSOCIATES, INC.

Test Boring: B-18

Project: Proposed Drive Shack - Restaurant and Golf Driving Range

Project Number: E40550.01

Drilled By: Pac Drill

Drill Type: Fraste L.A.R.

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

Logged By: Jovany C.

Date: February 24, 2020

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: 35 Feet

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
30	7/6 8/6 8/6		Stiff	DD=75.5 pcf	16	37.7
35	6/6 11/6 11/6	ML	SANDY SILT; very stiff, very moist, non-plastic, dark-gray		22	
40	12/6 16/6 10/6				26	
45	3/6 4/6 4/6	CL	LEAN CLAY; medium stiff, wet, medium plasticity, dark-gray		8	
50	3/6 4/6 7/6		Stiff		11	
			Bottom of boring B-18 at 51.5 feet BSG			
55						

Notes: *Groundwater encountered at about 35 feet BSG during drilling on February 24, 2020. Groundwater was measured at 18 feet BSG on February 25, 2020.*

Figure Number

Moore Twining Associates, Inc.

Test Boring: B-19

Project: Proposed Drive Shack - Restaurant and Golf Driving Range

Project Number: E40550.01

Drilled By: Pac Drill

Drill Type: Fraste L.A.R.

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

Logged By: Jovany C.

Date: February 24, 2020

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: 38.5 Feet

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
0		SM	FILL - SILTY SAND; moist, fine to medium grained, brown to red brown, moderate resistance to hand auger, plastic debris			
	7/6 8/6 8/6	SP-SM	POORLY GRADED SAND WITH SILT; medium dense, moist, fine to coarse grained, brown to red- brown		16	5.0
5	6/6/ 5/6 5/6	CL	SANDY LEAN CLAY; stiff, moist, low plasticity, brown, iron oxide staining		10	
10	11/6 15/6 17/6		Very stiff, low to medium plasticity, green-brown	DD=103.9 pcf	32	20.7
15	4/6 7/6 9/6		Dark greenish-brown, decrease in sand content		16	21.1
20	6/6 13/6 17/6		LEAN CLAY; very stiff, moist, low to medium plasticity, greenish-brown	DD=96.9 pcf	30	24.2
25	5/6 8/6 11/6				19	23.5

Notes: *Groundwater encountered at 38.50 feet BSG during drilling on February 24, 2020. Groundwater was measured at 29 feet BSG on February 25, 2020.*

Figure Number

MOORE TWINING ASSOCIATES, INC.

Test Boring: B-19

Project: Proposed Drive Shack - Restaurant and Golf Driving Range

Project Number: E40550.01

Drilled By: Pac Drill

Drill Type: Fraste L.A.R.

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

Logged By: Jovany C.

Date: February 24, 2020

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: 38.5 Feet

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
30	9/6 12/6 15/6		Bluish-gray to greenish-brown	DD=97.6 pcf LL=49 PI=31	27	25.1
35	5/6 6/6 9/6		Stiff, dark-gray		15	29.7
40	4/6 3/6 2/6		Medium stiff, wet	DD=81.0 pcf ø=19° C=320 psf	5	34.9
45	3/6 3/6 3/6				6	32.6
50	6/6 8/6 13/6		Very stiff, grayish-blue	DD=89.9 pcf	21	30.6
55	6/6 8/6 12/6				20	24.2
			Bottom of boring B-19 at 56.5 feet BSG			

Notes: *Groundwater encountered at 38.50 feet BSG during drilling on February 24, 2020. Groundwater was measured at 29 feet BSG on February 25, 2020.*

Figure Number

MOORE TWINING ASSOCIATES, INC.

Since 1898

Test Boring: B-20

Project: Proposed Drive Shack - Restaurant and Golf Driving Range

Project Number: E40550.01

Drilled By: Pac Drill

Drill Type: Fraste L.A.R.

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

Logged By: Jovany C.

Date: February 25, 2020

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: 42.5 Feet

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
0	10/6 6/6 5/6	SP	POORLY GRADED SAND; medium dense, moist, fine to coarse grained, brown		11	
5	3/6 5/6 6/6	CL	SANDY LEAN CLAY; stiff, moist, low plasticity, brown		11	
10	5/6 6/6 8/6		Low to medium plasticity, decrease in sand content		14	
15	10/6 12/6 16/6		Very stiff, iron oxide staining	DD=94.6 pcf	28	26.3
20	5/6 7/6 10/6				17	
25	4/6 4/6 4/6		Medium stiff, grayish-blue, interbedded shells		8	

Notes: *Groundwater encountered at 42.5 feet BSG during drilling on February 25, 2020. Groundwater was measured at 37 feet BSG on February 26, 2020.*

Figure Number

Test Boring: B-20

Project: Proposed Drive Shack - Restaurant and Golf Driving Range

Project Number: E40550.01

Drilled By: Pac Drill

Drill Type: Fraste L.A.R.

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

Logged By: Jovany C.

Date: February 25, 2020

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: 42.5 Feet

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
30	8/6 9/6 10/6	CH	FAT CLAY; Stiff, moist, high plasticity, gray blue	DD=83.5 pcf ø=18° C=700 psf LL=69 PI=47 Sand=7.0% -#200=93.0%	19	32.4
35	8/6 7/6 5/6	SP-SM	POORLY GRADED SAND with Silt; medium dense, wet, fine-grained, light-gray to brown, 1 inch layer of clay		12	
40	19/6 35/6 50/5.5		Very dense, dry, light-gray		>85	
45	13/6 20/6 26/6		Dense	Sand=90.6% -#200=9.4% LL=NV PI=NP	46	2.7
50	18/6 26/6 28/6		Very dense		54	
55	20/6 24/6 30/6				54	

Notes: *Groundwater encountered at 42.5 feet BSG during drilling on February 25, 2020. Groundwater was measured at 37 feet BSG on February 26, 2020.*

Figure Number

MOORE TWINING ASSOCIATES, INC.

Test Boring: B-20

Project: Proposed Drive Shack - Restaurant and Golf Driving Range

Project Number: E40550.01

Drilled By: Pac Drill

Drill Type: Fraste L.A.R.

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

Logged By: Jovany C.

Date: February 25, 2020

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: 42.5 Feet

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
60	13/6 35/6 13/6		Dense, wet		48	
65	5/6 7/6 7/6		Medium dense, 1 inch layer of clay in sample shoe		14	
			Bottom of boring B-20 at 66.5 feet BSG			
70						
75						
80						
85						

Notes: *Groundwater encountered at 42.5 feet BSG during drilling on February 25, 2020. Groundwater was measured at 37 feet BSG on February 26, 2020.*

Figure Number

MOORE TWINING ASSOCIATES, INC.

Test Boring: B-21

Project: Proposed Drive Shack - Restaurant and Golf Driving Range

Project Number: E40550.01

Drilled By: Pac Drill

Drill Type: Fraste L.A.R.

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

Logged By: Amanda T.

Date: February 27, 2020

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: N/E

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
0	10/6 5/6 4/6	ML	SANDY SILT; medium stiff, moist, non-plastic, red-brown		9	6.4
	16/6 20/6 14/6		Very stiff	DD=122.0 pcf	34	5.7
5	4/6 3/6 7/6	CL	SANDY LEAN CLAY; stiff, moist, low to medium plasticity, brown		10	15.8
10	14/6 50/6		Hard		>50	
15	5/6 7/6 9/6		Very stiff, low plasticity, blueish-green, decrease in sand content		16	
20	5/6 6/6 8/6		Stiff		14	
			Bottom of boring B-21 at 21.5 feet BSG			
25						

Notes: *Groundwater was not encountered during drilling on February 27, 2020.*

Figure Number

MOORE TWINING ASSOCIATES, INC.

Since 1898

Test Boring: B-22

Project: Proposed Drive Shack - Restaurant and Golf Driving Range

Project Number: E40550.01

Drilled By: Pac Drill

Drill Type: Fraste L.A.R.

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

Logged By: Amanda T.

Date: February 28, 2020

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: N/E

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
0	5/6 2/6 2/6	ML	SANDY SILT; soft, moist, non plastic, dark-brown		4	
5	3/6 3/6 5/6	CL	LEAN CLAY; medium stiff, moist, low plasticity, brown		8	
10	3/6 5/6 7/6		Olive-gray		12	
15	6/6 7/6 8/6		Olive-brown, with shells		15	
20	4/6 5/6 6/6		Stiff, bluish-green		11	
25	5/6 8/6 9/6		Very stiff	DD=96.7 pcf	17	21.8

Notes: *Groundwater was not encountered during drilling on February 28, 2020.*

Figure Number

MOORE TWINING ASSOCIATES, INC.

Since 1898

Test Boring: B-22

Project: Proposed Drive Shack - Restaurant and Golf Driving Range

Project Number: E40550.01

Drilled By: Pac Drill

Drill Type: Fraste L.A.R.

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

Logged By: Amanda T.

Date: February 28, 2020

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: N/E

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
30	5/6 6/6 6/6		Stiff, gray, with shell		12	
35	5/6 8/6 29/6	SM	SILTY SAND; dense, moist, fine to medium grained, gray	DD=100.5 Sand=72.6% -#200=27.4%	37	14.3
40	17/6 22/6 23/6				45	
45	16/6 23/6 22/6				45	
50	0/6 5/6 6/6	CL	LEAN CLAY; stiff, moist, low to medium plasticity, dark-brown	LL=48 PI=19	11	
55	8/6 9/6 10/6		Very stiff, gray	ø=24° C=340 psf	19	

Notes: *Groundwater was not encountered during drilling on February 28, 2020.*

Figure Number

MOORE TWINING ASSOCIATES, INC.

Since 1898

Test Boring: B-22

Project: Proposed Drive Shack - Restaurant and Golf Driving Range

Project Number: E40550.01

Drilled By: Pac Drill

Drill Type: Fraste L.A.R.

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

Logged By: Amanda T.

Date: February 28, 2020

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: N/E

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
60	2/6 4/6 3/6		Medium stiff		7	
65	8/6 10/6 8/6		Stiff		18	
70	3/6 10/6 27/6	SC	CLAYEY SAND; dense, moist, fine grained, dark-brown		37	
		SP	POORLY GRADED SAND; dense, moist, fine to medium grained, gray			
75	15/6 33/6 35/6	SP	Very dense, fine to coarse gravel		68	
			Bottom of boring B-22 at 76.5 feet BSG			
80						
85						

Notes: *Groundwater was not encountered during drilling on February 28, 2020.*

Figure Number

MOORE TWINING ASSOCIATES, INC.

Since 1898

Test Boring: B-23

Project: Proposed Drive Shack - Restaurant and Golf Driving Range

Project Number: E40550.01

Drilled By: Pac Drill

Drill Type: Fraste L.A.R.

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

Logged By: Amanda T.

Date: February 27, 2020

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: N/E

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
0	4/6 2/6 2/6	CL	LEAN CLAY; soft, moist, low plasticity, dark-brown		4	
5	1/6 1/6 1/6		Very soft		2	
10	0/6 0/6 1/6		Olive to dark-brown		1	
15	0/6 4/6 5/6		Stiff, low to medium plasticity, gray		9	
20	6/6 6/6 8/6	SC	CLAYEY SAND; stiff, moist, fine to medium grained, light- brown		14	
25	20/6 23/6 21/6		Medium dense		44	

Notes: *Groundwater was not encountered during drilling on February 27, 2020.*

Figure Number

MOORE TWINING ASSOCIATES, INC.

Test Boring: B-23

Project: Proposed Drive Shack - Restaurant and Golf Driving Range

Project Number: E40550.01

Drilled By: Pac Drill

Drill Type: Fraste L.A.R.

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

Logged By: Amanda T.

Date: February 27, 2020

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: N/E

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
30	4/6 6/6 8/6	CL	LEAN CLAY; stiff, moist, low to medium plasticity, gray		14	
35	7/6 13/6 28/6	SC	CLAYEY SAND; dense, moist, fine to medium grained, gray		41	
			Bottom of boring B-23 at 36.5 feet BSG			
40						
45						
50						
55						

Notes: *Groundwater was not encountered during drilling on February 27, 2020.*

Figure Number

MOORE TWINING ASSOCIATES, INC.

Test Boring: B-24

Project: Proposed Drive Shack - Restaurant and Golf Driving Range

Project Number: E40550.01

Drilled By: Pac Drill

Drill Type: Fraste L.A.R.

Auger Type: 6-5/8" Hollow Stem Augers

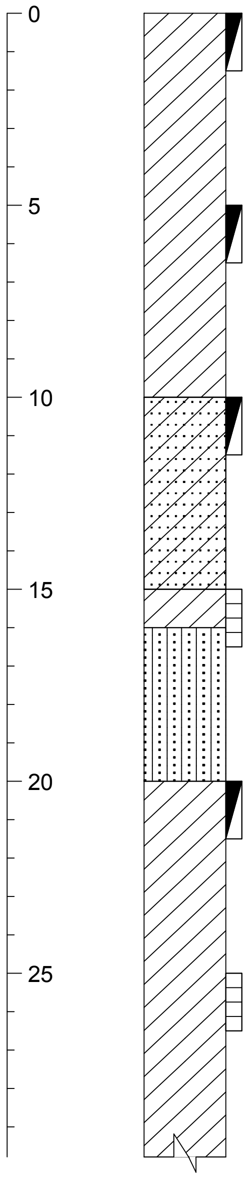
Hammer Type: 140 LB Auto Trip Hammer

Logged By: Jovany C.

Date: February 26, 2020

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: 30 Feet



ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
0	10/6 3/6 6/6	CL	SANDY LEAN CLAY; stiff, moist, low plasticity, brown		9	
5	9/6 9/6 8/6		Very stiff, weakly cemented, trace fine gravel		17	
10	15/6 13/6 10/6	SC	CLAYEY SAND; medium dense, moist, fine to medium grained, brown, trace fine gravel		23	
15	9/6 12/6 14/6	CL	SANDY LEAN CLAY; very stiff, moist, low to medium plasticity, brown to blue	DD=102.3 pcf	26	16.8
		SM	SILTY SAND; medium dense, moist, fine to medium grained, dark red-brown			
20	4/6 5/6 8/6	CL	SANDY LEAN CLAY; stiff, moist, low to medium plasticity, blue, iron oxide staining, some organics		13	
25	5/6 8/6 10/6		Stiff, no organics	DD=96.8 pcf	18	26.9

Notes: *Groundwater was encountered at 30.00 feet BSG during drilling on February 26, 2020. Groundwater was measured at 24 feet BSG on February 27, 2020.*

Figure Number

MOORE TWINING ASSOCIATES, INC.
Since 1898

Test Boring: B-24

Project: Proposed Drive Shack - Restaurant and Golf Driving Range

Project Number: E40550.01

Drilled By: Pac Drill

Drill Type: Fraste L.A.R.

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

Logged By: Jovany C.

Date: February 26, 2020

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: 30 Feet

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
30	5/6 5/6 5/6		Wet, dark-gray		10	
35	2/6 3/6 3/6		Medium stiff		6	
	11/6 50/6		Hard		>50	
		SP	POORLY GRADED SAND; very dense, moist, fine to medium grained, light-gray			
40			Bottom of boring B-24 at 39.5 feet BSG			
45						
50						
55						

Notes: *Groundwater was encountered at 30.00 feet BSG during drilling on February 26, 2020. Groundwater was measured at 24 feet BSG on February 27, 2020.*

Figure Number

MOORE TWINING ASSOCIATES, INC.

Since 1898

Test Boring: B-25

Project: Proposed Drive Shack - Restaurant and Golf Driving Range

Project Number: E40550.01

Drilled By: Pac Drill

Drill Type: Fraste L.A.R.

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

Logged By: Amanda T.

Date: February 26, 2020

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: N/E

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
0	3/6 2/6 4/6	CL	LEAN CLAY; medium stiff, moist, low plasticity, brown		6	
5	2/6 2/6 2/6		Soft, dark-brown		4	
10	0/6 0/6 2/6		Low to medium plasticity		2	
15	3/6 4/6 6/6		Medium stiff		10	
20	2/6 2/6 5/6		Medium stiff, gray, with sand		7	
25	8/6 7/6 17/6	SC	CLAYEY SAND; medium dense, moist, fine to medium grained, gray		24	
	7/6 6/6				20	

Notes: *Groundwater was not encountered during drilling on February 26, 2020.*

Figure Number

MOORE TWINING ASSOCIATES, INC.

Since 1898

Test Boring: B-25

Project: Proposed Drive Shack - Restaurant and Golf Driving Range

Project Number: E40550.01

Drilled By: Pac Drill

Drill Type: Fraste L.A.R.

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

Logged By: Amanda T.

Date: February 26, 2020

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: N/E

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
30	14/6		Bottom of boring B-25 at 30 feet BSG			
35						
40						
45						
50						
55						

DRAFT

Notes: *Groundwater was not encountered during drilling on February 26, 2020.*

Figure Number

MOORE TWINING ASSOCIATES, INC.

Since 1898

Test Boring: B-26

Project: Proposed Drive Shack - Restaurant and Golf Driving Range

Project Number: E40550.01

Drilled By: Pac Drill

Drill Type: Fraste L.A.R.

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

Logged By: Jovany C.

Date: February 26, 2020

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: N/E

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
0	2/6 3/6 3/6	CL	SANDY LEAN CLAY; medium stiff, moist, low plasticity, dark brown, with rootlets		6	13.0
5	3/6 6/6 6/6		Medium stiff	DD=103.5 pcf LL=31 PI=18	12	22.6
10	2/6 2/6 2/6		Soft, low to medium plasticity, black		4	
15	1/6 2/6 2/6				4	
	7/6 9/6 11/6		Stiff, moist, low to medium plasticity, bluish-gray	DD=106.1 pcf	20	18.8
20						
	5/6 4/6 7/6		Stiff, black to gray		11	18.7
25			Bottom of boring B-26 at 25 feet BSG			

Notes: *Groundwater was not encountered during drilling on February 26, 2020.*

Figure Number

KEY TO SYMBOLS

Symbol	Description
Strata symbols	
	SM: Silty sand
	SP: Poorly graded sand
	CL: LEAN CLAY
	Fill
	ML: Silt
	ASPHALTIC CONCRETE
	SC: Clayey sand

Notes:

1. Test borings were drilled between July 15, 2019 and July 30, 2019 using a CME-75 drill rig equipped with 6-5/8" inch outside diameter hollow-stem augers and using a limited access rig (L.A.R.) equipped with 6 inch outside diameter hollow stem augers. Additional soil borings were drilled between Febraury 24, 20 and February 28, 20 using a limited acess rig equipped with 6 inch outisde diameter hollow stem augers.

2. Groundwater was encountered during drilling (see logs).

3. Boring locations were located by pace with reference to the existing site features.

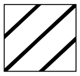
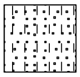
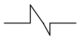
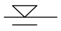
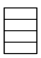
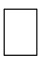
4. These logs are subject to the limitations, conclusions, and recommendations in this report.

5. The "N-value" reported for the California Modified Split Barrel Sampler is the uncorrected field blow count. This value shold not be interpreted as an SPT equivalent N-value.

6. Results of tests conducted on samples recovered are reported on the logs. Abbreviations used are:

AMSL	=	Above mean sea level
O.D.	=	Outside diameter
DD	=	Dry density (pcf)
-#200	=	Percent passing #200 sieve (%)
N/A	=	Not applicable
N/E	=	None encountered
pcf	=	pounds per cubic foot
psf	=	pounds per square foot
BSG	=	below site grade
LL	=	Liquid Limit
PI	=	Plasticity Index
C	=	Cohesion
ø	=	Angle of Internal Friction
NV	=	No Value
NP	=	Non Plastic

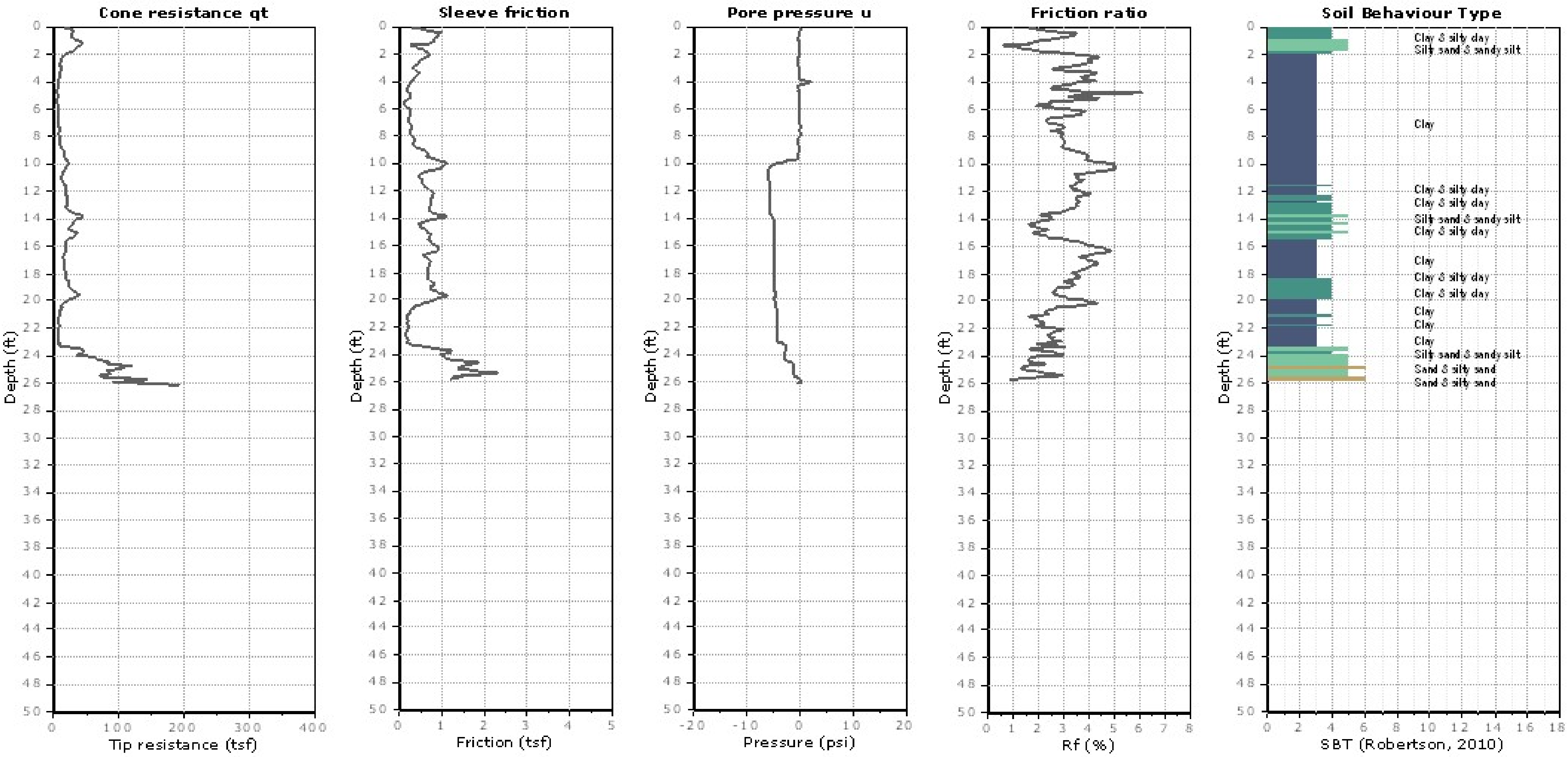
KEY TO SYMBOLS

Symbol	Description
Strata symbols	
	CH: FAT CLAY
	SP-SM: Poorly graded sand with silt
Misc. Symbols	
	Boring continues
	Water table during drilling
Soil Samplers	
	Standard penetration test
	California Modified split barrel ring sampler
	Undisturbed thin wall Shelby tube

Kehoe Testing and Engineering
714-901-7270
steve@kehoetesting.com
www.kehoetesting.com

Project: **Moore Twining Associates** **CPT-1**

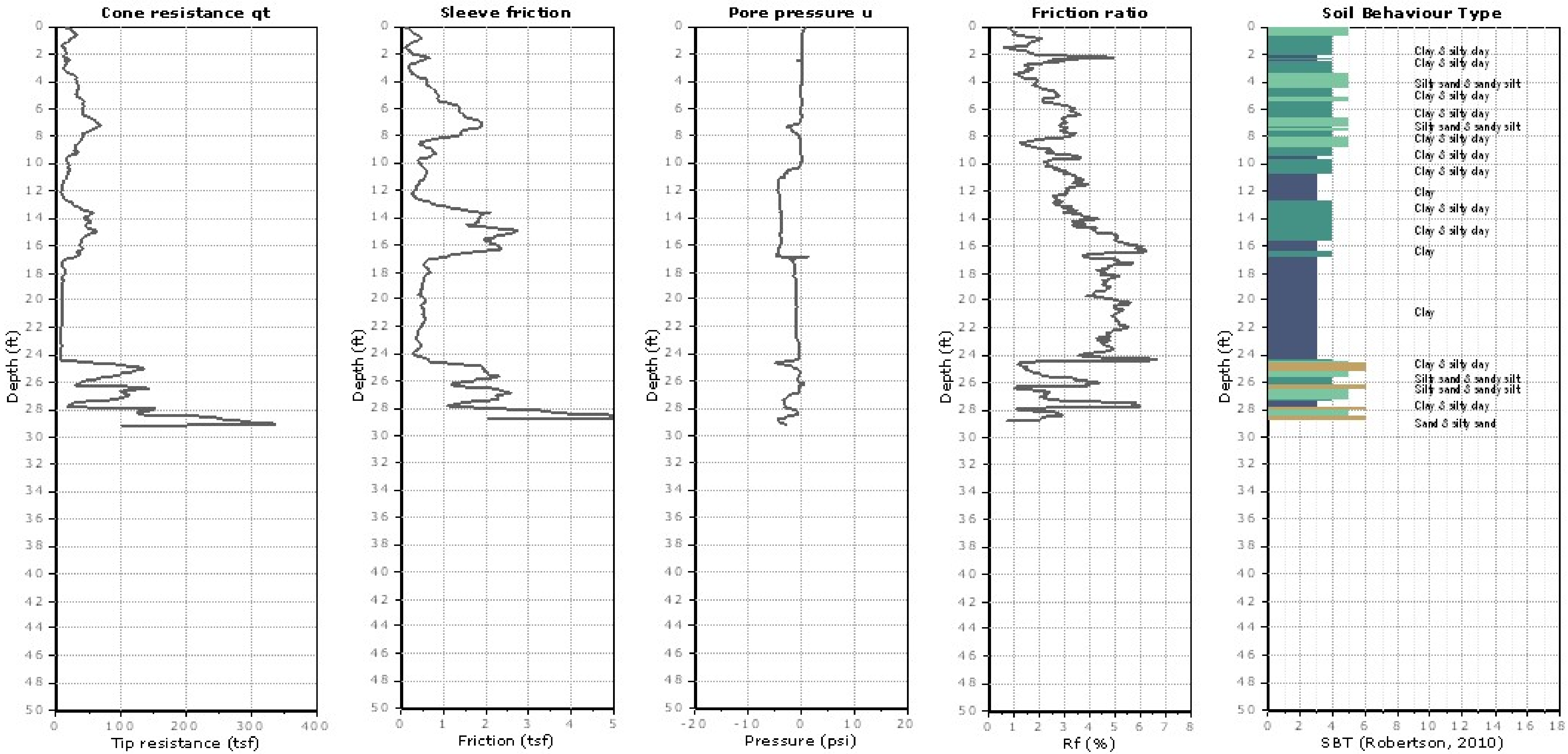
Location: **Newport Beach Golf Course** Total depth: 26.13 ft, Date: 7/23/2019



Kehoe Testing and Engineering
714-901-7270
steve@kehoetesting.com
www.kehoetesting.com

Project: Moore Twining Associates **CPT-2**

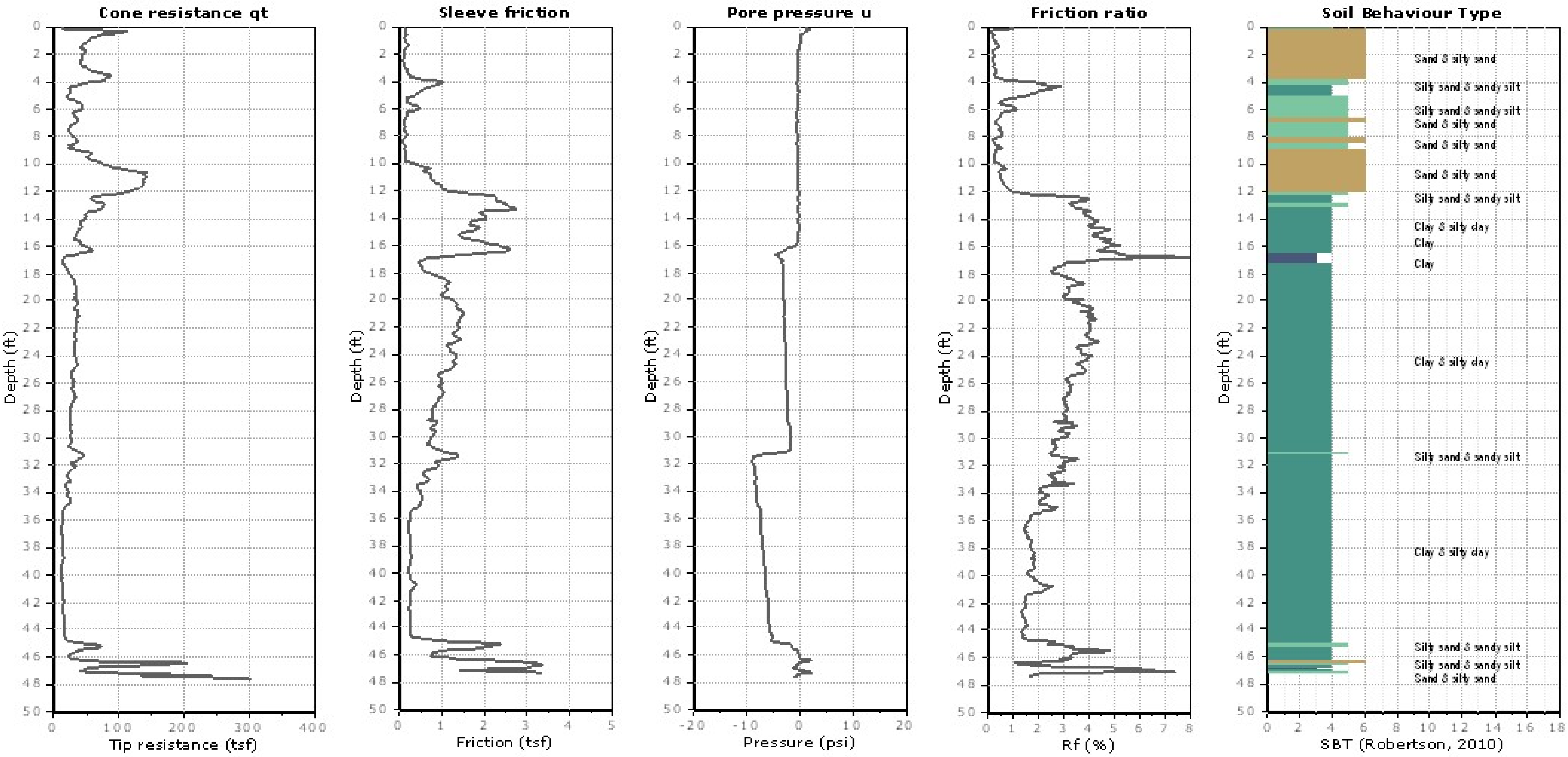
Location: Newport Beach Golf Course Total depth: 29.14 ft, Date: 7/23/2019



Kehoe Testing and Engineering
714-901-7270
steve@kehoetesting.com
www.kehoetesting.com

Project: Moore Twining Associates
Location: Newport Beach Golf Course

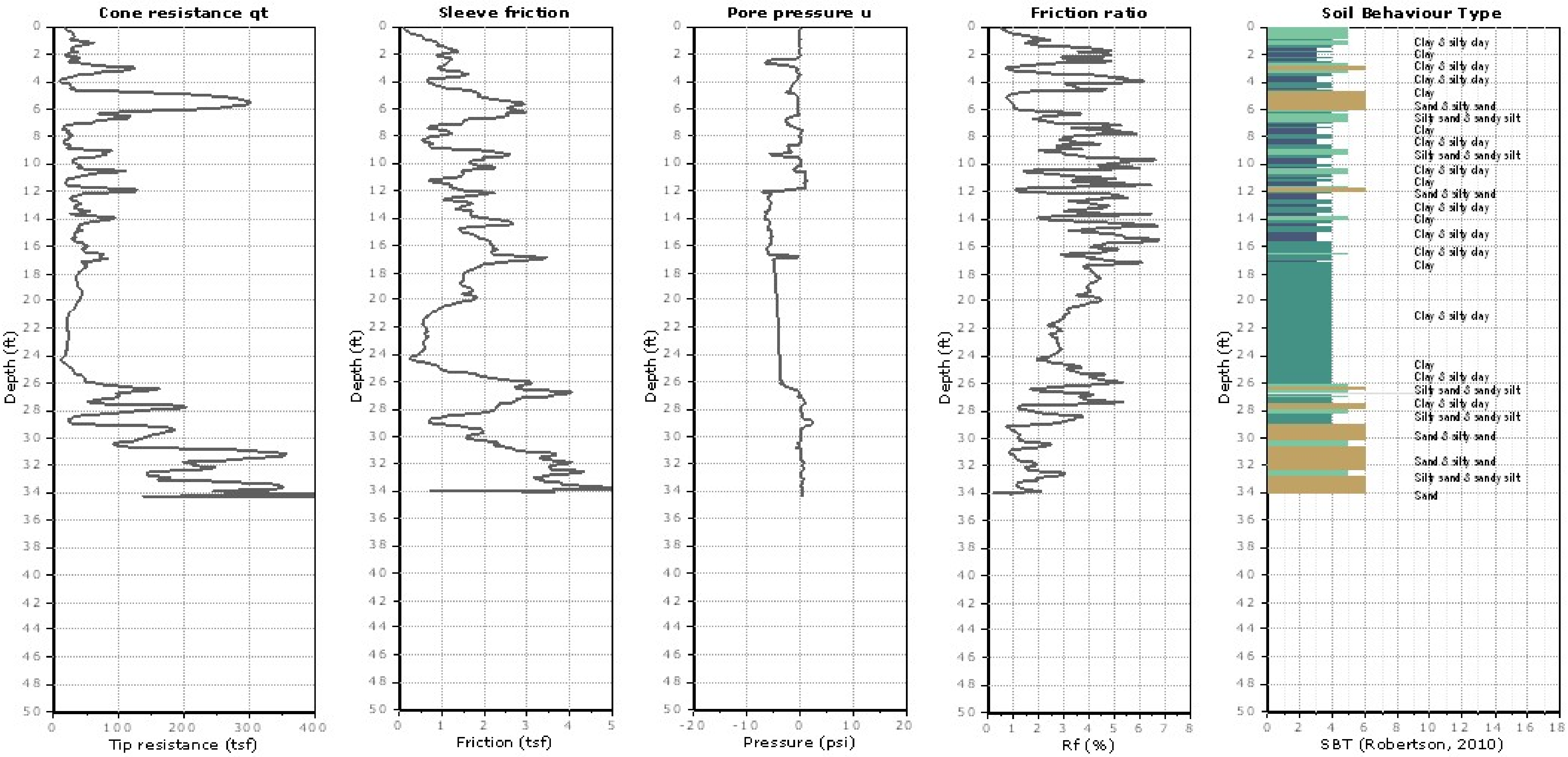
CPT-3
Total depth: 47.58 ft, Date: 7/23/2019



Kehoe Testing and Engineering
714-901-7270
steve@kehoetesting.com
www.kehoetesting.com

Project: **Moore Twining Associates**
Location: **Newport Beach Golf Course**

CPT-4
Total depth: 34.40 ft, Date: 7/23/2019



Project Name: <u>Drive Shack Driving Range and Restaurant</u> **Project No.:** <u>E40550.01</u>
Location: <u>3100 Irvine Avenue, Newport Beach, CA</u>

Temporary Piezometers Groundwater Depth

Boring Location	Well Depth, Feet BSG	Date Measured	Depth to Water, Feet BSG	Estimated Surface Elevation* (Feet AMSL)	Approximate Groundwater Elevation (Feet AMSL)
B-17	35	2/28/2020	28	34	6
B-18	50	2/28/2020	18	33	15
B-19	55	2/28/2020	24	36	12
B-22	55	2/28/2020	Dry	30	N/A
B-23	35	2/28/2020	Dry	20	N/A
B-24	40	2/28/2020	24	28	4
B-17	35	4/17/2020	27.7	34	6.3
B-18	50	4/17/2020	19	33	14.0
B-19	55	4/17/2020	22.2	36	13.8
B-22	55	4/17/2020	Dry	30	N/A
B-23	35	4/17/2020	Dry	20	N/A
B-24	40	4/17/2020	18.4	28	9.6

*Surface elevations estimated from topographic survey provided by Kimley-Horn

APPLICATION FOR WELL CONSTRUCTION PERMIT

ORANGE COUNTY HEALTH CARE AGENCY
ENVIRONMENTAL HEALTH DIVISION
1241 E. DYER ROAD, SUITE 120
SANTA ANA, CA 92705-5611
(714) 433-6000
FAX: (714) 433-6481

WELL PERMIT NUMBER 20-02-09

Permit expires on 02.11.2021

CITY Newport Beach
DATE 1/31/20

WELL LOCATION (ADDRESS IF AVAILABLE) 3100 Irvine Avenue, Newport Beach, CA

NAME OF WELL OWNER Brett Feuerstein

ADDRESS 8294 Mira Mesa Blvd

CITY San Diego, CA 92126 ZIP TELEPHONE (858) 271-4682

NAME OF CONSULTING FIRM Moore Twining & Associates, Inc

BUSINESS ADDRESS 2527 Fresno Street

CITY Fresno ZIP 93721 TELEPHONE 559-268-7021

NAME OF DRILLING CO. Pacific Drilling Co. C-57 LICENSE NO. 681380

CITY San Diego ZIP 92110 TELEPHONE 619-294-3682

TYPE OF WELL (CHECK)

- ☐ PRIVATE DOMESTIC
- ☐ PUBLIC DOMESTIC
- ☐ IRRIGATION
- ☐ CATHODIC
- ☐ PROBE SURVEY
- ☒ MONITORING
- ☐ SOIL BORING
- ☐ OTHER ____

TOTAL NUMBER 6

A. WELLS – SUBMIT A WELL CONSTRUCTION DIAGRAM (INCLUDE DIMENSIONS)

B. SOIL BORINGS AND PROBES –
TOTAL DEPTH depths range from 30' to 55'
SEALING MATERIAL Bentonite & Concrete

C. PROPOSED START DATE 2/24

DIAGRAM OF WELL SITE (Use additional sheets and/or attachments)

See attached

☒ SITE PLAN ATTACHED

I hereby agree to comply in every respect with all requirements of the Health Care Agency and with all ordinances and laws of the County of Orange and of the State of California pertaining to well construction, reconstruction and destruction, including the requirements to maintain the integrity of all significant confining zones.

APPLICANT'S SIGNATURE [signature] DATE 2/3/20

PRINT NAME Zubair Anwar

PHONE NUMBER 559-268-7021 x258 FAX NUMBER

FOR ACCOUNTING USE ONLY:

HSO NO. 402986 CHECK NO. 60605 02/04/20

DATE 02/06/20 AMOUNT $1,175.00

INTL. SL

APPROVAL BY OTHER AGENCIES:

JURISDICTION ____

REMARKS ____

AUTHORIZED SIGNATURE ____ DATE ____

DISPOSITION OF PERMIT (DO NOT FILL IN):

☒ **APPROVED** SUBJECT TO THE FOLLOWING CONDITIONS:

A. NOTIFY THIS AGENCY AT LEAST **48 HOURS**

- ☒ PRIOR TO START. Notify of any changes.
- ☐ PRIOR TO SEALING THE ANNULAR SPACE OR FILLING OF THE CONDUCTOR CASING.

B. ☐ SUBMIT TO THE AGENCY WITHIN 30 DAYS AFTER COMPLETION OF WORK, A WELL COMPLETION REPORT AND/OR DRILLING LOGS. PLEASE REFERENCE PERMIT NO.

C. ☒ SECURE ALL MONITORING WELLS TO PREVENT TAMPERING.

D. ☒ OTHER Notify when all work is complete and include the depth to 1st water.

☐ **DENIED**

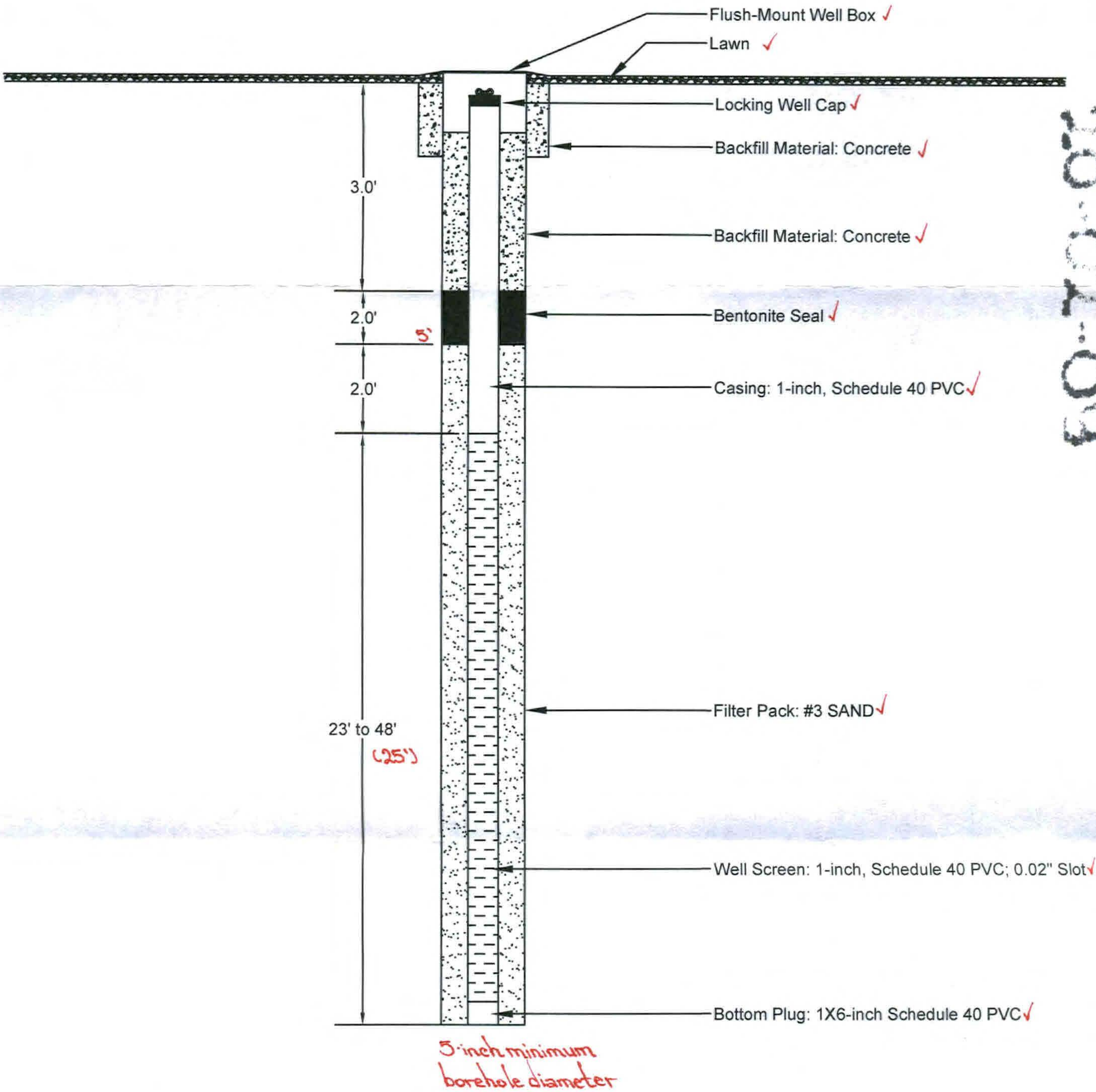
PERMIT ISSUED BY Juan Arzora [signature] DATE 02.10.2020

PRINT NAME Juan Arzora PHONE NUMBER 7144336287

WHEN SIGNED BY ORANGE COUNTY HEALTH CARE AGENCY REPRESENTATIVE, THIS APPLICATION IS A PERMIT.

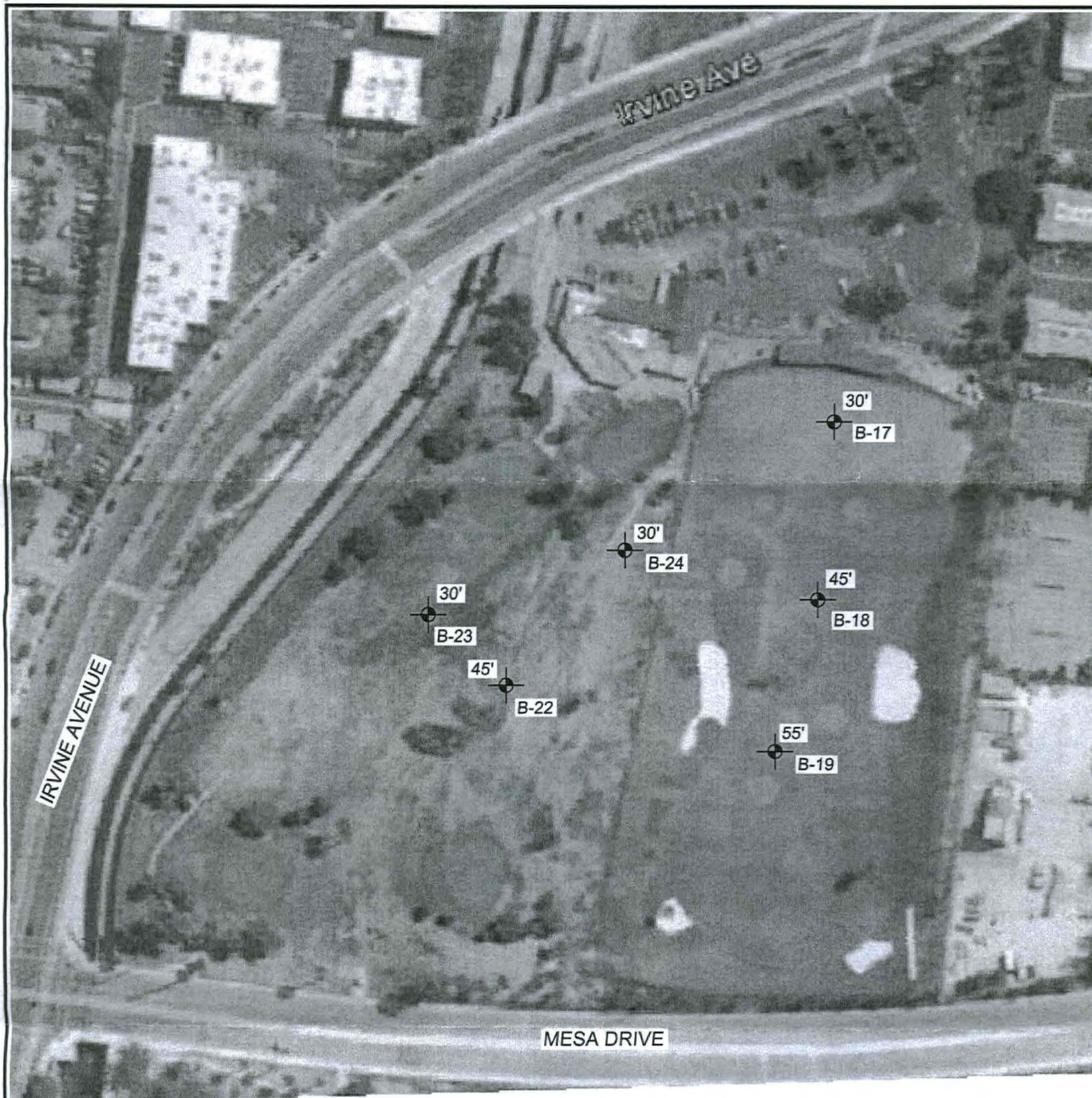
@.F272-09.0803 (R11/01)

GROUNDWATER MONITORING WELL



NOT TO SCALE

GROUNDWATER MONITORING WELL DIAGRAM 3100 IRVINE AVENUE NEWPORT BEACH, CALIFORNIA	FILE NO. 40550-01-01	DATE DRAWN: 1/31/20	MOORE TWINING ASSOCIATES, INC.
	DRAWN BY: RM	APPROVED BY:	
	PROJECT NO. E40550.01	DRAWING NO. 2	



PIEZOMETER WELL LOCATION

N

0 150

APPROXIMATE SCALE IN FEET

PROPOSED TEST BORING LOCATION MAP NEC OF MESA DRIVE AND IRVINE AVENUE NEWPORT BEACH, CALIFORINA	FILE NO. 40550-01-01	DATE DRAWN: 11/18/19	MOORE TWINING ASSOCIATES, INC.
	DRAWN BY: RM	APPROVED BY:	
	PROJECT NO. E40550.01	DRAWING NO. 1	

B45691

ORANGE COUNTY HEALTH CARE AGENCY
ENVIRONMENTAL HEALTH DIVISION
HEALTH SERVICE ORDER

Wells 402986

Date 2/6/20 Initials SL

Client Name Brett Feuerstein

Address 8294 Mira Mesa Blvd

San Diego, CA 92126 Ph#

Paid By Moore Twining Associates, Inc

Address 2527 Fresno Street

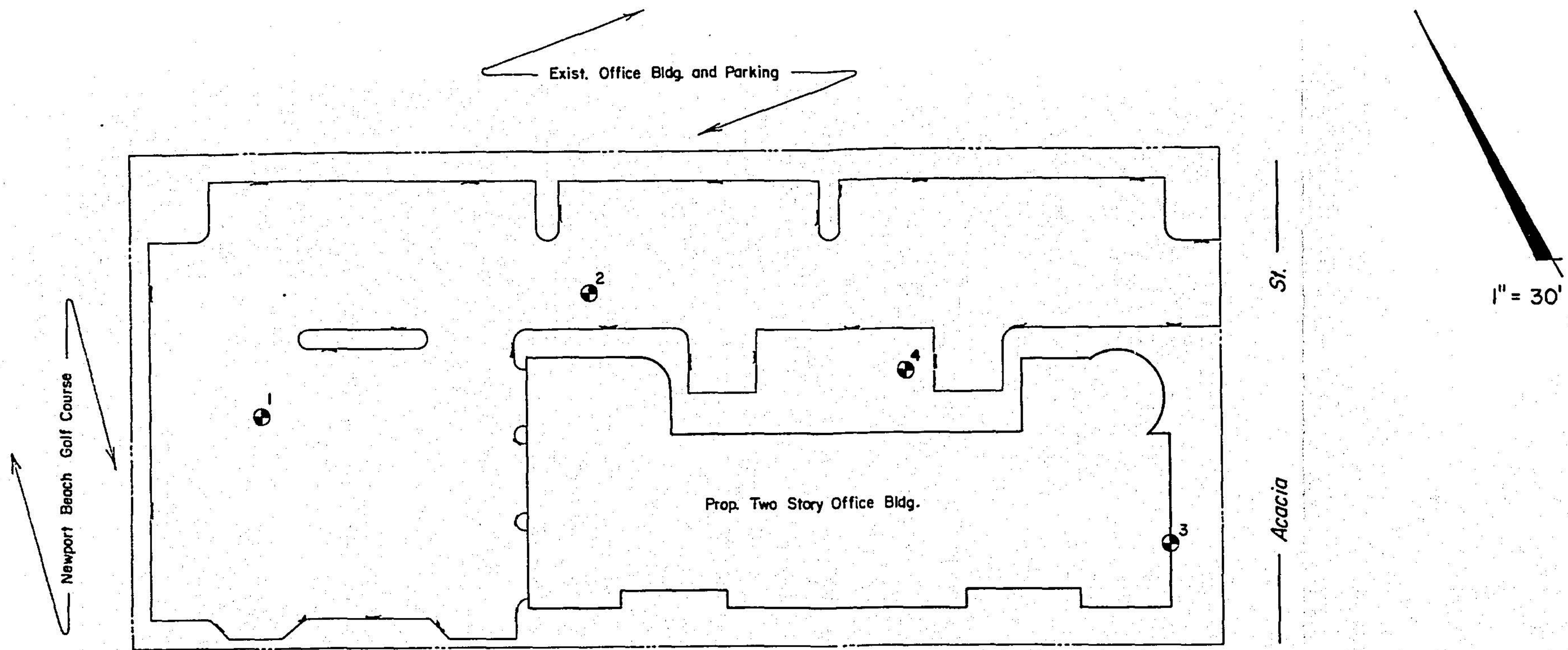
Fresno, CA 93721 Ph#

Please circle the respective service code(s)

01	CEQ/HSF (Acct/Bat#)	$
02	CEQ Plan Check/Foods (PC#)	$
03	CEQ Plan Check/Pools (PC#)	$
04	Food Vehicles Cat Decal No(s)	$
05	CEQ/Court Restitution/Judgment Name Case#	$
06	Hotels/Motels (Acct/Bat#)	$
07	Massage Parlor (Acct/Bat#)	$
08	Noise	$
09	Liquid Waste Hauler	$
10	Farm Labor Camp Registration	$
11	Aboveground Petroleum Storage Act	$
12	Hazardous Waste (Acct/Bat#)	$
13	Hazardous Waste Fines	$
14	Hazardous Waste Restitution/Judgment Name Case#	$
15	Hazardous Waste Clean-up	$
16	Medical Waste/Body Art)	$
17	UST/HSF (Acct/Bat#)	$
18	UST Plan Check (PC#)	$
19	UST State Surcharge	$
20	UST Restitution/Judgment Name Case#	$
21	Wells (Const X Recon Destr) Water Cath Init. Monit.) Add. Monit. #Wells Driller Consultant	$ 1,175.00
22	Backflow/Cross Connection Client(s)	$
23	Small Water Systems	$
24	CUPA - Base Fee	$
25	CUPA - CalArp	$
26	FOG- OC Sanitation District	$
27	Tierred Permitting	$
__	**OTHER**	$
__	**OTHER**	$
__	**OTHER**	$
__	**OTHER**	$

PAID BY CHECK NO: 60605

dated: 02/04/20



Test Borings - Approx.

PLOT PLAN

BACA ASSOCIATES
Project: A-0675-F
Plate: B

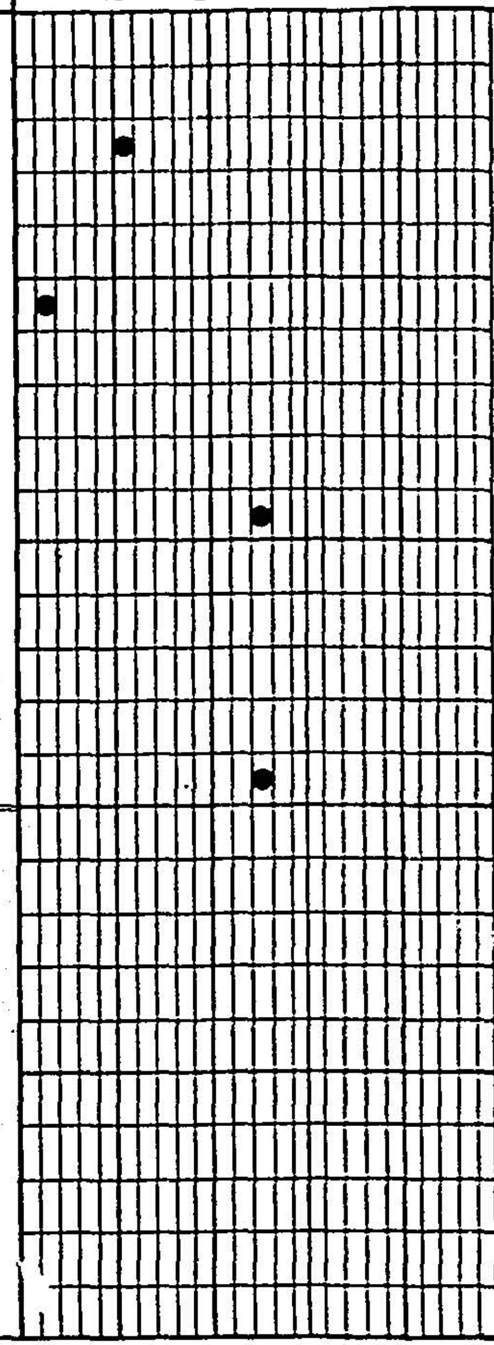
LOG OF BORING Nº 1 BB-1

DATE DRILLED 8/5/89	DRILLING EQUIPMENT Hollow-Stem Flight Auger
DRIVING WEIGHT 140 lbs. - 30" drop	SURFACE ELEVATION

Depth in Feet	Samples	Blows per foot	SOILS CLASSIFICATION (landscape area)	COLOR	MOISTURE	CONSISTENCY	DRY UNIT WEIGHT LB. PER CU. FT.
			SAND, fine to medium, variable clayey to sl. clayey, scat. gravels	brown	moist	mod. comp.	
	●	34					109
5					damp to dry		
	●	22					104
			CLAY, very silty, numerous veins and lenses of fine sand and silty sand	gray and gray brown	very moist	firm	
	●	28					85
10							
	●	29					93
15			End @ 15.0 ft.				
			Notes: (1) No ground water				
20							
25							

SHEAR RESISTANCE @ ANTICIPATED PRESSURE - KIPS PER SQUARE FOOT
▲ 1 2 3 4 5

MOISTURE CONTENT - % DRY WEIGHT
● 10 20 30 40 50



Acacia Plaza III
Santa Ana Heights, California

PROJECT No.	A-0675-F
PLATE	C

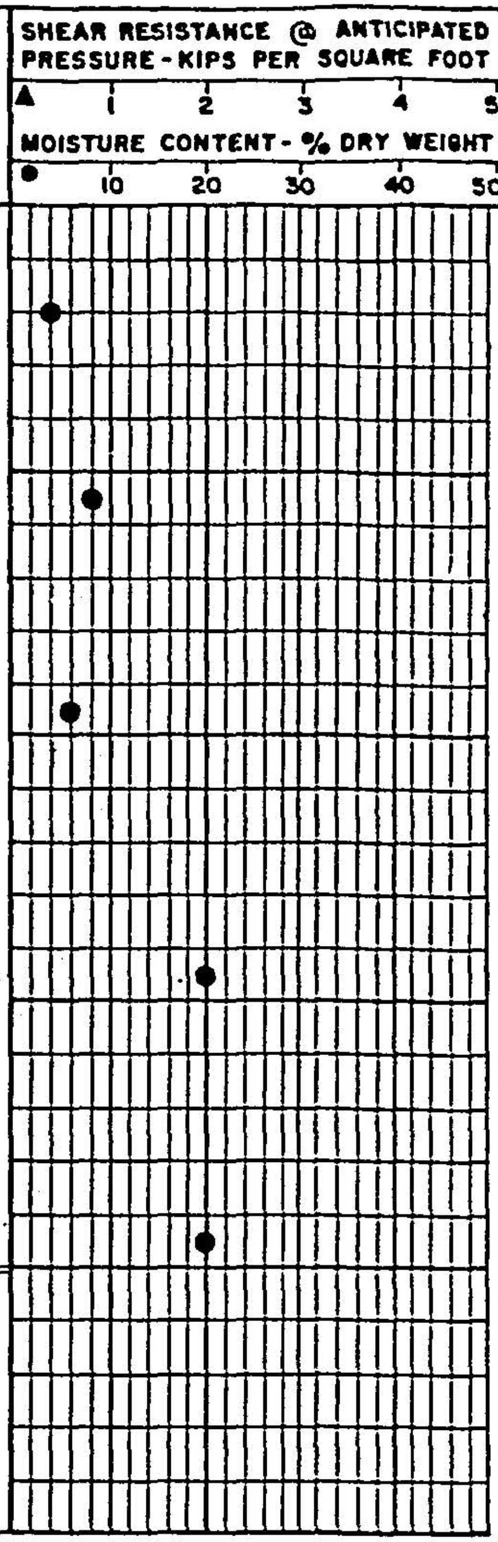
BACA ASSOCIATES
CONSULTING FOUNDATION ENGINEERS & ENGINEERING GEOLOGISTS

LOG OF BORING Nº 2 BB-2

DATE DRILLED 8/5/89 | **DRILLING EQUIPMENT** Hollow-Stem Flight Auger

DRIVING WEIGHT 140 lbs. - 30" drop | **SURFACE ELEVATION**

Depth in Feet	Samples	Blows per foot	SOILS CLASSIFICATION	COLOR	MOISTURE	CONSISTENCY	DRY UNIT WEIGHT LB. PER CU. FT.
			SAND, fine to medium, variable clayey to sl. clayey, scat. gravels	light brown	dry	loose	
	■	36			sl. moist	mod. comp.	118
				brown			
5							
	■	34					110
			fine to medium, silty to slight silty			comp.	
	■	88					118
10							
			CLAY, silty, numerous veins and lenses of sand and silty sand	gray with red brown stains	very moist	firm to stiff	
	■	55					97
15							
	■	25					102
20			End @ 20.0 ft.				
			Notes: (1) No ground water				
25							



Acacia Plaza III
Santa Ana Heights, California

PROJECT No. A-0675-F

PLATE D

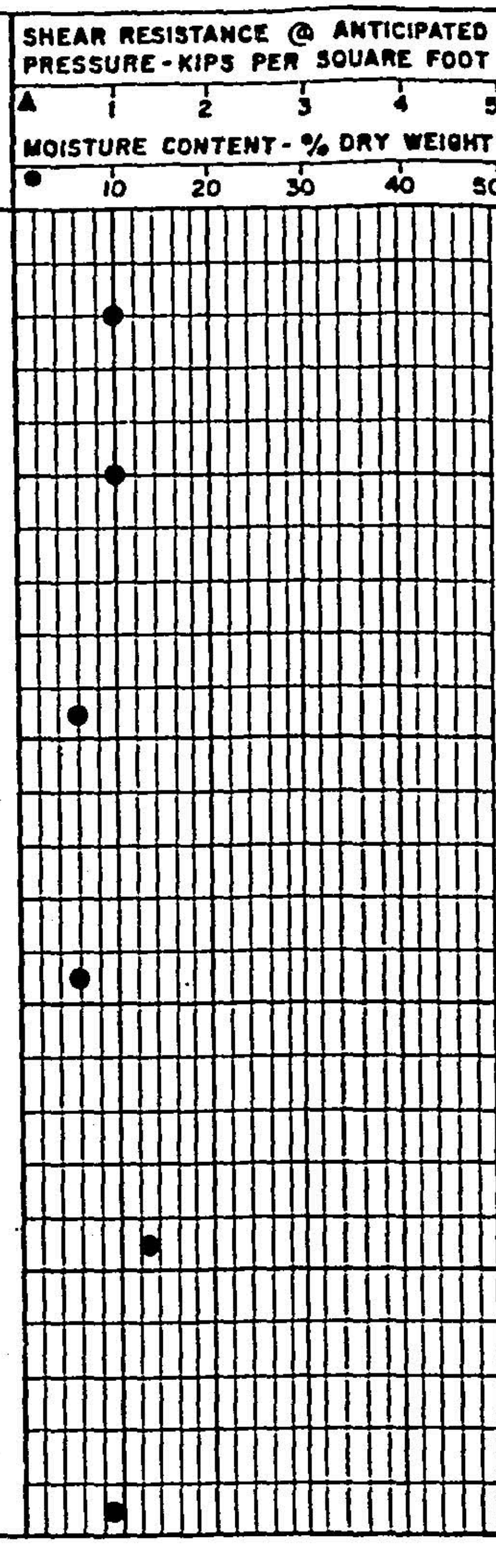
BACA ASSOCIATES
CONSULTING FOUNDATION ENGINEERS & ENGINEERING GEOLOGISTS

LOG OF BORING Nº 3 BB-3

DATE DRILLED 3/5/89 | DRILLING EQUIPMENT Hollow-Stem Flight Auger

DRIVING WEIGHT 140 lbs. - 30" drop | SURFACE ELEVATION

Depth in Feet	Samples	Blows per foot	SOILS CLASSIFICATION	COLOR	MOISTURE	CONSISTENCY	DRY UNIT WEIGHT LB. PER CU. FT.
			SAND, fine to medium, silty, sl. clayey, scat. gravels	brown	moist	comp.	
	●	46					116
			fine to coarse, sl. clay binder, variable scat. to moderate gravels			mod. comp. to comp.	
5	●	28					116
					sl. moist		
	●	20					109
10							
	●	28					108
15							
			fine to medium, clean, occasional clay/silt veins	tan with pale gray veins	moist	dense	
	●	67					103
20							
	●	66					101
25							



End @ 25.0 ft.

Notes: (1) No ground water

Acacia Plaza III
Santa Ana Heights, California

PROJECT No.	A-0675-F
PLATE	E

BACA ASSOCIATES
CONSULTING FOUNDATION ENGINEERS & ENGINEERING GEOLOGISTS

LOG OF BORING Nº4 BB-4

DATE DRILLED 8/5/89 | **DRILLING EQUIPMENT** Hollow-Stem Flight Auger

DRIVING WEIGHT 140 lbs. - 30" drop | **SURFACE ELEVATION**

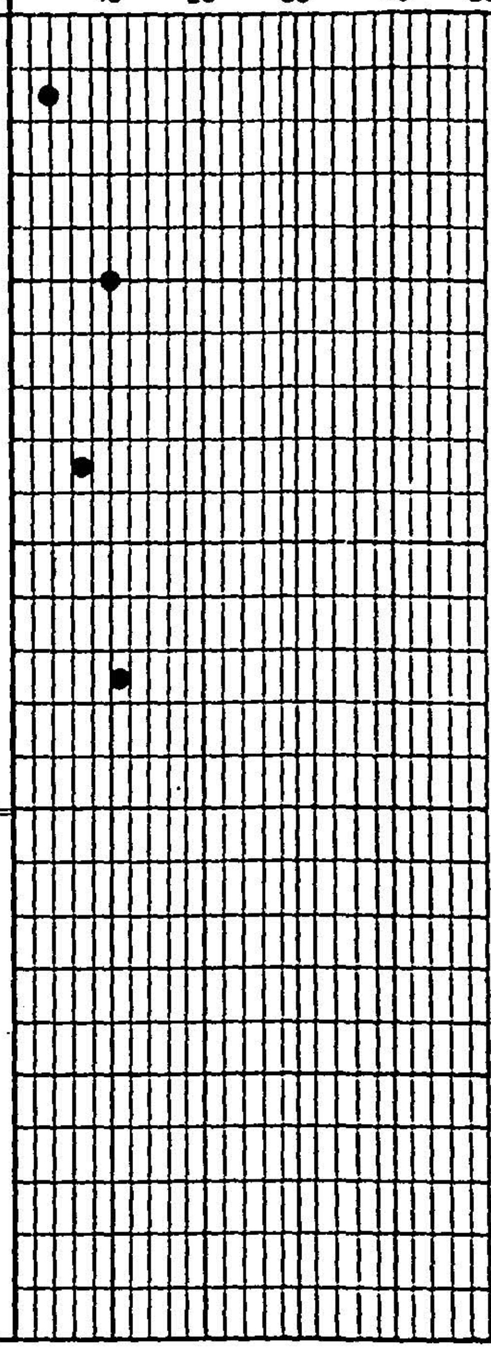
Depth in Feet	Samples	Blows per foot	SOILS CLASSIFICATION	COLOR	MOISTURE	CONSISTENCY	DRY UNIT WEIGHT LB. PER CU.FT.
			SAND, fine to medium, silty, variable	brown	dry	loose	
	■	20	clayey to sl. clayey, scat. gravels		sl. moist	mod. comp.	109
					moist	comp.	
5	■	38					115
			medium to coarse, variable sl. clay	red brown	sl. moist		
	■	52	binder to clean, heavy gravels				111
10							
			very fine to fine, sl. silty, with	pale gray brown	moist		
	■	35	minor silt veins				101
15			End @ 15.0 ft.				
			Notes: (1) No ground water				
20							
25							

SHEAR RESISTANCE @ ANTICIPATED PRESSURE - KIPS PER SQUARE FOOT

▲ 1 2 3 4 5

MOISTURE CONTENT - % DRY WEIGHT

● 10 20 30 40 50



Acacia Plaza III
Santa Ana Heights, California

PROJECT No. A-0675-F

PLATE F

BACA ASSOCIATES
CONSULTING FOUNDATION ENGINEERS & ENGINEERING GEOLOGISTS

APPENDIX C

LABORATORY TESTS

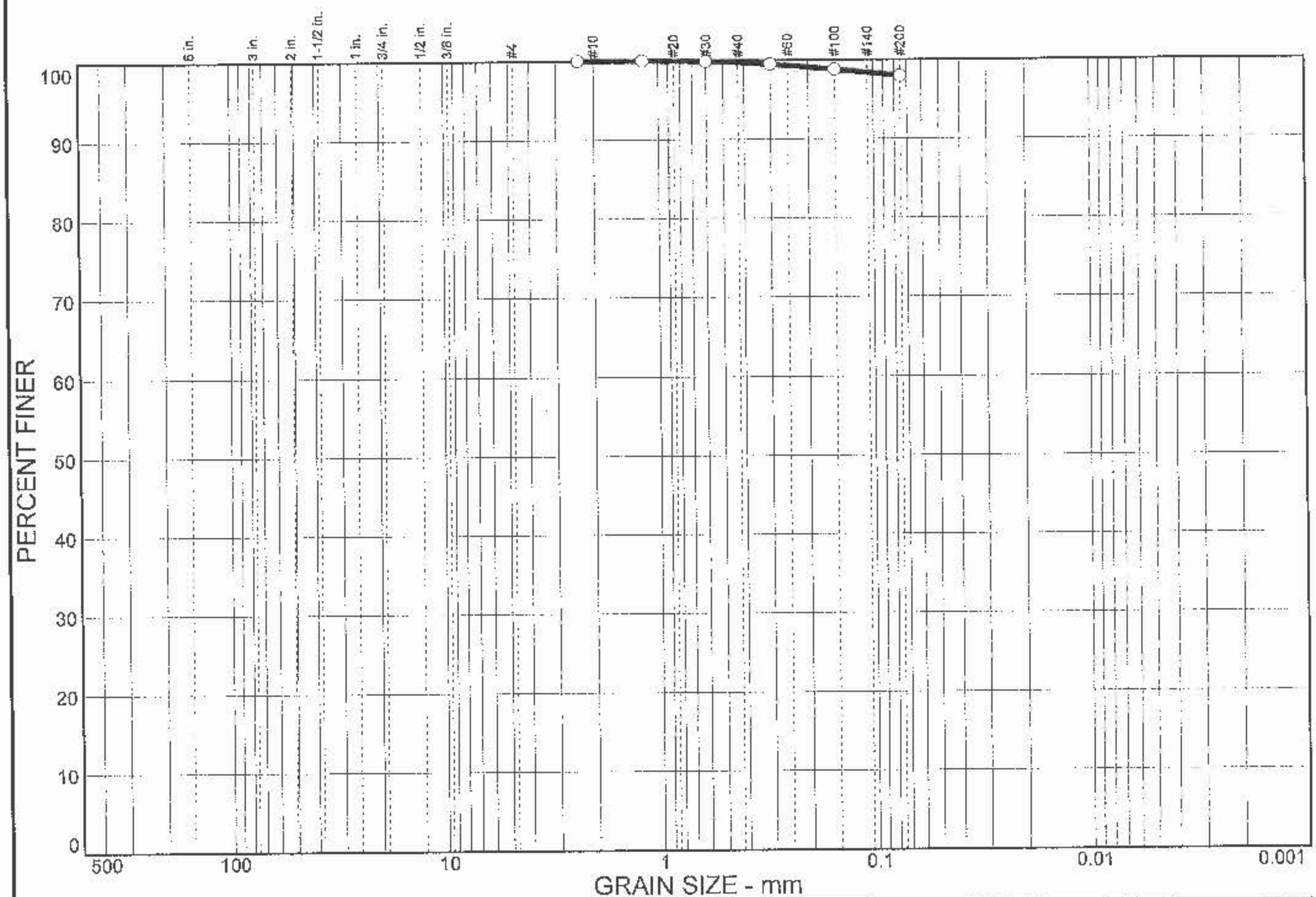
APPENDIX C

RESULTS OF LABORATORY TESTS

This appendix contains the individual results of the following tests. The results of the moisture content and dry density tests are included on the test boring logs in Appendix B. These data, along with the field observations, were used to prepare the final test boring logs in Appendix B.

These Included:	**To Determine:**
Moisture Content (ASTM D2216)	Moisture contents representative of field conditions at the time the sample was taken.
Density Determination (ASTM D2216)	Dry unit weight of sample representative of in-situ or in-place undisturbed condition.
Grain-Size Distribution (ASTM D422)	Size and distribution of soil particles, i.e., sand, gravel and fines (silt and clay).
Atterberg Limits (ASTM D4318)	Determines the moisture content where the soil behaves as a viscous material (liquid limit) and the moisture content at which the soil reaches a plastic state
Expansion Index (ASTM D4829)	Swell potential of soil with increases in moisture content.
Consolidation (ASTM 2435)	The amount and rate at which a soil sample compresses when loaded, and the influence of saturation on its behavior.
Direct Shear (ASTM D3080)	Soil shearing strength under varying loads and/or moisture conditions.
R-Value (CTM 301)	The capacity of a subgrade or subbase to support a pavement section designed to carry a specified traffic load.
Moisture-Density Relationship (ASTM D1557)	The optimum (best) moisture content for compacting soil and the maximum dry unit weight (density) for a given compactive effort.
Sulfate Content (ASTM D4327)	Percentage of water-soluble sulfate as (SO4) in soil samples. Used as an indication of the relative degree of sulfate attack on concrete and for selecting the cement type.
Chloride Content (ASTM D4327)	Percentage of soluble chloride in soil. Used to evaluate the potential attack on encased reinforcing steel.
Resistivity (ASTM D1125)	The potential of the soil to corrode metal.
pH (ASTM D4972)	The acidity or alkalinity of subgrade material.

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	2.0	98.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#8	100.0		
#16	100.0		
#30	99.9		
#50	99.5		
#100	98.8		
#200	98.0		

* (no specification provided)

Material Description

Lean clay

Atterberg Limits

PL= 23 LL= 40 PI= 17

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO=

Remarks

Sample No.: B-2 **Source of Sample:** **Date:** 7/29/19
Location: **Elev./Depth:** 60-61.5'

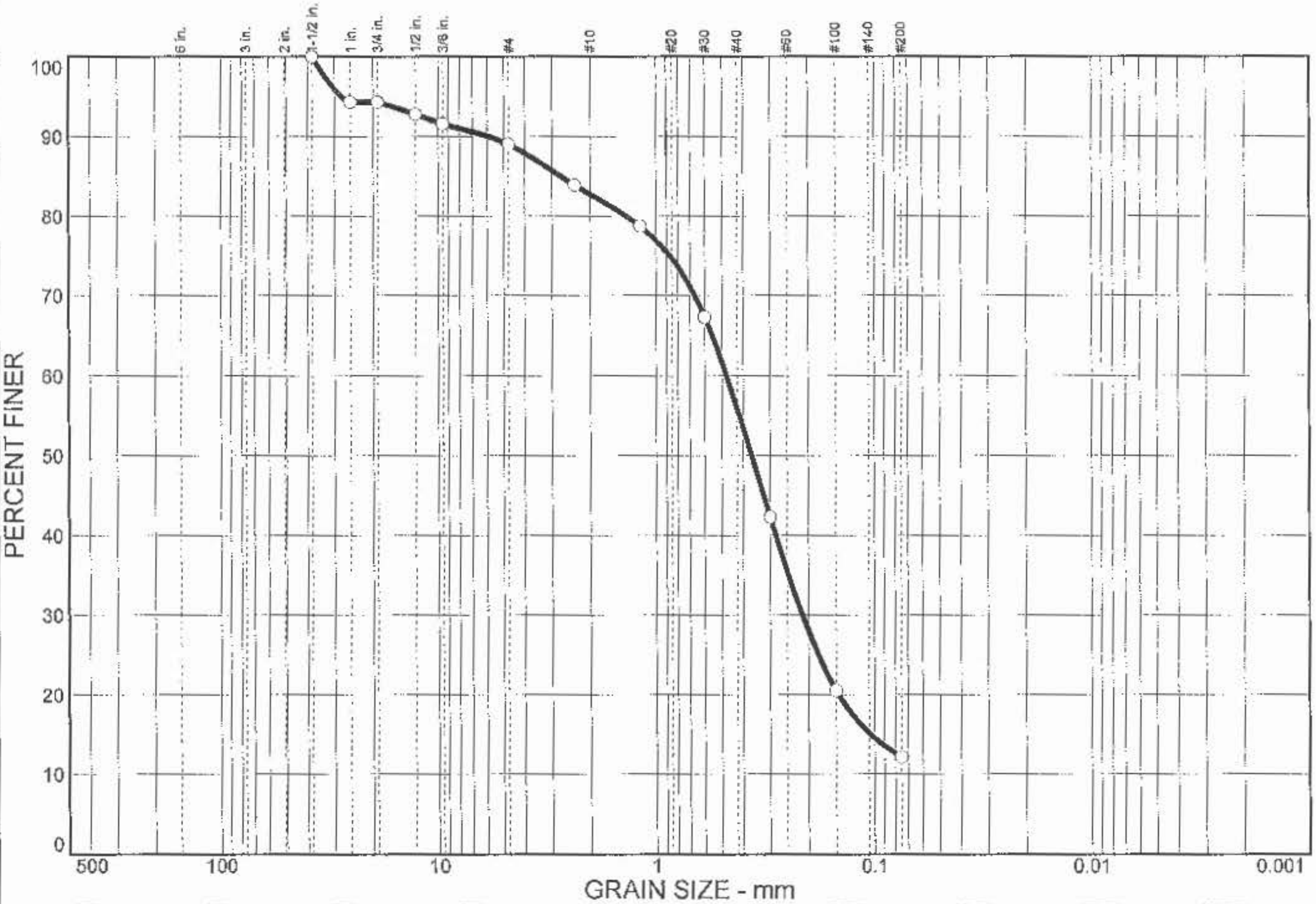
Moore Twining Associates, Inc.

Fresno, CA

Client:
Project: Proposed Drive Shack Restaurant & Golf Driving Range

Project No: E40550.01 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	11.0	76.9	12.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1-1/2 in.	100.0		
1 in.	94.3		
3/4 in.	94.3		
1/2 in.	92.8		
3/8 in.	91.6		
#4	89.0		
#8	83.9		
#16	78.7		
#30	67.3		
#50	42.3		
#100	20.5		
#200	12.1		

* (no specification provided)

Material Description

Silty sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 2.73 D_{60}= 0.477 D_{50}=
D_{30}= 0.213 D_{15}= 0.105 D_{10}=
C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

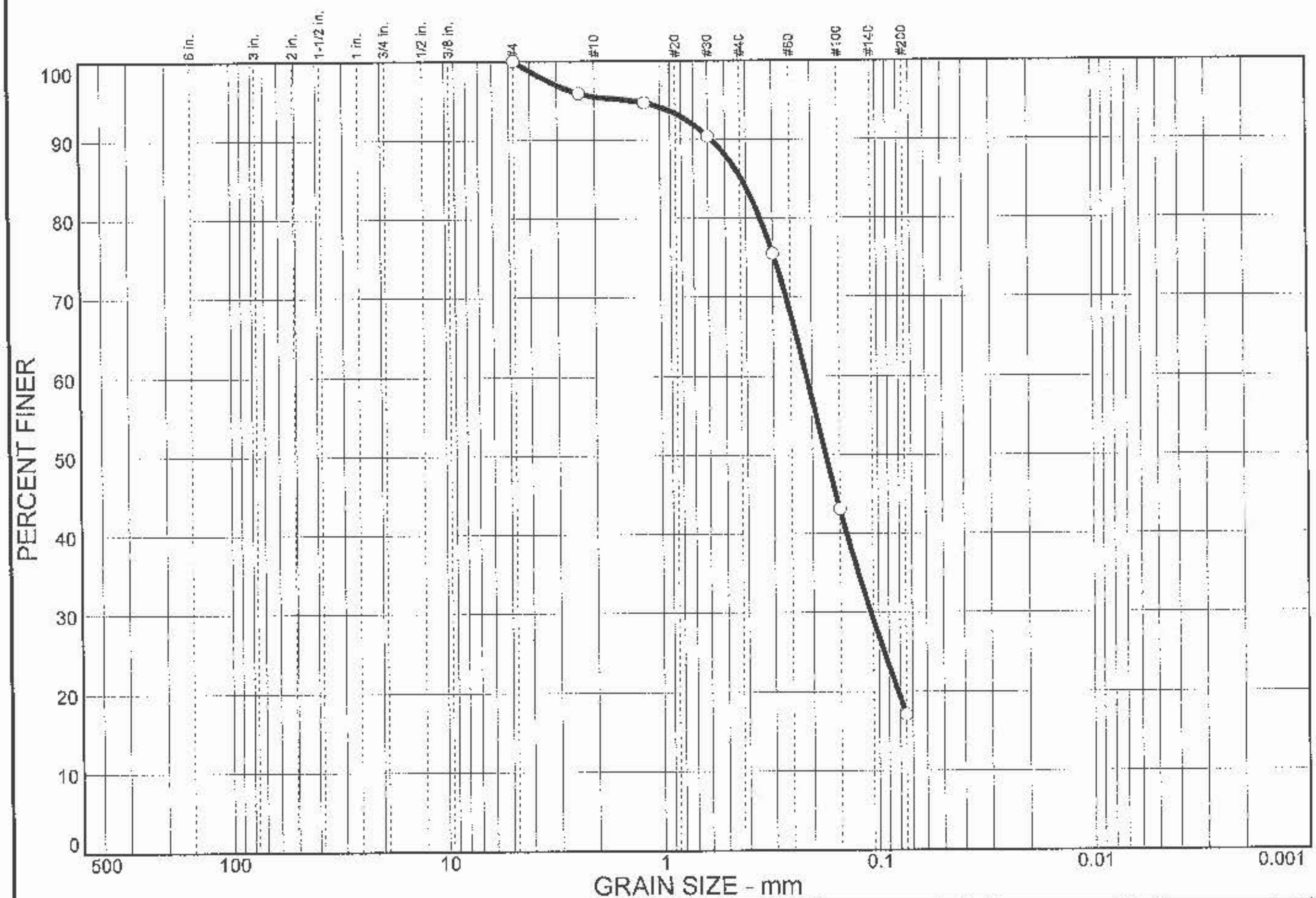
Sample No.: B-3 **Source of Sample:** **Date:** 7/22/19
Location: **Elev./Depth:** 25-26.5'

Moore Twining Associates, Inc.

Fresno, CA

Client:
Project: Proposed Drive Shack Restaurant & Golf Driving Range
Project No: E40550.01 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	82.9	17.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	95.9		
#16	94.7		
#30	90.4		
#50	75.5		
#100	43.1		
#200	17.1		

* (no specification provided)

Material Description

Silty sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 0.420 D_{60}= 0.212 D_{50}= 0.173
D_{30}= 0.109 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Sample No.: B-3 **Source of Sample:** **Date:** 7/22/19
Location: **Elev./Depth:** 30-31.5'

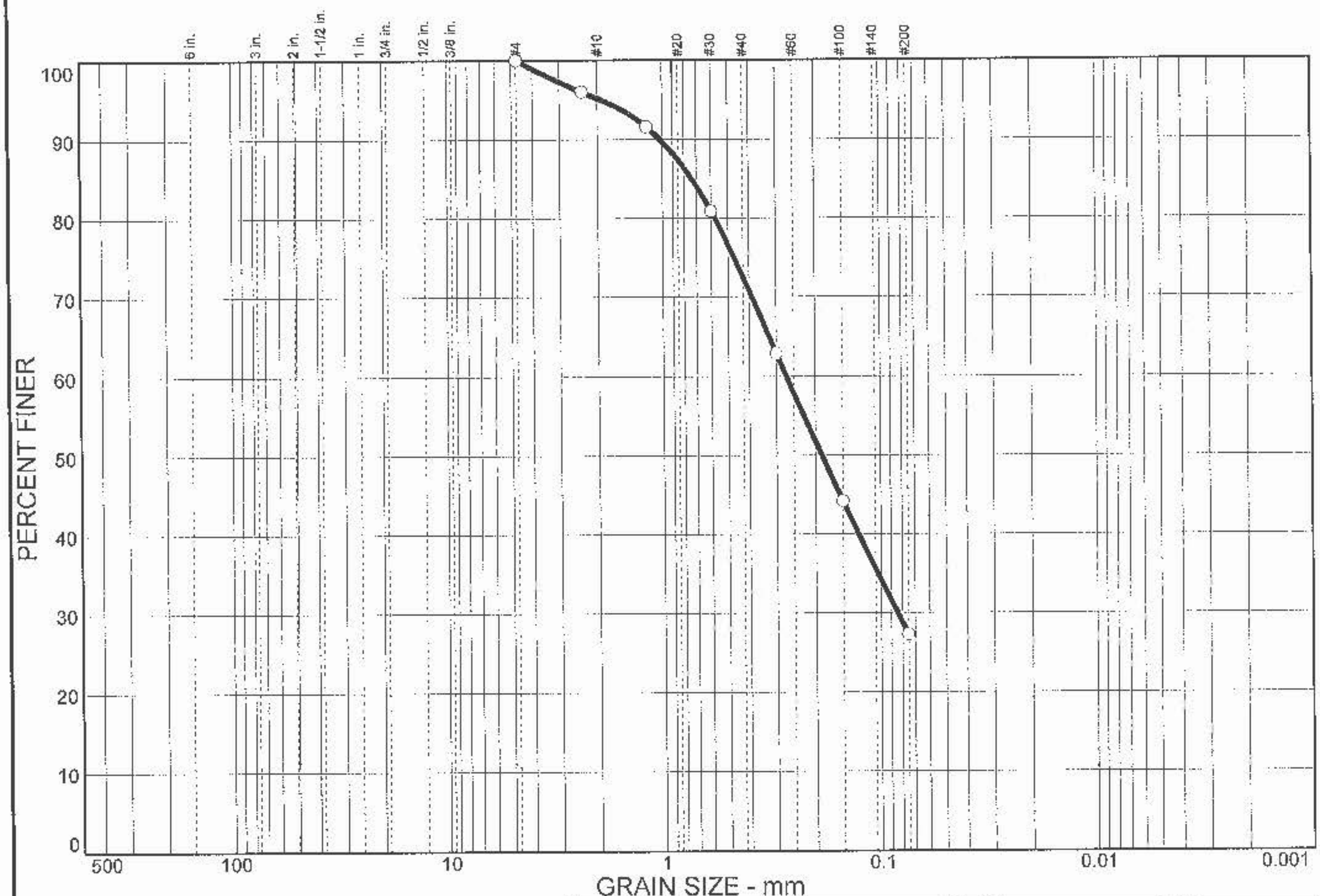
Moore Twining Associates, Inc.

Fresno, CA

Client:
Project: Proposed Drive Shack Restaurant & Golf Driving Range

Project No: E40550.01 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	72.7	27.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	96.0		
#16	91.6		
#30	80.9		
#50	62.9		
#100	44.2		
#200	27.3		

* (no specification provided)

Material Description

Silty sand

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{85}= 0.737 D_{60}= 0.270 D_{50}=
D_{30}= 0.0840 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

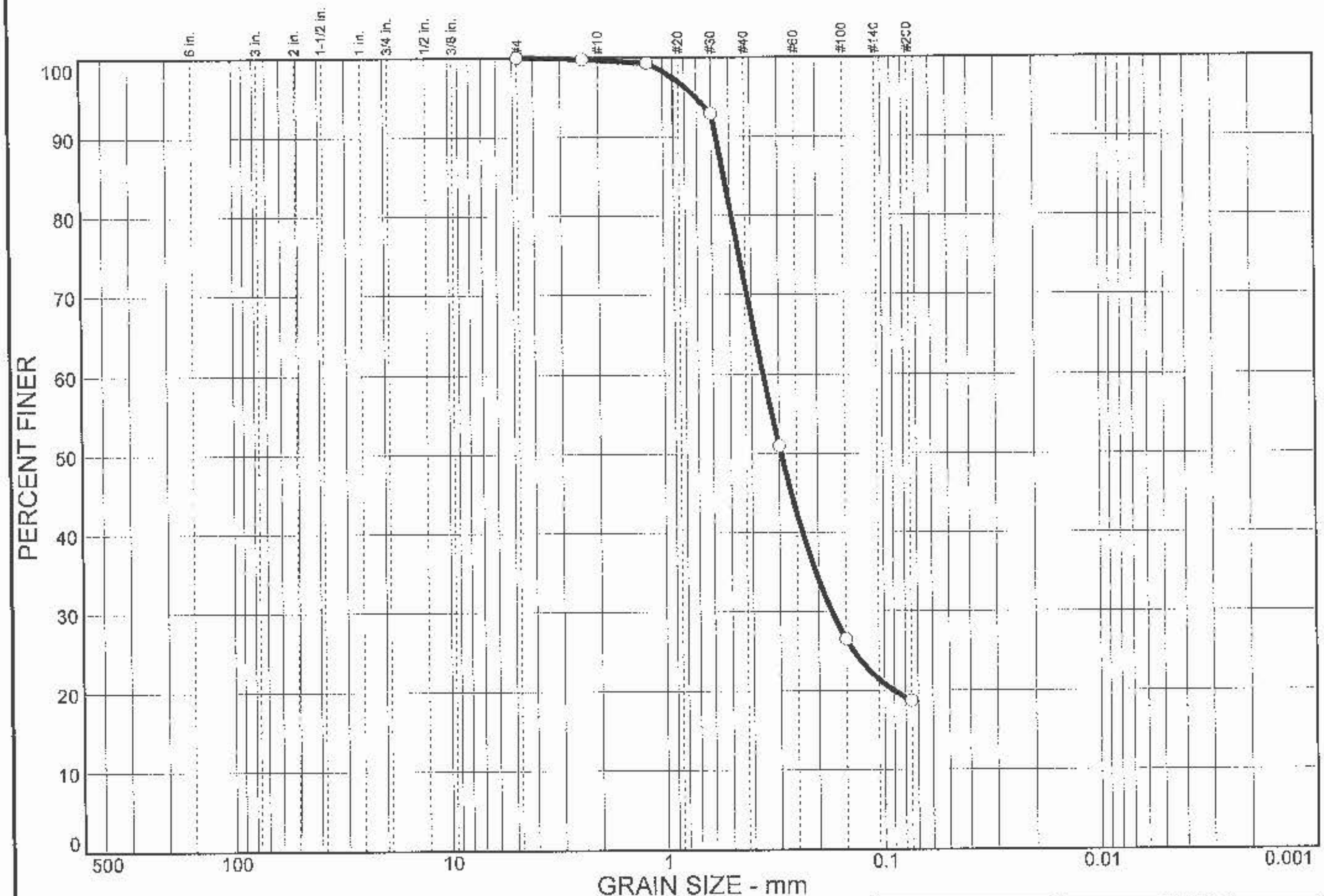
Sample No.: B-5 **Source of Sample:** **Date:** 7/22/19
Location: **Elev./Depth:** 18.5-20.0'

Moore Twining Associates, Inc.

Fresno, CA

Client:
Project: Proposed Drive Shack Restaurant & Golf Driving Range
Project No: E40550.01 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	81.3	18.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	99.8		
#16	99.3		
#30	92.9		
#50	51.0		
#100	26.5		
#200	18.7		

* (no specification provided)

Material Description

Silty sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 0.530 D_{60}= 0.354 D_{50}= 0.294
D_{30}= 0.174 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Sample No.: B-7 **Source of Sample:** **Date:** 7/29/19
Location: **Elev./Depth:** 15-16.5'

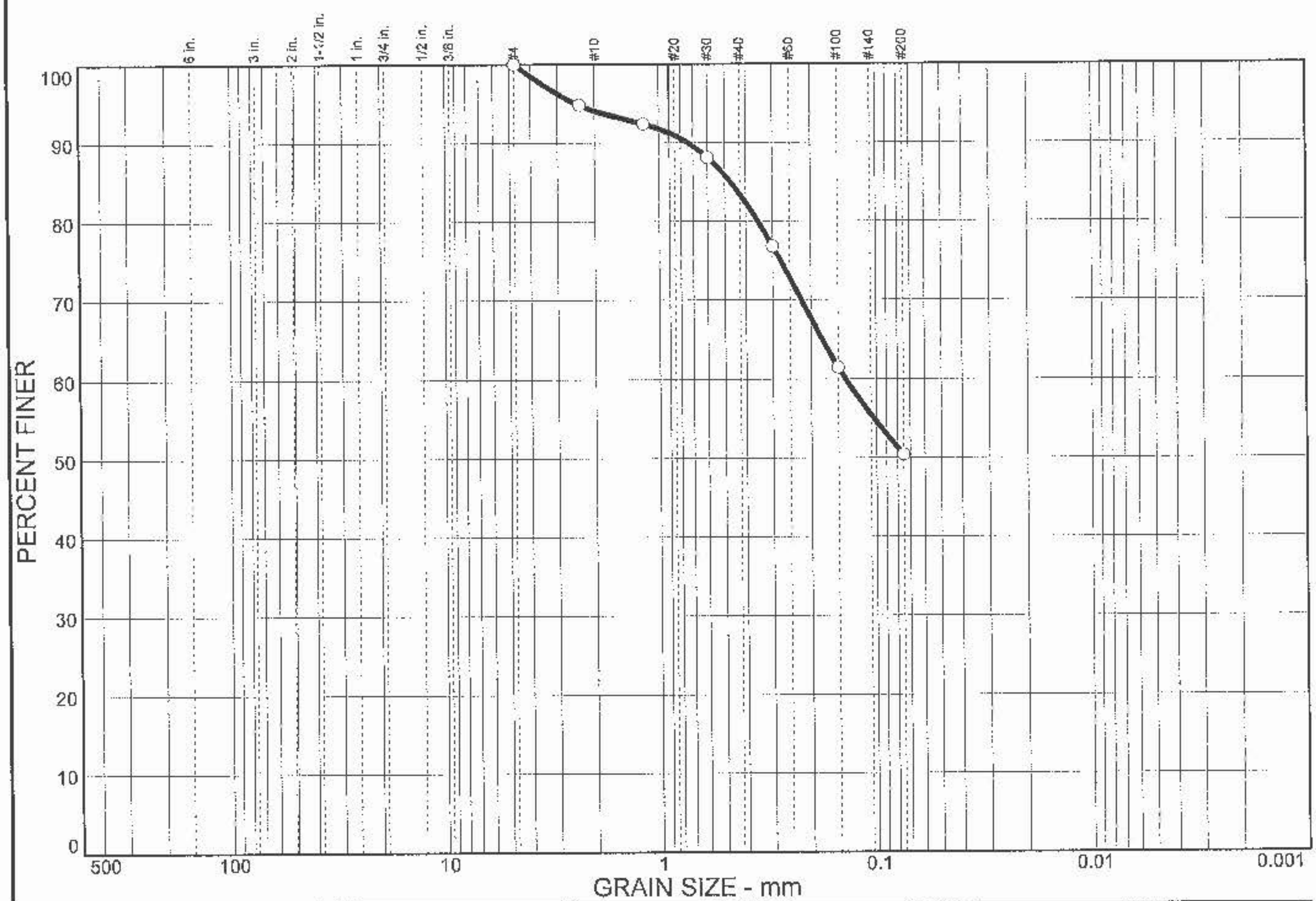
Moore Twining Associates, Inc.

Fresno, CA

Client:
Project: Proposed Drive Shack Restaurant & Golf Driving Range

Project No: E40550.01 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	49.6	50.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	94.8		
#16	92.4		
#30	88.1		
#50	76.8		
#100	61.5		
#200	50.4		

* (no specification provided)

Material Description

Sandy silt

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 0.472 D_{60}= 0.139 D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= ML AASHTO=

Remarks

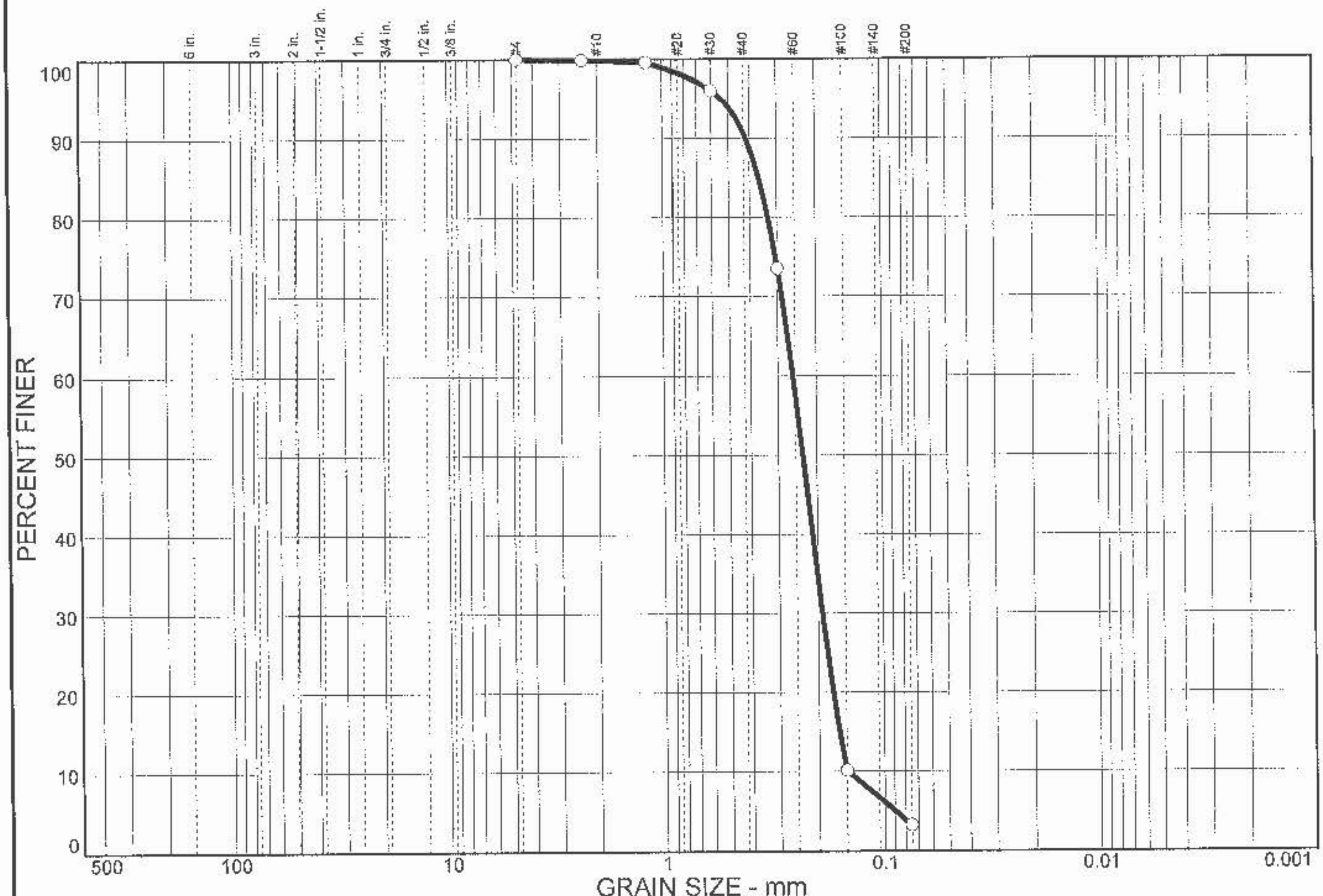
Sample No.: B-9 **Source of Sample:** **Date:** 7/29/19
Location: **Elev./Depth:** 5-6.5'

Moore Twining Associates, Inc.

Fresno, CA

Client:
Project: Proposed Drive Shack Restaurant & Golf Driving Range
Project No: E40550.01 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	96.8	3.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	99.9		
#16	99.6		
#30	96.0		
#50	73.5		
#100	10.1		
#200	3.2		

* (no specification provided)

Material Description

Poorly graded sand

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{85}= 0.364 D_{60}= 0.257 D_{50}= 0.232
D_{30}= 0.191 D_{15}= 0.161 D_{10}= 0.149
C_u= 1.73 C_c= 0.96

Classification

USCS= SP AASHTO=

Remarks

Sample No.: B-9 **Source of Sample:** **Date:** 7/29/19
Location: **Elev./Depth:** 15-16.5'

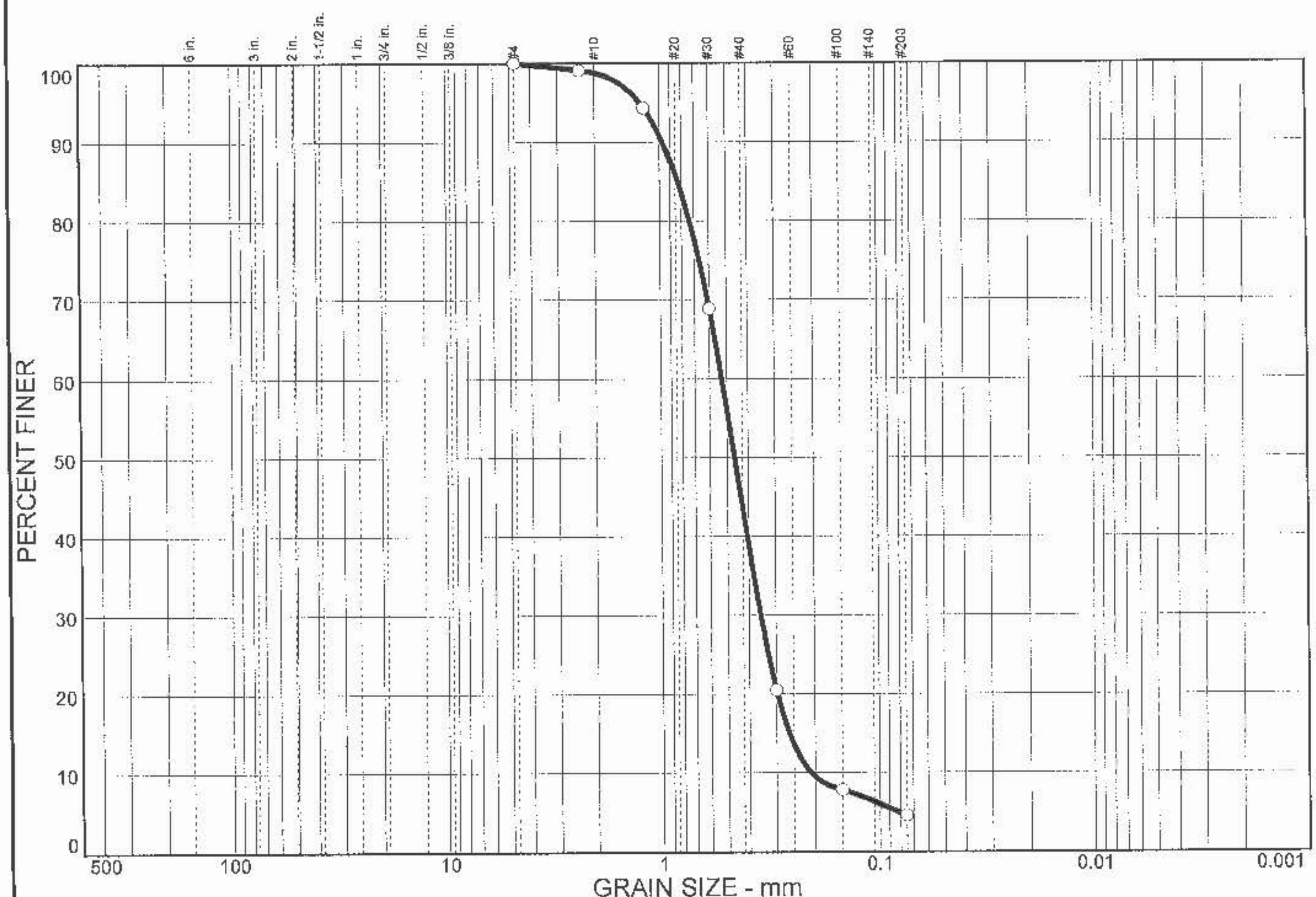
Moore Twining Associates, Inc.

Fresno, CA

Client:
Project: Proposed Drive Shack Restaurant & Golf Driving Range

Project No: E40550.01 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	95.5	4.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	99.1		
#16	94.3		
#30	68.9		
#50	20.5		
#100	7.8		
#200	4.5		

Material Description

Poorly graded sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 0.829 D_{60}= 0.527 D_{50}= 0.462
D_{30}= 0.353 D_{15}= 0.262 D_{10}= 0.209
C_u= 2.52 C_c= 1.13

Classification

USCS= SP AASHTO=

Remarks

* (no specification provided)

Sample No.: B-11 **Source of Sample:** **Date:** 7/15/19
Location: **Elev./Depth:** 20-21.5'

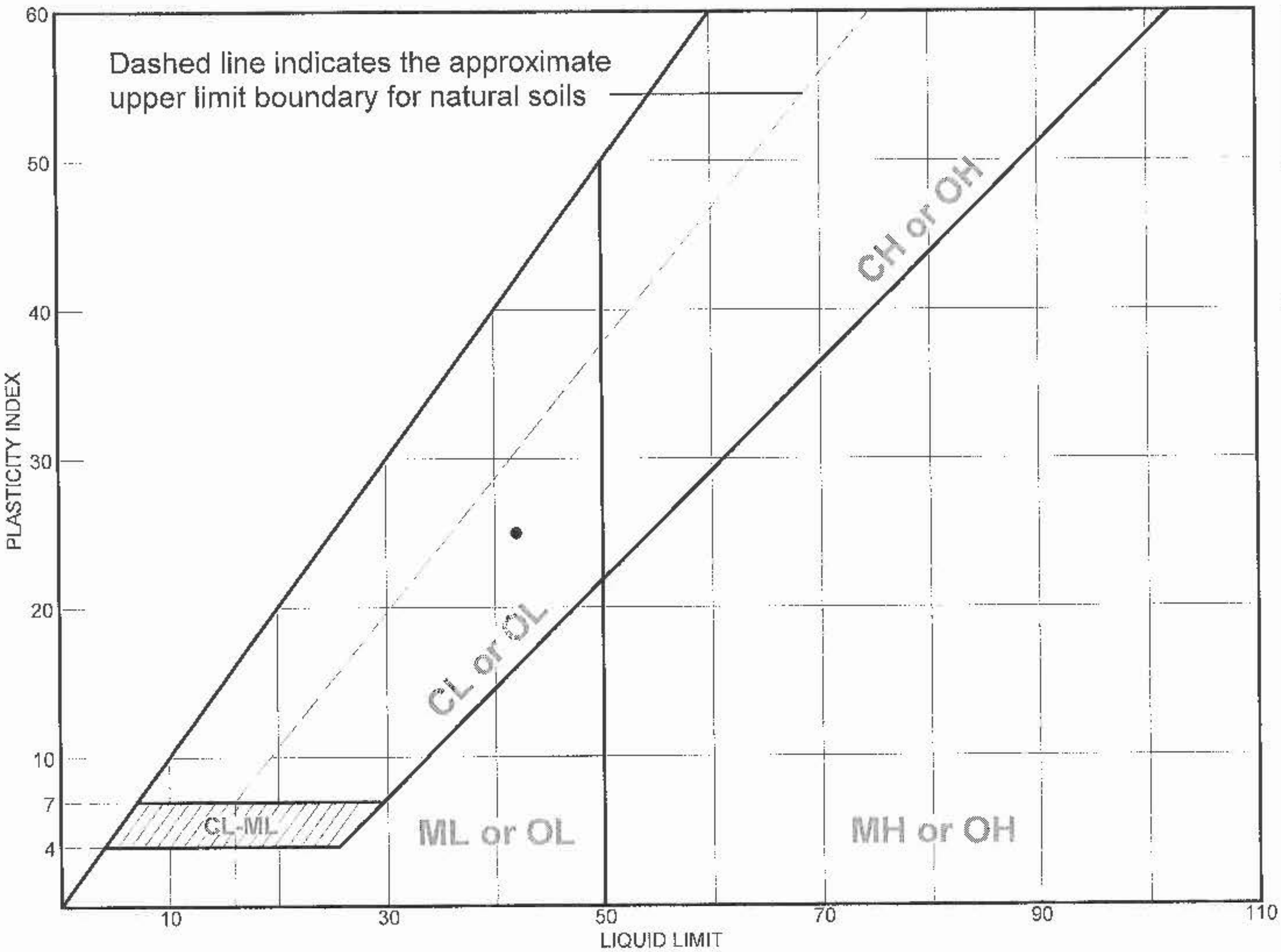
Moore Twining Associates, Inc.

Fresno, CA

Client:
Project: Proposed Drive Shack Restaurant & Golf Driving Range

Project No: E40550.01 **Figure**

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Sandy lean clay	42	17	25			CL

Project No. E40550.01 **Client:**

Project: Proposed Drive Shack Restaurant & Golf Driving Range

● **Source:** **Sample No.:** B-2 **Elev./Depth:** 35-36.5'

Moore Twining Associates, Inc.

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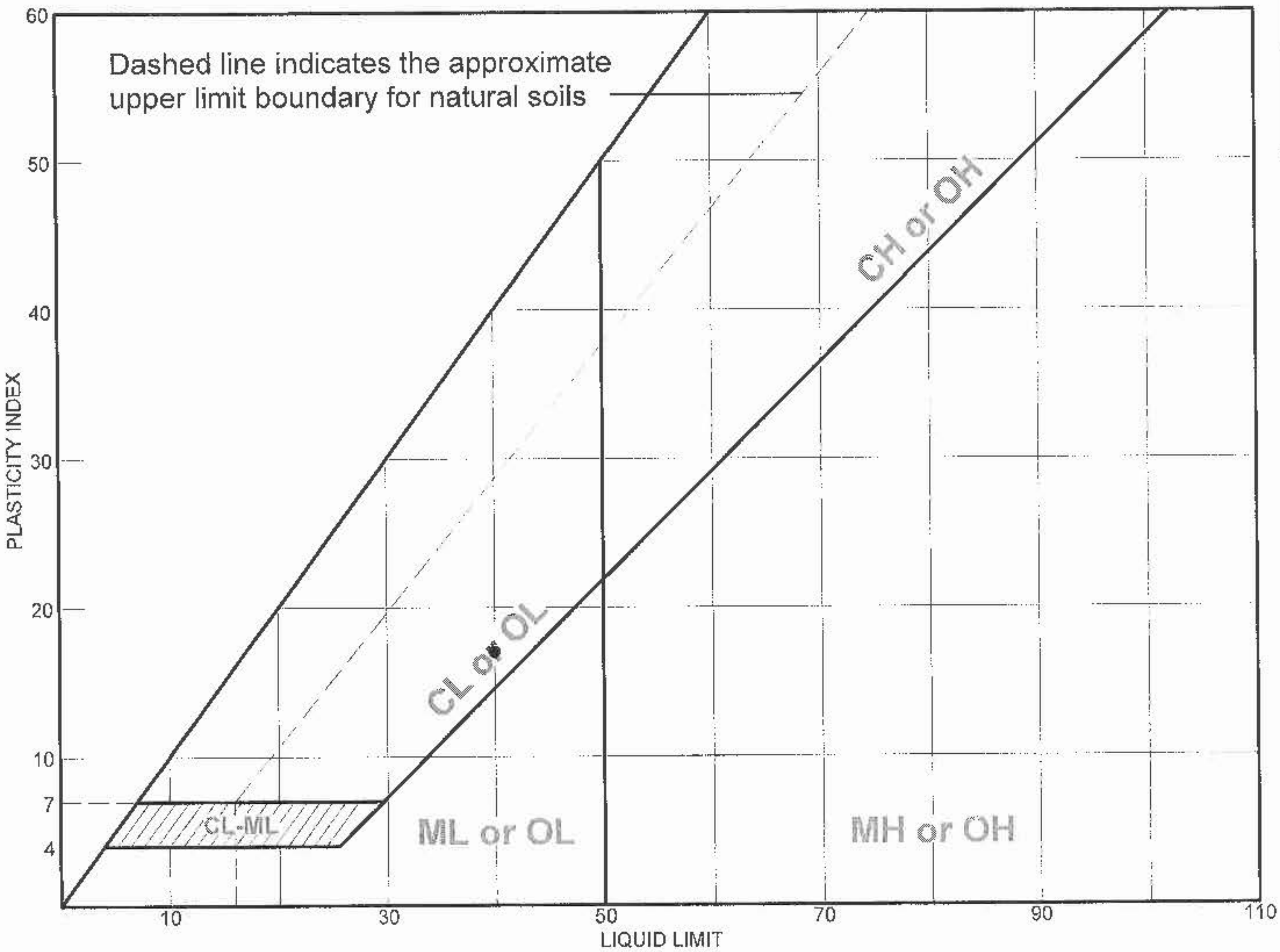
Remarks:

●

Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Lean clay	40	23	17	99.7	98.0	CL

Project No. E40550.01 **Client:**

Project: Proposed Drive Shack Restaurant & Golf Driving Range

● **Source:** **Sample No.:** B-2 **Elev./Depth:** 60-61.5'

Remarks:

●

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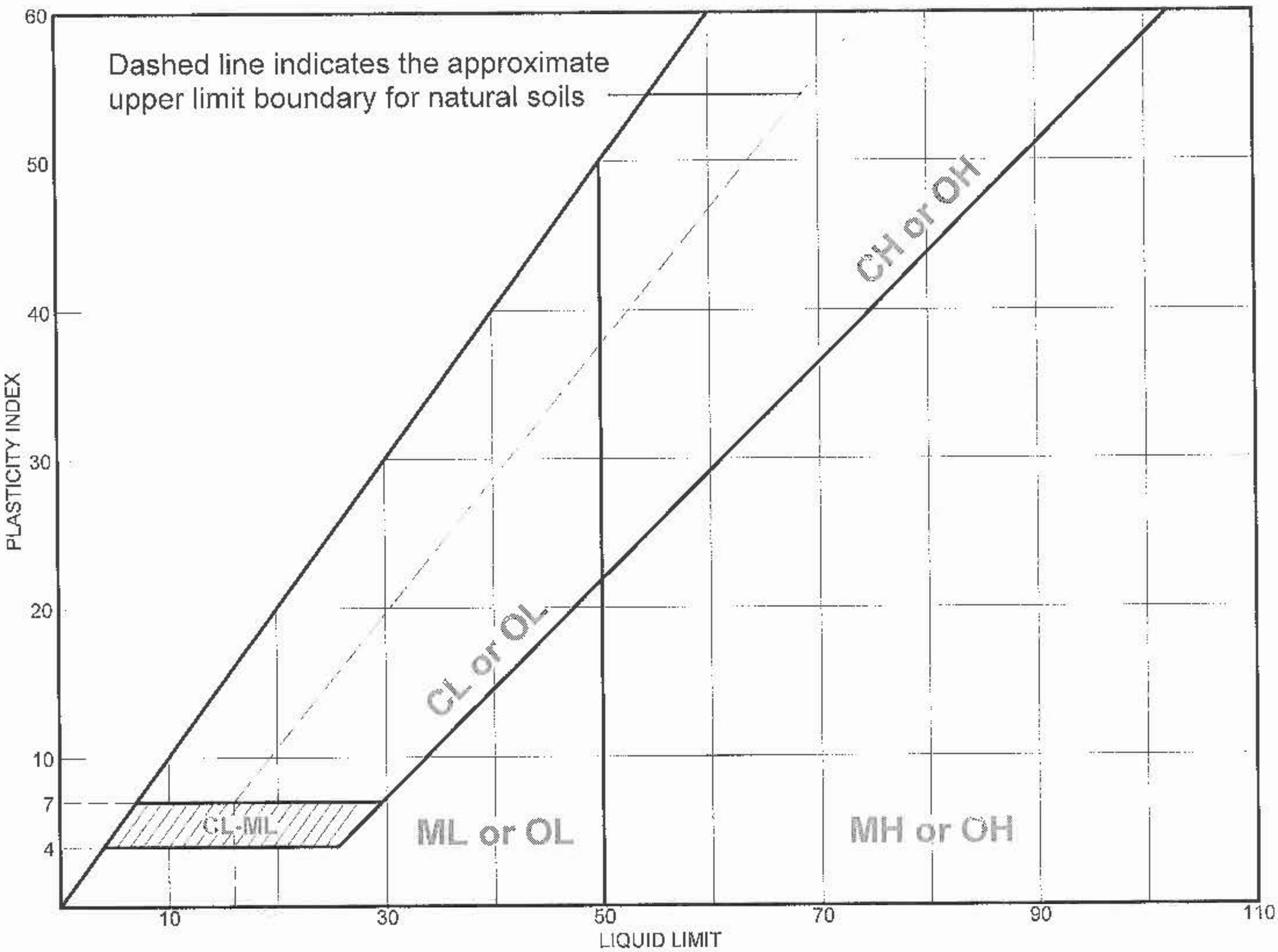
Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Silty sand	NV	NP	NP	72.5	27.3	SM

Project No. E40550.01 **Client:**

Project: Proposed Drive Shack Restaurant & Golf Driving Range

● **Source:** **Sample No.:** B-5 **Elev./Depth:** 18.5-20.0'

Remarks:

●

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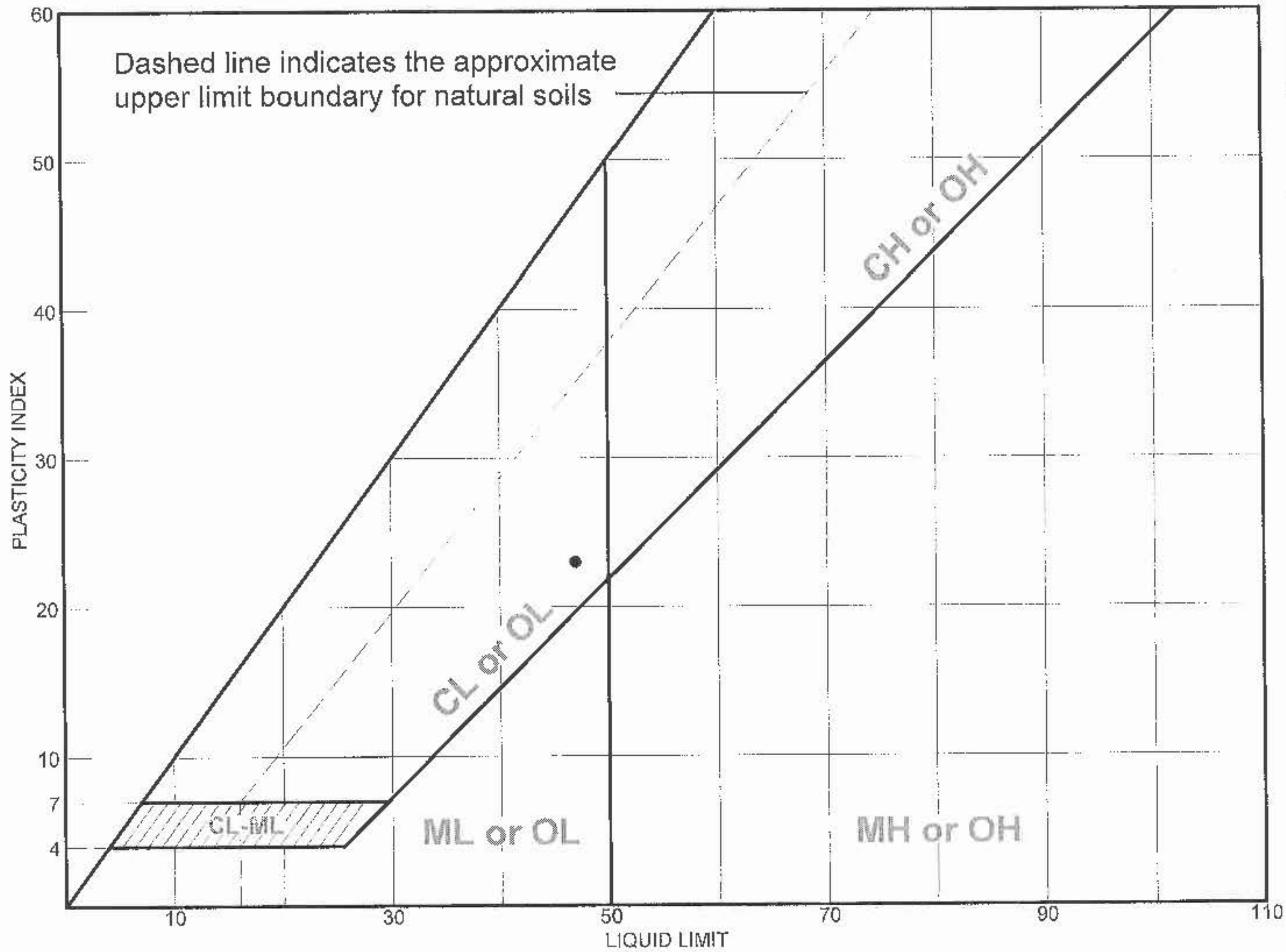
Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Lean clay	47	24	23			CL

Project No. E40550.01 **Client:**

Project: Proposed Drive Shack Restaurant & Golf Driving Range

● **Source:** **Sample No.:** B-7 **Elev./Depth:** 5-6.5'

Remarks:

●

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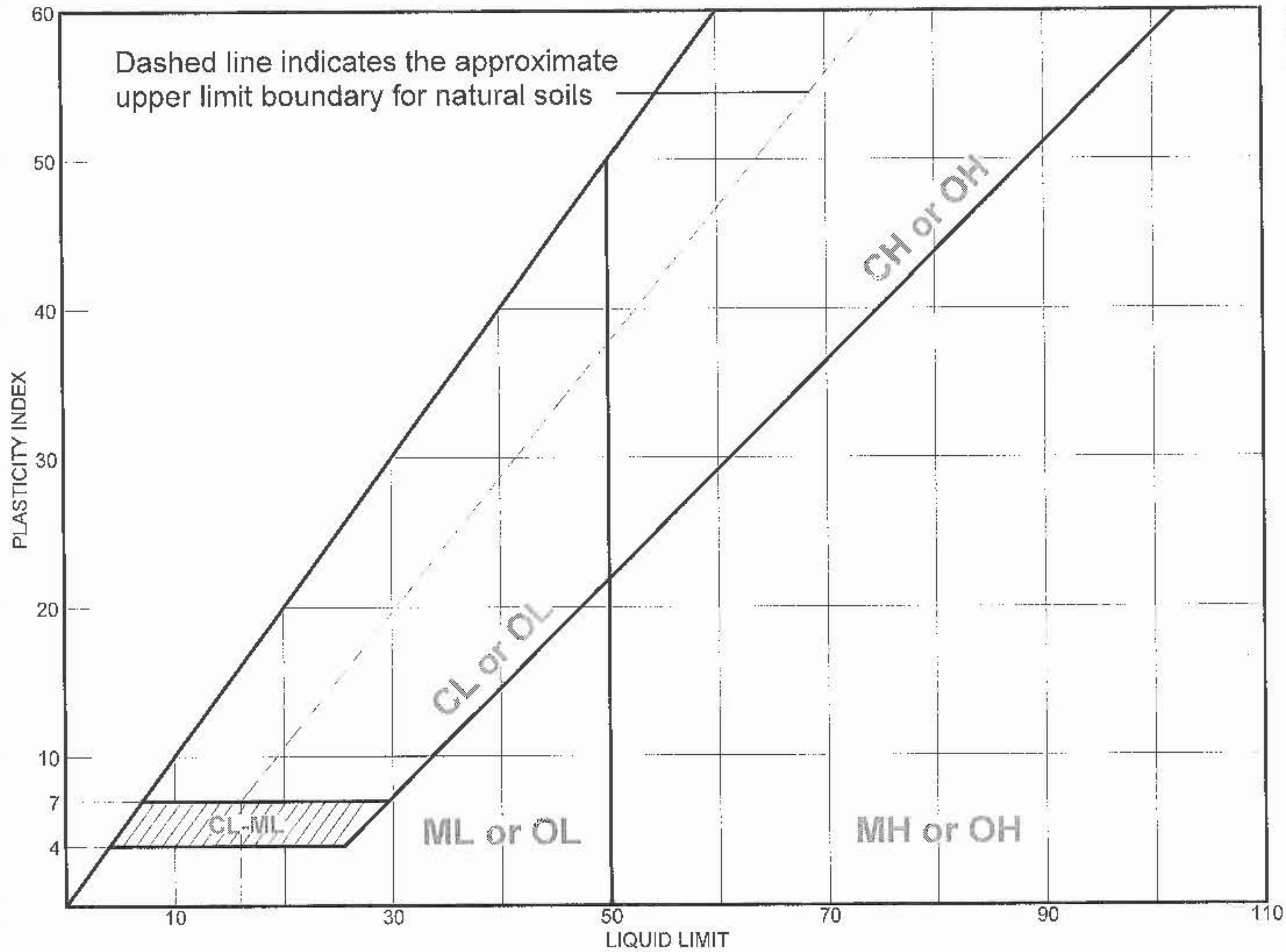
Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Poorly graded sand	NV	NP	NP	90.6	3.2	SP

Project No. E40550.01 **Client:**

Project: Proposed Drive Shack Restaurant & Golf Driving Range

● **Source:** **Sample No.:** B-9 **Elev./Depth:** 15-16.5'

Remarks:

●

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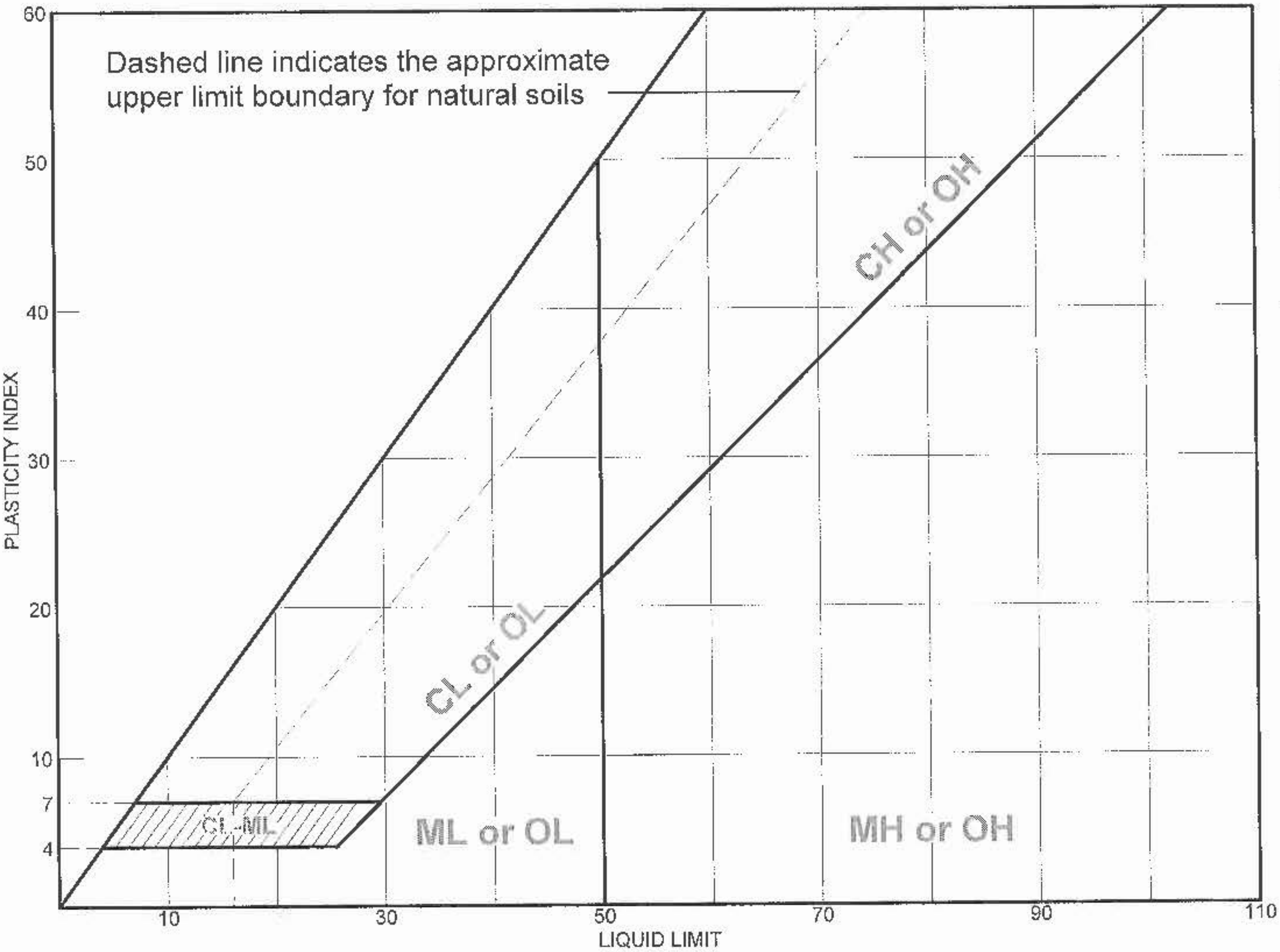
Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Silty sand	NV	NP	NP			SM

Project No. E40550.01 **Client:**

Project: Proposed Drive Shack Restaurant & Golf Driving Range

● **Source:** **Sample No.:** B-11 **Elev./Depth:** 15-16.5'

Remarks:

●

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Figure

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EXPANSION INDEX TEST, ASTM D4829

MTA PROJECT NAME:	Proposed Drive Shack Restaurant and Golf Driving Range	REPORT DATE:	8/19/2019
		TEST DATE:	7/12/2019
MTA PROJECT NO.:	E40550.01		
SAMPLE I.D.:	B-2 @ 0-5'		
SAMPLED BY:	JC		
SAMPLE DATE:	7/29/2019	TESTED BY:	MA

MATERIALS DESCRIPTION: Silty sand

% PASSING # 4 SIEVE: 100

Initial Moisture Determination:		Final Moisture Determination:	
Pan + Wet Soil Wt., gm	250.0	Wet Soil Wt., lbs	0.9714
Pan + Dry Soil Wt., gm	231.8	Dry Soil Wt., lbs	0.8577
Pan Wt., gm	0.0		
Initial % Moisture Content	7.9	Final % Moisture Content	13.3

Initial Expansion Data:		**Final Expansion Data:**	
Ring + Sample Wt., lbs	0.9250	Ring + Sample Wt., lbs	0.9714
Ring Wt., lbs	0.0000	Ring Wt., lbs	0.0000
Remolded Wt., lbs	0.9250	Remolded Wt., lbs	0.9714
Remolded Wet Density, pcf	127.2	Remolded Wet Density, pcf	133.6
Remolded Dry Density, pcf	117.9	Remolded Dry Density, pcf	118.0

Expansion Data:

Initial Volume	Final Volume
0.00727222	0.007269

Initial Gage Reading, in:	0.0500
Final Gage Reading, in:	0.0496
Expansion, in:	-0.0004
Expansion Index	0

Comments: **Very Low Expansion Potential**

Classification of Expansive Soils. (Table No.1 From ASTM D4829)

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

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Fresno, CA 93721

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EXPANSION INDEX TEST, ASTM D4829

MTA PROJECT NAME:	Proposed Drive Shack Restaurant and Golf Driving Range	REPORT DATE:	8/19/2019
		TEST DATE:	7/12/2019
MTA PROJECT NO.:	E40550.01		
SAMPLE I.D.:	B-4 @ 3-5'		
SAMPLED BY:	JC		
SAMPLE DATE:	7/22/2019	TESTED BY:	MA

MATERIALS DESCRIPTION: Sandy lean clay

% PASSING # 4 SIEVE: 100

Initial Moisture Determination:		Final Moisture Determination:	
Pan + Wet Soil Wt., gm	250.0	Wet Soil Wt., lbs	0.8018
Pan + Dry Soil Wt., gm	205.8	Dry Soil Wt., lbs	0.5782
Pan Wt., gm	0.0		
Initial % Moisture Content	21.5	Final % Moisture Content	38.7

Initial Expansion Data:		**Final Expansion Data:**	
Ring + Sample Wt., lbs	0.7024	Ring + Sample Wt., lbs	0.8018
Ring Wt., lbs	0.0000	Ring Wt., lbs	0.0000
Remolded Wt., lbs	0.7024	Remolded Wt., lbs	0.8018
Remolded Wet Density, pcf	96.6	Remolded Wet Density, pcf	108.2
Remolded Dry Density, pcf	79.5	Remolded Dry Density, pcf	78.0

Expansion Data:

Initial Volume	Final Volume
0.00727222	0.007412

Initial Gage Reading, in:	0.0500
Final Gage Reading, in:	0.0692
Expansion, in:	0.0192
Expansion Index	19

Comments: **Very Low Expansion Potential**

Classification of Expansive Soils. (Table No.1 From ASTM D4829)

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

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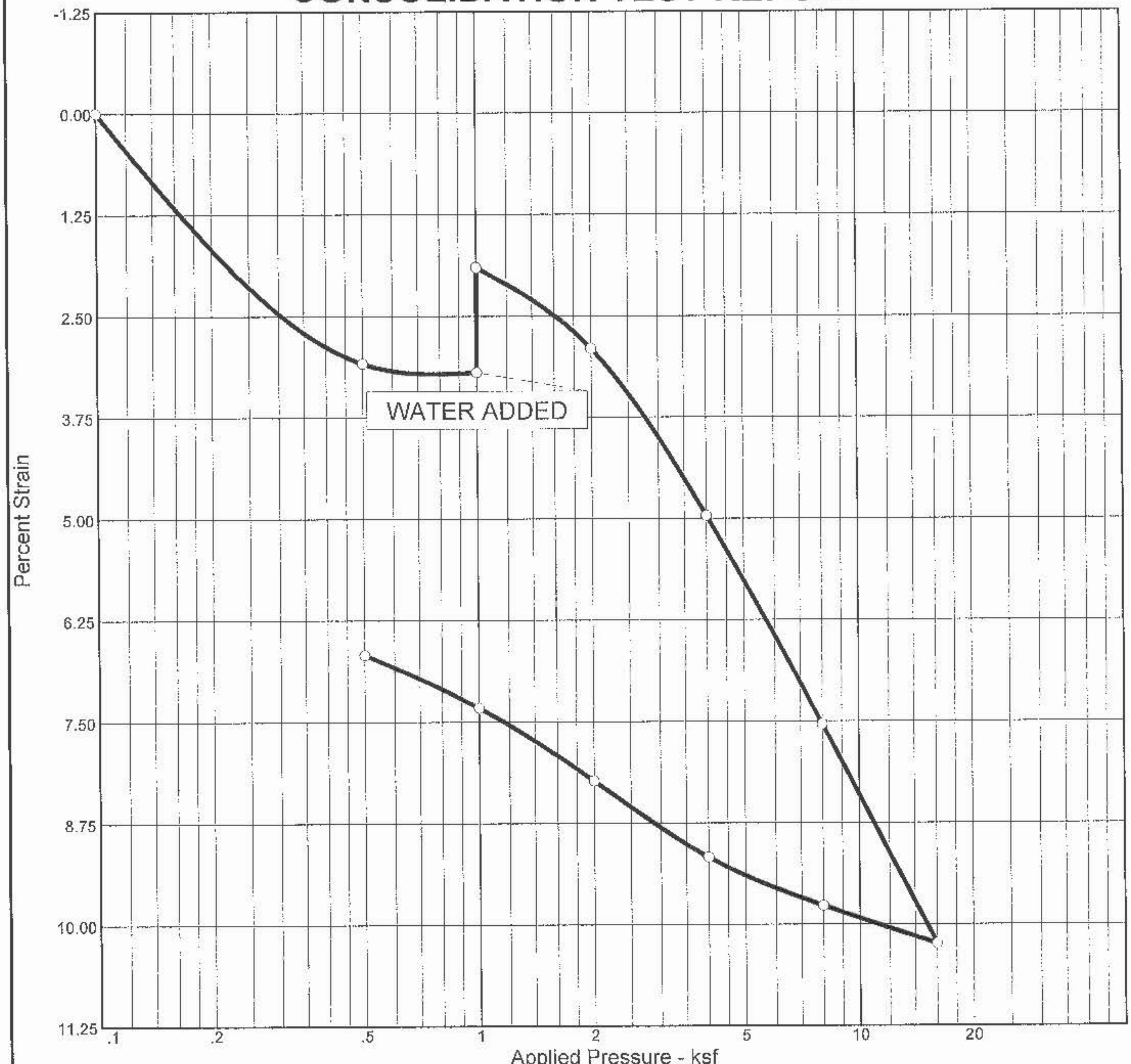
CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (ksf)	P_c (ksf)	C_c	C_s	Swell Press. (ksf)	Swell %	e_o
Sat.	Moist.											
84.3 %	14.7 %	113.1			2.65		2.64	0.13	0.03	2.26	1.3	0.462

MATERIAL DESCRIPTION	USCS	AASHTO
Sandy lean clay	CL	

Project No. E40550.01 **Client:**

Project: Proposed Drive Shack Restaurant & Golf Driving Range

Source: **Sample No.:** B-4 **Elev./Depth:** 8.5-10'

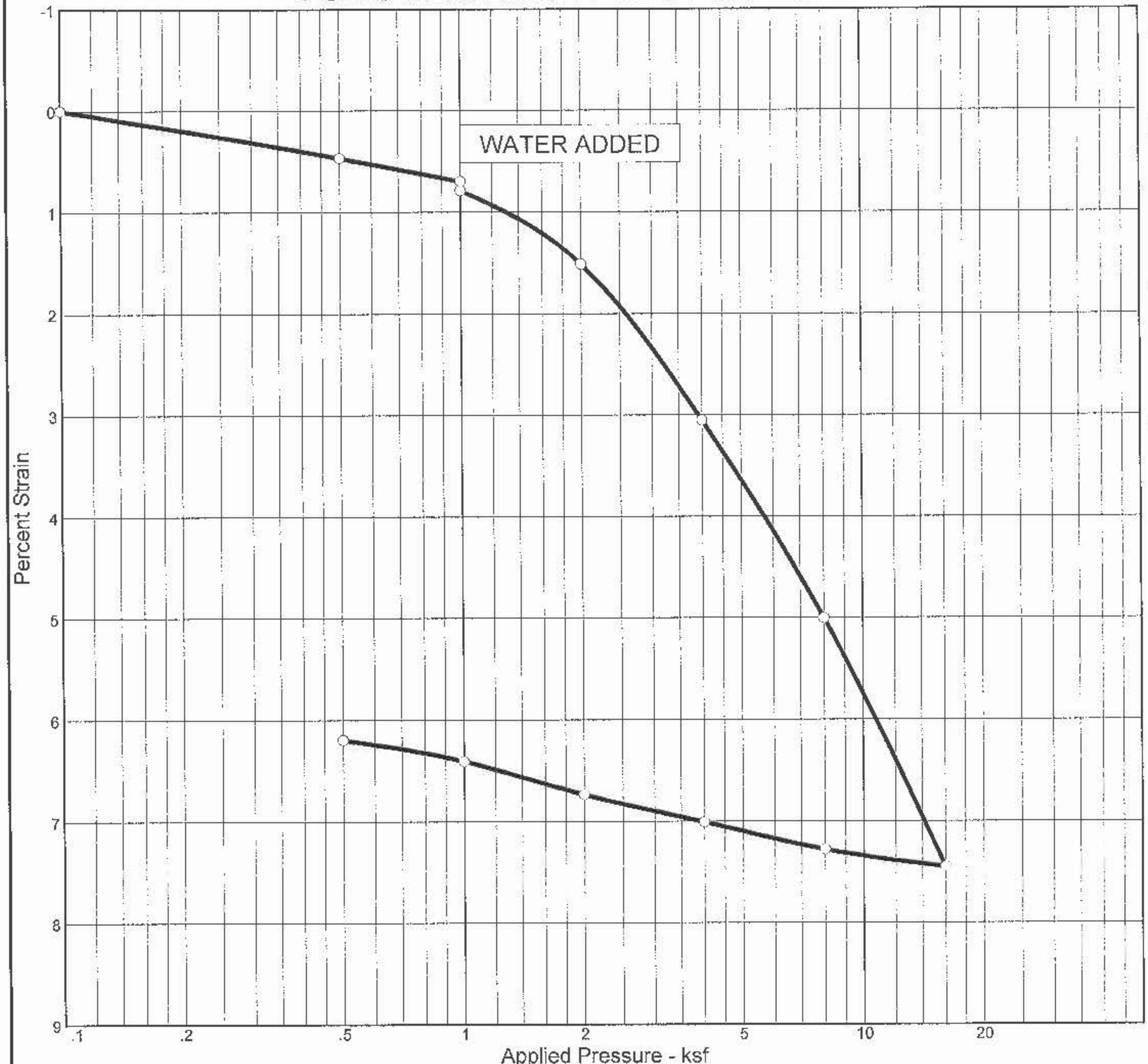
Moore Twining Associates, Inc.

Fresno, CA

Remarks:

Figure

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (ksf)	P_c (ksf)	C_c	C_s	Swell Press. (ksf)	Clpse. %	e_o
Sat.	Moist.											
10.2 %	2.0 %	109.1			2.65		3.46	0.12	0.01		0.1	0.517

MATERIAL DESCRIPTION	USCS	AASHTO
Sandy lean clay	CL	

Project No. E40550.01 **Client:**

Project: Proposed Drive Shack Restaurant & Golf Driving Range

Source: **Sample No.:** B-8 **Elev./Depth:** 5-6.5'

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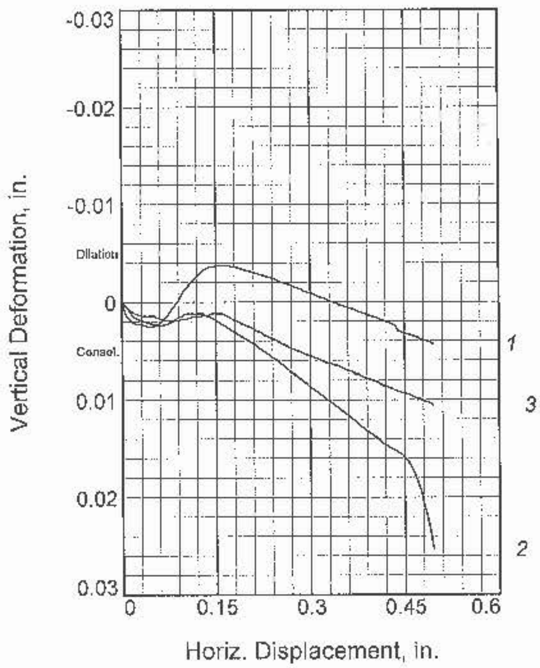
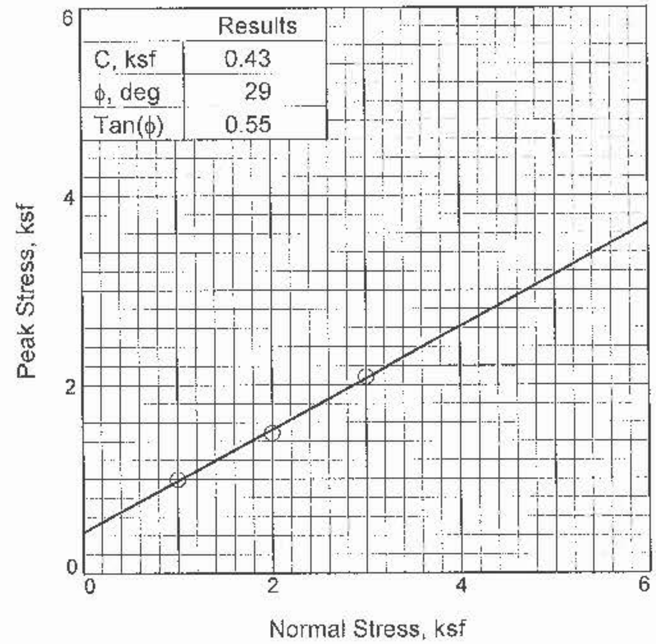
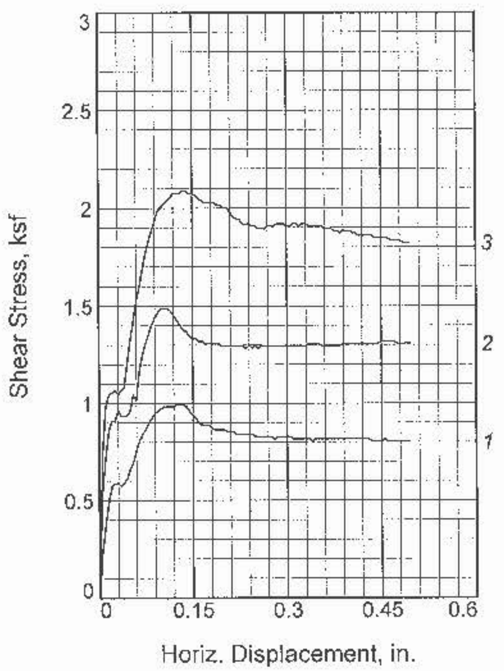
Remarks:

Figure







	Sample No.	1	2	3
Initial	Water Content, %	26.0	27.5	27.7
	Dry Density, pcf	96.4	95.6	98.9
	Saturation, %	96.2	99.6	109.2
	Void Ratio	0.7154	0.7311	0.6730
	Diameter, in.	2.42	2.42	2.42
	Height, in.	1.00	1.00	1.00
At Test	Water Content, %	24.6	24.3	24.5
	Dry Density, pcf	99.6	99.6	103.9
	Saturation, %	98.7	97.6	109.9
	Void Ratio	0.6605	0.6610	0.5918
	Diameter, in.	2.42	2.42	2.42
	Height, in.	0.97	0.96	0.95
	Normal Stress, ksf	1.00	2.00	3.00
	Peak Stress, ksf	1.00	1.49	2.09
	Displacement, in.	0.13	0.10	0.14
	Ultimate Stress, ksf			
	Displacement, in.			
	Strain at peak, %	5.2	4.1	5.6

Sample Type:

Description: Sandy lean clay

LL= 42 **PL=** 17 **PI=** 25

Specific Gravity= 2.65

Remarks:

Figure ________

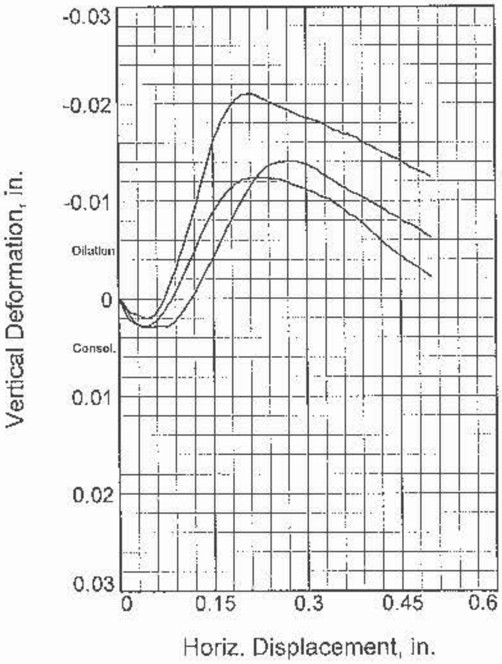
Client:

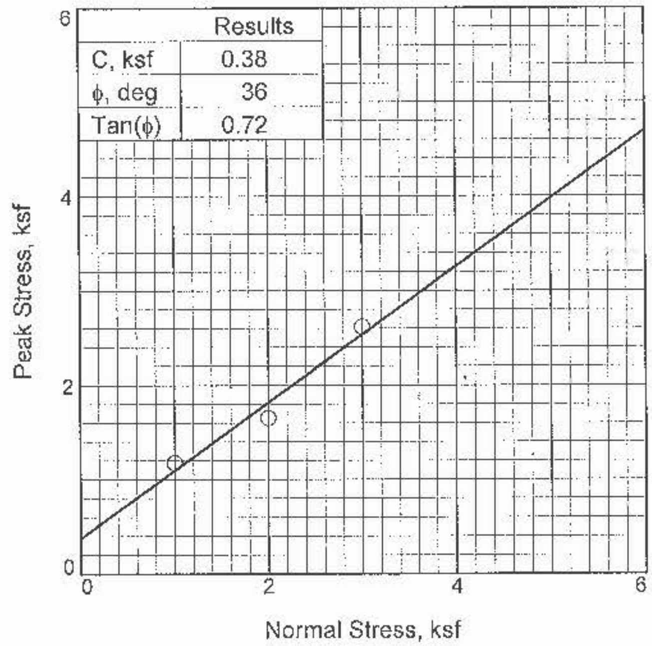
Project: Proposed Drive Shack Restaurant & Golf Driving Range

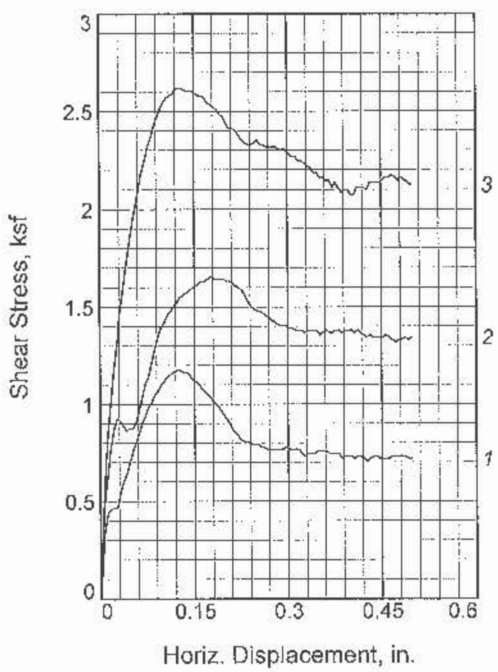
Sample Number: B-2 **Depth:** 35-36.5'

Proj. No.: E40550.01 **Date Sampled:** 7/22/19

DIRECT SHEAR TEST REPORT
Moore Twining Associates, Inc.
Fresno, CA







	Sample No.	1	2	3
Initial	Water Content, %	18.4	12.6	14.9
	Dry Density, pcf	99.8	97.2	93.4
	Saturation, %	74.2	47.5	51.4
	Void Ratio	0.6576	0.7016	0.7712
	Diameter, in.	2.42	2.42	2.42
	Height, in.	1.00	1.00	1.00
At Test	Water Content, %	23.3	24.0	26.4
	Dry Density, pcf	101.5	99.5	96.2
	Saturation, %	98.0	96.2	97.3
	Void Ratio	0.6303	0.6619	0.7193
	Diameter, in.	2.42	2.42	2.42
	Height, in.	0.98	0.98	0.97
	Normal Stress, ksf	1.00	2.00	3.00
	Peak Stress, ksf	1.18	1.66	2.62
	Displacement, in.	0.12	0.18	0.12
	Ultimate Stress, ksf			
	Displacement, in.			
	Strain at peak, %	5.0	7.3	5.0

Sample Type:

Description: Silty sand

Specific Gravity= 2.65

Remarks:

Figure ________

Client:

Project: Proposed Drive Shack Restaurant & Golf Driving Range

Sample Number: B-3 **Depth:** 25-26.5'

Proj. No.: E40550.01 **Date Sampled:** 7/22/19

DIRECT SHEAR TEST REPORT
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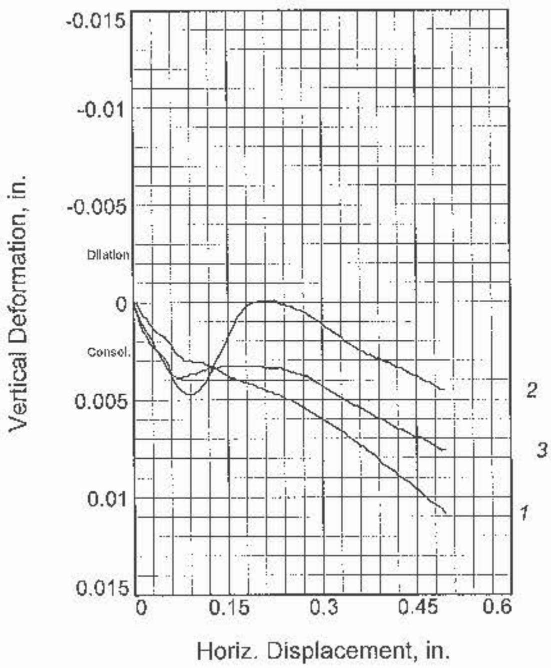
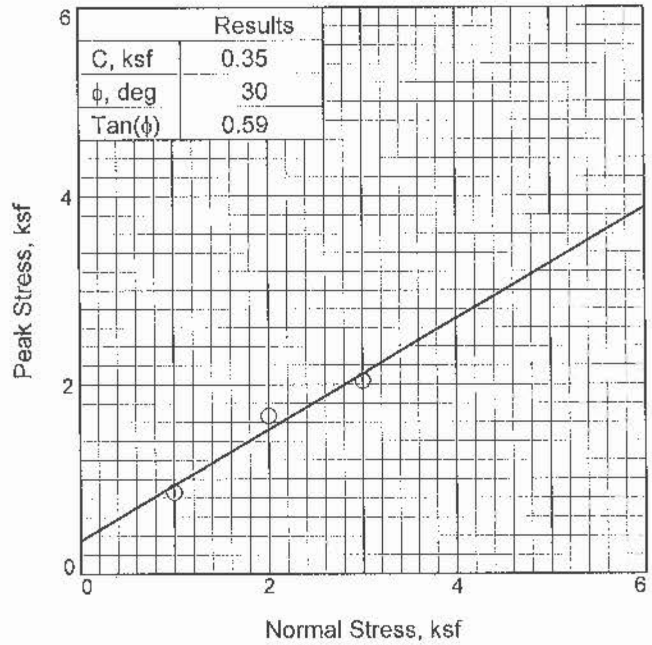
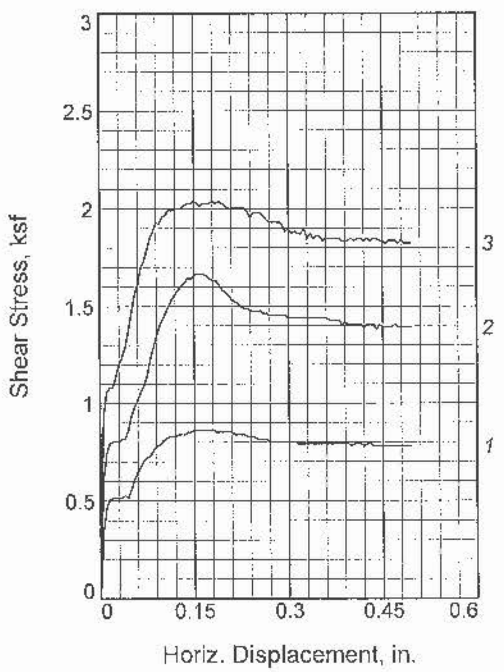
Fresno, CA







	Sample No.	1	2	3
Initial	Water Content, %	35.0	32.2	31.8
	Dry Density, pcf	83.3	88.7	89.2
	Saturation, %	94.1	98.7	98.6
	Void Ratio	0.9868	0.8658	0.8536
	Diameter, in.	2.42	2.42	2.42
	Height, in.	1.00	1.00	1.00
At Test	Water Content, %	34.2	29.5	29.1
	Dry Density, pcf	86.3	92.3	93.1
	Saturation, %	99.0	98.7	99.1
	Void Ratio	0.9165	0.7929	0.7765
	Diameter, in.	2.42	2.42	2.42
	Height, in.	0.96	0.96	0.96
	Normal Stress, ksf	1.00	2.00	3.00
	Peak Stress, ksf	0.86	1.67	2.04
	Displacement, in.	0.15	0.16	0.15
	Ultimate Stress, ksf			
	Displacement, in.			
	Strain at peak, %	6.2	6.4	6.2

Sample Type:
Description: Silty sand

LL= NV **PI=** NP
Specific Gravity= 2.65
Remarks:

Figure ______

Client:

Project: Proposed Drive Shack Restaurant & Golf Driving Range

Sample Number: B-5 **Depth:** 18.5-20.0'

Proj. No.: E40550.01 **Date Sampled:** 7/22/19

DIRECT SHEAR TEST REPORT
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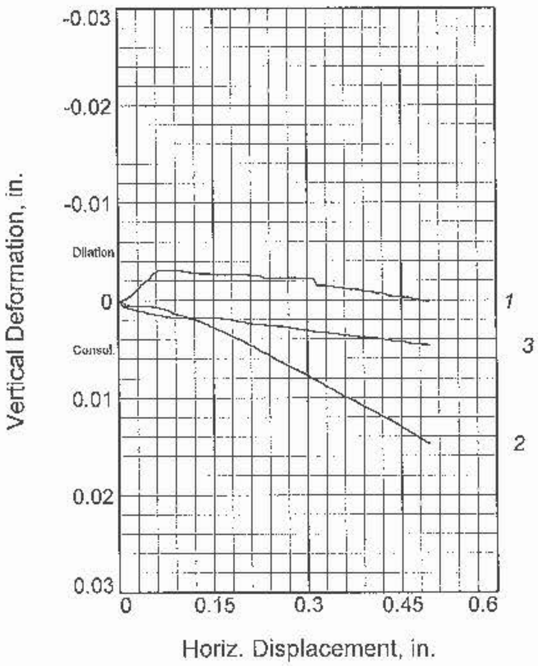
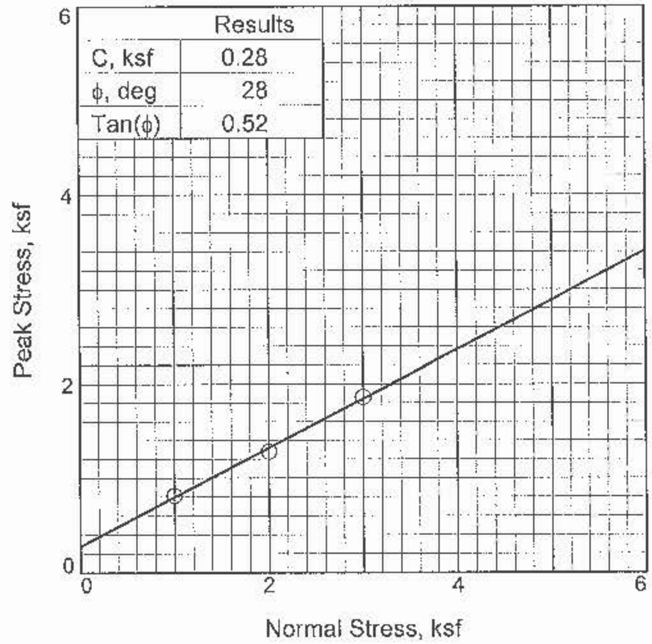
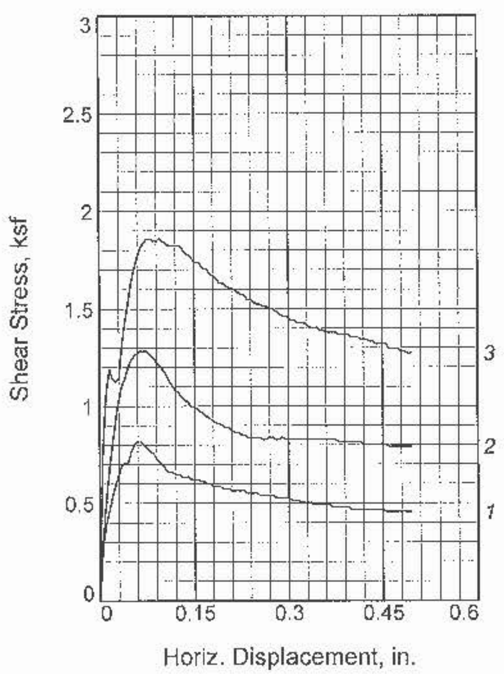






	Sample No.	1	2	3
Initial	Water Content, %	34.5	36.2	33.4
	Dry Density, pcf	83.8	83.3	86.6
	Saturation, %	93.8	97.4	97.4
	Void Ratio	0.9750	0.9849	0.9097
	Diameter, in.	2.42	2.42	2.42
	Height, in.	1.00	1.00	1.00
At Test	Water Content, %	35.1	35.4	33.4
	Dry Density, pcf	85.2	85.0	88.6
	Saturation, %	98.9	99.2	102.1
	Void Ratio	0.9406	0.9452	0.8680
	Diameter, in.	2.42	2.42	2.42
	Height, in.	0.98	0.98	0.98
	Normal Stress, ksf	1.00	2.00	3.00
	Peak Stress, ksf	0.82	1.28	1.86
	Displacement, in.	0.06	0.07	0.08
	Ultimate Stress, ksf			
	Displacement, in.			
	Strain at peak, %	2.5	2.7	3.1

Sample Type:

Description: Lean clay

LL= 47 **PL=** 24 **PI=** 23

Specific Gravity= 2.65

Remarks:

Figure ________

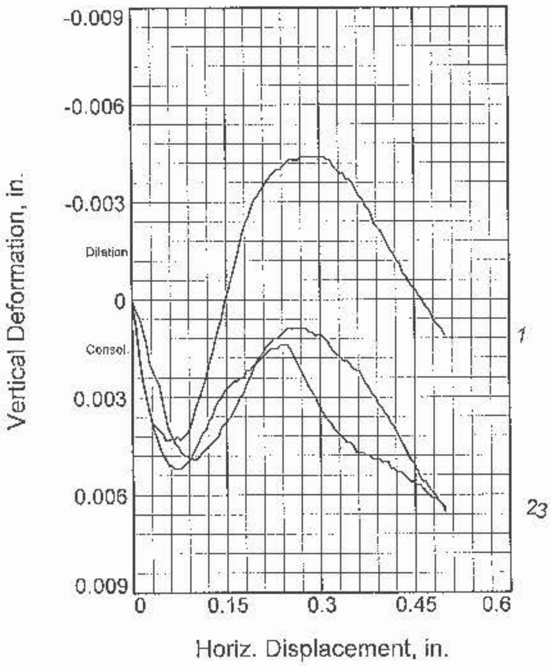
Client:

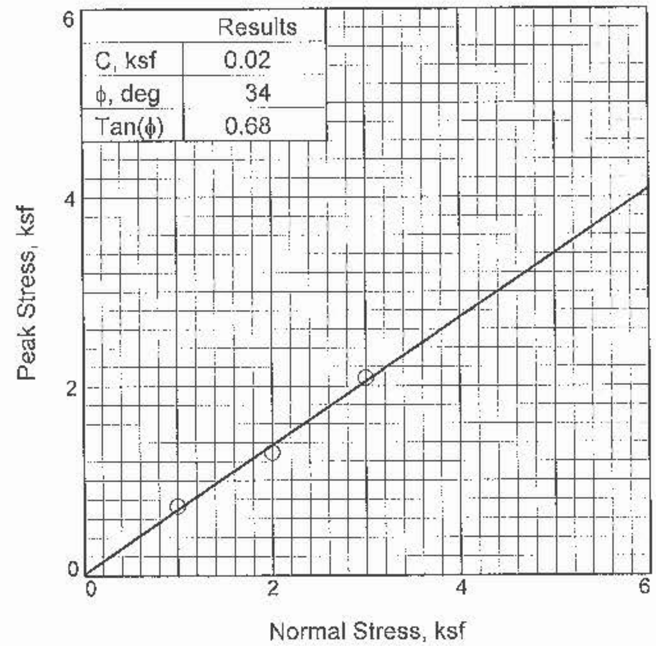
Project: Proposed Drive Shack Restaurant & Golf Driving Range

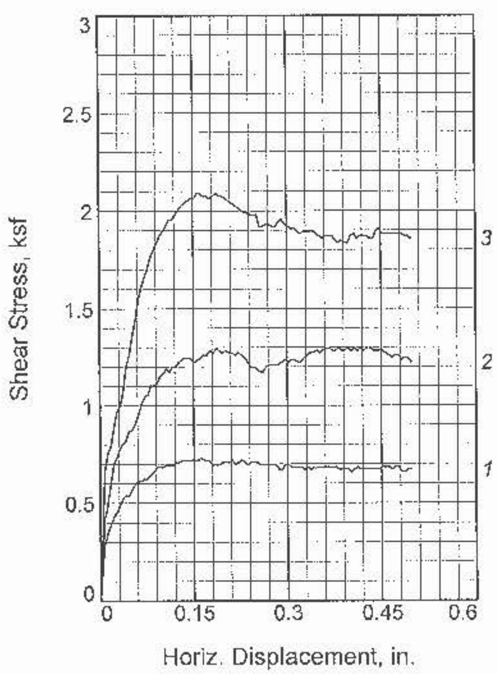
Sample Number: B-7 **Depth:** 5-6.5'

Proj. No.: E40550.01 **Date Sampled:** 7/22/19

DIRECT SHEAR TEST REPORT
Moore Twining Associates, Inc.
Fresno, CA







	Sample No.	1	2	3
Initial	Water Content, %	16.6	10.7	17.6
	Dry Density, pcf	80.6	87.2	87.9
	Saturation, %	41.8	31.5	52.8
	Void Ratio	1.0524	0.8978	0.8817
	Diameter, in.	2.42	2.42	2.42
	Height, in.	1.00	1.00	1.00
At Test	Water Content, %	37.2	31.5	30.2
	Dry Density, pcf	81.7	88.7	89.7
	Saturation, %	96.1	96.4	95.0
	Void Ratio	1.0259	0.8648	0.8439
	Diameter, in.	2.42	2.42	2.42
	Height, in.	0.99	0.98	0.98
	Normal Stress, ksf	1.00	2.00	3.00
	Peak Stress, ksf	0.73	1.30	2.09
	Displacement, in.	0.16	0.19	0.16
	Ultimate Stress, ksf			
	Displacement, in.			
	Strain at peak, %	6.7	7.7	6.5

Sample Type:

Description: Silty sand

Specific Gravity= 2.65

Remarks:

Figure ________

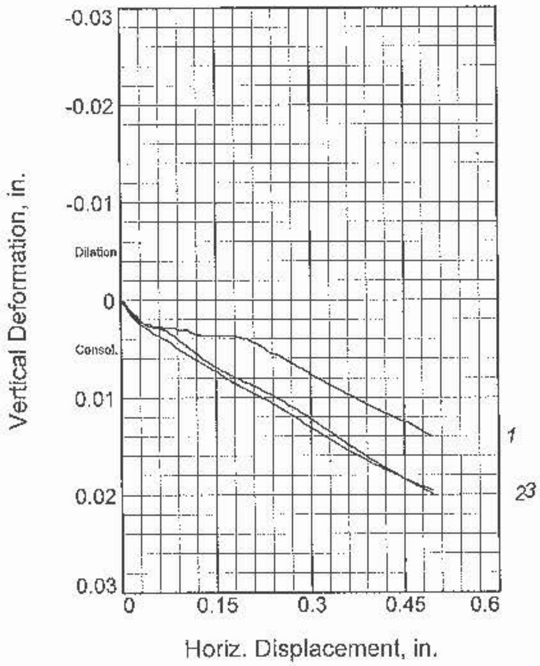
Client:

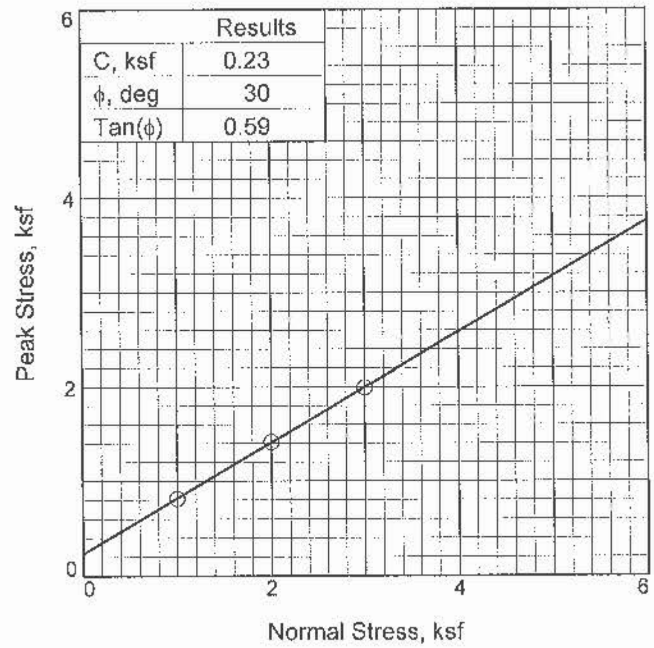
Project: Proposed Drive Shack Restaurant & Golf Driving Range

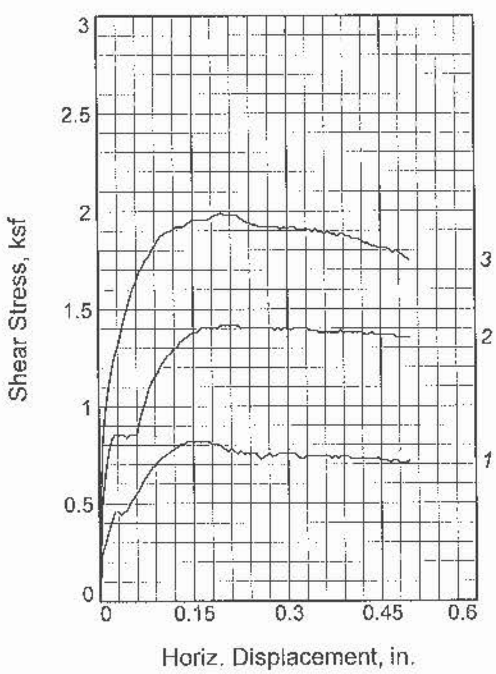
Sample Number: B-9 **Depth:** 10-11.5'

Proj. No.: E40550.01 **Date Sampled:** 7/22/19

DIRECT SHEAR TEST REPORT
Moore Twining Associates, Inc.
Fresno, CA







	Sample No.	1	2	3
Initial	Water Content, %	30.9	31.9	33.2
	Dry Density, pcf	79.1	80.6	80.8
	Saturation, %	75.1	80.2	84.0
	Void Ratio	1.0922	1.0524	1.0482
	Diameter, in.	2.42	2.42	2.42
	Height, in.	1.00	1.00	1.00
At Test	Water Content, %	38.6	36.8	35.3
	Dry Density, pcf	81.5	83.2	83.9
	Saturation, %	99.3	98.6	96.1
	Void Ratio	1.0305	0.9888	0.9726
	Diameter, in.	2.42	2.42	2.42
	Height, in.	0.97	0.97	0.96
	Normal Stress, ksf	1.00	2.00	3.00
	Peak Stress, ksf	0.82	1.42	1.99
	Displacement, in.	0.14	0.20	0.20
	Ultimate Stress, ksf			
	Displacement, in.			
	Strain at peak, %	5.8	8.1	8.1

Sample Type:

Description: Sandy lean clay

Specific Gravity= 2.65

Remarks:

Figure ________

Client:

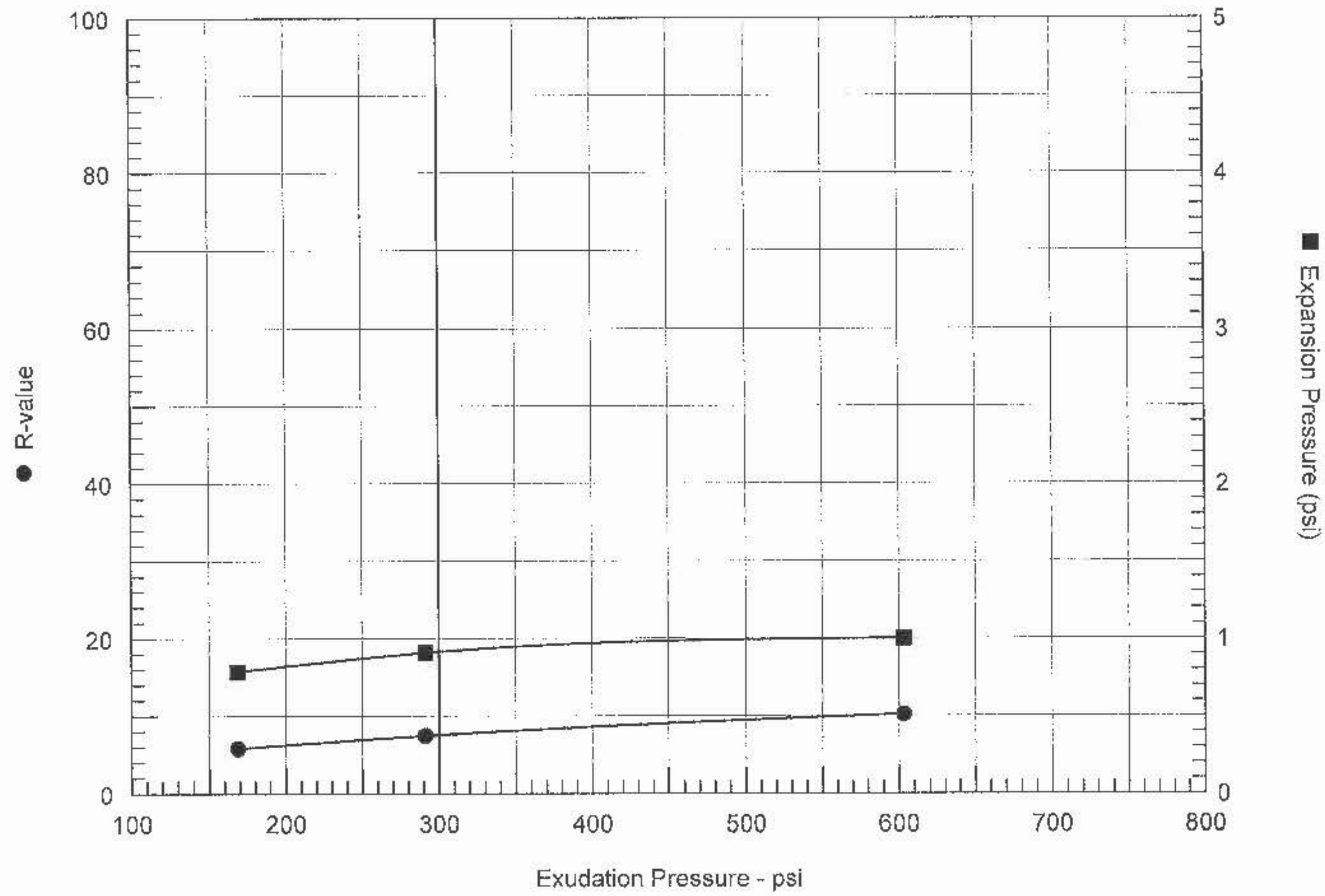
Project: Proposed Drive Shack Restaurant & Golf Driving Range

Sample Number: B-16 **Depth:** 3.5-5'

Proj. No.: E40550.01 **Date Sampled:** 7/22/19

DIRECT SHEAR TEST REPORT
Moore Twining Associates, Inc.
Fresno, CA

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - ASTM D 2844

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psi	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	50	115.1	15.7	1.00	127	2.46	603	10	10
2	30	110.4	17.8	0.79	139	2.57	169	6	6
3	30	112.6	16.7	0.91	134	2.51	291	7	7

Test Results	Material Description
R-value at 300 psi exudation pressure = 8 **Exp. pressure at 300 psi exudation pressure =** 0.92 psi	Sandy lean clay

Project No.: E40550.01
Project: Proposed Drive Shack Restaurant & Golf Driving Range
Sample Number: B-12 **Depth:** 0.7-5'

Date: 9/13/2019

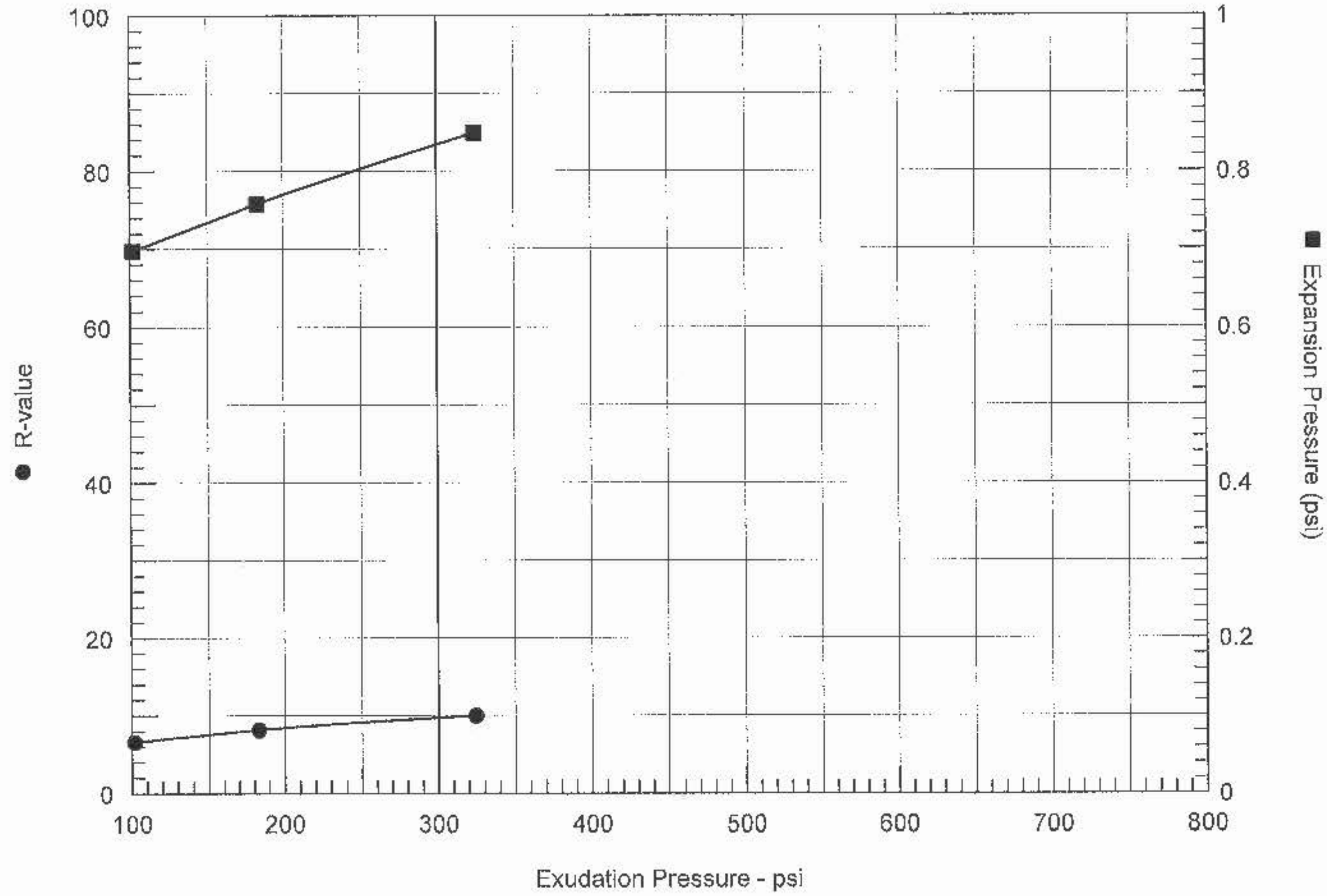
Tested by:
Checked by:
Remarks:

R-VALUE TEST REPORT

Moore Twining Associates, Inc.

Figure ______

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - ASTM D 2844

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psi	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	100	99.7	25.8	0.85	130	2.52	325	10	10
2	30	96.7	28.2	0.70	139	2.61	102	6	7
3	50	97.9	27.0	0.76	135	2.57	183	8	8

Test Results	Material Description
R-value at 300 psi exudation pressure = 10 **Exp. pressure at 300 psi exudation pressure =** 0.83 psi	Lean clay

Project No.: E40550.01

Project: Proposed Drive Shack Restaurant & Golf Driving Range

Sample Number: B-7 **Depth:** 0-5'

Date: 9/13/2019

Tested by:

Checked by:

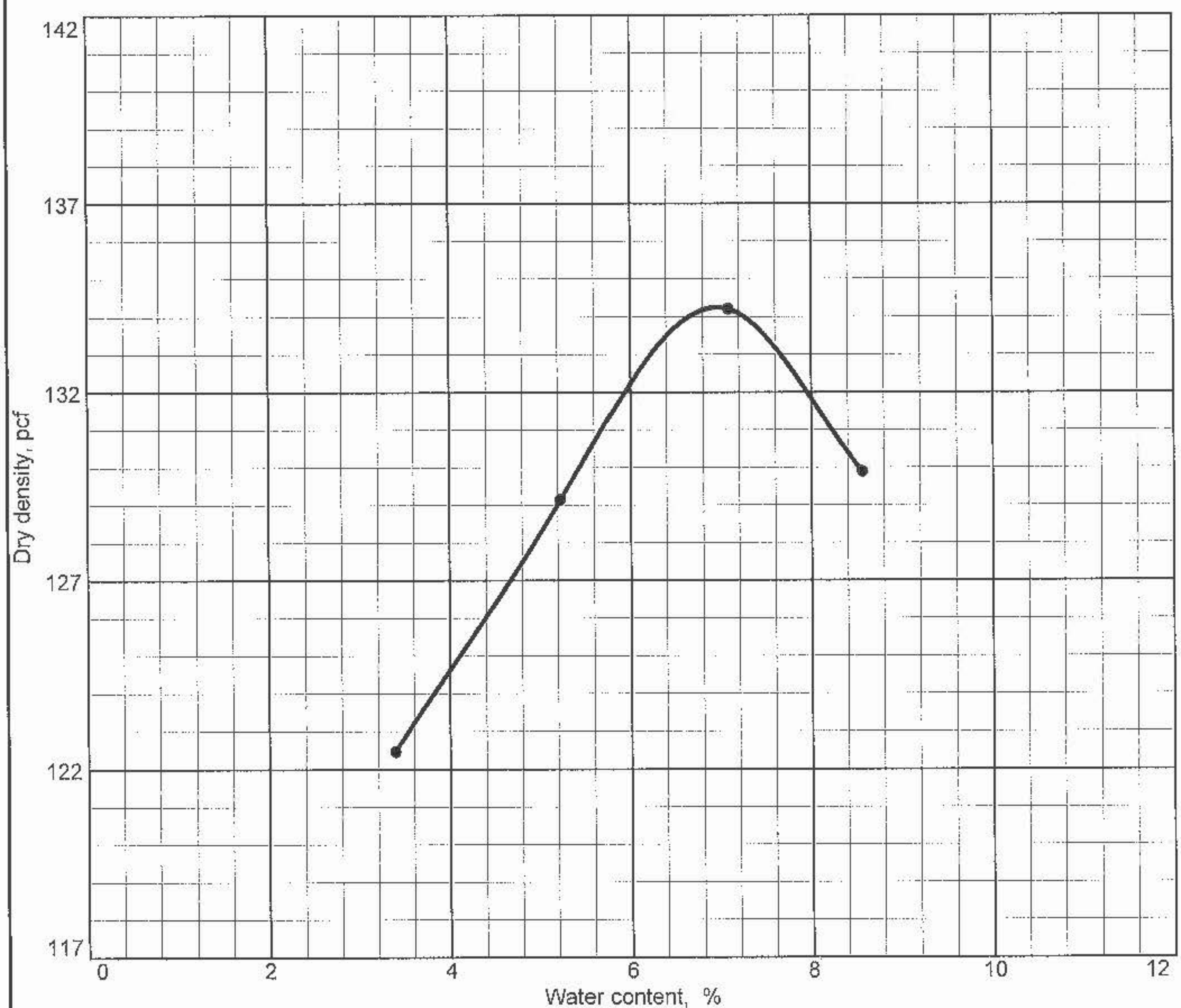
Remarks:

R-VALUE TEST REPORT

Moore Twining Associates, Inc.

Figure ______

COMPACTION TEST REPORT



Test specification: ASTM D 1557-12 Method A Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
0-5'							1.4	

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 134.3 pcf	Silty sand
Optimum moisture = 7.0 %	

Project No. E40550.01 **Client:**

Project: Proposed Drive Shack Restaurant & Golf Driving Range

● **Source:** **Sample No.:** B-2 **Elev./Depth:** 0-5'

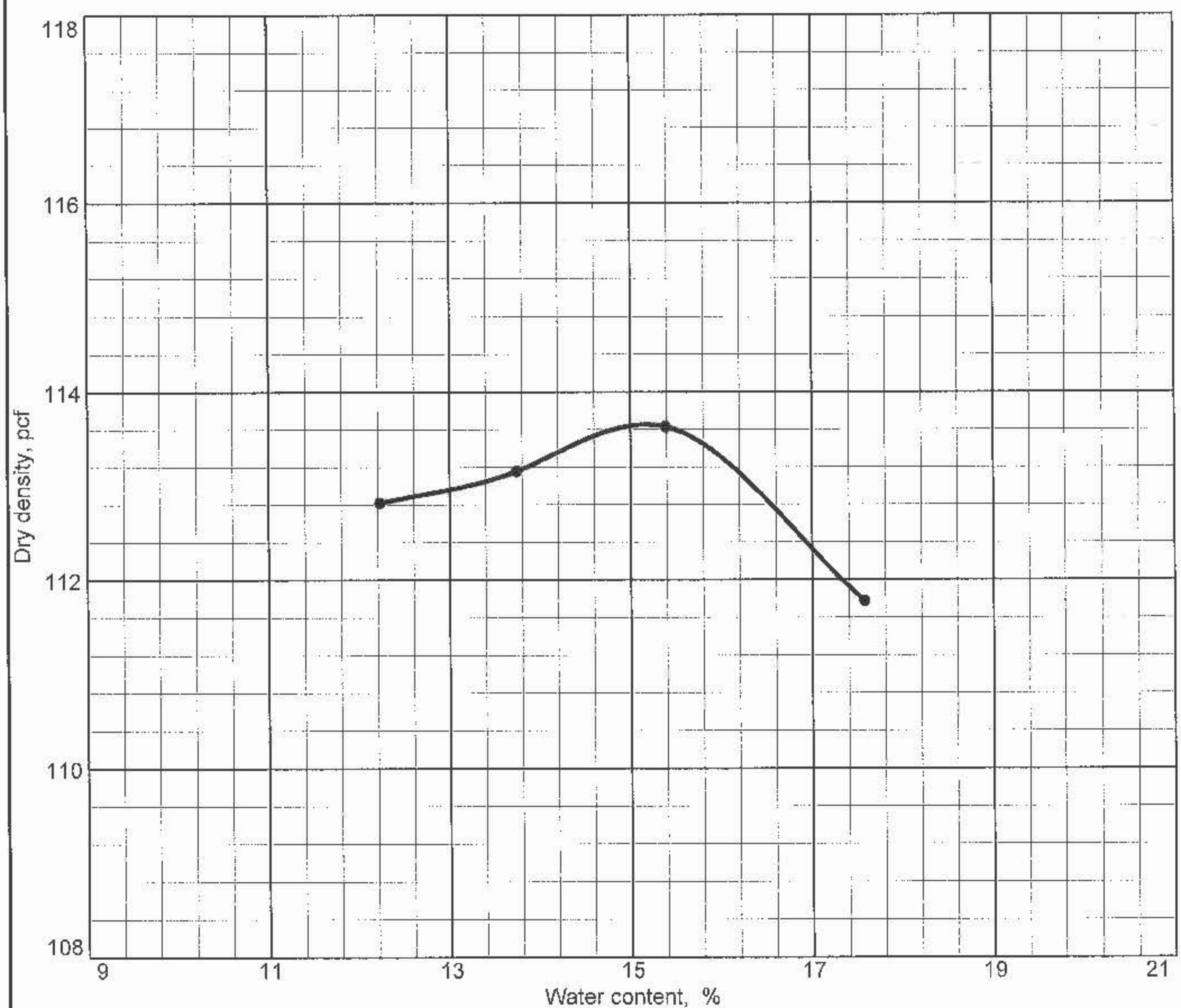
Remarks:

Moore Twining Associates, Inc.

Fresno, CA

Figure

COMPACTION TEST REPORT



Test specification: ASTM D 1557-12 Method A Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
0-5'							0.8	

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 113.7 pcf Optimum moisture = 15.2 %	Lean clay

Project No. E40550.01 **Client:**

Project: Proposed Drive Shack Restaurant & Golf Driving Range

● **Source:** **Sample No.:** B-7 **Elev./Depth:** 0-5'

Moore Twining Associates, Inc.

Fresno, CA

Remarks:

Figure

MOORE TWINING
ASSOCIATES, INC.
California ELAP Certificate #1371

2527 Fresno Street
Fresno, CA 93721
(559) 268-7021 Phone
(559) 268-0740 Fax

August 14, 2019

Work Order #: **FH07003**

Zubair Anwar
MTA Geotechnical Division
2527 Fresno Street
Fresno, CA 93721

RE: Proposed Drive Shack & Golf Driving Range

Enclosed are the analytical results for samples received by our laboratory on **08/07/19** . For your reference, these analyses have been assigned laboratory work order number **FH07003**.

All analyses have been performed according to our laboratory's quality assurance program. All results are intended to be considered in their entirety, Moore Twining Associates, Inc. (MTA) is not responsible for use of less than complete reports. Results apply only to samples analyzed.

If you have any questions, please feel free to contact us at the number listed above.

Sincerely,

Moore Twining Associates, Inc.

Susan Federico

Susan Federico
Client Services Representative

MOORE TWINING
ASSOCIATES, INC.
California ELAP Certificate #1371

2527 Fresno Street
Fresno, CA 93721
(559) 268-7021 Phone
(559) 268-0740 Fax

MTA Geotechnical Division 2527 Fresno Street Fresno CA, 93721	**Project:** Proposed Drive Shack & Golf Driving Range **Project Number:** E40550.01 **Project Manager:** Zubair Anwar	**Reported:** 08/14/2019

Analytical Report for the Following Samples

Sample ID	Notes	Laboratory ID	Matrix	Date Sampled	Date Received
B4 @ 3 - 5		FH07003-01	Soil	08/07/19 00:00	08/07/19 09:18
B9 @ 0 - 5		FH07003-02	Soil	08/07/19 00:00	08/07/19 09:18

MOORE TWINING ASSOCIATES, INC.
California ELAP Certificate #1371

2527 Fresno Street
Fresno, CA 93721
(559) 268-7021 Phone
(559) 268-0740 Fax

MTA Geotechnical Division 2527 Fresno Street Fresno CA, 93721	**Project:** Proposed Drive Shack & Golf Driving Range **Project Number:** E40550.01 **Project Manager:** Zubair Anwar	**Reported:** 08/14/2019

B4 @ 3 - 5

FH07003-01 (Soil) Sampled: 08/07/19 00:00

Analyte	Flag	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method
Inorganics									
Chloride		**42**	6.0	mg/kg	3	B9H0712	08/07/19	08/09/19	ASTM D4327-84
Chloride		**0.0042**	0.00060	% by Weight	3	[CALC]	08/09/19	08/09/19	ASTM D4327-84
Sulfate as SO4		**0.029**	0.00060	% by Weight	3	[CALC]	08/09/19	08/09/19	ASTM D4327-84
pH		**7.8**	0.10	pH Units	1	B9H0712	08/07/19	08/09/19	ASTM D4972-89 Mod
Sulfate as SO4		**290**	6.0	mg/kg	3	B9H0712	08/07/19	08/09/19	ASTM D4327

B9 @ 0 - 5

FH07003-02 (Soil) Sampled: 08/07/19 00:00

Analyte	Flag	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method
Inorganics									
Chloride		**180**	12	mg/kg	6	B9H0712	08/07/19	08/09/19	ASTM D4327-84
Chloride		**0.018**	0.0012	% by Weight	6	[CALC]	08/09/19	08/09/19	ASTM D4327-84
Sulfate as SO4		**0.054**	0.0012	% by Weight	6	[CALC]	08/09/19	08/09/19	ASTM D4327-84
pH		**8.6**	0.10	pH Units	1	B9H0712	08/07/19	08/09/19	ASTM D4972-89 Mod
Sulfate as SO4		**540**	12	mg/kg	6	B9H0712	08/07/19	08/09/19	ASTM D4327

Notes and Definitions

µg/L	micrograms per liter (parts per billion concentration units)
mg/L	milligrams per liter (parts per million concentration units)
mg/kg	milligrams per kilogram (parts per million concentration units)
ND	Analyte NOT DETECTED at or above the reporting limit
RPD	Relative Percent Difference

Analysis of pH, filtration, and residual chlorine is to take place immediately after sampling in the field.
If the test was performed in the laboratory, the hold time was exceeded. **(for aqueous matrices only)**

MOORE TWINING

CHAIN OF CUSTODY / ANALYSIS REQUEST

2527 FRESNO STREET • FRESNO, CA 93721 • PHONE (559) 268-7021 • FAX: (559) 268-0740

ANALYTICAL CHEMISTRY DIVISION
CALIFORNIA ELAP CERTIFICATION # 1371

WORK ORDER #: F407003
PAGE 1 OF 2

REPORT TO:
ATTENTION: Zubair Answar
COMPANY NAME:
ADDRESS:
PHONE:
EMAIL / FAX:

☐ **INVOICE TO:**
ATTENTION:
COMPANY NAME:
ADDRESS:
PHONE:
EMAIL / FAX:

☐ **REPORT COPY TO:**

REPORTING:
☑ STANDARD FORMAT ☐ PDF
☐ EDT (SWRCB) ☐ EXCEL
☐ GEOTRACKER/COELT (LUFT)
GLOBAL ID:
☐ COUNTY ENVIRONMENTAL HEALTH:
☐ STATE WATER RESOURCES CONTROL BOARD:
☐ OTHER:

SAMPLE INFORMATION
SAMPLED BY (PRINT):
SIGNATURE:
☐ PUBLIC SYSTEM ☑ ROUTINE
☐ PRIVATE WELL ☐ REPEAT
☐ OTHER ☐ REPLACEMENT

TURN AROUND TIME
☐ STANDARD
☑ RUSH, DUE ON: 5-days

SAMPLE TYPES
SOLID:
BS - BIOSOLID
CR - CERAMIC
SL - SOIL/SOLID
LIQUID:
DW - DRINKING WATER
GW - GROUND WATER
OL - OIL
SF - SURFACE WATER
ST - STORM WATER
WW - WASTEWATER

PROJECT INFORMATION
CONTRACT / P.O. NO.:
PROJECT: Proposed drive shack Restaurant and golf driving Range
PROJECT NUMBER: E40550.01
PROJECT MANAGER: Zubair Answar

NOTES ON RECEIVED CONDITION:
☐ CUSTODY SEAL(S) BROKEN ☐ SAMPLES(S) DAMAGED
☐ ON ICE ☐ AMBIENT TEMP. ☐ INCORRECT PRESERVATION

ANALYSIS REQUESTED

LAB USE	CLIENT SAMPLE ID	DATE	TIME	TYPE	Corrosion										STATION CODE
1	B4@3-5	8/7/19	N/A	SL	✓										
2	B9@0-5	8/7/19	N/A	SL	✓										

COMMENTS / ADDITIONAL INSTRUCTIONS:

RELINQUISHED BY	COMPANY	DATE	TIME	RECEIVED BY	COMPANY
Miguel Alcaraz	MTA/MAT	8-7-19	0918	[illegible]	[illegible]

FL-SC-0005-04 A

Moore Twining Associates

Sample Integrity Page 2 of 2 WO# FH07603 MTA Bottles: Yes or No

COC Info						
Was temperature within range? Chemistry ≤6°C Micro <10°C Temp____°C	Yes No N/A	Did all bottle labels agree with COC?	Yes No N/A	Were there bubbles in VOA vials? (**Volatiles Only**)	Yes No N/A
If samples were taken today, is there evidence that chilling has begun? Recvd____C°	Yes No N/A	Was a sufficient amount of sample received?	Yes No N/A	Was PM notified of discrepancies? PM: By/Time:	Yes No N/A
Did all bottles arrive unbroken and intact?	Yes No N/A	Were correct containers and preservatives received for the tests requested?	Yes No N/A		
Do samples have a hold time <72 hours?	Yes No N/A				

Bottles Received

125ml (A) 250ml (B) 1Liter (C) 40ml VOA (V)	1-2																		
Bacti $Na_2S_2O_3$																			
None (P)																			
Cr6 Buffer (P) Borate Carbonate Buffer																			
HNO_3 (P)																			
H_2SO_4 (P)																			
NaOH (P)																			
NaOH+ZnAc (P)																			
Dissolved Oxygen 300ml (P)																			
None (AG)																			
None (CG) 500ml																			
$Na_2S_2O_3$ 250ml (Brown P) 549																			
$Na_2S_2O_3$ (AG)																			
$Na_2S_2O_3$ (AG)																			
Thio/K Citrate																			
NH_4Cl (AG) 552																			
HCl (AG)																			
None (CG) 500ml																			
H_3PO_4 (AG)																			
Other:																			
Plastic Bag	1																		
Low Level Hg/Metals Double Bag																			
Client Own																			
Glass Jar: 125/ 250/ 500																			
Soil Tube: Brass/ Steel/ Plastic																			
5 g Encore																			
Ascorboc Acid (AG) Voa																			
1gallon Cubitainer																			

Comments

Filter or Split	Container	Preservative	Date/Time/Initials
S P F			
S P F			
S P F			
S P F			
S P F			

Labeled by: M @ 0947 Labels checked by: [illegible] @ 0945 FL-SC-0003-06

MOORE TWINING ASSOCIATES, INC.

Project Name:	Proposed Drive Shack Restaurant and Golf Driving Range	Report Date:	8/22/2019
		Sample Date:	7/22/2019
Project Number:	E40550.01		
		Sampled By:	JC
Subject:	Minimum Resistivity, ASTM G187	Tested By:	MA
Material Description:	Clayey sand	Test Date:	8/20/2019
Location:	B-4 @ 3-5'		

Laboratory Test Results, Minimum Resistivity - ASTM G187

Total Water Added, mls	Resistivity, Ohm-cm
50 mls	66,700
100 mls	57,362
150 mls	40,687
200 mls	30,015
250 mls	13,340
300 mls	8,671
350 mls	6,337
400 mls	2,868
450 mls	2,935

Remarks: Min. Resistivity is 2,868 Ohm-cm

www.mooretwining.com

PH: 559.268.7021
FX: 559.268.7126
2527 Fresno Street
Fresno, CA 93721

MOORE TWINING ASSOCIATES, INC.

Project Name:	Proposed Drive Shack Restaurant and Golf Driving Range	Report Date:	8/23/2019
		Sample Date:	7/22/2019
Project Number:	E40550.01		
		Sampled By:	JC
Subject:	Minimum Resistivity, ASTM G187	Tested By:	MA
Material Description:	Clayey sand	Test Date:	8/20/2019
Location:	B-9 @ 0-5'		

Laboratory Test Results, Minimum Resistivity - ASTM G187

Total Water Added, mls	Resistivity, Ohm-cm
50 mls	62,698
100 mls	41,354
150 mls	27,347
200 mls	18,009
250 mls	13,340
300 mls	10,005
350 mls	7,337
400 mls	8,004

Remarks: Min. Resistivity is 7,337 Ohm-cm

PH: 559.268.7021
FX: 559.268.7126
2527 Fresno Street
Fresno, CA 93721

14 3100 Irvine Ave PC#1349G-98

3100 IRVINE AVE.

G 9800394

1349G-98

9/29/99

NorCal Engineering
Soils and Geotechnical Consultants
10641 [illegible]umbolt Street Los Alamitos, CA 90720
(562) 799-9469 Fax (562) 799-9459

May 3, 1999 Project Number 7533-98

Duran Construction Compa[illegible]y
22901 Savi Ranch Parkway, Suite A
Yorba Linda, California 9[illegible]87

Attn. Mr. Ray Duran

Re: **Foundation Excavation Observations** - Proposed Leonard's Golf Shop Expansion - Located at 3100 Irvine Avenue, in the City of Newport Beach, California

Dear Mr. Duran:

Pursuant to your request, this firm has observed and approved foun[illegible] [illegible]avations for the above referenced project. The foundation excavations f[illegible] [illegible] [illegible]dition have been excavated into competent native soils and are cons[illegible] [illegible] their intended use. We appreciate this opportunity to be of service to you. If you have any further questions, please do not hesitate to contact the undersigned.

Respectfully submitted,
NORCAL ENGINEERING

Keith D. Tucker

REGISTERED PROFESSIONAL ENGINEER
KEITH D. TUCKER
No. 841
Exp. 12/31/00
GEOTECHNICAL
STATE OF CALIFORNIA

Keith D. Tucker
Project Engineer
R.G.E. 841

Gregory H. Bennett
Project Manager

NorCal Engineering
Soils and Geotechnical Consultants
10641 Humbolt Street Los Alamitos, CA 90720
(562) 799-9469 Fax (562) 799-9459

May 6, 1999 Project Number 7533-98

Duran Construction Company
22901 Savi Ranch Parkway, Suite A
Yorba Linda, California 92887

Attn: Mr. Ray Duran

RE: **Observation and Testing of Rough Grading Operations** – Proposed Leonard's Golf Shop Expansion – Located at 3100 Irvine Avenue, in the City of Newport Beach, California

Dear Mr. Duran:

Pursuant to your request, this firm has observed and tested rough grading operations at the above referenced project. Results of the compaction tests are attached and locations of these tests are shown on the accompanying Site Plan. All work was performed in accordance with our Geotechnical Investigation dated July 16, 1998, Project Number 7533-98 and all present day standards of the Geotechnical Engineering Industry.

Site Grading

All vegetation and demolition debris was stripped and removed from the fill area prior to grading operations. The existing low density soils were removed to competent native soils, the exposed subgrade scarified moisture conditioned and then recompacted to a minimum of 90% relative compaction. All excavations were observed and approved by this firm prior to placement of fill material. The overexcavation consisted of a minimum of five horizontal feet or to the depth of fill placed, whichever is greater beyond the outside edge of all proposed foundations with exception.

Fill soils placed were compacted to a minimum of 90% of the laboratory standard in lifts not in excess of eight inches in thickness. The maximum depth of fill placed was 2 feet. A track loader was utilized for compaction control. A water hose provided moisture control. The approximate limits of compacted fill are indicated on the attached Site Plan.

Laboratory/Field Testing

The relative compaction was determined by Sand Cone Method (ASTM: D1556-82) and by the Drive Tube Method (ASTM: D2937). The maximum density of the fill soils was obtained by the laboratory standard (ASTM: D1557-91) and results are shown on Table I. Compaction tests were performed a minimum of every 500 cubic yards placed and every two feet in depth of fill placed. Results of field density tests are presented in Table II.

Conclusions

The geotechnical engineering aspects of the grading have been observed and are in compliance with the geotechnical engineer's recommendations. The development has been graded to the approval of this firm and is suitable for its intended use.

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

Respectfully submitted,
NORCAL ENGINEERING

Keith D. Tucker

Keith D. Tucker
Project Engineer
R.G.E. 841

REGISTERED PROFESSIONAL ENGINEER
KEITH D. TUCKER
No. 841
Exp. 12/31/00
GEOTECHNICAL
STATE OF CALIFORNIA

Scott D. Spensiero
Project Manager

TABLE I
MAXIMUM DENSITY TESTS
(ASTM: D-1557-91)

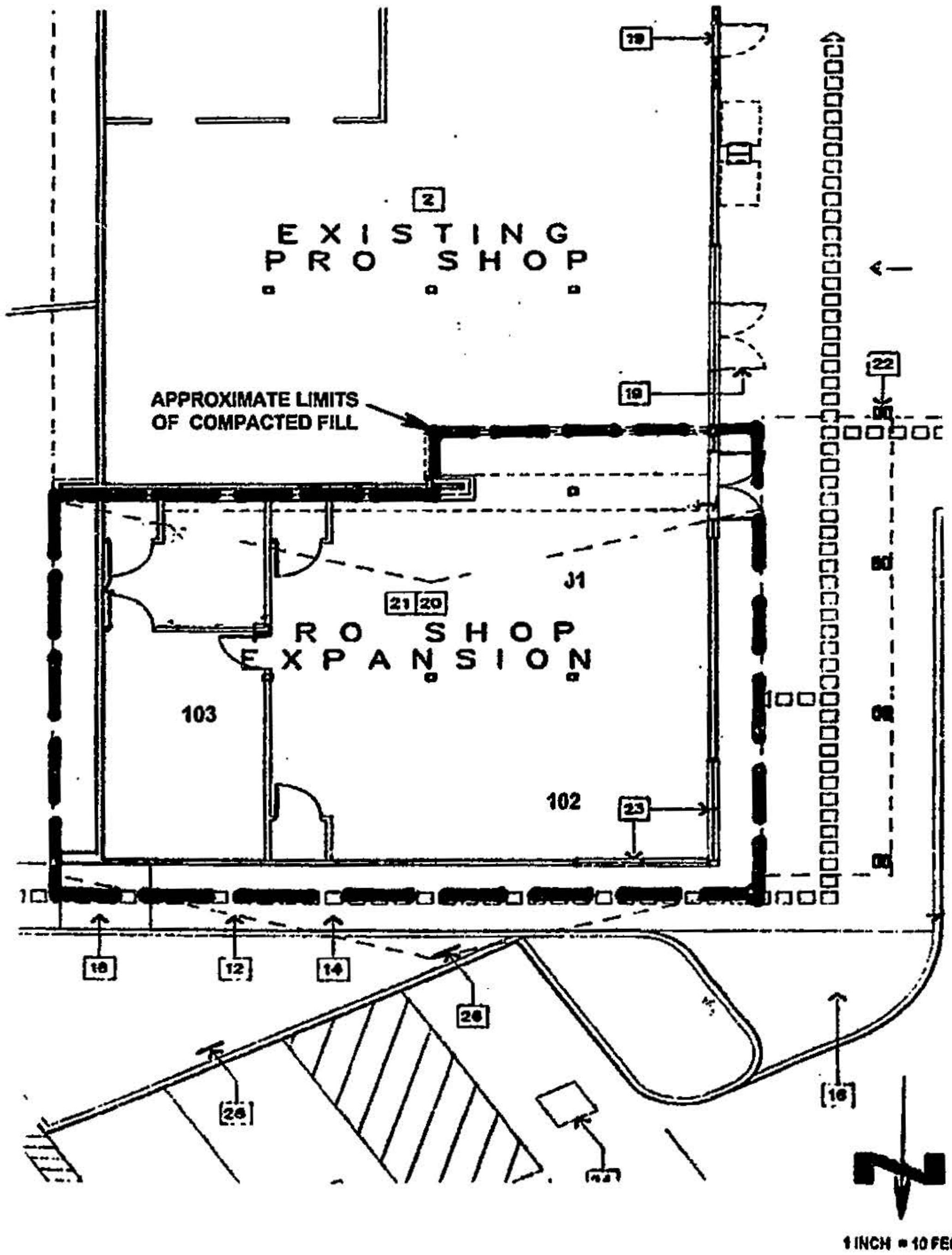
Soil Type	Classification	Optimum Moisture	Maximum Dry Density (lbs./cu.ft.)
I	Clayey SILT	15.5	116.5

TABLE II
SUMMARY OF COMPACTION TEST RESULTS

Date of Test	Test No.	Depth	Percent Moisture	Unit Wt. lbs./cu.ft.	Relative Compaction	Soil Type
4/29/99	101	2.0-2.5	18.9	105.2	90	I
4/29/99	102	1.0-1.5	17.1	116.1	90	I
4/29/99	103	0.0-0.5	14.3	107.1	92	I

*Depth below finished grade

**Retest of failing tests after area reworked



NorCal Engineering SOILS AND GEOTECHNICAL CONSULTANTS	SITE PLAN APPROXIMATE LOCATION OF COMPACTION TESTS
DURAN	
PROJECT 7533-98 DATE MAY 1999	

P/C1349.98

Soils Investigation
Proposed Leonard's Golf Shop Expansion
3100 Irvine Avenue
Newport Beach, California

APPROVED
FOR PERMIT ISSUANCE
SCOTT FAZEKAS & ASSOCIATES, INC.

BY ____________________ DATE __________
These plans have been reviewed for adherence to the applicable codes and ordinance. Authorization is hereby granted to issue a building permit pending approval by all applicable City agencies.

The issuance or granting of a permit based on approval of these plans shall not be construed to permit or approve any violation of the applicable codes ... presumed to give ... or cancel the provisions of such

Prepared For:
Duran Construction Corporation
22901 Savi Ranch Parkway, Suite A
Yorba Linda, California 92887

Project Number 7533-98
July 16, 1998

NorCal Engineering

NorCal Engineering
SOILS AND GEOTECHNICAL CONSULTANTS
10641 HUMBOLT STREET LOS ALAMITOS, CA 90720
(562)799-9469 FAX (562)799-9459

July 16, 1998 Project Number 7533-98

Duran Construction Corporation
22901 Savi Ranch Parkway, Suite A
Yorba Linda, California 92887

Attn: Mr. Ray Duran

RE: **Soils Investigation** - Proposed Leonard's Golf Shop Expansion - Located at 3100 Irvine Avenue, in the City of Newport Beach, California

Dear Mr. Duran:

Pursuant to your request, this firm has performed a Soils Investigation for the above referenced project in accordance with your authorization. The purpose of this investigation is to evaluate the geotechnical conditions of the subject site and to provide recommendations for the proposed golf shop expansion. This soils engineering report presents the finding of our study along with conclusions and recommendations for development.

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

Respectfully submitted,
NORCAL ENGINEERING

REGISTERED PROFESSIONAL ENGINEER
KEITH D. TUCKER
No. 841
Exp. 12/31/00
GEOTECHNICAL
STATE OF CALIFORNIA

Keith D. Tucker
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Structural Considerations

This geotechnical engineering report presents the findings of our study along with engineering analysis and recommendations for the proposed development. It is proposed to construct a one story, 1,300 square feet addition to the existing golf shop facility. Other improvements may consist of asphaltic and/or concrete parking and driveway areas and landscaping. Final building plans shall be reviewed by this firm prior to submittal for city approval to determine the need for any additional study and revised recommendations pertinent to the proposed development, if necessary.

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The property lies within the Irvine Golf Course in the city of Newport Beach. The proposed expansion area is currently covered with asphaltic concrete pavement and planter areas.

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The exploratory explorations revealed the existing earth materials to consist of surficial fill and natural soil zones. A detailed description of the subsurface conditions is listed on the excavation logs in Appendix A. These soils are described as follows:

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Groundwater was encountered at a depth of 7 feet below existing grades.

Laboratory Tests

Relatively undisturbed samples of the subsurface soils were obtained to perform laboratory testing and analysis for direct shear, consolidation tests, and to determine in-place moisture/densities. These undisturbed samples consisted of one inch rings with inside diameter of 2.5 inches. Bulk bag samples were obtained in the upper soils for expansion index tests and maximum density tests. Wall loadings on the order of 2,000 lbs./lin.ft. and maximum compression loads on the order of 20 kips were utilized for testing and design purposes. All test results are included in Appendix B, unless otherwise noted.

A. The field moisture content (ASTM:D 2216) and the dry densities of the ring samples were determined in the laboratory. This data is listed on the logs of borings.

B. Maximum density tests (ASTM: D-1557-78) were performed on typical samples of the upper soils. Results of these tests are shown on Table I.

C. Expansion index tests in accordance with the Uniform Building Code Standard No. 29-2 were performed on remolded samples of the upper soils to determine the expansive characteristics and to provide any necessary recommendations for reinforcement of the slabs-on-grade and the foundations. Results of these tests are provided on Table II.

D. Direct shear tests (ASTM: D-3080) were performed on undisturbed and disturbed samples of the subsurface soils. These tests were performed to determine parameters for the calculation of the safe bearing capacity. The test is performed under saturated conditions at loads of 500 lbs./sq.ft., 1,000 lbs./sq.ft., and 2,000 lbs./sq.ft. with results shown on Plate A.

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F. The potential corrosive effects of the on-site soils to concrete are being determined in the laboratory per EPA test method 9038. The test results will be provided in an addendum to this report.

Conclusions and Recommendations

Based upon our evaluations, the proposed development is acceptable from a geotechnical engineering standpoint. By following the recommendations and guidelines set forth in our report, the structures will be safe from excessive settlements under the anticipated design loadings and conditions. The proposed development shall meet all requirements of the City Building Ordinance and will not impose any adverse effect on existing adjacent structures.

It is recommended that site inspections be performed by a representative of this firm during all grading and construction of the development to verify the findings and recommendations documented in this report. Any unusual conditions which may be encountered in the course of the project development may require the need for additional study and revised recommendations.

Site Grading Recommendations

Any vegetation shall be removed and hauled from proposed grading areas prior to the start of grading operations. Any removed soils may be reutilized as compacted fill once any deleterious material or oversized materials (in excess of eight inches) are removed. All grading operations shall be performed in accordance with the attached "Specifications for Compacted Fill Operations."

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All upper disturbed soils (±12 inches) in areas to provide structural support shall be removed to competent native material, the exposed surface scarified to a depth of 12 inches, brought to the proper moisture content and compacted to a minimum of 90% of the laboratory standard (ASTM: D-1557-78) prior to placement of any additional compacted fill soils, foundations, slabs-on-grade and pavement. Grading shall extend a minimum of five horizontal feet or to the depth of vertical overexcavation, whichever is greater, beyond the outside edge of the perimeter foundation where possible.

A diligent search shall be conducted during grading operations in an effort to uncover any underground structures, irrigation or utility lines. If found, these structures and lines shall be either removed or properly abandoned prior to the proposed construction. Care should be taken to provide or maintain adequate lateral support for all adjacent improvements and structures at all times during the grading operations and construction phase. Adequate drainage away from the structures, pavement and slopes should be provided at all times.

Temporary Excavations

Temporary unsurcharged excavations over 4 feet in height in the existing site materials may be trimmed at a 1 to 1(horizontal to vertical) gradient. Cuts over 8 feet in height must be assessed by this firm prior to excavation activities. In areas where soil with little or no binder is encountered, where adverse geological conditions are exposed, or where excavations are adjacent to existing structures, shoring, slot-cutting, or flatter excavations may be required. The temporary cut slope gradients given above do not preclude local raveling and sloughing. All excavations shall be made in accordance with the requirements of CAL-OSHA and other public agencies having jurisdiction.

Foundation Design

The foundations may be designed utilizing safe being capacity of 1,500 psf for an embedded depth of 24 inches below lowest adjacent grade into approved compacted fill soils or competent native soils. All continuous foundations shall be reinforced with a minimum of one #5 bar, top and bottom. A representative of this firm shall inspect all foundation excavations prior to pouring concrete.

Care should be taken when excavating foundations adjacent to the existing structure so that proper lateral support is not removed from existing foundations. This may require the slot-cutting of new foundations in the area.

Lateral Resistance

The following values may be utilized in resisting lateral loads imposed on the structure. Requirements of the Uniform Building Code should be adhered to when the coefficient of friction and passive pressures are combined.

Coefficient of Friction - 0.35
Equivalent Passive Fluid Pressure = 200 lbs./cu.ft.
Maximum Passive Pressure = 2,000 lbs./cu.ft.

The passive pressure recommendations are valid only for either competent native soils and/or compacted fill soils.

Settlement Analysis

Resultant pressure curves for the consolidation tests are shown on Plate B. Computations utilizing these curves and the recommended safe bearing capacities reveal that the foundations will experience settlements on the order of 1/2 inch and differential settlements of less than 1/4 inch.

Retaining Wall Design Parameters

Active earth pressures against retaining walls will be equal to the pressures developed by the following fluid densities. These values are for **granular backfill material** placed adjacent to the walls at various ground slopes above the walls.

Surface Slope of Retained Materials (Horizontal to Vertical)	Equivalent Fluid Density (lb./cu.ft.)
Level	30
5 to 1	35
4 to 1	38
3 to 1	40
2 to 1	45

Any applicable short-term construction surcharges and seismic forces should be added to the above lateral pressure values. All walls shall be waterproofed as needed and protected from hydrostatic pressure by a reliable permanent subdrain system.

Slab Recommendations

All concrete slabs-on-grade shall be a minimum of four inches in thickness and may be placed on approved compacted fill soils. A vapor barrier should be utilized in areas which would be sensitive to the infiltration of moisture. This membrane should be placed beneath a 4 inch thick sand layer and not directly beneath the concrete due to the possibility of curling of the slab. Slabs shall be reinforced with a minimum of #3 bars, placed 18 inches on center in both directions, positioned mid-height in the slab. All concrete slab areas to receive floor coverings should be moisture tested to meet all manufacturer requirements prior to placement.

Slab subgrade soils shall be moisture conditioned to approximately 120% of optimum moisture levels immediately prior to placement of concrete.

Closure

The recommendations and conclusions contained in this report are based upon the soil conditions uncovered in our test excavations. No warranty of the soil condition between our excavations is implied. NorCal Engineering should be notified for possible further recommendations if unexpected to unfavorable conditions are encountered during construction phase. It is the responsibility of the owner to ensure that all information within this report is submitted to the Architect and appropriate Engineers for the project.

This firm should have the opportunity to review the final plans to verify that all our recommendations are incorporated. This report and all conclusions are subject to the review of the controlling authorities for the project.

A preconstruction conference should be held between the developer, general contractor, grading contractor, city inspector, architect, and soil engineer to clarify any questions relating to the grading operations and subsequent construction. Our representative should be present during the grading operations and construction phase to certify that such recommendations are complied within the field.

This soils investigation has been conducted in a manner consistent with the level of care and skill exercised by members of our profession currently practicing under similar conditions in the Southern California area. No other warranty, expressed or implied, is made.

SPECIFICATIONS FOR PLACEMENT OF COMPACTED FILL

Preparation

Any existing low density soils and/or saturated soils shall be removed to competent natural soil under the inspection of the Soils Engineering Firm. After the exposed surface has been cleansed of debris and/or vegetation, it shall be scarified until it is uniform in consistency, brought to the proper moisture content and compacted to a minimum of 90% relative compaction (in accordance with ASTM: D-1557-78).

Material For Fill

The on-site soils or approved import soils may be utilized for the compacted fill provided they are free of any deleterious materials and shall not contain any rocks, brick, asphaltic concrete, concrete or other hard materials greater than eight inches in maximum dimensions. Any import soil must be approved by the Soils Engineering firm a minimum of 24 hours prior to importation of site.

Placement of Compacted Fill Soils

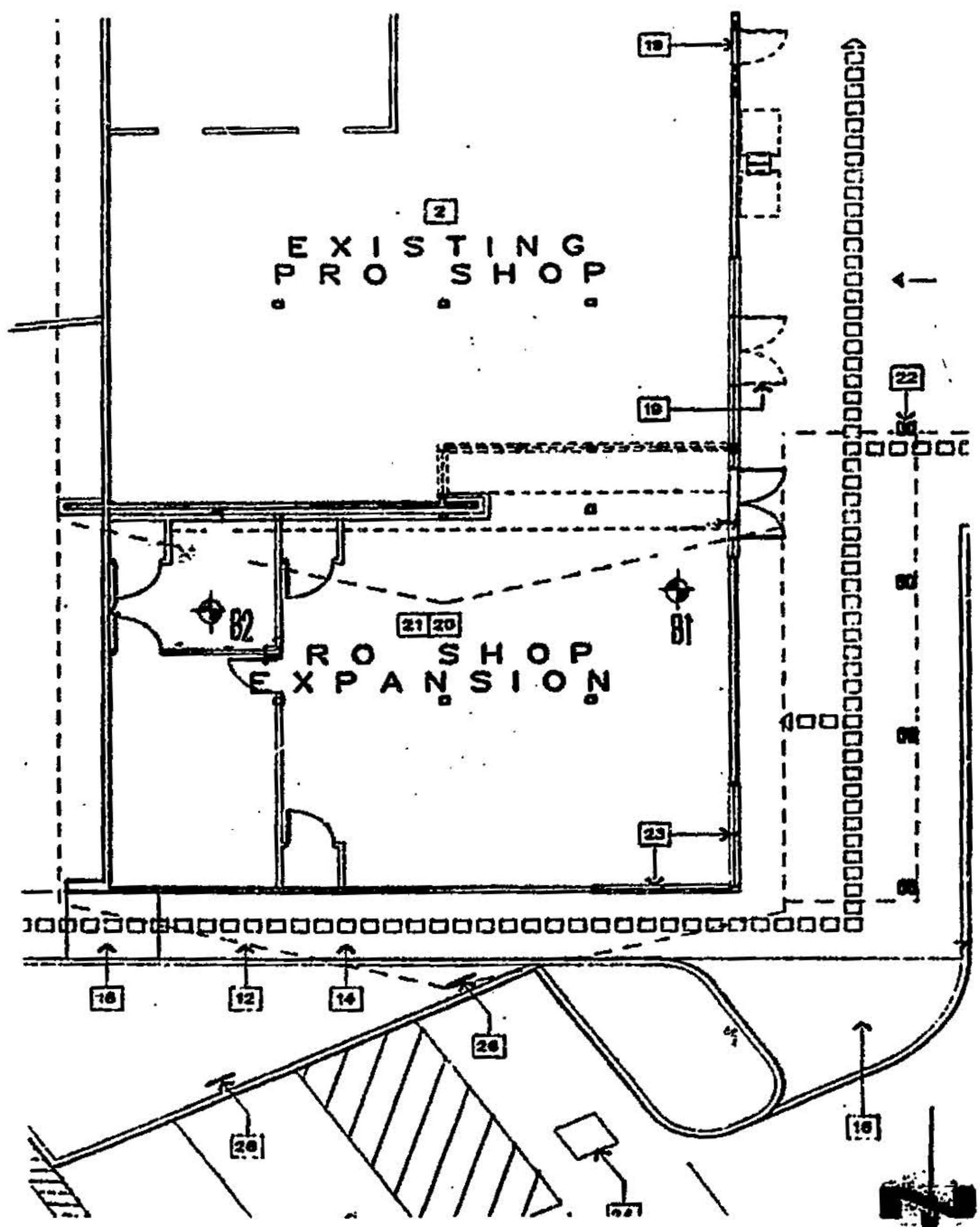
The approved fill soils shall be placed in layers not excess of six inches in thickness. Each lift shall be uniform in thickness and thoroughly blended. The fill soils shall be brought to within 15% of the optimum moisture content, unless otherwise specified by the Soils Engineering firm. Each lift shall be compacted to a minimum of 90% relative compaction (in accordance with ASTM: D-1557-78) and approved prior to the placement of the next layer of soil. Compaction tests shall be obtained at the discretion of the Soils Engineering firm but to a minimum of one test for every 500 cubic yards placed and/or for every 2 feet of compacted fill placed.

The minimum relative compaction shall be obtained in accordance with accepted methods in the construction industry. The final grade of the structural areas shall be in a dense and smooth condition prior to placement of slabs-on-grade or pavement areas. No fill soils shall be placed, spread or compacted during unfavorable weather conditions. When the grading is interrupted by heavy rains, compaction operations shall not be resumed until approved by the Soils Engineering firm.

Grading Observations

The controlling governmental agencies should be notified prior to commencement of any grading operations. This firm recommends that the grading operations be conducted under the observation of a Soils Engineering firm as deemed necessary. A 24 hour notice must be provided to this firm prior to the time of our initial inspection.

Observation shall include the clearing and grubbing operations to assure that all unsuitable materials have been properly removed; approve the exposed subgrade in areas to receive fill and in areas where excavation has resulted in the desired finished grade and designate areas of overexcavation; and perform field compaction tests to determine relative compaction achieved during fill placement. In addition, all foundation excavations shall be observed by the Soils Engineering firm to confirm that appropriate bearing materials are present at the design grades and recommend any modifications to construct footings.



NorCal Engineering
SOILS AND GEOTECHNICAL CONSULTANTS

DURAN

PROJECT 7533-98 | DATE JULY 1998

APPROXIMATE
LOCATION OF FIELD EXPLORATIONS

July 16, 1998

Project Number 7533-98

APPENDICES
(In order of appearance)

Appendix A - Logs of Exploratory Explorations
*Logs of Test Borings B1 and B2

Appendix B - Laboratory Analysis
*Table I - Maximum Dry Density Tests
*Table II - Expansion Index Tests

*Plate A - Direct Shear Tests
*Plate B - Consolidation Tests

July 16, 1998

Project Number 7533-98

APPENDIX A

NorCal Engineering

MAJOR DIVISIONS			SYMBOLS	TYPICAL NAMES
COARSE GRAINED SOILS (MORE THAN 50% OF MATERIAL IS LARGER THAN 200 SIEVE SIZE)	GRAVELS (MORE THAN 50% OF COARSE FRACTION IS LARGER THAN THE NO.4 SIEVE SIZE)	CLEAN GRAVELS (LITTLE OR NO FINES)	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
			GP	POORLY GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES.
		GRAVELS WITH FINES (APPRECIABLE AMT. OF FINES)	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES.
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES.
	SANDS (MORE THAN 50% OF COARSE FRACTION IS SMALLER THAN THE NO.4 SIEVE SIZE)	CLEAN SANDS	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES.
			SP	POORLY GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES.
		SANDS WITH FINES (APPRECIABLE AMT. OF FINES)	SM	SILTY SANDS, SAND-SILT MIXTURES.
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES.
FINE GRAINED SOILS (MORE THAN 50% OF MATERIAL IS SMALLER THAN 200 SIEVE SIZE	SILTS AND CLAYS (LIQUID LIMIT LESS THAN 50)		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY.
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS.
			OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS
	SILTS AND CLAYS (LIQUID LIMIT MORE THAN 50)		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS.
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS.
HIGHLY ORGANIC SOILS			Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS

BOUNDARY CLASSIFICATIONS. SOILS POSSESSING CHARACTERISTICS OF TWO GROUPS ARE DESIGNATED BY COMBINATIONS OF GROUP SYMBOLS

NorCal Engineering
SOILS AND GEOTECHNICAL CONSULTANTS

UNIFIED SOIL CLASSIFICATION SYSTEM

PROJECT | DATE

	MOISTURE (%)	DRY DENSITY (PCF)	PENETRATION RESISTANCE (BLOWS/FOOT)	SAMPLE TYPE	DEPTH (FEET)	DESCRIPTION OF SUBSURFACE MATERIALS THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED.	ELEVATION (FEET)
					0	.ill - Slightly clayey SAND, reddish brown moist, loose	
	10.5	119.7		R/B			
	15.5	114.2		R		Native - Slightly clayey SAND, reddish brown, moist, dense	
					5		
	19.7	109.5		R		Clayey SILT, brown, stiff, moist	
	17.7	108.7		R		Medium to coarse grained, SAND, reddish brown, dense, wet	
	14.6	111.6		R			
					10	Clayey SAND, reddish brown, dense, wet	
					15		
					20		
					25		
					30		
					35		

SAMPLE TYPES

- C Rock Core
- S Standard Split Spoon
- R Ring Sample
- B Bulk Sample
- J Jar Sample

DATE DRILLED: 7-13-98
EQUIPMENT USED: Hand Auger
GROUNDWATER LEVEL: 7.0'

NorCal Engineering
SOILS AND GEOTECHNICAL CONSULTANTS

LOG OF BORING #1

PROJECT 7533-98 | DATE

	MOISTURE (%)	DRY DENSITY (PCF)	PENETRATION RESISTANCE (BLOWS/FOOT)	SAMPLE TYPE	DEPTH (FEET)	DESCRIPTION OF SUBSURFACE MATERIALS	ELEVATION (FEET)
						THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED.	
					0	Fill - Slightly clayey SAND, reddish brown, moist, loose	
	13.9	122.4		R			
	15.9	114.8		R		Native - Slightly clayey SAND, reddish brown, moist, dense	
					5	Clayey SILT grey/brown, moist, stiff	
						- increase in sand content with depth	
					10		
					15		
					20		
					25		
					30		
					35		

SAMPLE TYPES

C Rock Core
S Standard Split Spoon
R Ring Sample
B Bulk Sample
J Jar Sample

DATE DRILLED: 7-13-98
EQUIPMENT USED: Hand Auger
GROUNDWATER LEVEL: None encountered

NorCal Engineering
SOILS AND GEOTECHNICAL CONSULTANTS

LOG OF BORING #2

PROJECT 7533-98 DATE

July 16, 1998

Project Number 7533-98

APPENDIX B

July 16, 1998

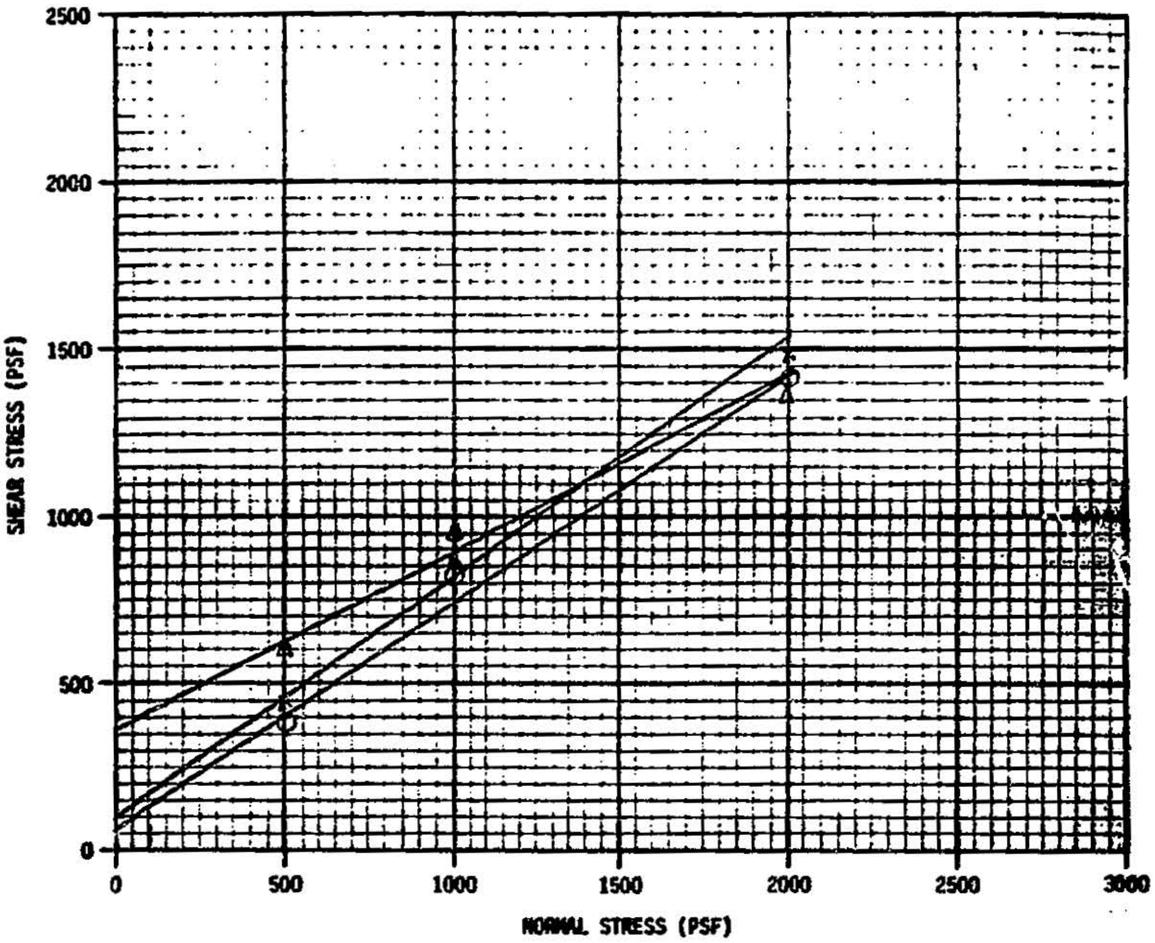
Project Number 7533-98

TABLE I
MAXIMUM DENSITY TESTS
(ASTM: D-1557-78)

Sample	Classification	Optimum Moisture	Maximum Dry Density (lbs./cu.ft.)
B1 @ 0-2'	slightly clayey SAND	9.0	128.0
B2 @ 2.5-3	clayey SILT	15.5	116.5

TABLE II
EXPANSION INDEX TESTS
(U.B.C. STD. 29-2)

Sample	Classification	Expansion Index
B1 @ 0-2'	slightly clayey SAND	05
B2 @ 2.5-3	clayey SILT	74



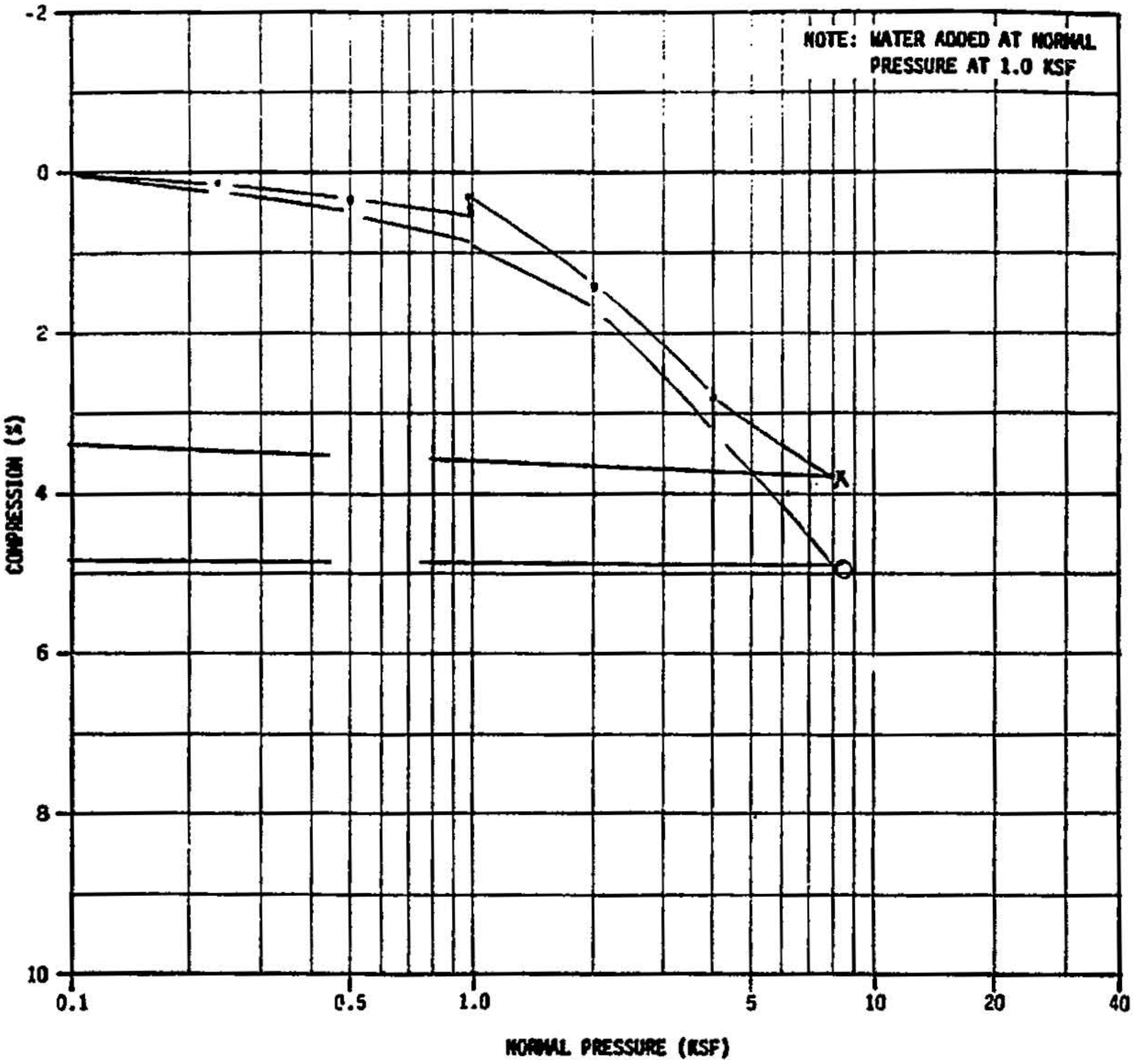
SYMBOL	BORING NUMBER	DEPTH (FEET)	ø (DEGREES)	C (PSF)	DRY DENSITY (PCF)	MOISTURE CONTENT (%)
X	1	2.0	35	100	119.7	10.5
O	2	2.0	33	75	122.4	13.9
Δ	2	4.0	27	375	114.8	16.9
□						

NOTE: TESTS PERFORMED ON SATURATED SAMPLES UNLESS SHOWN BELOW.
(FM) FIELD MOISTURE
TESTS PERFORMED ON UNDISTURBED SAMPLES UNLESS SHOWN BELOW.
(R) SAMPLES REMOLDED AT 90% OF MAXIMUM DRY DENSITY

NorCal Engineering
SOILS AND GEOTECHNICAL CONSULTANTS

PROJECT 7533-98 | DATE

DIRECT SHEAR TEST RESULTS
Plate A



SYMBOL	BORING NUMBER	DEPTH (FEET)	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)
X	1	4.0	114.2	15.5		
O	1	8.0	108.7	17.7		
Δ						
□						

——— COMPRESSION (FM) FIELD MOISTURE - NO WATER ADDED

— — — REBOUND (R) SAMPLE REMOLDED AT 90% OF MAXIMUM DRY DENSITY

NorCal Engineering
SOILS AND GEOTECHNICAL CONSULTANTS

PROJECT 7533-98 DATE

CONSOLIDATION TEST RESULTS

Plate B

Soils Investigation CNB
Proposed ~~Leonard's Golf Shop~~ Expansion
3100 ~~Irvine~~ Avenue
Newport Beach, California

1349G-98

Prepared For:

Duran Construction Corporation
22901 Savi Ranch Parkway, Suite A
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Keith D. Tucker
Project Engineer
R.G.E. 841

REGISTERED PROFESSIONAL ENGINEER
KEITH D. TUCKER
No. 841
Exp. 12/31/00
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STATE OF CALIFORNIA

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Conclusions and Recommendations

Based upon our evaluations, the proposed development is acceptable from a geotechnical engineering standpoint. By following the recommendations and guidelines set forth in our report, the structures will be safe from excessive settlements under the anticipated design loadings and conditions. The proposed development shall meet all requirements of the City Building Ordinance and will not impose any adverse effect on existing adjacent structures.

It is recommended that site inspections be performed by a representative of this firm during all grading and construction of the development to verify the findings and recommendations documented in this report. Any unusual conditions which may be encountered in the course of the project development may require the need for additional study and revised recommendations.

Site Grading Recommendations

Any vegetation shall be removed and hauled from proposed grading areas prior to the start of grading operations. Any removed soils may be reutilized as compacted fill once any deleterious material or oversized materials (in excess of eight inches) are removed. All grading operations shall be performed in accordance with the attached "Specifications for Compacted Fill Operations."

All upper disturbed soils (±12 inches) in areas to provide structural support shall be removed to competent native material, the exposed surface scarified to a depth of 12 inches, brought to the proper moisture content and compacted to a minimum of 90% of the laboratory standard (ASTM: D-1557-78) prior to placement of any additional compacted fill soils, foundations, slabs-on-grade and pavement. Grading shall extend a minimum of five horizontal feet or to the depth of vertical overexcavation, whichever is greater, beyond the outside edge of the perimeter foundation where possible.

A diligent search shall be conducted during grading operations in an effort to uncover any underground structures, irrigation or utility lines. If found, these structures and lines shall be either removed or properly abandoned prior to the proposed construction. Care should be taken to provide or maintain adequate lateral support for all adjacent improvements and structures at all times during the grading operations and construction phase. Adequate drainage away from the structures, pavement and slopes should be provided at all times.

Temporary Excavations

Temporary unsurcharged excavations over 4 feet in height in the existing site materials may be trimmed at a 1 to 1(horizontal to vertical) gradient. Cuts over 8 feet in height must be assessed by this firm prior to excavation activities. In areas where soil with little or no binder is encountered, where adverse geological conditions are exposed, or where excavations are adjacent to existing structures, shoring, slot-cutting, or flatter excavations may be required. The temporary cut slope gradients given above do not preclude local raveling and sloughing. All excavations shall be made in accordance with the requirements of CAL-OSHA and other public agencies having jurisdiction.

Foundation Design

The foundations may be designed utilizing safe being capacity of 1,500 psf for an embedded depth of 24 inches below lowest adjacent grade into approved compacted fill soils or competent native soils. All continuous foundations shall be reinforced with a minimum of one #5 bar, top and bottom. A representative of this firm shall inspect all foundation excavations prior to pouring concrete.

Care should be taken when excavating foundations adjacent to the existing structure so that proper lateral support is not removed from existing foundations. This may require the slot-cutting of new foundations in the area.

Lateral Resistance

The following values may be utilized in resisting lateral loads imposed on the structure. Requirements of the Uniform Building Code should be adhered to when the coefficient of friction and passive pressures are combined.

Coefficient of Friction - 0.35
Equivalent Passive Fluid Pressure = 200 lbs./cu.ft.
Maximum Passive Pressure = 2,000 lbs./cu.ft.

The passive pressure recommendations are valid only for either competent native soils and/or compacted fill soils.

Settlement Analysis

Resultant pressure curves for the consolidation tests are shown on Plate B. Computations utilizing these curves and the recommended safe bearing capacities reveal that the foundations will experience settlements on the order of 1/2 inch and differential settlements of less than 1/4 inch.

Retaining Wall Design Parameters

Active earth pressures against retaining walls will be equal to the pressures developed by the following fluid densities. These values are for **granular backfill material** placed adjacent to the walls at various ground slopes above the walls.

Surface Slope of Retained Materials (Horizontal to Vertical)	Equivalent Fluid Density (lb./cu.ft.)
Level	30
5 to 1	35
4 to 1	38
3 to 1	40
2 to 1	45

Any applicable short-term construction surcharges and seismic forces should be added to the above lateral pressure values. All walls shall be waterproofed as needed and protected from hydrostatic pressure by a reliable permanent subdrain system.

Slab Recommendations

All concrete slabs-on-grade shall be a minimum of four inches in thickness and may be placed on approved compacted fill soils. A vapor barrier should be utilized in areas which would be sensitive to the infiltration of moisture. This membrane should be placed beneath a 4 inch thick sand layer and not directly beneath the concrete due to the possibility of curling of the slab. Slabs shall be reinforced with a minimum of #3 bars, placed 18 inches on center in both directions, positioned mid-height in the slab. All concrete slab areas to receive floor coverings should be moisture tested to meet all manufacturer requirements prior to placement.

Slab subgrade soils shall be moisture conditioned to approximately 120% of optimum moisture levels immediately prior to placement of concrete.

Closure

The recommendations and conclusions contained in this report are based upon the soil conditions uncovered in our test excavations. No warranty of the soil condition between our excavations is implied. NorCal Engineering should be notified for possible further recommendations if unexpected to unfavorable conditions are encountered during construction phase. It is the responsibility of the owner to ensure that all information within this report is submitted to the Architect and appropriate Engineers for the project.

This firm should have the opportunity to review the final plans to verify that all our recommendations are incorporated. This report and all conclusions are subject to the review of the controlling authorities for the project.

A preconstruction conference should be held between the developer, general contractor, grading contractor, city inspector, architect, and soil engineer to clarify any questions relating to the grading operations and subsequent construction. Our representative should be present during the grading operations and construction phase to certify that such recommendations are complied within the field.

This soils investigation has been conducted in a manner consistent with the level of care and skill exercised by members of our profession currently practicing under similar conditions in the Southern California area. No other warranty, expressed or implied, is made.

SPECIFICATIONS FOR PLACEMENT OF COMPACTED FILL

Preparation

Any existing low density soils and/or saturated soils shall be removed to competent natural soil under the inspection of the Soils Engineering Firm. After the exposed surface has been cleansed of debris and/or vegetation, it shall be scarified until it is uniform in consistency, brought to the proper moisture content and compacted to a minimum of 90% relative compaction (in accordance with ASTM: D-1557-78).

Material For Fill

The on-site soils or approved import soils may be utilized for the compacted fill provided they are free of any deleterious materials and shall not contain any rocks, brick, asphaltic concrete, concrete or other hard materials greater than eight inches in maximum dimensions. Any import soil must be approved by the Soils Engineering firm a minimum of 24 hours prior to importation of site.

Placement of Compacted Fill Soils

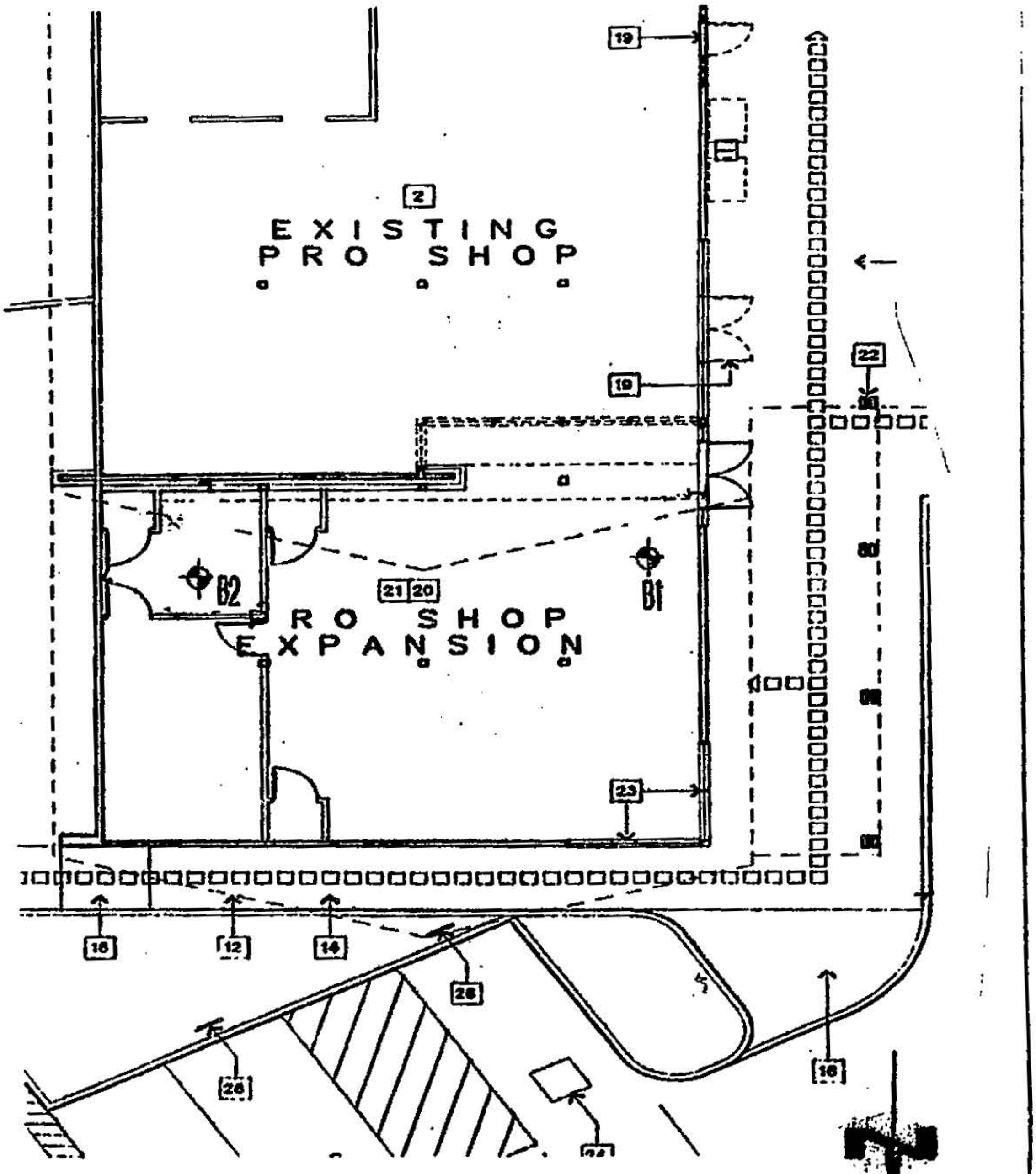
The approved fill soils shall be placed in layers not excess of six inches in thickness. Each lift shall be uniform in thickness and thoroughly blended. The fill soils shall be brought to within 15% of the optimum moisture content, unless otherwise specified by the Soils Engineering firm. Each lift shall be compacted to a minimum of 90% relative compaction (in accordance with ASTM: D-1557-78) and approved prior to the placement of the next layer of soil. Compaction tests shall be obtained at the discretion of the Soils Engineering firm but to a minimum of one test for every 500 cubic yards placed and/or for every 2 feet of compacted fill placed.

The minimum relative compaction shall be obtained in accordance with accepted methods in the construction industry. The final grade of the structural areas shall be in a dense and smooth condition prior to placement of slabs-on-grade or pavement areas. No fill soils shall be placed, spread or compacted during unfavorable weather conditions. When the grading is interrupted by heavy rains, compaction operations shall not be resumed until approved by the Soils Engineering firm.

Grading Observations

The controlling governmental agencies should be notified prior to commencement of any grading operations. This firm recommends that the grading operations be conducted under the observation of a Soils Engineering firm as deemed necessary. A 24 hour notice must be provided to this firm prior to the time of our initial inspection.

Observation shall include the clearing and grubbing operations to assure that all unsuitable materials have been properly removed; approve the exposed subgrade in areas to receive fill and in areas where excavation has resulted in the desired finished grade and designate areas of overexcavation; and perform field compaction tests to determine relative compaction achieved during fill placement. In addition, all foundation excavations shall be observed by the Soils Engineering firm to confirm that appropriate bearing materials are present at the design grades and recommend any modifications to construct footings.



NorCal Engineering
SOILS AND GEOTECHNICAL CONSULTANTS

DURAN

PROJECT 7533-98 | DATE JULY 1998

APPROXIMATE
LOCATION OF FIELD EXPLORATIONS

July 16, 1998 Project Number 7533-98

APPENDICES

(In order of appearance)

Appendix A - Logs of Exploratory Explorations
***Logs of Test Borings B1 and B2**

Appendix B - Laboratory Analysis
***Table I - Maximum Dry Density Tests**
***Table II - Expansion Index Tests**

***Plate A - Direct Shear Tests**
***Plate B - Consolidation Tests**

July 16, 1998

Project Number 7533-98

APPENDIX A

NorCal Engineering

MAJOR DIVISIONS			SYMBOLS	TYPICAL NAMES
COARSE GRAINED SOILS (MORE THAN 50% OF MATERIAL IS LARGER THAN 200 SIEVE SIZE)	GRAVELS (MORE THAN 50% OF COARSE FRACTION IS LARGER THAN THE NO.4 SIEVE SIZE)	CLEAN GRAVELS (LITTLE OR NO FINES)	GW	WELL GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
			GP	POORLY GRADED GRAVELS OR GRAVEL - SAND MIXTURES, LITTLE OR NO FINES.
		GRAVELS WITH FINES (APPRECIABLE AMT OF FINES)	GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES.
			GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES.
	SANDS (MORE THAN 50% OF COARSE FRACTION IS SMALLER THAN THE NO.4 SIEVE SIZE)	CLEAN SANDS	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES.
			SP	POORLY GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES.
		SANDS WITH FINES (APPRECIABLE AMT. OF FINES)	SM	SILTY SANDS, SAND - SILT MIXTURES.
			SC	CLAYEY SANDS, SAND - CLAY MIXTURES.
FINE GRAINED SOILS (MORE THAN 50% OF MATERIAL IS SMALLER THAN 200 SIEVE SIZE)	SILTS AND CLAYS (LIQUID LIMIT LESS THAN 50)		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY.
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS.
			OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS
	SILTS AND CLAYS (LIQUID LIMIT MORE THAN 50)		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS.
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS.
HIGHLY ORGANIC SOILS			Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS

BOUNDARY CLASSIFICATIONS. SOILS POSSESSING CHARACTERISTICS OF TWO GROUPS ARE DESIGNATED BY COMBINATIONS OF GROUP SYMBOLS

NorCal Engineering SOILS AND GEOTECHNICAL CONSULTANTS	UNIFIED SOIL CLASSIFICATION SYSTEM
PROJECT	DATE

	MOISTURE (%)	DRY DENSITY (PCF)	PENETRATION RESISTANCE (BLOWS/FOOT)	SAMPLE TYPE	DEPTH (FEET)	DESCRIPTION OF SUBSURFACE MATERIALS	ELEVATION (FEET)
						THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED.	
					0	Fill - Slightly clayey SAND, reddish brown moist, loose	
	10.5	119.7		R/B			
	15.5	114.2		R		Native - Slightly clayey SAND, reddish brown, moist, dense	
					5		
	19.7	109.5		R		Clayey SILT, brown, stiff, moist	
	17.7	108.7		R		Medium to coarse grained, SAND, reddish brown, dense, wet	
	14.6	111.6		R			
					10	Clayey SAND, reddish brown, dense, wet	
					15		
					20		
					25		
					30		
					35		

SAMPLE TYPES

C Rock Core
S Standard Split Spoon
R Ring Sample
B Bulk Sample
J Jar Sample

DATE DRILLED: 7-13-98
EQUIPMENT USED: Hand Auger
GROUNDWATER LEVEL: 7.0'

NorCal Engineering
SOILS AND GEOTECHNICAL CONSULTANTS

LOG OF BORING #1

PROJECT 7533-98 | DATE

	MOISTURE (%)	DRY DENSITY (PCF)	PENETRATION RESISTANCE (BLOWS/FOOT)	SAMPLE TYPE	DEPTH (FEET)	DESCRIPTION OF SUBSURFACE MATERIALS	ELEVATION (FEET)
	13.9	122.4		R	0	Fill - Slightly clayey SAND, reddish brown, moist, loose	
	15.9	114.8		R		Native - Slightly clayey SAND, reddish brown, moist, dense	
					5	Clayey SILT grey/brown, moist, stiff - increase in sand content with depth	
					10		
					15		
					20		
					25		
					30		
					35		

THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED.

SAMPLE TYPES
C Rock Core
S Standard Split Spoon
R Ring Sample
B Bulk Sample
J Jar Sample

DATE DRILLED: 7-13-98
EQUIPMENT USED: Hand Auger
GROUNDWATER LEVEL: None encountered

NorCal Engineering
SOILS AND GEOTECHNICAL CONSULTANTS

LOG OF BORING #2

PROJECT 7533-98 DATE

July 16, 1998 Project Number 7533-98

APPENDIX B

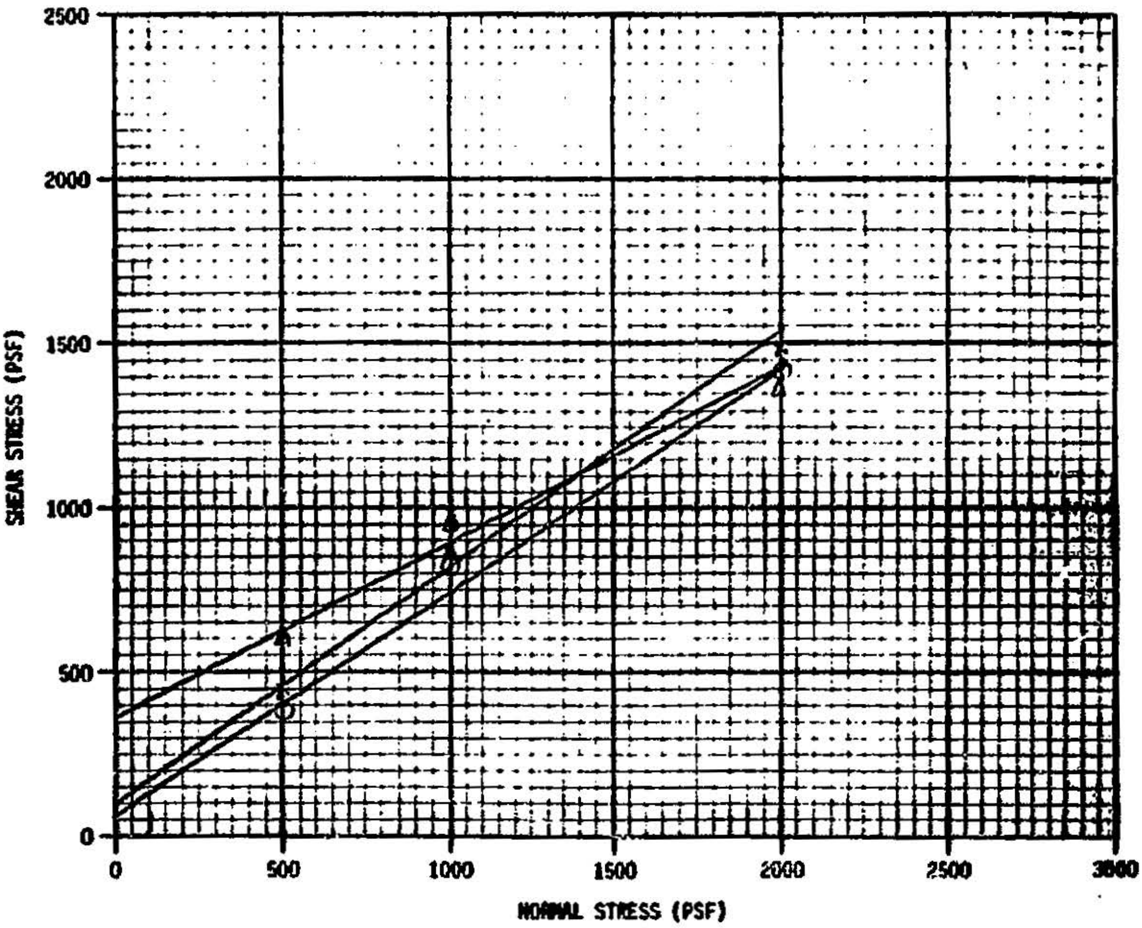
July 16, 1998 Project Number 7533-98

TABLE I
MAXIMUM DENSITY TESTS
(ASTM: D-1557-78)

Sample	Classification	Optimum Moisture	Maximum Dry Density (lbs./cu.ft.)
B1 @ 0-2'	slightly clayey SAND	9.0	128.0
B2 @ 2.5-3	clayey SILT	15.5	116.5

TABLE II
EXPANSION INDEX TESTS
(U.B.C. STD. 29-2)

Sample	Classification	Expansion Index
B1 @ 0-2'	slightly clayey SAND	05
B2 @ 2.5-3	clayey SILT	74



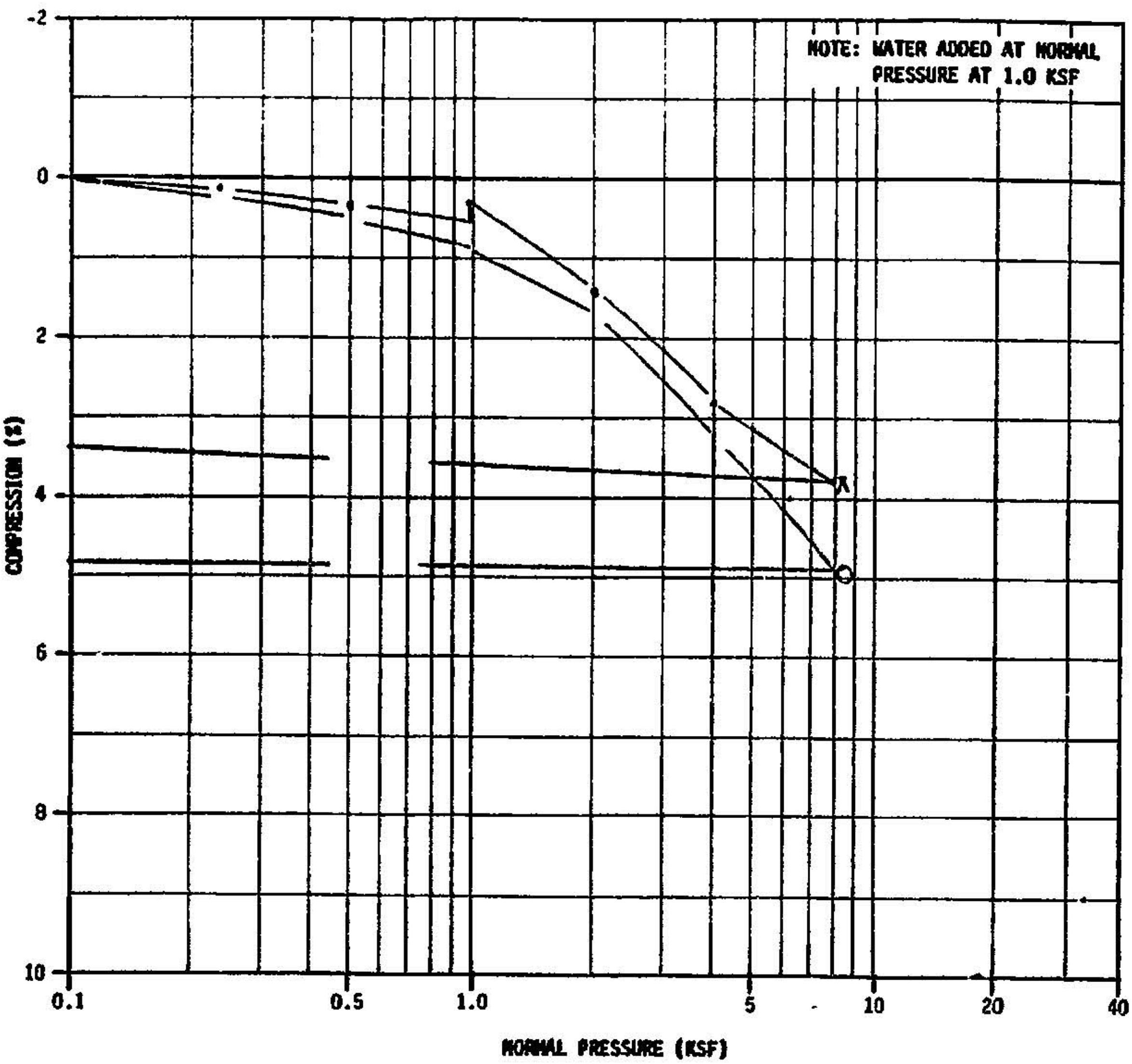
SYMBOL	BORING NUMBER	DEPTH (FEET)	Ø (DEGREES)	C (PSF)	DRY DENSITY (PCF)	MOISTURE CONTENT (%)
X	1	2.0	35	100	119.7	10.5
O	2	2.0	33	75	122.4	13.9
Δ	2	4.0	27	375	114.8	16.9
□						

NOTE: TESTS PERFORMED ON SATURATED SAMPLES UNLESS SHOWN BELOW.
(FM) FIELD MOISTURE
TESTS PERFORMED ON UNDISTURBED SAMPLES UNLESS SHOWN BELOW.
(R) SAMPLES REMOLDED AT 90% OF MAXIMUM DRY DENSITY

NorCal Engineering
SOILS AND GEOTECHNICAL CONSULTANTS

PROJECT 7533-98 | DATE

DIRECT SHEAR TEST RESULTS
Plate A



SYMBOL	BORING NUMBER	DEPTH (FEET)	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)
X	1	4.0	114.2	15.5		
O	1	8.0	108.7	17.7		
△						
□						

——— COMPRESSION (FM) FIELD MOISTURE - NO WATER ADDED

– – – REBOUND (R) SAMPLE REMOLDED AT 90% OF MAXIMUM DRY DENSITY

NorCal Engineering
SOILS AND GEOTECHNICAL CONSULTANTS

PROJECT 7533-98 DATE

CONSOLIDATION TEST RESULTS

Plate B

BACA ASSOCIATES, INC.
GEOTECHNICAL ENGINEERING CONSULTANTS
Soils - Foundations - Geology

1141 N. LEMON STREET, ANAHEIM, CALIFORNIA 92801 (714) 778-0702

August 19, 1989

Project: A-0675-F

DeMille and Healy Development
20301 Acacia Street
Suite 240
Santa Ana Heights, CA. 92707

Attention: Mr. Dan DeMille

Gentlemen:

Submitted herewith is the report of a geotechnical soils and foundation investigation conducted by this office for the proposed Acacia Plaza III office building project located on Acacia Street in the Orange County district of Santa Ana Heights, California.

The project site is currently occupied by several one-story residence and garage buildings, as well as other associated features such as paved drives, fences and yard walls, walkways, various moderate to large size trees, etc. It is possible that subterranean waste disposal structures (septic tanks, cesspools, etc.) may also occur within the property. Partial excavation and recompaction is recommended to provide for a firm, uniform, subgrade support condition under the building, particularly in view of the considerable amount of site demolition clearing and associated disturbance to be performed. Conventional shallow footings will provide adequate foundation support for proposed buildings and other structures.

The investigation was made in accordance with generally accepted engineering procedures and included such field and laboratory tests considered necessary in the circumstances. In the opinion of the undersigned, the accompanying report has been substantiated by mathematical data in conformity with generally accepted engineering principles and presents fairly the design information requested by your organization.

Respectfully submitted,

BACA ASSOCIATES

Albert Baca, RCE #28927, GE #106

REGISTERED PROFESSIONAL ENGINEER
ALBERT BACA
No. 106
Exp. 3-31-91
GEOTECHNICAL
STATE OF CALIFORNIA

REGISTERED PROFESSIONAL ENGINEER
ALBERT BACA
No. 28927
Exp. 3-31-91
CIVIL
STATE OF CALIFORNIA

AB/se

Distribution: (5) DeMille and Healy Development
(1) Nuttall-Uchizono Associates

INTRODUCTION

The primary objectives of this study were to explore subsurface conditions beneath the project site and evaluate the existing earth materials relative to foundation support, lateral pressure design considerations, floor slab support and A.C. pavement design. Also presented in this report are general observations, data and recommendations relating to site preparation, grading and earthwork compaction, as well as soil concrete corrosion potential.

The general scope of work directed at meeting the study objectives included the following:

(1) Review of current tentative project plans, as well as periodic discussion of various project development features and considerations with the client.

(2) Subsurface exploration by means of four test borings with a flight-auger drill rig.

(3) Laboratory testing to establish earth material characteristics.

(4) Geotechnical evaluation and analysis of field and laboratory test data.

(5) Preparation of report.

This report has been prepared for the exclusive use of the client and their consultants in the design of the proposed Acacia Plaza III office building development.

SITE CONDITIONS

The rectangular shaped, approximate one acre property is located on the northwest side of Acacia Street about 500 feet southwest of its intersection with Orchard Drive in the unincorporated Orange County community of Santa Ana Heights, California. The Newport Beach Golf Course borders the rear property line on the northwest. The adjacent property to the northeast is occupied by an existing office building complex (Acacia Plaza II), while lots to the southwest are occupied by older residences. The approximate site location with respect to surrounding streets and highways, the general topographical setting of the area, and other landmarks is shown on Plate A, Vicinity Map.

Topographically, the subject property and adjacent lots to the northeast and southwest are essentially level, with a slight southeast to northwest drainage gradient towards the somewhat lower golf course area. The total on-site topographical relief is estimated to be on the order of 4 to 5 feet.

The project site is occupied by several small one-story residence and garage structures. Other typical appurtenances include paved driveways, concrete walkways, yard fences and walls, lawns, other landscaped areas and numerous moderate to large size trees. It is understood that now abandoned on-site waste disposal systems (septic tanks, cesspools, etc.) may possibly occur within the property, probably in close proximity to the existing residences.

PROPOSED CONSTRUCTION

It is understood that the existing buildings and all other appurtenant features will be demolished and/or removed in the course of preparing the site for new construction.

The primary element of the proposed development will consist of a two-story office building. The approximate tentative building location is shown on Plate B, Plot Plan. It is understood that the planned building structure will probably be of typical woodframe construction with lower level concrete floor slabs on grade.

Based on past experience with similar types of construction, it is estimated that structural foundation loads will be on the order of 1500 to 2500 pounds per lineal foot along continuous bearing walls, and/or 30 to 50 kips at isolated column supports.

The major portion of remaining non-building site areas will be employed as A.C. paved driveways and parking stalls with some local perimeter and interior planters.

It is anticipated that grading required to prepare the site for construction will involve relatively modest grade changes, possibly on the order of 3 to 4 foot maximum depth cuts and/or fills (exclusive of subterranean excavation if any).

FIELD INVESTIGATION

The field investigation consisted of subsurface exploration by means of four (4) test borings made with a hollow-stem, continuous flight auger drill rig. Exploration depths ranged between 15 to 25 feet. Approximate test boring locations are shown on Plate B.

A continuous record of the earth materials encountered during exploratory drilling was made by the field engineer and is presented on Plates C and F, "Logs of Borings". It should be noted that the lines designating the interfaces between various strata on the boring logs represent approximate boundaries only since the actual transition between materials may be somewhat gradual.

"Undisturbed" samples were secured at selected depth intervals for laboratory examination and testing. Sampling was accomplished with a 2.5 inch I. D. steel barrel lined with a series of one-inch long thin brass rings. The sample barrel was driven approximately 12 inches with a 140-pound weight dropped 30 inches. Recorded blow counts for 12 inches of sampler penetration are tabulated in the "Blows per Foot" column of the boring logs. Disturbed bulk samples of the various predominant materials observed were also obtained.

It should be noted that the hollow-stem drilling equipment employed uses continuous flight auger sections resulting in full temporary casing of the test boring, thereby not allowing caving to occur. It is probable that an open boring would have experienced only slight to occasional local moderate caving, however.

SUBSURFACE CONDITIONS

In addition to the existing building slabs, immediate surface conditions include various walkway and drive concrete pavements, lawn grass covers, other landscaping, and local areas of exposed earth. It is possible that the upper, variable 1 to 3 foot zone may consist of fill and/or processed native materials associated with the original development of the site.

Natural deposits beneath the project site are mapped as Pleistocene age marine terrace deposits reportedly consisting of essentially flat lying, interbedded silty/clayey sands and silty/sandy clays. These upper terrace deposits have been estimated to be in excess of 100 feet thick in the site vicinity, followed by the Niguel (Pliocene age) and older Tertiary sedimentary formations (bedrock) which extend down to the granitic basement complex at a depth estimated to be about 15,000 feet.

The soil profile as observed within the 25-foot maximum depth explored generally consisted of fine to medium grained sands with a variable moderate to very slight clay content. A silty clay deposit encountered in borings 1 and 2 at a depth of about 7 feet and 12 feet, respectively, apparently feathers out to the southeast, or at least dips below the bottom of boring 3 and 4. Also, the sand texture coarseness and clay/silt content appear to increase and decrease, respectively, toward the southeast.

As reflected by the common moderate to high sampler blow counts recorded during exploratory drilling operations (see Plates C to F, the site deposits exhibit a firm to very firm in-situ consistency, generally improving gradually with depth.

No groundwater or local perched seepage zones were observed within the 25-foot maximum depth explored.

More detailed descriptions of the soil profile as observed in the test borings are presented on Plates C to F.

LABORATORY TESTING

In-situ density and/or moisture content values were determined for all the undisturbed samples obtained during exploratory drilling operations. Test results are plotted and tabulated on Plates C to F, Logs of Borings.

Mechanical analyses by the hydrometer test method were performed on selected samples to confirm field classifications. Test results were as follows:

Boring No.	Depth (feet)	Percent Sand	Percent Silt	Percent Clay
2	2.0	60	25	15
2	5.5	72	10	18
2	9.5	75	12	13
2	14.5	27	31	42
2	19.5	15	40	45
* 4	2.5	65	18	17

*Bulk Sample

An Expansion Index test was performed on a bulk sample selected as being generally representative of the existing near surface clayey sand soils (boring #4 @ 2.5 feet). Test results were as follows:

(1) Moisture @ Compaction = 7.7 percent

(2) Dry Unit Weight = 119.0 pcf

(3) Expansion Index = 24 (Low expansive per UBC Table 29)

Direct shear testing was concentrated on various "undisturbed" samples representative of the common clayey to slight clayey sands within the upper 5 to 10 foot zone. Testing was performed under various normal loads in the saturated-drained condition. Individual plotted test results, as well as the estimated average friction angle and cohesion values are presented on Plate G.

Consolidation (load-deformation) tests were also performed on various typical undisturbed soil samples. Plotted test results are presented on Plates H, I, J. and K.

A chemical analysis was performed on a bulk sample specimen obtained in boring #4 at a depth of 2.5 feet. Test results indicated a soluble sulfate content of 169 ppm (Test Method No. Calif. 417A). Based on this test result, the site soils are characterized by a very low concrete corrosion potential and the use of special sulfate resistant cement is not considered necessary.

CONCLUSIONS AND RECOMMENDATIONS

Based on the findings of this investigation, it is concluded that development of the site as planned is feasible relative to soils foundation conditions.

Conventional shallow spread footings should provide adequate foundation support for proposed building structure. In view of the considerable amount of demolition, site clearing and probable attendant surficial disturbance anticipated to prepare the site for grading and construction, as well as possible local non-uniformities of the upper clayey sand soils, partial excavation and recompaction is recommended for the building area in order to secure a known uniform subgrade support condition.

Following are more specific observations, conclusions, and design recommendations.

A. Site Preparation Earthwork:

Prior to grading, the site should be cleared of existing buildings, pavement, slabs and other structures, as well as any significant vegetation, debris, demolition rubble, etc. Tree roots should be removed to a depth of at least 3.0 feet below existing or finished grades, whichever is lower. Any buried debris, rubble or other contaminated material exposed during subsequent earthwork operations should also be removed. Excavations made for removal of any existing foundations, utility lines, septic tanks, other subterranean structures, tree roots, etc., should be cleared of loose material and backfilled with clean compacted soil.

Existing cesspools, if any, should be broken off at a depth of at least 5.0 feet, cleared of any significant bottom sludge, mud, debris, etc., filled with clean pea gravel and covered over with clean compacted fill. Removal of bottom debris and/or sludge can usually be accomplished fairly readily by "drilling out" with a large diameter auger.

In order to improve the general consistency and uniformity of the upper subgrade soils, expose and correct any possible existing loose and/or contaminated local backfills, shallow buried structures, etc., and recompact any demolition disturbance, it is recommended that the building area be processed in the following manner to a distance of at least 5 feet outside the exterior building wall perimeter:

(1) Remove the existing surface soils to a depth of at least 2.5 feet below the existing or final ground surface, whichever is lower, and stockpile for subsequent recompaction.

(2) The exposed over-cut surface should then be scarified to an additional depth of at least 6 inches, watered or aerated as required, thoroughly mixed to a uniform near optimum moisture condition, and recompacted to at least 90 percent of the ASTM D-1557-78 laboratory test standard.

(3) Backfill with the stockpiled excavation material and/or other approved native or import soils. All backfill should be spread, watered, mixed, and compacted by mechanical means in approximate 6-inch thick lifts. The degree of compaction obtained should be at least 90 percent of the ASTM D-1557-78 laboratory test standard.

(4) Continue filling as required to secure final building pad subgrade elevations.

Prior to placing new fill in other non-building areas, the exposed cleared surface should be plowed, scarified, or otherwise processed to a depth of at least 8 inches, watered and/or aerated as required, thoroughly mixed to a uniform, near optimum moisture condition, and recompacted to at least 90 percent of the ASTM D-1557-78 test standard. The final exposed surface within cut or "at grade" A.C. or concrete paved areas should also be processed in this manner.

All new fill should be spread, watered, mixed and compacted by mechanical means in approximate 6-inch thick lifts to at least 90 percent of the aforementioned standard.

Backfill placed in narrow, restricted areas, such as along utility trenches, may be placed in 12- to 24-inch thick lifts. Backfill consolidation by flooding or jetting should not be allowed. All backfill should be mechanically compacted to at least 90 percent of the aforementioned test standard.

Completed building, exterior concrete and A.C. pavement subgrades should be trimmed and rolled to a firm smooth surface. Final watering and rolling should be performed immediately prior to placing concrete or paving.

Imported fill material should consist of clean, granular soils free from vegetation, debris, or rocks larger than 3 inches. The Expansion Index Value should not exceed a maximum of 20.

All earthwork operations should be subject to compaction control inspection and testing by the Soils Engineer. The Soils Engineer should be notified at least two days in advance of the start of grading. A joint meting between a representative of the client, the contractor and the Soils Engineer is recommended prior to grading to discuss specific procedures and scheduling.

B. Foundation Support:

Assuming compliance with site preparation and earthwork compaction recommendations, the proposed building structure may be supported on conventional shallow spread footings bearing on the new compacted backfill-fill zone. A maximum allowable bearing value of 2000 psf may be used for design purposes. The recommended design bearing value is for dead plus live loads and may be increased one-third for combined dead, live and seismic forces.

Footings should be at least 12 inches in width and should extend to a depth of at least 18 inches below the lowest adjacent finished subgrade or interior floor slab surface. It is also recommended that nominal steel reinforcement at least equivalent to one #5 bar both top and bottom be employed in all continuous bearing walls.

Bearing value analysis by the "Terzaghi" method and using shear strength values shown on Plate G indicates a safety factor of at least 4.4 for the recommended recommended 2000 psf design value. Also, the actual safety factor will probably be somewhat greater due to the recommended excavation and recompaction.

Estimated average settlements in inches for footings under the full recommended loading condition are as follows:

Footing Size (feet)	Continuous Footing	Square Footing
1.0	0.25	----
2.0	0.40	0.25
3.5	0.55	0.35
5.0	----	0.45

C. Concrete Slabs:

Based on field observations and laboratory test results, the upper clayey sand subgrade soils are generally classified as "low" or slightly expansive. Although not considered critical, it is recommended that nominal reinforcement such as "6x6-10/10" welded wire mesh be employed for all concrete floor slabs on grade (properly placed at near midpoint of the slab section). Also, the exposed finished subgrade surface should be maintained or restored to a moist, near optimum condition prior to placing concrete.

It is recommended that a moisture barrier be provided under office floors, carpeted areas, or other concrete slabs where slab moisture would be detrimental. A 6-mil vinyl plastic membrane with 6 inch sealed laps and 1 to 2 inches of protective clean sand bedding and cover should be adequate.

It is recommended that concrete slabs which are placed directly over a native soil subgrade and are subject to vehicle traffic loads be at least 5.0 inches in thickness. It is also suggested that nominal reinforcement such as "6x6-10/10" welded wire mesh be employed in new exterior concrete slabs and paving.

D. Lateral Pressure:

An allowable lateral bearing value against the sides of footings of 300 pounds per square foot per foot of depth to a maximum of 4500 pounds per square foot may be used provided there is positive contact between the vertical bearing surface and the adjacent soil.

Friction between the base of footings and/or floor slabs and the underlying soil may be assumed as 40 percent of the dead load. Friction and lateral pressure may be combined provided the assumed lateral bearing resistance does not exceed two-thirds of the allowable.

Recommended active lateral soil pressure values for design of drained retaining walls and/or depressed ramp walls are as follows:

*Slope of Retained Earth	Equivalent Fluid Pressure (pcf)
Level	30
4:1	35
2:1	45
1-1/2:1	55

*Slope inclination in a direction perpendicular to the wall face.

A pipe and gravel drain (4-inch perforated PVC schedule 40 embedded in at least 3 cubic feet of filter gravel per lineal foot of pipe) should be provided on the retained earth side and near the base of all retaining walls. Water intercepted near the base of the wall by the perforated PVC pipe should be directed to appropriate outlets. Typical weep-holes leading out of the gravel drain (no pipe) would be satisfactory for walls which face into open patio or yard areas.

All backfill placed behind retaining walls should be spread, watered or aerated as required, thoroughly mixed to a uniform near optimum moisture condition and compacted by mechanical means to at least 90 percent of the ASTM D-1557-78 laboratory test standard.

E. A.C. Paving:

In view of the unknown grading changes to be made in the course of developing the site, it is somewhat difficult to anticipate actual final subgrade soil mixtures and stabilometer test were, therefore, not performed. In any case, however, it is estimated that an "R" value of 30 would reasonably represent the near surface site soils. Based on this parameter, recommended pavement sections for probable traffic conditions and estimated Traffic Index design values are as follows:

Traffic Conditions	Assumed T. I.	A.C. (inches)	Rock Base (inches)
(1) Driveways	5.0	3.0	6.0
(2) Parking Stalls	4.0	2.5	4.0

It is recommended that the top 6 inches of the finished soil subgrade be watered, rolled and compacted at near the optimum moisture content to at least 90 percent of the ASTM D-1557-78 laboratory compaction standard. Final subgrade watering, rolling and compaction should be accomplished immediately prior to paving. The completed subgrade should be trimmed and rolled to a firm, smooth surface.

Base course material should be at least equivalent to "crushed miscellaneous base" as defined by the Standard Specifications for Public Works Construction, 1985 Edition (section 200-2.4, page #84). All rock base should be compacted to at least 95 percent of the ASTM D-1557-78 laboratory test standard.

REMARKS

Conclusions and recommendations presented in this report represent our best engineering judgement only based on the available preliminary design information and the data developed during the course of our study. No other warranty or responsibility is expressed or implied.

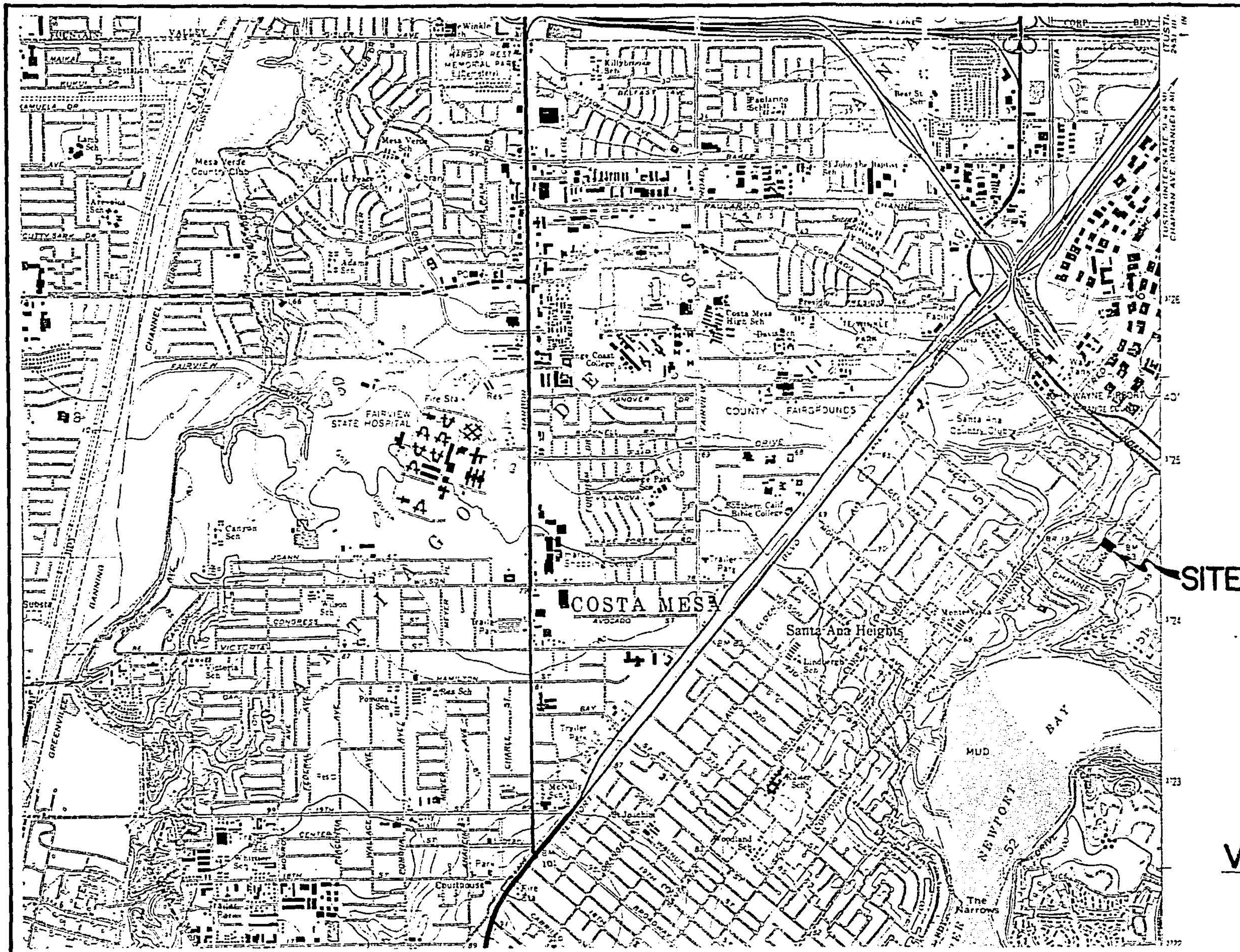
Soil conditions have been interpreted from existing surface exposures and the materials encountered in the test borings. These conditions may not necessarily represent other areas between or beyond the test borings.

All shoring and bracing should be in accordance with current requirements to CAL-OSHA, and the Industrial Accident Commission of the State of California, and all other public agencies having jurisdiction.

A reasonable effort was made to restore drill hole sites to their original condition. This included backfilling and tamping of the test borings and general surface cleanup. It should be noted that as with any backfill, residual consolidation and surface subsidence resulting in a possible hazardous condition could occur at the test borings. The client is cautioned to periodially examine the test boring sites, and, if necessary, backfill any resulting depressions.

This office will be further available for consultation or to make a final review of project plans and specifications to assist in assuring correct interpretation of this report's recommendations for use in applicable sections.

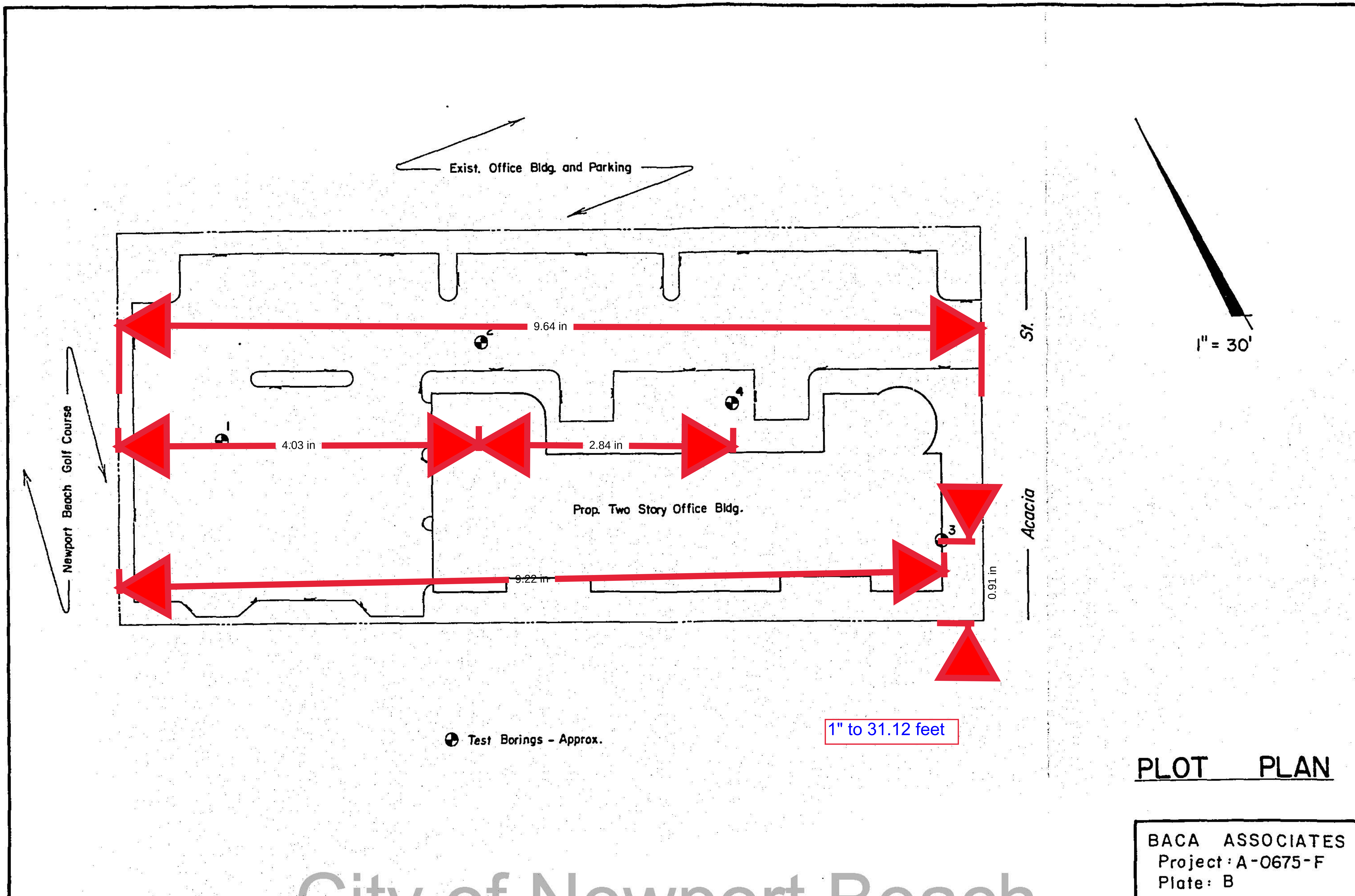
This report may be subject to review by the controlling public agencies for the project.



Ref: USGS Newport Beach Quad.

VICINITY MAP

BACA ASSOCIATES
Project: A-0675-F
Plate: A


Exist. Office Bldg. and Parking
Newport Beach Golf Course
Acacia St.
Prop. Two Story Office Bldg.
9.64 in
4:03 in
2.84 in
9.22 in
0.91 in
1" to 31.12 feet
Test Borings - Approx.
1" = 30'
PLOT PLAN
BACA ASSOCIATES
Project: A-0675-F
Plate: B

LOG OF BORING Nº 1

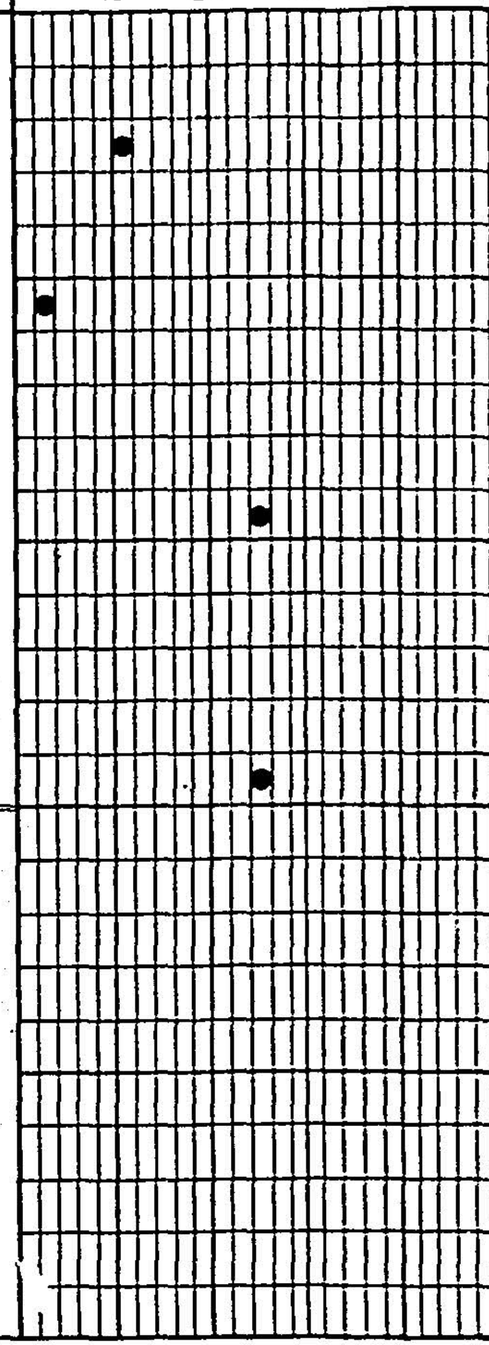
DATE DRILLED 8/5/89 | **DRILLING EQUIPMENT** Hollow-Stem Flight Auger

DRIVING WEIGHT 140 lbs. - 30" drop | **SURFACE ELEVATION**

Depth in Feet	Samples	Blows per foot	SOILS CLASSIFICATION (landscape area)	COLOR	MOISTURE	CONSISTENCY	DRY UNIT WEIGHT LB. PER CU. FT.
			SAND, fine to medium, variable clayey to sl. clayey, scat. gravels	brown	moist	mod. comp.	
	●	34					109
5					damp to dry		
	●	22					104
			CLAY, very silty, numerous veins and lenses of fine sand and silty sand	gray and gray brown	very moist	firm	
	●	28					85
10							
	●	29					93
15			End @ 15.0 ft.				
			Notes: (1) No ground water				
20							
25							

SHEAR RESISTANCE @ ANTICIPATED PRESSURE - KIPS PER SQUARE FOOT ▲ 1 2 3 4 5

MOISTURE CONTENT - % DRY WEIGHT ● 10 20 30 40 50



Acacia Plaza III
Santa Ana Heights, California

PROJECT No. A-0675-F

PLATE C

BACA ASSOCIATES
CONSULTING FOUNDATION ENGINEERS & ENGINEERING GEOLOGISTS

LOG OF BORING Nº 2

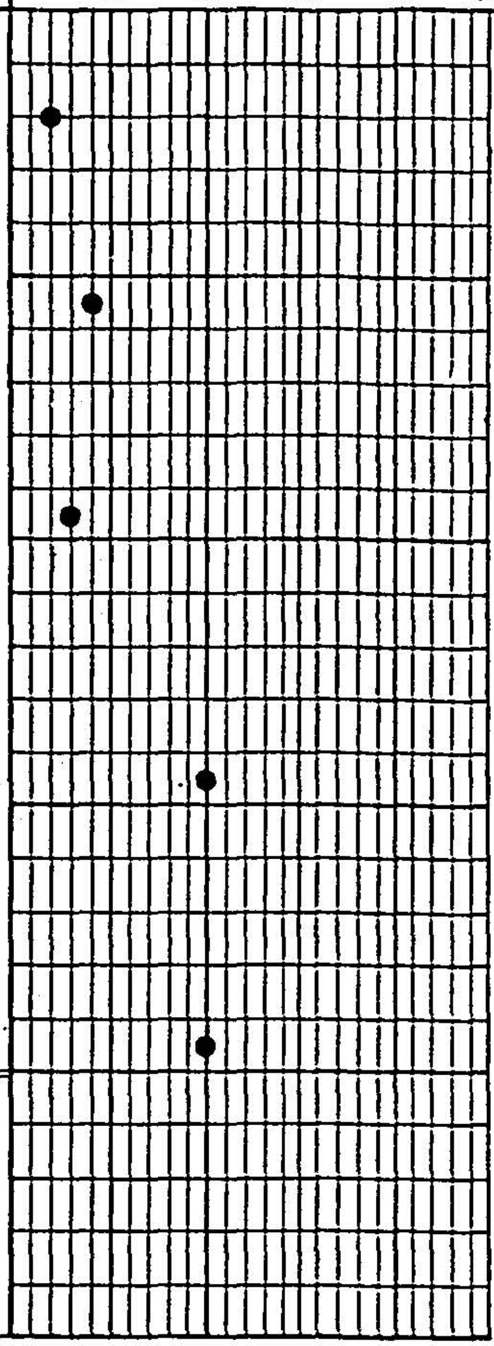
DATE DRILLED 8/5/89 | **DRILLING EQUIPMENT** Hollow-Stem Flight Auger

DRIVING WEIGHT 140 lbs. - 30" drop | **SURFACE ELEVATION**

Depth in Feet	Samples	Blows per foot	SOILS CLASSIFICATION	COLOR	MOISTURE	CONSISTENCY	DRY UNIT WEIGHT LB. PER CU. FT.
			SAND, fine to medium, variable clayey to sl. clayey, scat. gravels	light brown	dry	loose	
	■	36			sl. moist	mod. comp.	118
				brown			
5							
	■	34					110
			fine to medium, silty to slight silty			comp.	
	■	88					118
10							
			CLAY, silty, numerous veins and lenses of sand and silty sand	gray with red brown stains	very moist	firm to stiff	
	■	55					97
15							
	■	25					102
20			End @ 20.0 ft.				
			Notes: (1) No ground water				
25							

SHEAR RESISTANCE @ ANTICIPATED PRESSURE - KIPS PER SQUARE FOOT
▲ 1 2 3 4 5

MOISTURE CONTENT - % DRY WEIGHT
● 10 20 30 40 50



Acacia Plaza III
Santa Ana Heights, California

PROJECT No.	A-0675-F
PLATE	D

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LOG OF BORING Nº 3

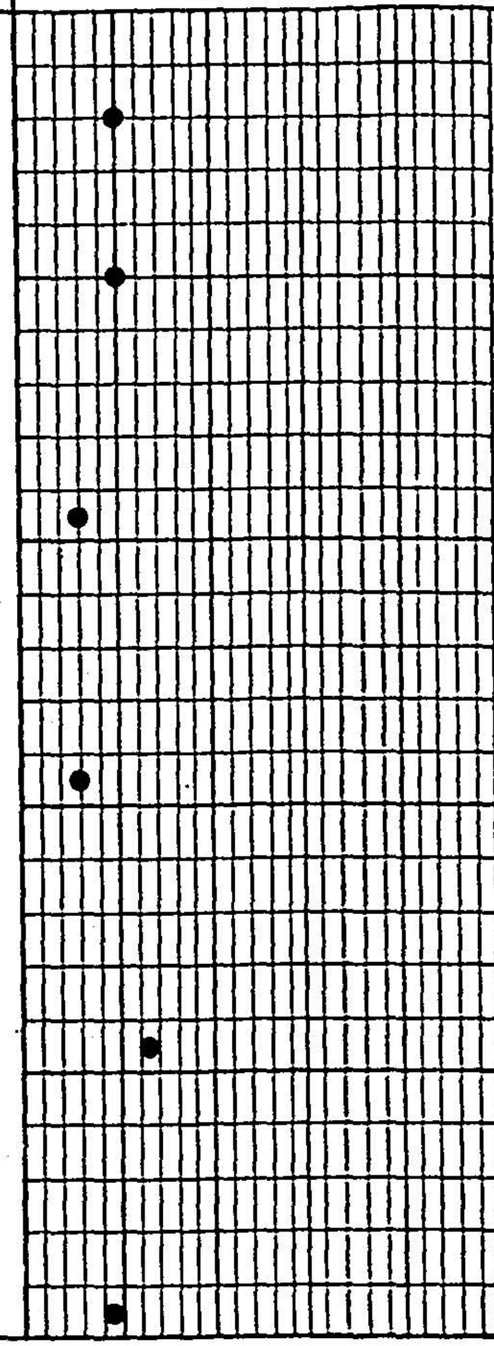
DATE DRILLED 3/5/89 | **DRILLING EQUIPMENT** Hollow-Stem Flight Auger

DRIVING WEIGHT 140 lbs. - 30" drop | **SURFACE ELEVATION**

Depth in Feet	Blows per foot	SOILS CLASSIFICATION	COLOR	MOISTURE	CONSISTENCY	DRY UNIT WEIGHT LB. PER CU. FT.
		SAND, fine to medium, silty, sl. clayey, scat. gravels	brown	moist	comp.	
	16					116
		fine to coarse, sl. clay binder, variable scat. to moderate gravels			mod. comp. to comp.	
5	28					116
				sl. moist		
	20					109
10						
	28					108
15						
		fine to medium, clean, occasional clay/silt veins	tan with pale gray veins	moist	dense	
	57					103
20						
	56					101
25						

SHEAR RESISTANCE @ ANTICIPATED PRESSURE - KIPS PER SQUARE FOOT
▲ 1 2 3 4 5

MOISTURE CONTENT - % DRY WEIGHT
● 10 20 30 40 50



End @ 25.0 ft. Notes: (1) No ground water

Acacia Plaza III
Santa Ana Heights, California

PROJECT No.	A-0675-F
PLATE	E

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LOG OF BORING Nº4

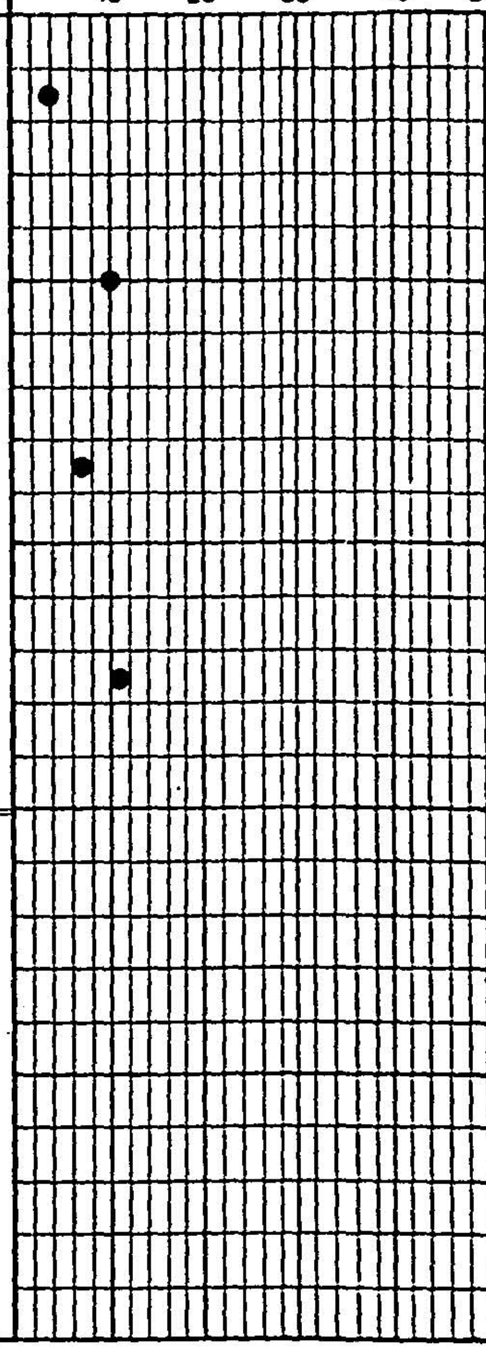
DATE DRILLED 8/5/89 | **DRILLING EQUIPMENT** Hollow-Stem Flight Auger

DRIVING WEIGHT 140 lbs. - 30" drop | **SURFACE ELEVATION**

Depth in Feet	Samples	Blows per foot	SOILS CLASSIFICATION	COLOR	MOISTURE	CONSISTENCY	DRY UNIT WEIGHT LB. PER CU.FT.
			SAND, fine to medium, silty, variable	brown	dry	loose	
	■	20	clayey to sl. clayey, scat. gravels		sl. moist	mod. comp.	109
					moist	comp.	
5	■	38					115
			medium to coarse, variable sl. clay	red brown	sl. moist		
	■	52	binder to clean, heavy gravels				111
10							
			very fine to fine, sl. silty, with	pale gray	moist		
	■	35	minor silt veins	brown			101
15			End @ 15.0 ft.				
			Notes: (1) No ground water				
20							
25							

SHEAR RESISTANCE @ ANTICIPATED PRESSURE-KIPS PER SQUARE FOOT ▲ 1 2 3 4 5

MOISTURE CONTENT - % DRY WEIGHT ● 10 20 30 40 50



Acacia Plaza III
Santa Ana Heights, California

PROJECT No. A-0675-F

PLATE F

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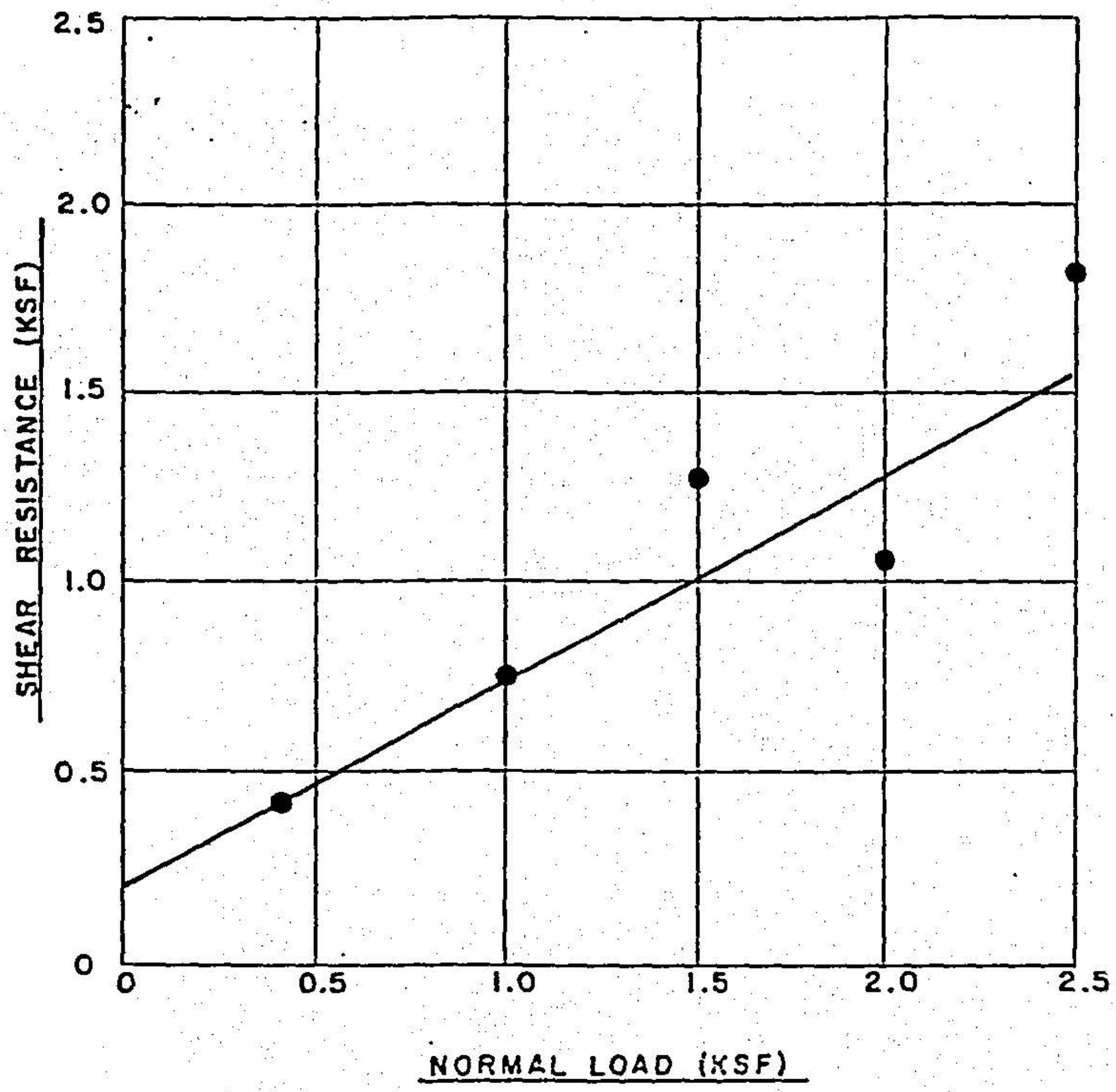
DIRECT SHEAR TESTS

UPPER CLAYEY SANDS



(1) Saturated-Drained Condition

(2) Friction Angle = 28°

(3) Cohesion = 200 psf

Acacia Plaza III Santa Ana Heights, California	PROJECT No.	A-0675-F
	PLATE	G

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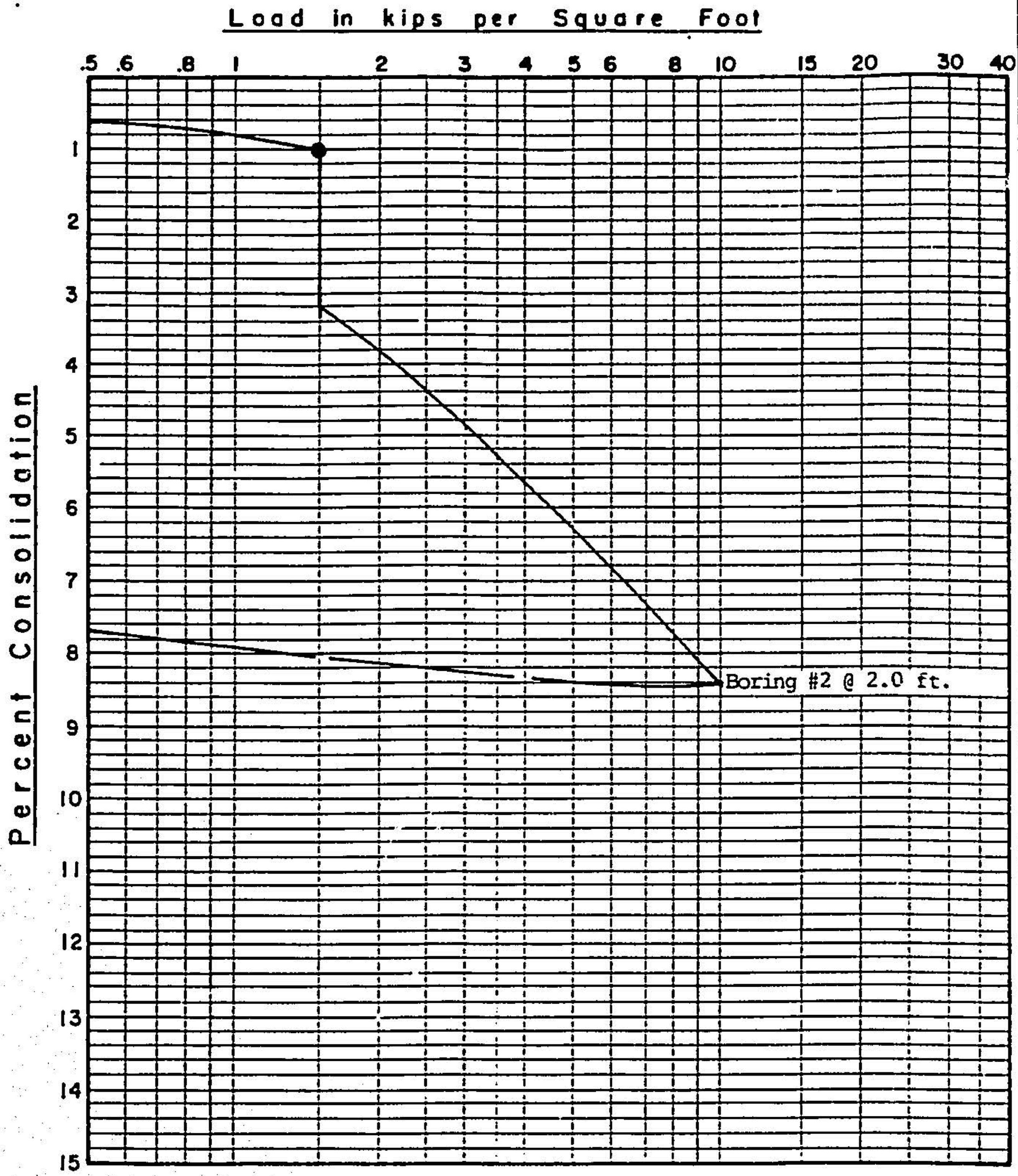
CONSOLIDATION TESTS



● WATER PERMITTED TO CONTACT SAMPLE

Acacia Plaza III Santa Ana Heights, California	PROJECT No.	A-0675-F
	PLATE	H

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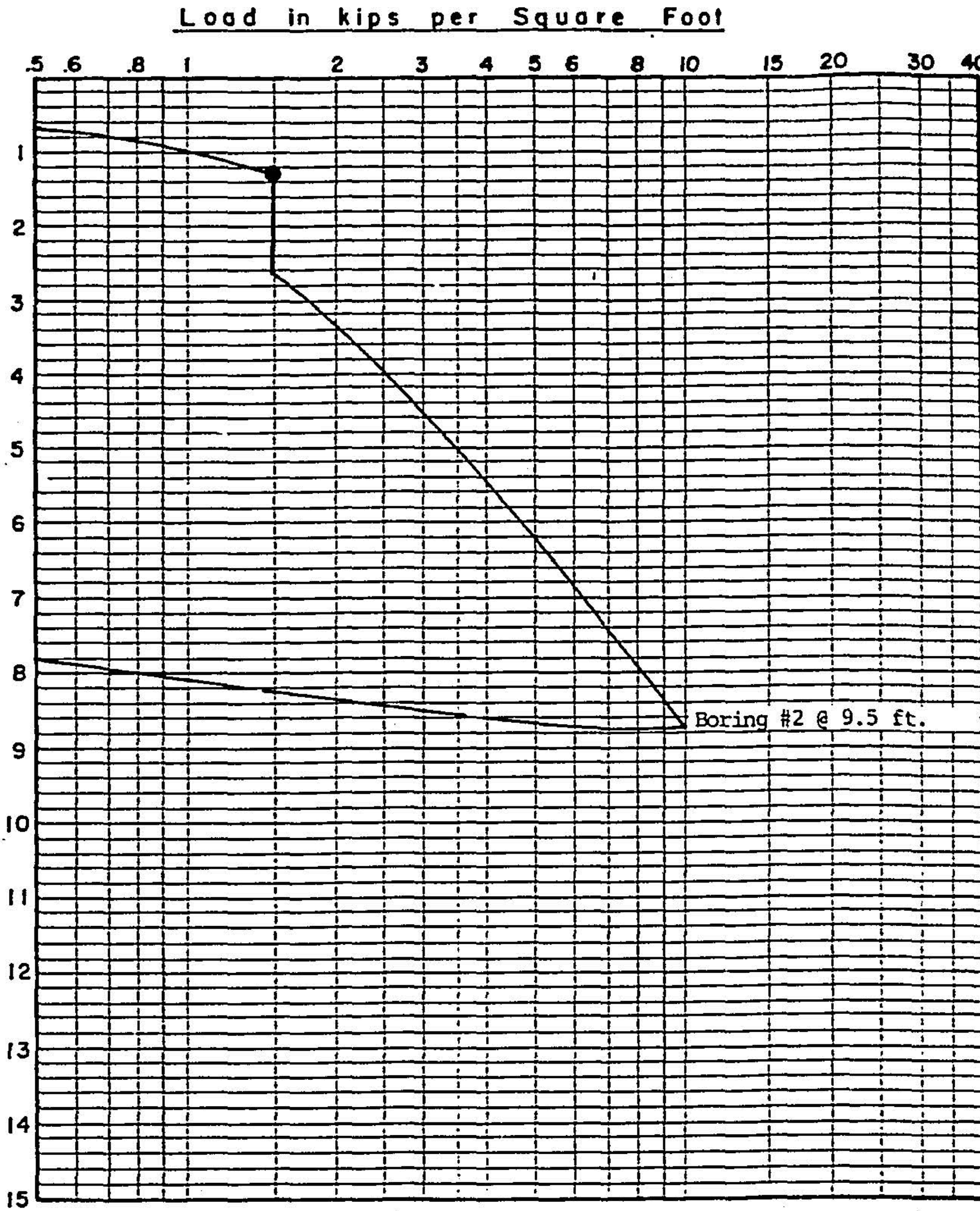
CONSOLIDATION TESTS



● WATER PERMITTED TO CONTACT SAMPLE

Acacia Plaza III Santa Ana Heights, California	PROJECT No.	A-0675-F
	PLATE	1

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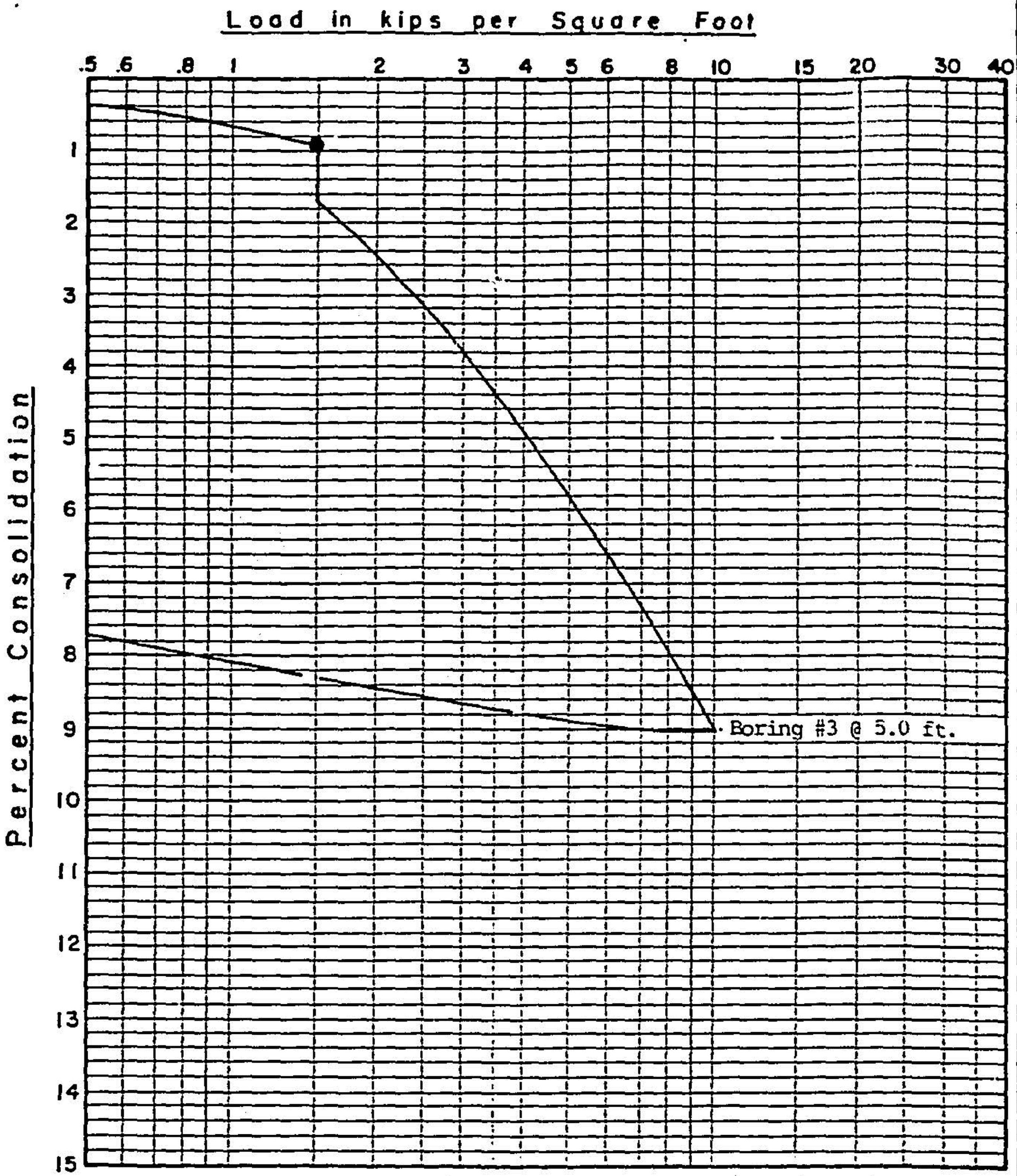
CONSOLIDATION TESTS



● WATER PERMITTED TO CONTACT SAMPLE

Acacia Plaza III Santa Ana Heights, California	PROJECT No.	A-0675-F
	PLATE	J

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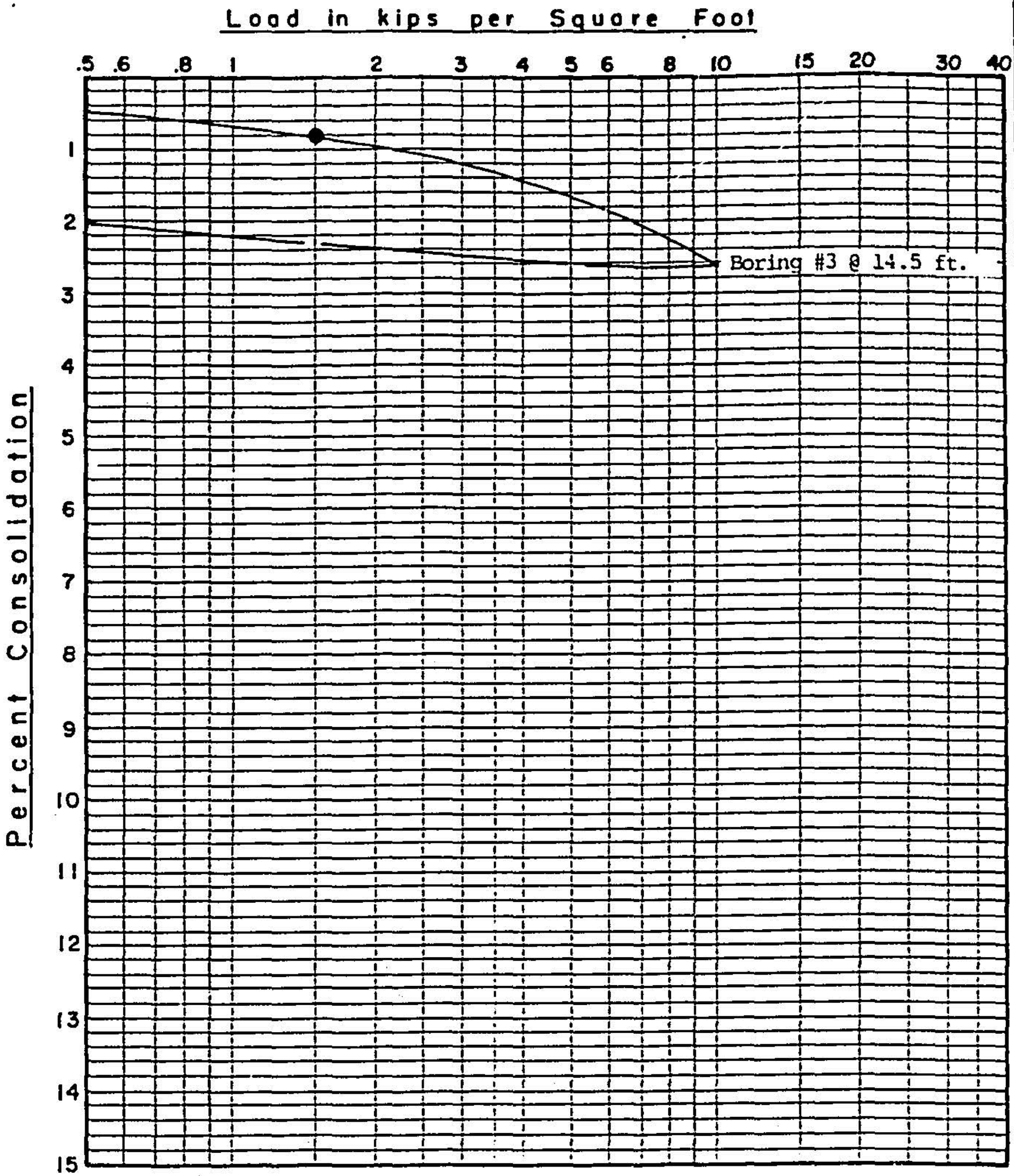
CONSOLIDATION TESTS



● WATER PERMITTED TO CONTACT SAMPLE

Acacia Plaza III Santa Ana Heights, California	PROJECT No.	A-0675-F
	PLATE	K

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APPENDIX D

SEISMIC DESIGN PARAMETERS

USGS web services were down for some period of time and as a result this tool wasn't operational, resulting in *timeout* error.
USGS web services are now operational so this tool should work as expected.

Wavegarden Cove NB

Latitude, Longitude: 33.6587, -117.8826

Date	5/7/2024, 3:12:53 PM
Design Code Reference Document	NEHRP-2015
Risk Category	II
Site Class	D - Stiff Soil

Type	Value	Description
S_S	1.311	MCE_R ground motion. (for 0.2 second period)
S_1	0.468	MCE_R ground motion. (for 1.0s period)
S_{MS}	1.311	Site-modified spectral acceleration value
S_{M1}	0.858 -See Section 11.4.7	Site-modified spectral acceleration value
S_{DS}	0.874	Numeric seismic design value at 0.2 second SA
S_{D1}	0.572 -See Section 11.4.7	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	D -See Section 11.4.7	Seismic design category
F_a	1	Site amplification factor at 0.2 second
F_v	1.832 -See Section 11.4.7	Site amplification factor at 1.0 second
PGA	0.564	MCE_G peak ground acceleration
F_{PGA}	1.1	Site amplification factor at PGA
PGA_M	0.62	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	1.311	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	1.424	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	2.5	Factored deterministic acceleration value. (0.2 second)
S1RT	0.468	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.506	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.823	Factored deterministic acceleration value. (1.0 second)
PGAd	1.021	Factored deterministic acceleration value. (Peak Ground Acceleration)
PGA_{UH}	0.564	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
C_{RS}	0.921	Mapped value of the risk coefficient at short periods
C_{R1}	0.926	Mapped value of the risk coefficient at a period of 1 s
C_V	1.362	Vertical coefficient

DISCLAIMER

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U.S. Geological Survey - Earthquake Hazards Program

Unified Hazard Tool

Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the U.S. Seismic Design Maps web tools (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

Please also see the new USGS Earthquake Hazard Toolbox for access to the most recent NSHMs for the conterminous U.S. and Hawaii.

Input

Edition

Dynamic: Conterminous U.S. 2014 (u…

Latitude

Decimal degrees

33.6587

Longitude

Decimal degrees, negative values for western longitudes

-117.8826

Site Class

259 m/s (Site class D)

Spectral Period

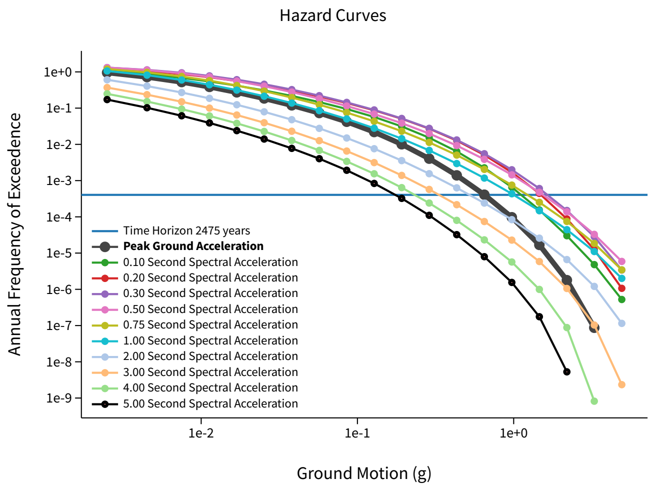
Peak Ground Acceleration

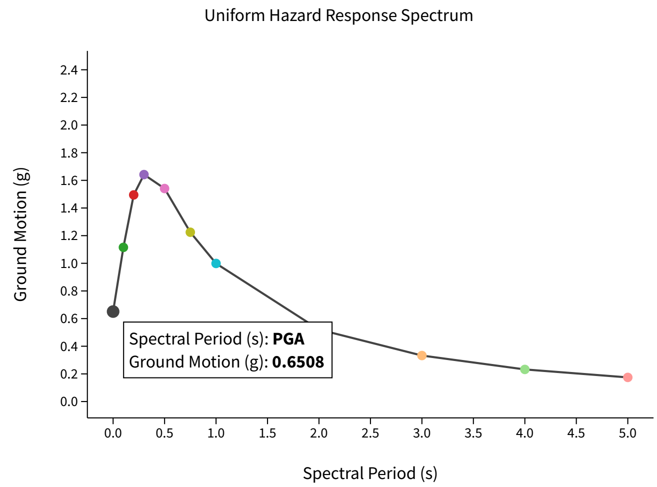
Time Horizon

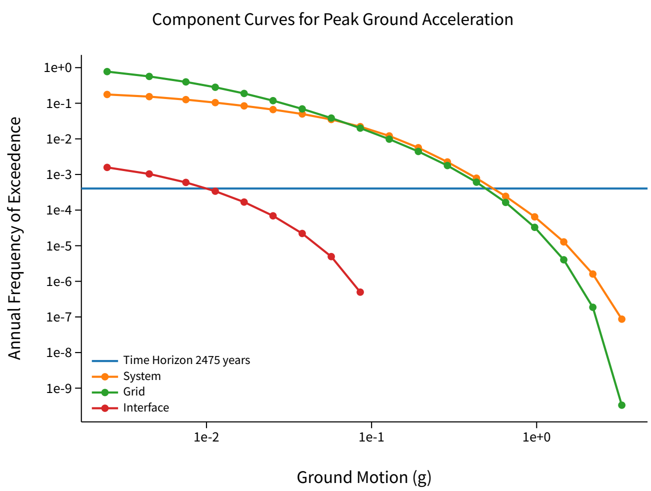
Return period in years

2475

Hazard Curve





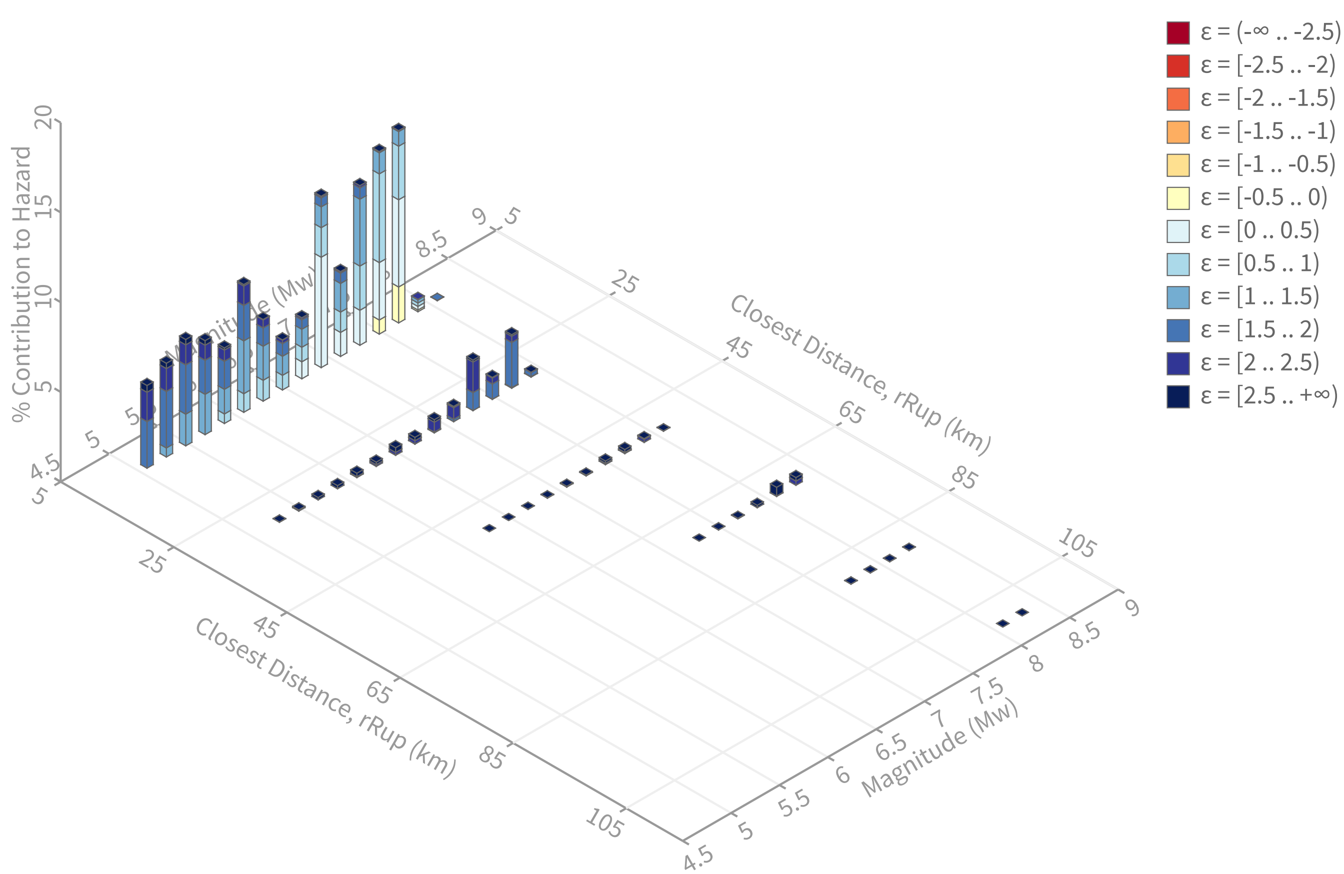


[View Raw Data]

Deaggregation

Component

Total



Summary statistics for, Deaggregation: Total

Deaggregation targets

Return period: 2475 yrs
Exceedance rate: 0.0004040404 yr^{-1}
PGA ground motion: 0.65084062 g

Recovered targets

Return period: 2949.8301 yrs
Exceedance rate: 0.00033900258 yr^{-1}

Totals

Binned: 100 %
Residual: 0 %
Trace: 0.1 %

Mean (over all sources)

m: 6.7
r: 10.93 km
ε_0: 1.24 σ

Mode (largest m-r bin)

m: 7.69
r: 5.67 km
ε_0: 0.44 σ
Contribution: 10.71 %

Mode (largest m-r-ε_0 bin)

m: 6.89
r: 3.35 km
ε_0: 0.29 σ
Contribution: 6.15 %

Discretization

r: min = 0.0, max = 1000.0, Δ = 20.0 km
m: min = 4.4, max = 9.4, Δ = 0.2
ε: min = -3.0, max = 3.0, Δ = 0.5 σ

Epsilon keys

ε0: [-∞ .. -2.5)
ε1: [-2.5 .. -2.0)
ε2: [-2.0 .. -1.5)
ε3: [-1.5 .. -1.0)
ε4: [-1.0 .. -0.5)
ε5: [-0.5 .. 0.0)
ε6: [0.0 .. 0.5)
ε7: [0.5 .. 1.0)
ε8: [1.0 .. 1.5)
ε9: [1.5 .. 2.0)
ε10: [2.0 .. 2.5)
ε11: [2.5 .. +∞]

Deaggregation Contributors

Source Set ↳ Source	Type	r	m	ε_0	lon	lat	az	%
UC33brAvg_FM32	System							32.30
San Joaquin Hills [0]		3.35	7.13	0.34	117.885°W	33.671°N	351.83	12.81
Newport-Inglewood alt 2 [0]		6.89	7.48	0.77	117.937°W	33.619°N	228.64	6.48
Compton [0]		16.72	7.35	1.27	118.043°W	33.702°N	288.18	2.70
Palos Verdes [6]		25.33	7.46	1.98	118.119°W	33.544°N	239.84	1.87
Newport-Inglewood (Offshore) [0]		8.15	6.55	1.37	117.915°W	33.591°N	201.47	1.83
San Joaquin Hills [1]		4.61	6.93	0.52	117.845°W	33.669°N	72.20	1.21
UC33brAvg_FM31	System							27.76
San Joaquin Hills [0]		3.35	7.52	0.29	117.885°W	33.671°N	351.83	8.25
Newport-Inglewood alt 1 [0]		7.02	7.45	0.77	117.940°W	33.619°N	230.44	7.15
Compton [0]		16.72	7.28	1.31	118.043°W	33.702°N	288.18	2.55
Newport-Inglewood (Offshore) [0]		8.15	6.46	1.41	117.915°W	33.591°N	201.47	2.01
Palos Verdes [6]		25.33	7.29	2.08	118.119°W	33.544°N	239.84	1.74
Whittier alt 1 [2]		28.76	7.61	1.98	117.731°W	33.884°N	29.17	1.08
UC33brAvg_FM31 (opt)	Grid							20.02
PointSourceFinite: -117.883, 33.699		6.78	5.66	1.34	117.883°W	33.699°N	0.00	3.30
PointSourceFinite: -117.883, 33.699		6.78	5.66	1.34	117.883°W	33.699°N	0.00	3.30
PointSourceFinite: -117.883, 33.717		8.09	5.68	1.53	117.883°W	33.717°N	0.00	2.09
PointSourceFinite: -117.883, 33.717		8.09	5.68	1.53	117.883°W	33.717°N	0.00	2.09
PointSourceFinite: -117.883, 33.735		8.95	5.94	1.54	117.883°W	33.735°N	0.00	1.55
PointSourceFinite: -117.883, 33.735		8.95	5.94	1.54	117.883°W	33.735°N	0.00	1.55
UC33brAvg_FM32 (opt)	Grid							19.93
PointSourceFinite: -117.883, 33.699		6.80	5.64	1.35	117.883°W	33.699°N	0.00	3.18
PointSourceFinite: -117.883, 33.699		6.80	5.64	1.35	117.883°W	33.699°N	0.00	3.18
PointSourceFinite: -117.883, 33.717		8.09	5.68	1.54	117.883°W	33.717°N	0.00	2.18
PointSourceFinite: -117.883, 33.717		8.09	5.68	1.54	117.883°W	33.717°N	0.00	2.18
PointSourceFinite: -117.883, 33.735		8.97	5.93	1.55	117.883°W	33.735°N	0.00	1.56
PointSourceFinite: -117.883, 33.735		8.97	5.93	1.55	117.883°W	33.735°N	0.00	1.56

APPENDIX E

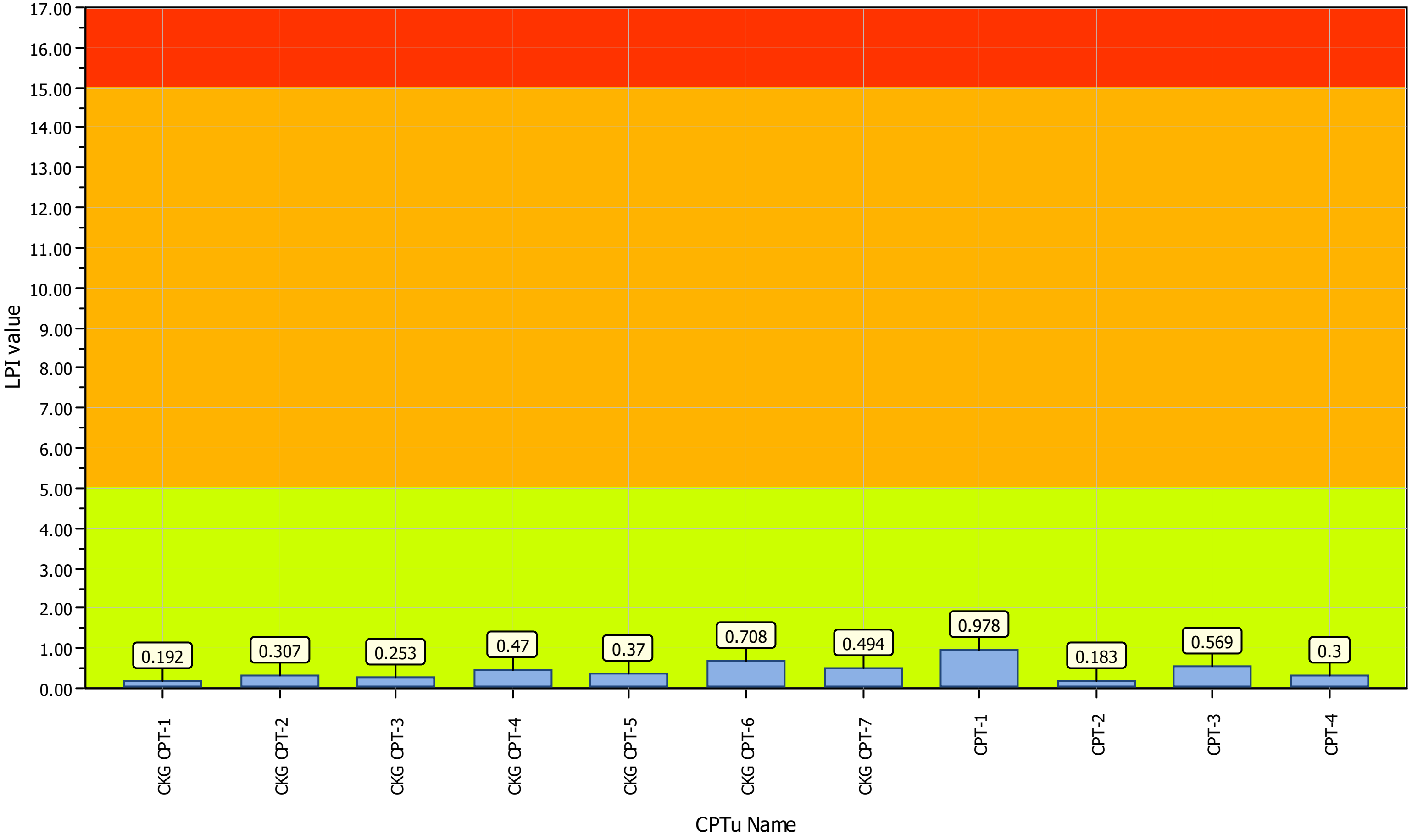
LIQUEFACTION ANALYSIS

CKGEO
Carl Kim Geotechnical, Inc.
945 Baileyana Road
Hillsborough, CA 94010
carlkimgeo@gmail.com

Project title : Carl Kim Geotechnical

Location : 3100 Irvine Ave, Newport Beach, CA

Overall Liquefaction Potential Index report



LPI color scheme

- Very high risk
- High risk
- Low risk

Basic statistics

Total CPT number: 11

100% low risk

0% high risk

0% very high risk

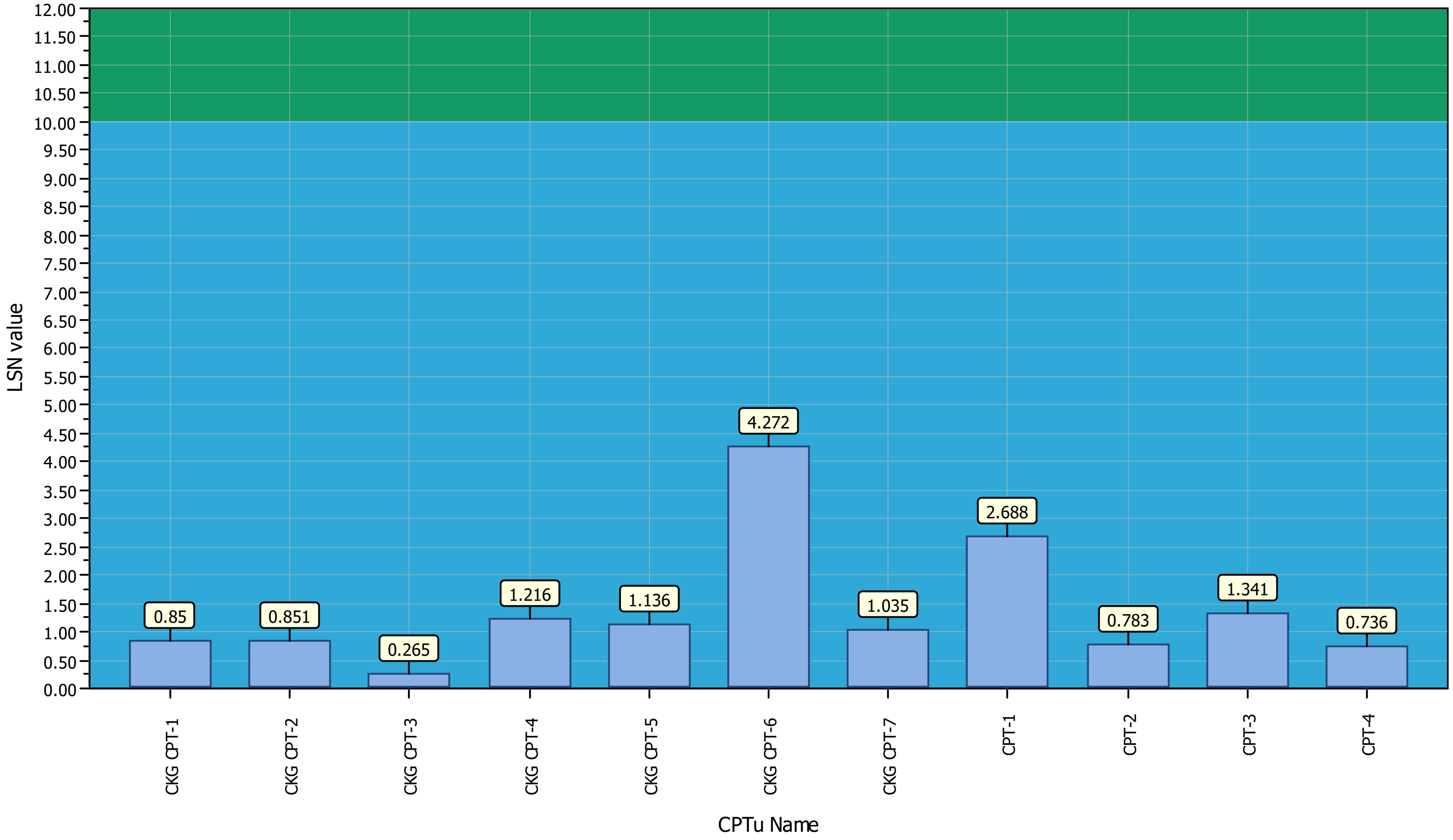
CKGEO

Carl Kim Geotechnical, Inc.
945 Baileyana Road
Hillsborough, CA 94010
carlkimgeo@gmail.com

Project title : Carl Kim Geotechnical

Location : 3100 Irvine Ave, Newport Beach, CA

Overall Liquefaction Severity Number report



LSN color scheme

- Severe damage
- Major expression of liquefaction
- Moderate to severe exp. of liquefaction
- Moderate expression of liquefaction
- Minor expression of liquefaction
- Little to no expression of liquefaction

Basic statistics

Total CPT number: 11

100% little liquefaction

0% minor liquefaction

0% moderate liquefaction

0% moderate to major liquefaction

0% major liquefaction

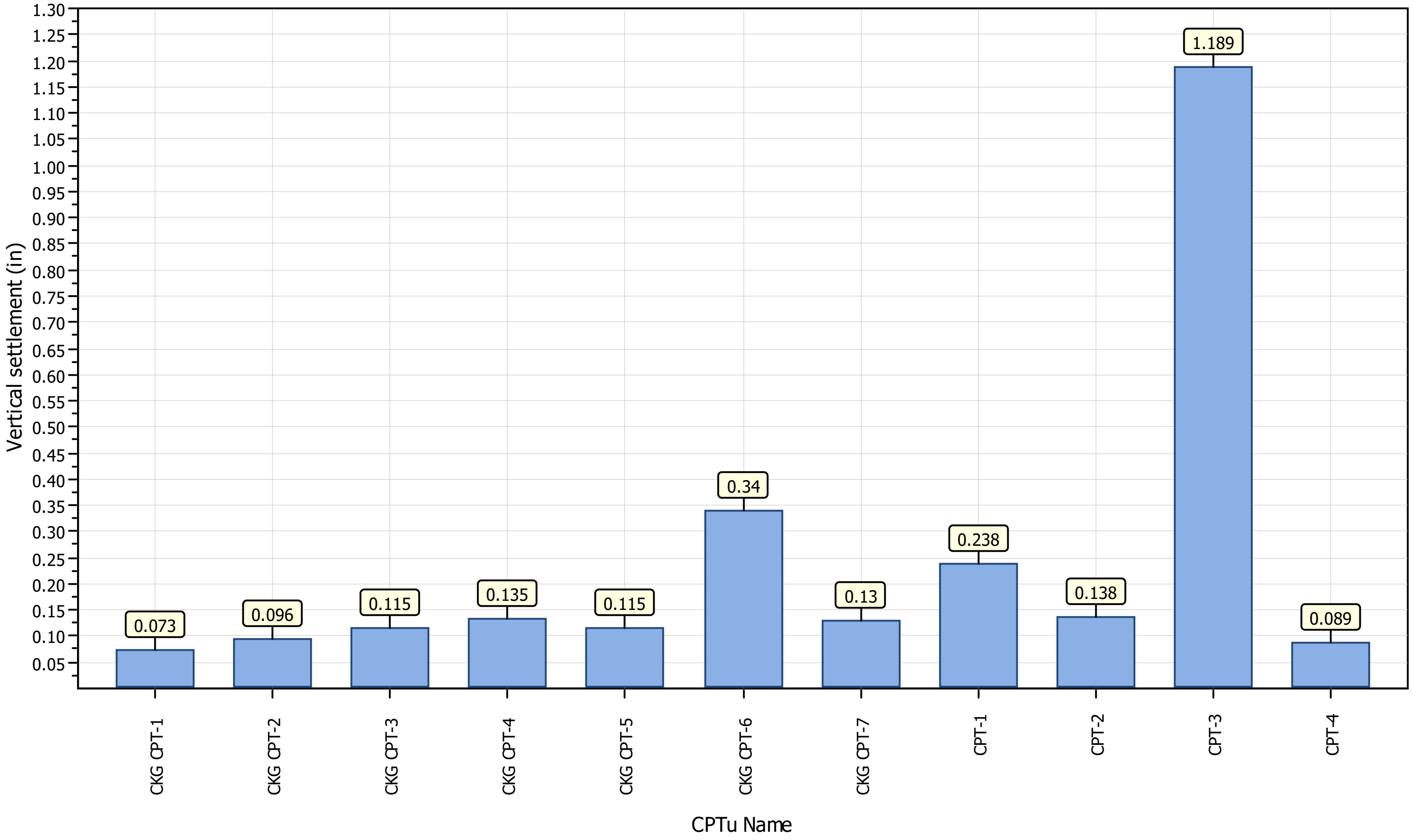
0% severe liquefaction

Carl Kim Geotechnical, Inc.
945 Baileyana Road
Hillsborough, CA 94010
carlkimgeo@gmail.com

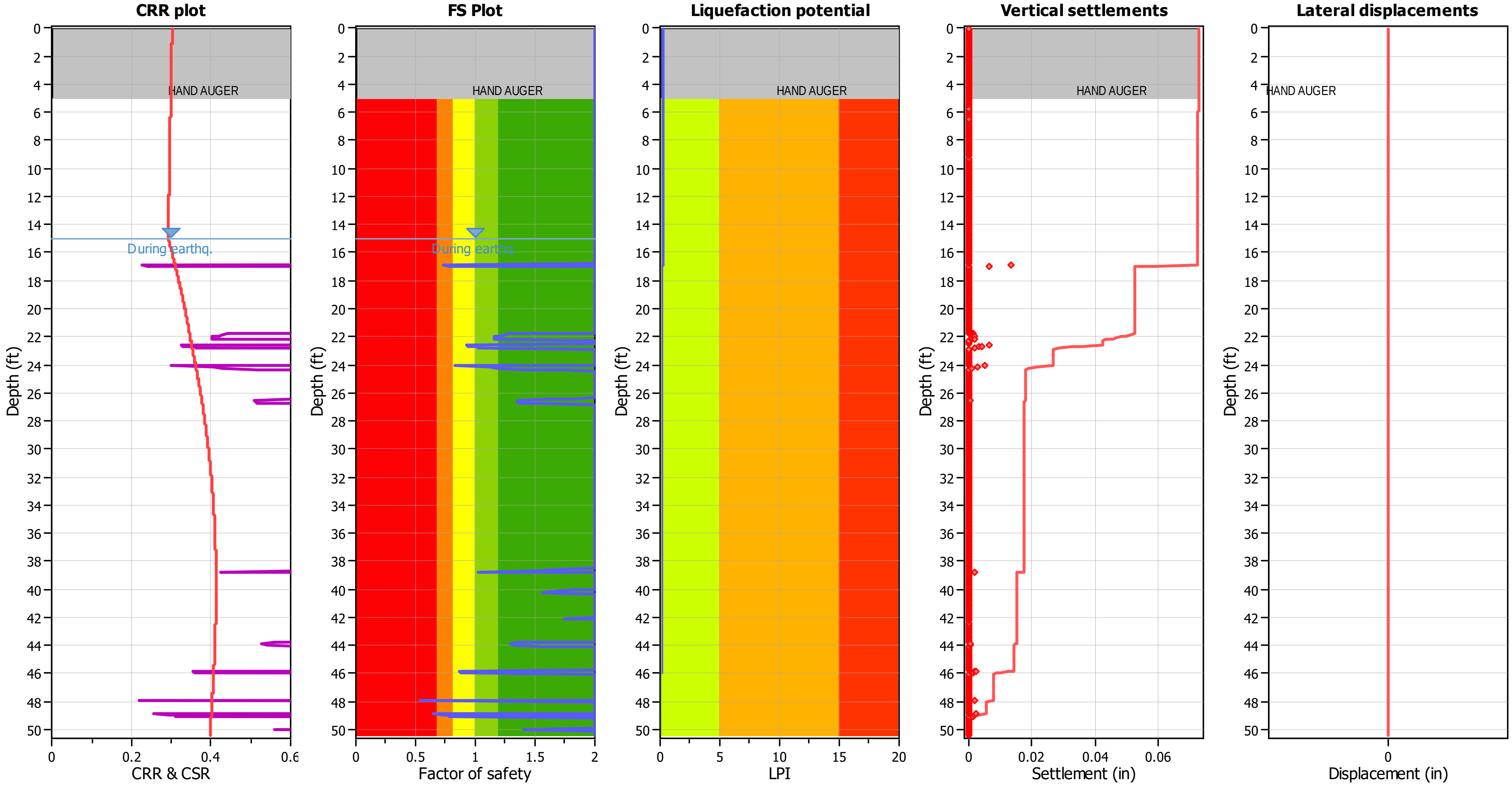
Project title : Carl Kim Geotechnical

Location : 3100 Irvine Ave, Newport Beach, CA

Overall vertical settlements report



Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	15.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.62	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	15.00 ft	Fill height:	N/A	Limit depth:	60.00 ft

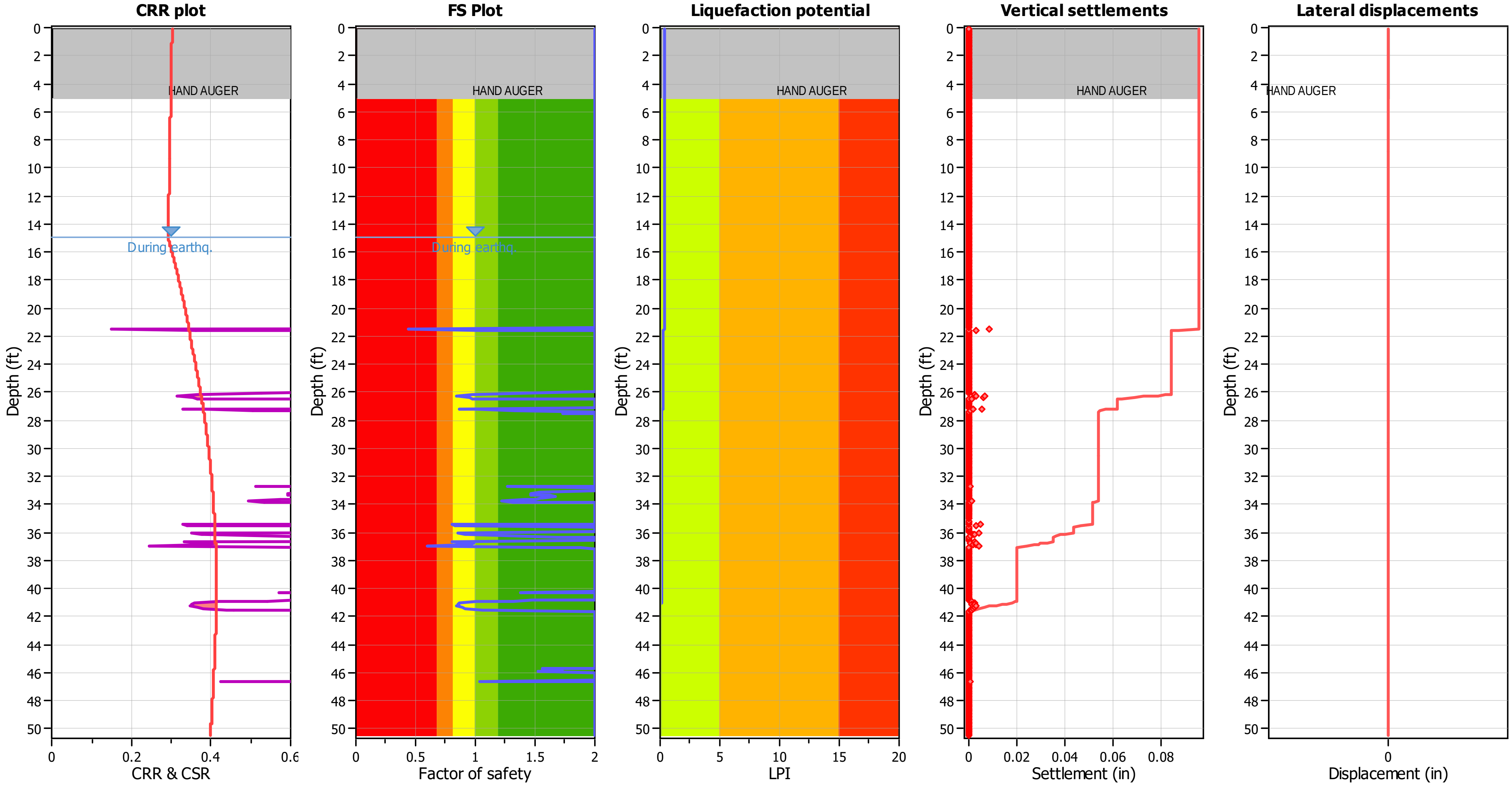
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis overall plots



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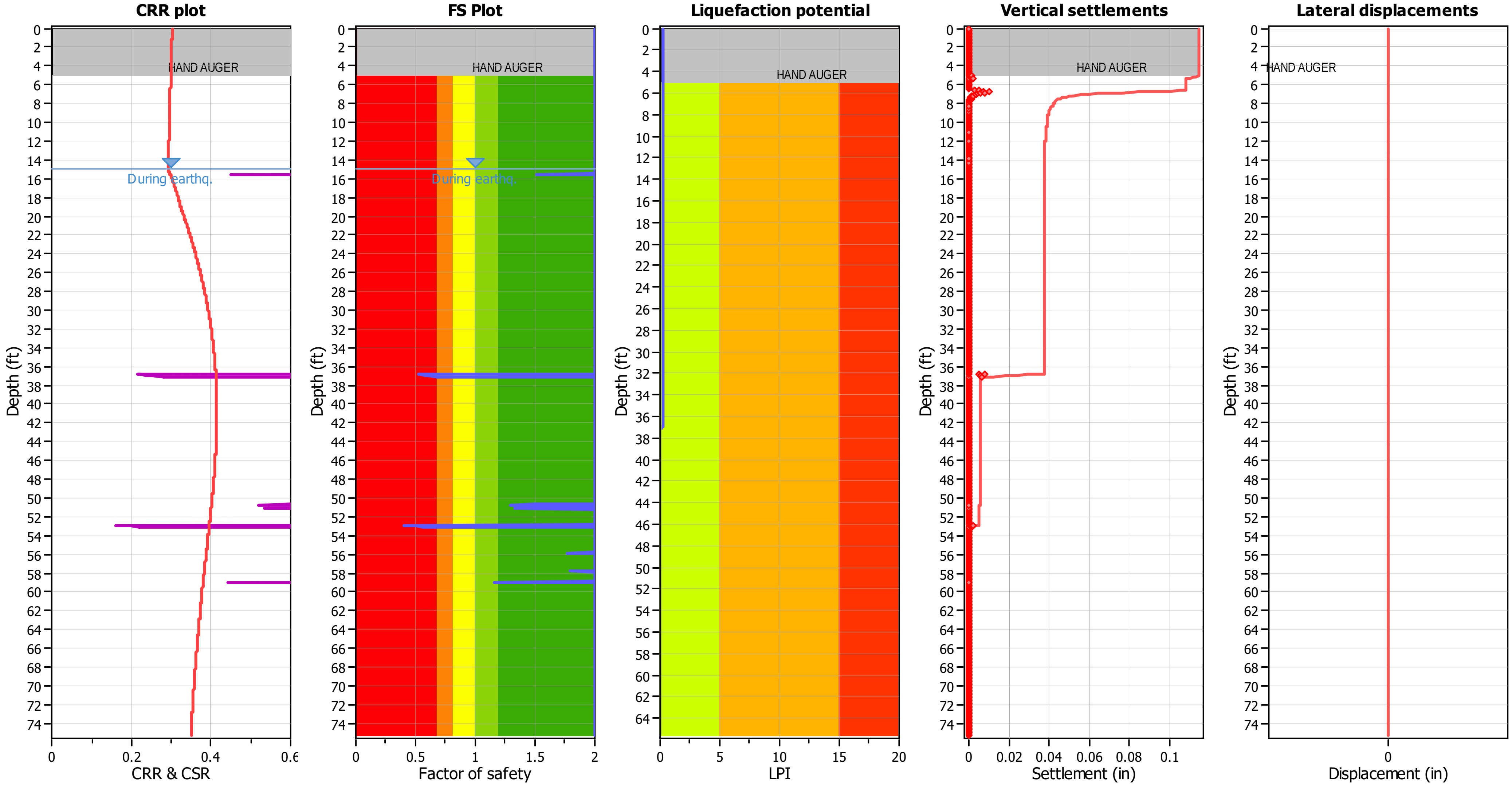
Liquefaction analysis overall plots



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Fines correction method:	NCEER (1998)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.62	Use fill:	No	Limit depth applied:	Yes
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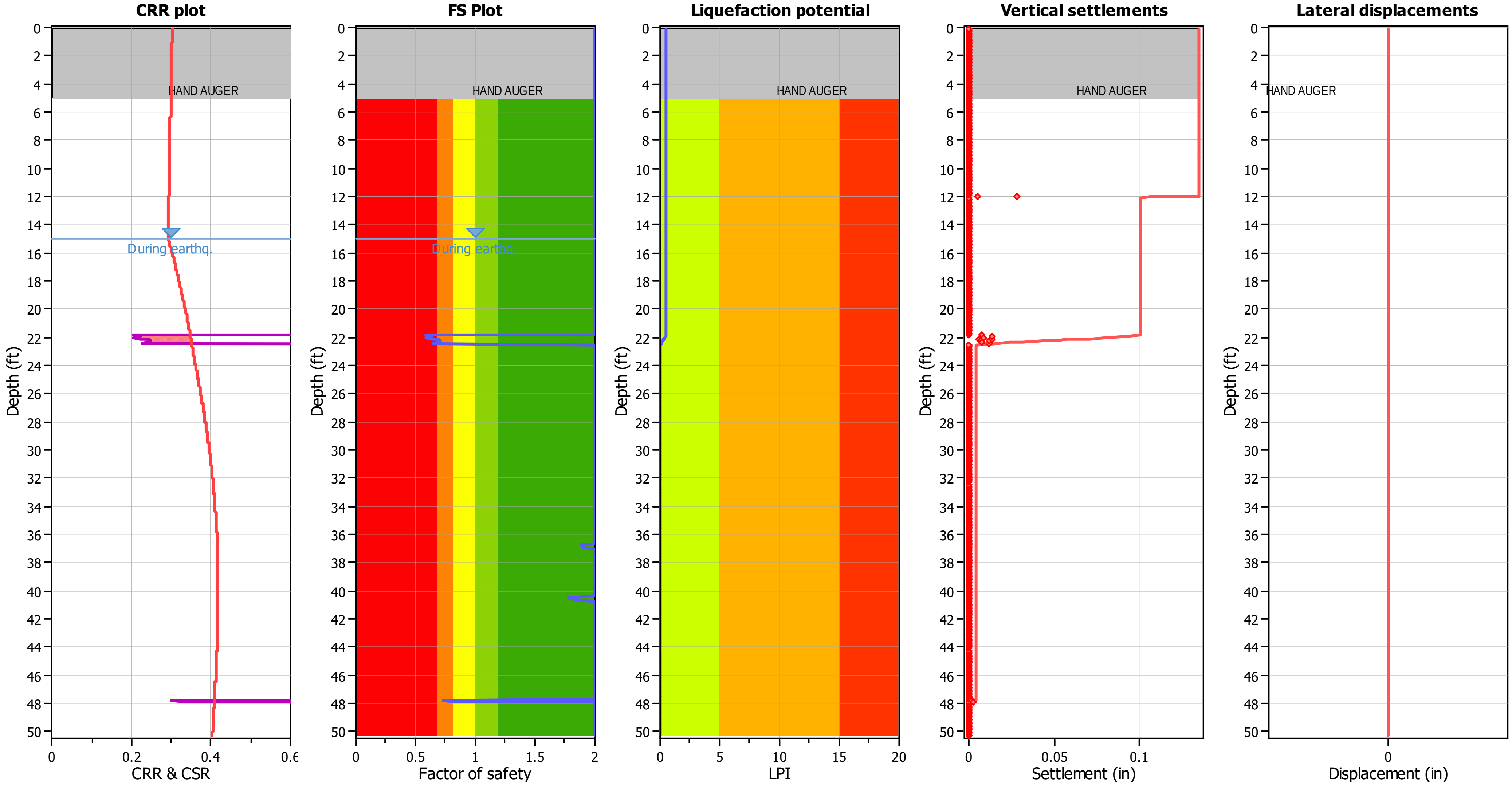
Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	15.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.62	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	15.00 ft	Fill height:	N/A	Limit depth:	60.00 ft

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LPI color scheme

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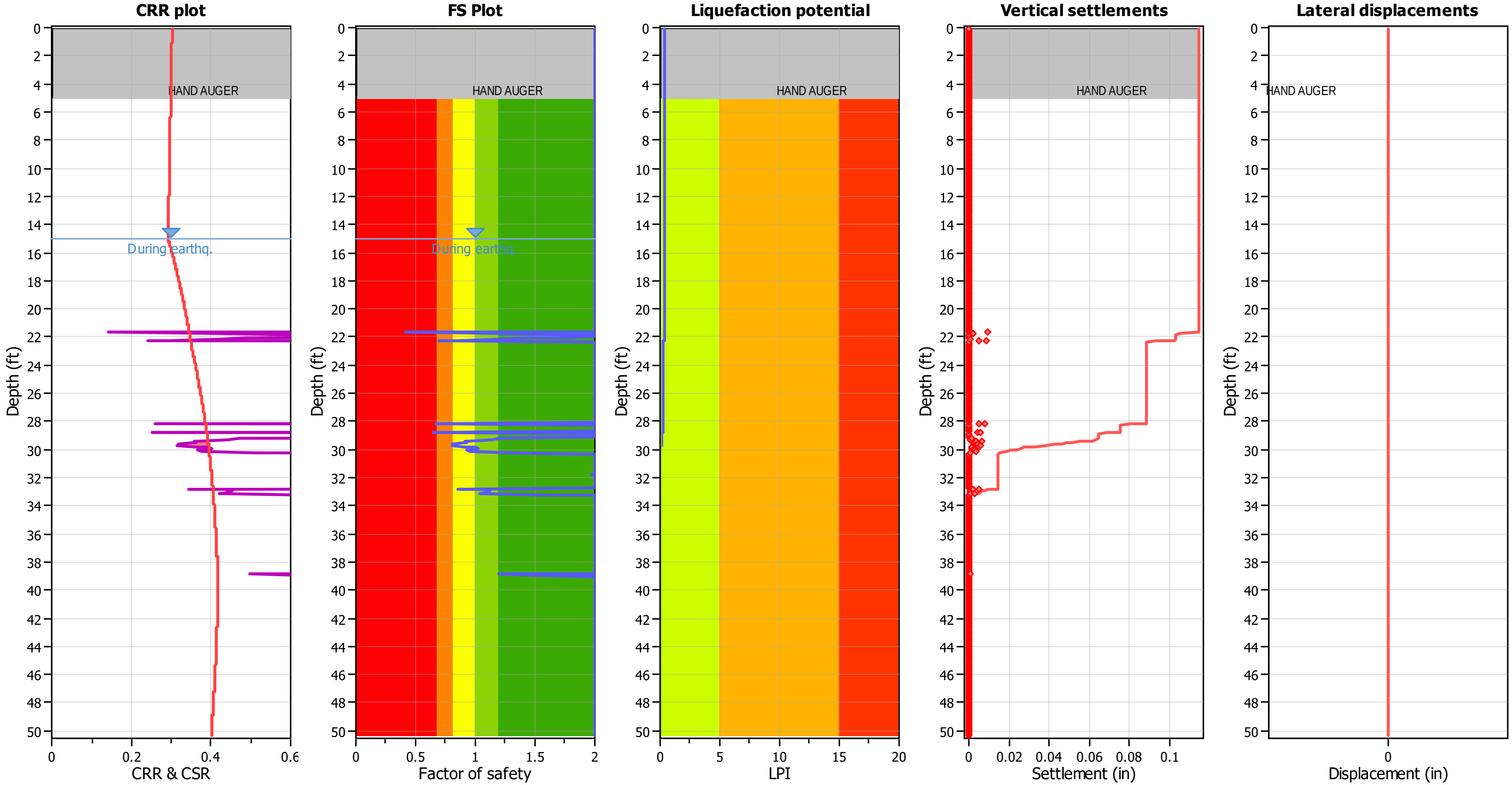
Liquefaction analysis overall plots



Input parameters and analysis data

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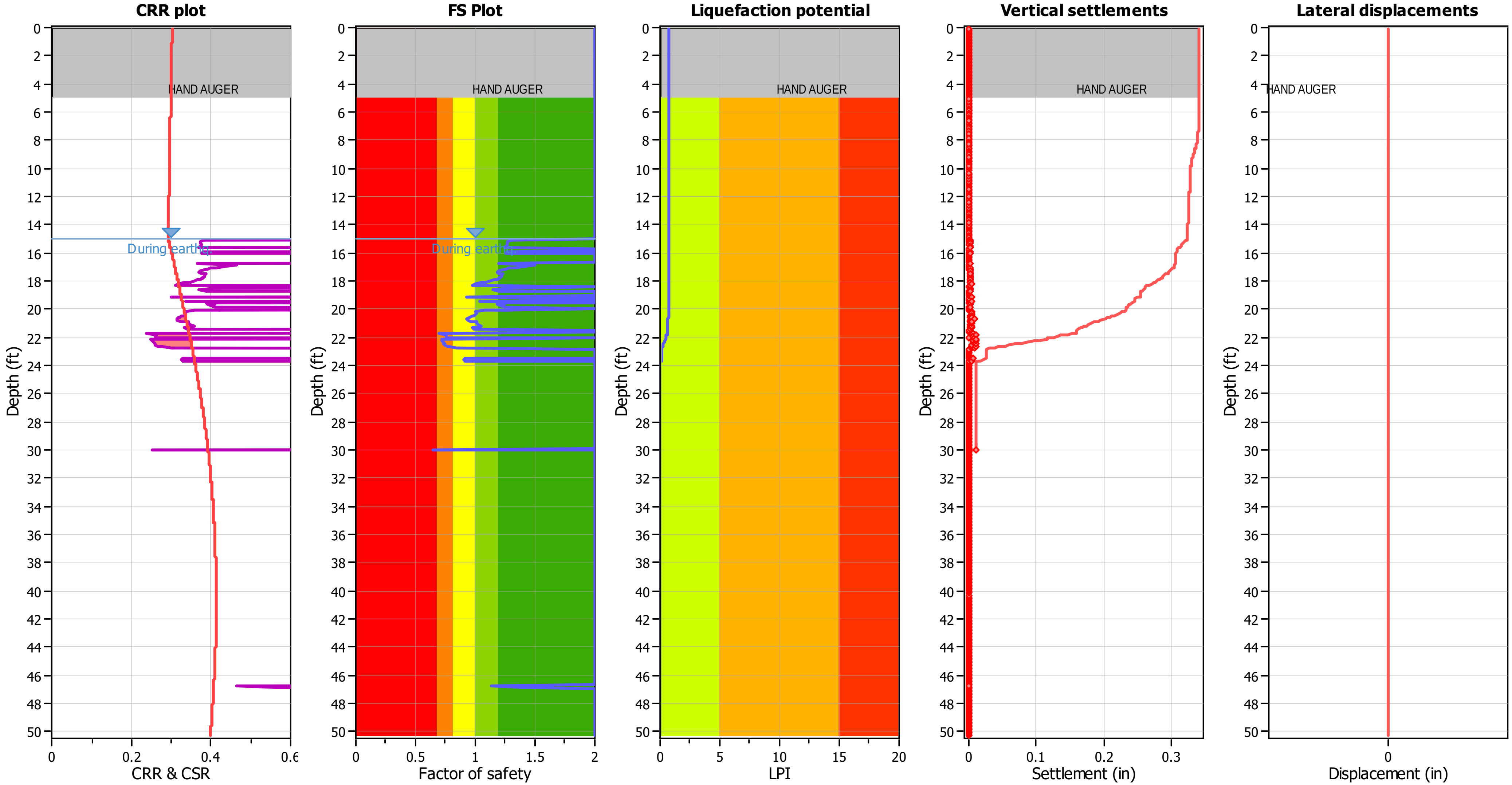
Liquefaction analysis overall plots



Input parameters and analysis data

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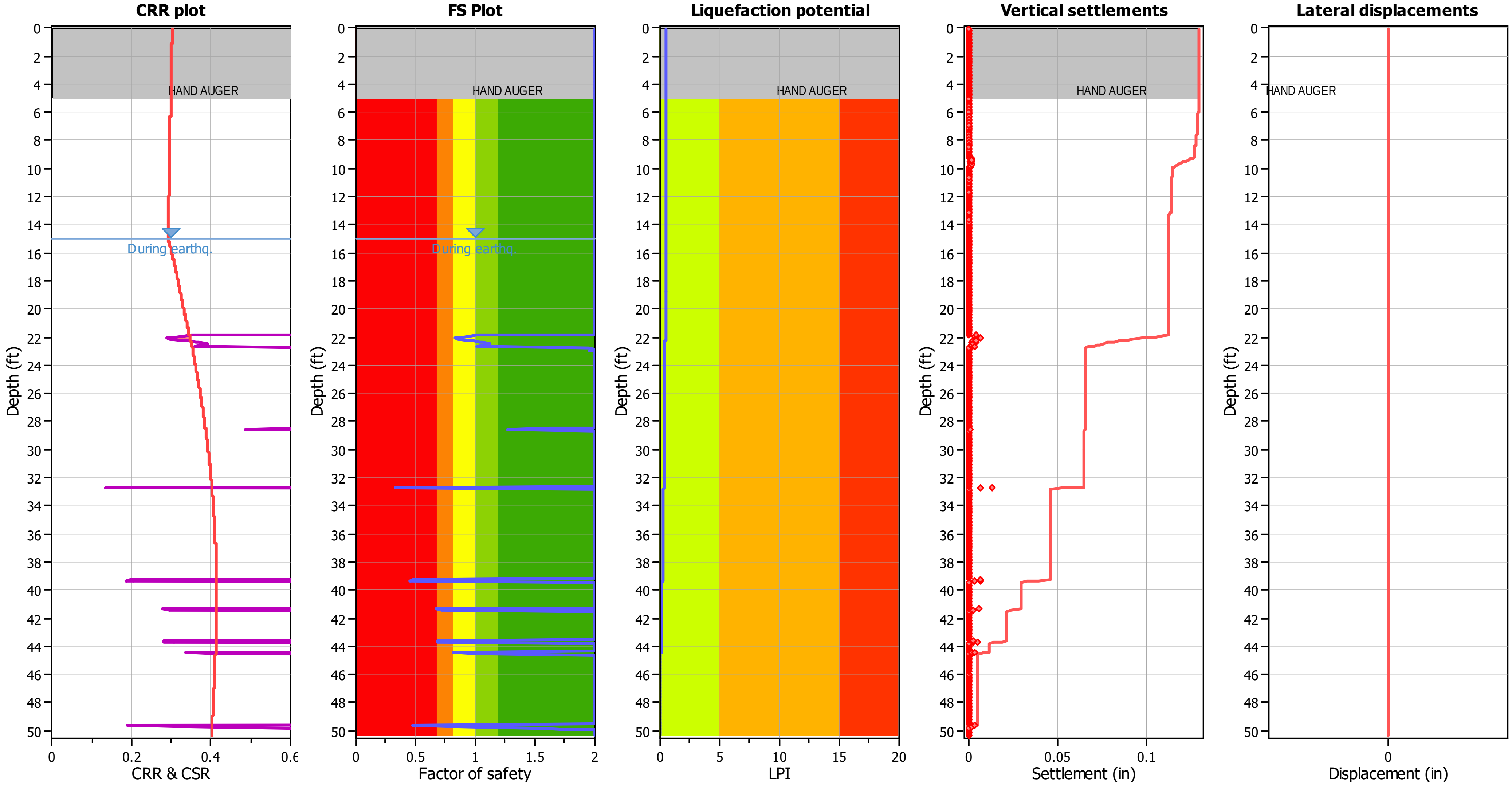

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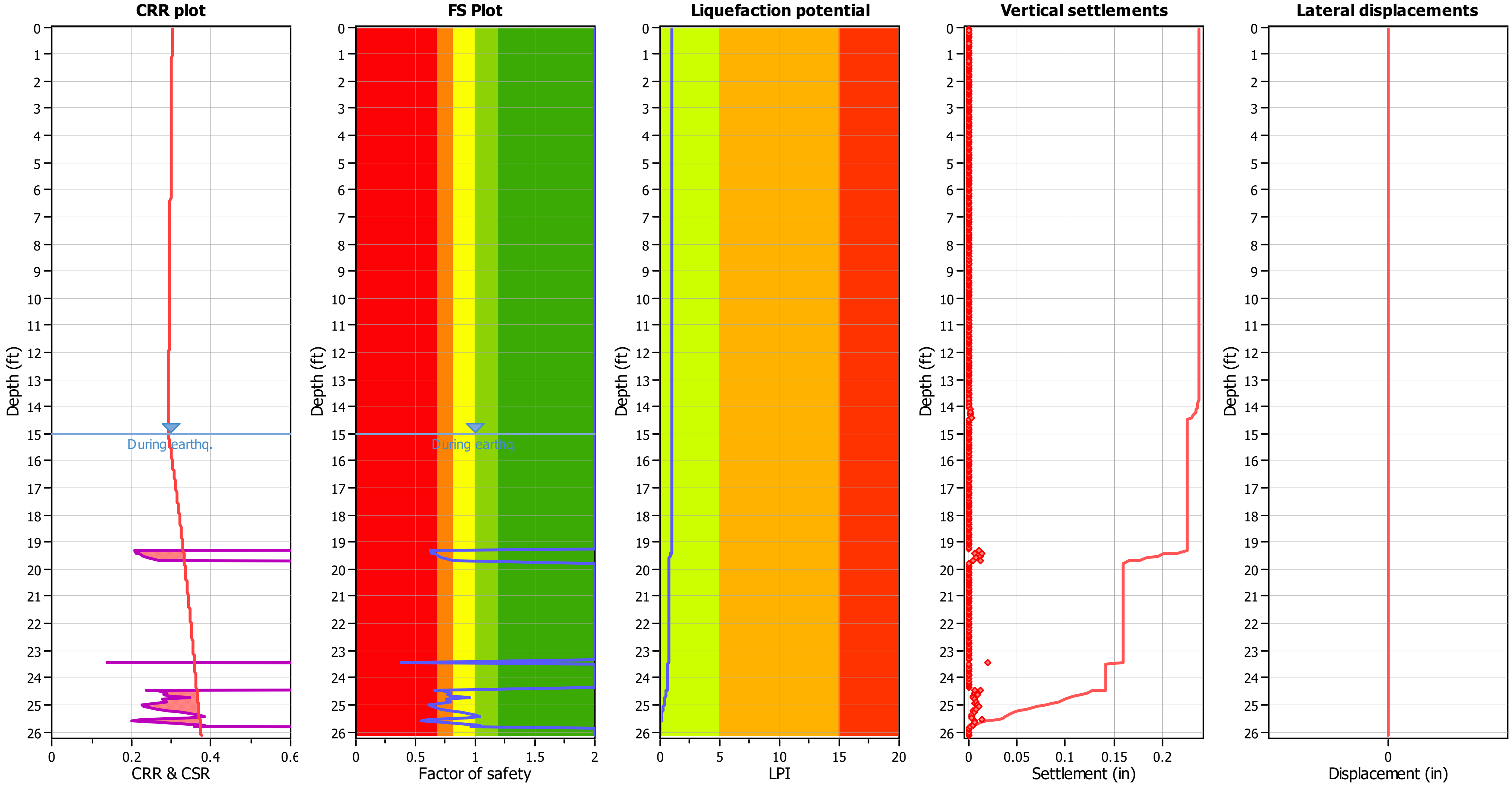

Input parameters and analysis data

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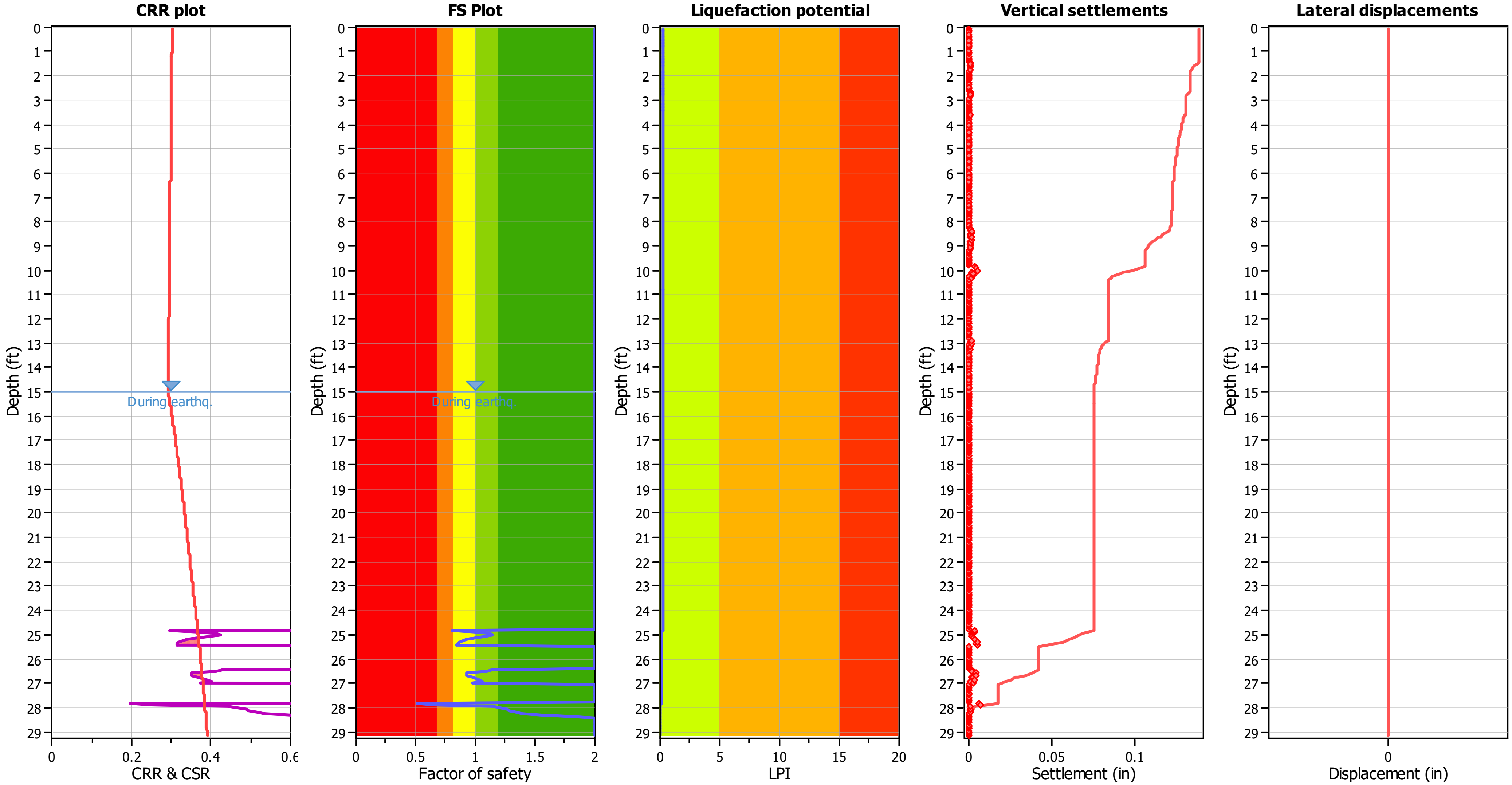

Input parameters and analysis data

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Fines correction method:	NCEER (1998)	Average results interval:	1	Transition detect. applied:	Yes
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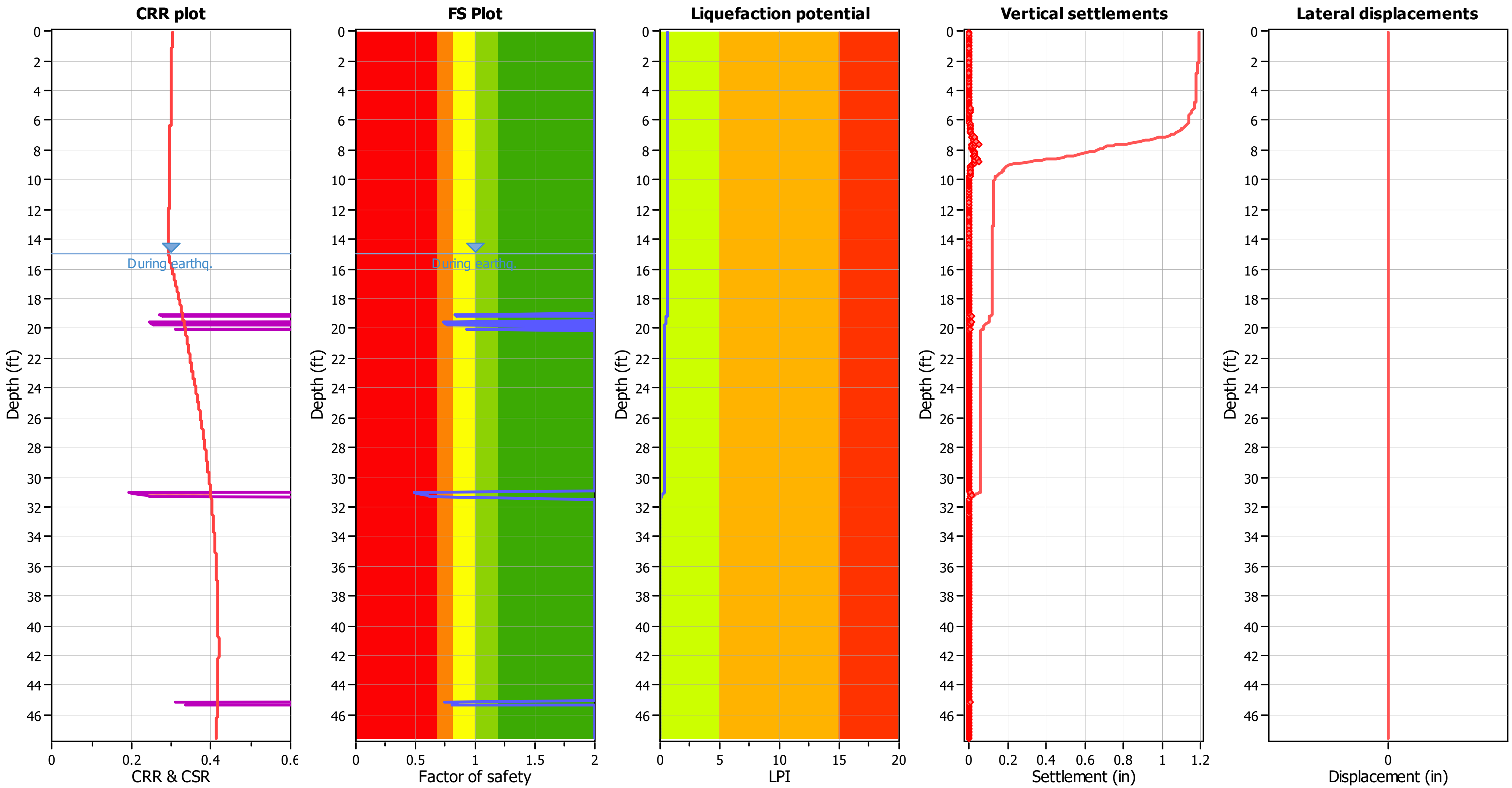
Liquefaction analysis overall plots



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Fines correction method:	NCEER (1998)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
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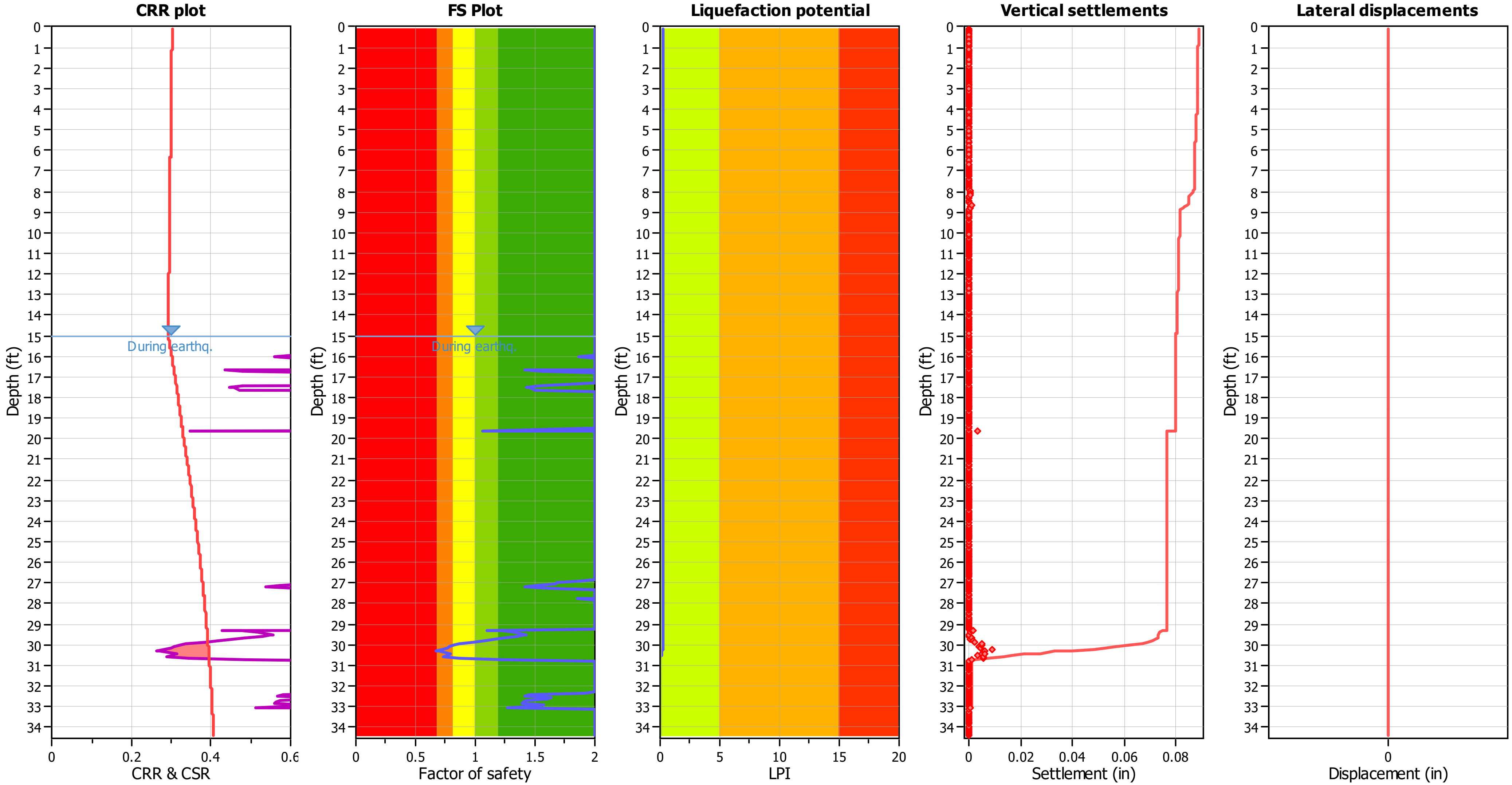
Liquefaction analysis overall plots



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Fines correction method:	NCEER (1998)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
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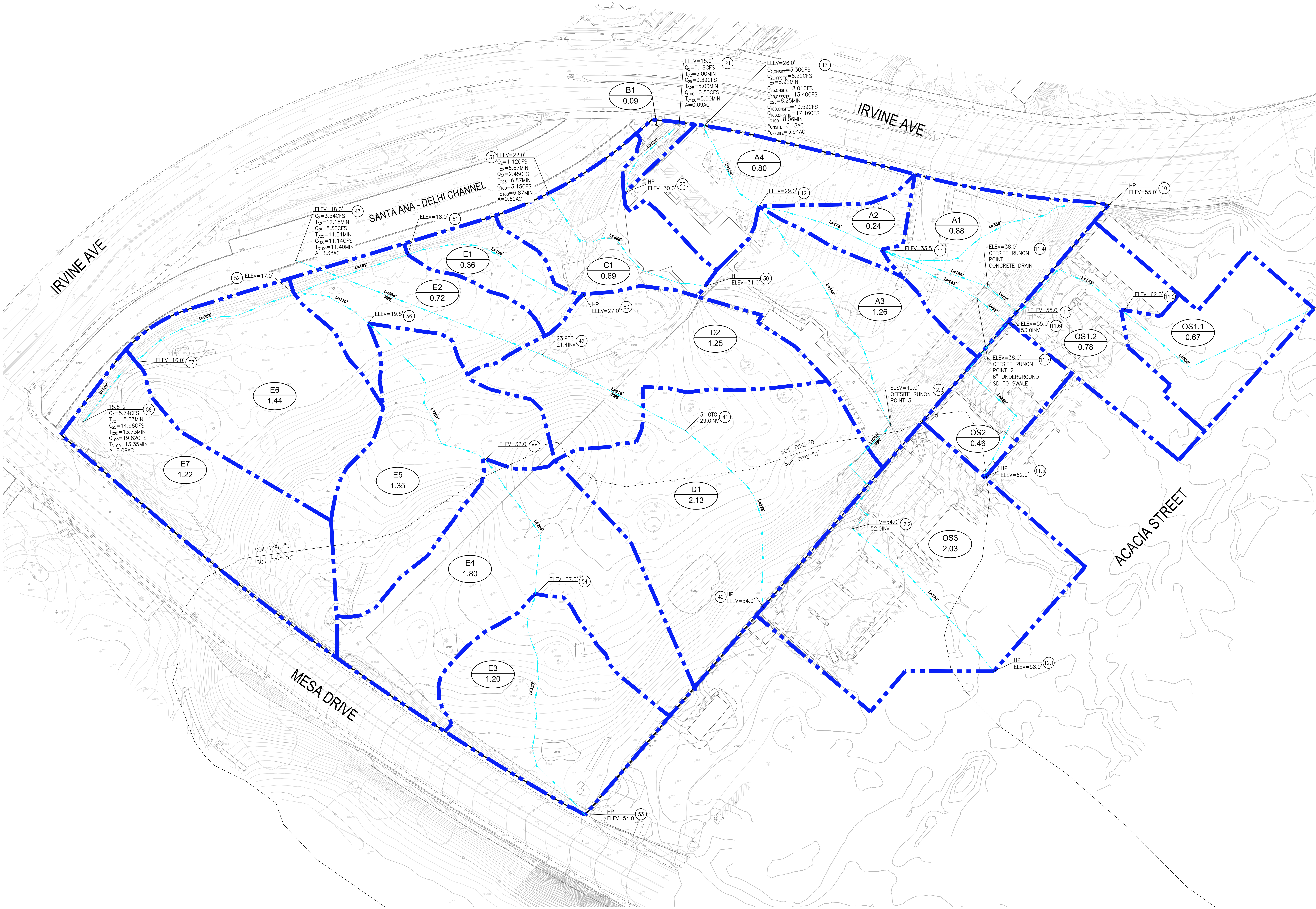
APPENDIX F

EARTHWORK AND GRADING GUIDE SPECIFICATIONS

APPENDIX G

HYDROLOGY CALCULATIONS

EXISTING CONDITION HYDROLOGY



2 YEAR ONSITE RUNOFF VOLUME – 1.78 AC–FT

DMA	AREA (AC)	Q2 (CFS)	Q25 (CFS)	Q100 (CFS)	TC2 (MIN)	TC25 (MIN)	TC100 (MIN)
A	3.18	3.30	8.01	10.59	8.92	8.25	8.06
OS (OFFSITE)	3.94	6.22	13.40	17.16			
B	0.09	0.18	0.39	0.50	5.00	5.00	5.00
C	0.69	1.12	2.45	3.15	6.87	6.87	6.87
D	3.38	3.54	8.56	11.14	12.18	11.51	11.40
E	8.09	5.74	14.95	19.82	15.33	13.73	13.35
TOTAL	19.37	20.10	47.76	62.36	-	-	-
TOTAL ONSITE	15.43	13.88	34.36	45.2			
TOTAL OFFSITE	3.94	6.22	13.4	17.16			

SOIL TYPE "C" & "D"

ABBREVATIONS

AC	ACRE
AC–FT	ACRE–FOOT
CFS	CUBIC FEET PER SECOND
ELEV	SURFACE ELEVATION
HP	HIGH POINT
INV	PIPE INVERT ELEVATION
L	LENGTH
MIN	MINUTES
Q	FLOW RATE
S	SLOPE
T_C	TIME OF CONCENTRATION
CB	CATCH BASIN

LEGEND

- PROPERTY LINE
- EXISTING STORM DRAIN
- DRAINAGE BOUNDARY
- DRAINAGE SUB–BOUNDARY
- XX NODE
- ON–SITE AREA DRAIN LINE
- TIME OF CONCENTRATION FLOW PATH
- L=XXX' FLOW PATH LENGTH
- SOIL TYPE DELINEATION
- X / X.XX DRAINAGE BOUNDARY DESIGNATION AND AREA

N

50' 0' 25' 50'

SCALE: 1" = 50'

SNUG HARBOR
NEWPORT BEACH, CA 92660

BACK BAY BARRELS, LLC
3857 BIRCH STREET, SUITE 521
NEWPORT BEACH, CA 92660

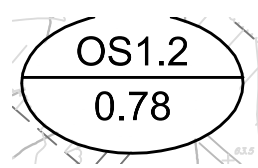
FUSCOE ENGINEERING
15535 Sand Canyon Ave, Suite 100
Irvine, California 92618
949.474.1960
fuscoe.com

8/8/2024

```
****************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
         (c) Copyright 1983-2016 Advanced Engineering Software (aes)
             Ver. 23.0  Release Date: 07/01/2016  License ID 1355

                           Analysis prepared by:

                          Fuscoe Engineering, Inc.
                           15535 Sand Canyon Ave.
                                 Suite 100
                              Irvine, CA 92618

 ************************* DESCRIPTION OF STUDY **************************
* SNUG HARBOR                                                              *
* EXISTING CONDITION                                                       *
* 2 YR                                                                     *
 **************************************************************************

  FILE NAME: SNUG2EX.DAT
  TIME/DATE OF STUDY: 16:49 08/06/2024
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =    2.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   6.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) I ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  ================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

+--------------------------------------------------------------------------+
| SUBAREA A                                                                |
|                                                                          |
|                                                                          |
+--------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE     10.00 TO NODE     11.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   330.00
  ELEVATION DATA: UPSTREAM(FEET) =     55.00  DOWNSTREAM(FEET) =     33.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.339
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  2.180
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
```

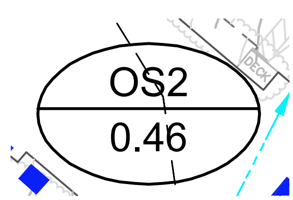
```
  COMMERCIAL                 D        0.88      0.20     0.100    57    5.34
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      1.71
  TOTAL AREA(ACRES) =      0.88   PEAK FLOW RATE(CFS) =      1.71

****************************************************************************
  FLOW PROCESS FROM NODE     11.00 TO NODE     11.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =    5.34
  RAINFALL INTENSITY(INCH/HR) =   2.18
  AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.10
  EFFECTIVE STREAM AREA(ACRES) =       0.88
  TOTAL STREAM AREA(ACRES) =       0.88
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       1.71

****************************************************************************
  FLOW PROCESS FROM NODE     11.10 TO NODE     11.20 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   330.00
  ELEVATION DATA: UPSTREAM(FEET) =     63.00  DOWNSTREAM(FEET) =     62.00
```


```
  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    9.862
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.533
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 D        0.67      0.20     0.100    57    9.86
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      0.91
  TOTAL AREA(ACRES) =      0.67   PEAK FLOW RATE(CFS) =      0.91

****************************************************************************
  FLOW PROCESS FROM NODE     11.20 TO NODE     11.30 IS CODE =  91
----------------------------------------------------------------------------
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM NODE ELEVATION(FEET) =     62.00
  DOWNSTREAM NODE ELEVATION(FEET) =     55.00
```



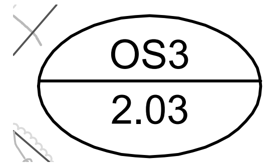

```
  CHANNEL LENGTH THRU SUBAREA(FEET) =   173.00
  "V" GUTTER WIDTH(FEET) =   3.00   GUTTER HIKE(FEET) =  0.160
  PAVEMENT LIP(FEET) =  0.010   MANNING'S N = .0150
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.02000
  MAXIMUM DEPTH(FEET) =  10.00
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.476
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 D        0.78      0.20     0.100    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      1.42
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   4.29
  AVERAGE FLOW DEPTH(FEET) =   0.19   FLOOD WIDTH(FEET) =    4.62
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   0.67   Tc(MIN.) =   10.53
  SUBAREA AREA(ACRES) =    0.78       SUBAREA RUNOFF(CFS) =    1.02
  EFFECTIVE AREA(ACRES) =    1.45     AREA-AVERAGED Fm(INCH/HR) =   0.02
  AREA-AVERAGED Fp(INCH/HR) =   0.20  AREA-AVERAGED Ap =   0.10
```

```
  TOTAL AREA(ACRES) =        1.5         PEAK FLOW RATE(CFS) =       1.90

  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.20   FLOOD WIDTH(FEET) =    6.42
  FLOW VELOCITY(FEET/SEC.) =   4.41   DEPTH*VELOCITY(FT*FT/SEC) =   0.90
  LONGEST FLOWPATH FROM NODE     11.10 TO NODE     11.30 =     503.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     11.30 TO NODE     11.40 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     55.00  DOWNSTREAM(FEET) =    38.00
  FLOW LENGTH(FEET) =     52.00   MANNING'S N =  0.015
  DEPTH OF FLOW IN  36.0 INCH PIPE IS   2.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  12.25
  GIVEN PIPE DIAMETER(INCH) =  36.00     NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       1.90
  PIPE TRAVEL TIME(MIN.) =   0.07    Tc(MIN.) =   10.61
  LONGEST FLOWPATH FROM NODE     11.10 TO NODE     11.40 =     555.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     11.40 TO NODE     11.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =      38.00  DOWNSTREAM(FEET) =      33.50
  CHANNEL LENGTH THRU SUBAREA(FEET) =    150.00   CHANNEL SLOPE =  0.0300
  CHANNEL BASE(FEET) =    15.00    "Z" FACTOR =    0.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =  10.00
  CHANNEL FLOW THRU SUBAREA(CFS) =       1.90
  FLOW VELOCITY(FEET/SEC.) =   2.51   FLOW DEPTH(FEET) =   0.05
  TRAVEL TIME(MIN.) =   1.00   Tc(MIN.) =   11.60
  LONGEST FLOWPATH FROM NODE     11.10 TO NODE     11.00 =     705.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     11.00 TO NODE     11.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   11.60
  RAINFALL INTENSITY(INCH/HR) =   1.40
  AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.10
  EFFECTIVE STREAM AREA(ACRES) =       1.45
  TOTAL STREAM AREA(ACRES) =       1.45
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       1.90

****************************************************************************
  FLOW PROCESS FROM NODE     11.50 TO NODE     11.60 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   265.00
  ELEVATION DATA: UPSTREAM(FEET) =      62.00  DOWNSTREAM(FEET) =      55.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.859
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  2.067
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp        Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 D        0.46      0.20      0.100    57   5.86
```



```
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      0.85
  TOTAL AREA(ACRES) =      0.46   PEAK FLOW RATE(CFS) =      0.85

****************************************************************************
  FLOW PROCESS FROM NODE     11.60 TO NODE     11.70 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    53.00  DOWNSTREAM(FEET) =    38.00
  FLOW LENGTH(FEET) =    52.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN   6.0 INCH PIPE IS   2.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  12.70
  GIVEN PIPE DIAMETER(INCH) =   6.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       0.85
  PIPE TRAVEL TIME(MIN.) =   0.07    Tc(MIN.) =    5.93
  LONGEST FLOWPATH FROM NODE     11.50 TO NODE     11.70 =     317.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     11.70 TO NODE     11.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     38.00  DOWNSTREAM(FEET) =     33.50
  CHANNEL LENGTH THRU SUBAREA(FEET) =   143.00   CHANNEL SLOPE =  0.0315
  CHANNEL BASE(FEET) =   15.00   "Z" FACTOR =   0.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =  10.00
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.85
  FLOW VELOCITY(FEET/SEC.) =   1.69   FLOW DEPTH(FEET) =   0.03
  TRAVEL TIME(MIN.) =   1.41   Tc(MIN.) =    7.34
  LONGEST FLOWPATH FROM NODE     11.50 TO NODE     11.00 =     460.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     11.00 TO NODE     11.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  3 ARE:
  TIME OF CONCENTRATION(MIN.) =    7.34
  RAINFALL INTENSITY(INCH/HR) =   1.82
  AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.10
  EFFECTIVE STREAM AREA(ACRES) =       0.46
  TOTAL STREAM AREA(ACRES) =       0.46
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       0.85

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       1.71    5.34    2.180  0.20( 0.02) 0.10      0.9      10.00
      2       1.90   11.60    1.396  0.20( 0.02) 0.10      1.5      11.10
      3       0.85    7.34    1.817  0.20( 0.02) 0.10      0.5      11.50

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  3 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       3.82    5.34    2.180  0.20( 0.02) 0.10      1.9      10.00
      2       3.84    7.34    1.817  0.20( 0.02) 0.10      2.3      11.50
      3       3.64   11.60    1.396  0.20( 0.02) 0.10      2.8      11.10
```

```
  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       3.84    Tc(MIN.) =     7.34
  EFFECTIVE AREA(ACRES) =       2.26   AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =        2.8
  LONGEST FLOWPATH FROM NODE     11.10 TO NODE     11.00 =     705.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     11.00 TO NODE     12.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     33.50  DOWNSTREAM(FEET) =     29.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   174.00   CHANNEL SLOPE =  0.0259
  CHANNEL BASE(FEET) =   15.00   "Z" FACTOR =   0.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =  10.00
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.695
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 D       0.24      0.20     0.100    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       4.02
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.09
  AVERAGE FLOW DEPTH(FEET) =   0.09   TRAVEL TIME(MIN.) =   0.94
  Tc(MIN.) =    8.27
  SUBAREA AREA(ACRES) =     0.24       SUBAREA RUNOFF(CFS) =    0.36
  EFFECTIVE AREA(ACRES) =      2.50     AREA-AVERAGED Fm(INCH/HR) =   0.02
  AREA-AVERAGED Fp(INCH/HR) =   0.20  AREA-AVERAGED Ap =   0.10
  TOTAL AREA(ACRES) =        3.0         PEAK FLOW RATE(CFS) =       3.84
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.09   FLOW VELOCITY(FEET/SEC.) =   2.95
  LONGEST FLOWPATH FROM NODE     11.10 TO NODE     12.00 =     879.00 FEET.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        3.82    6.27    1.987  0.20( 0.02) 0.10       2.1      10.00
      2        3.84    8.27    1.695  0.20( 0.02) 0.10       2.5      11.50
      3        3.64   12.54    1.336  0.20( 0.02) 0.10       3.0      11.10
  NEW PEAK FLOW DATA ARE:
  PEAK FLOW RATE(CFS) =       3.84  Tc(MIN.) =    8.27
  AREA-AVERAGED Fm(INCH/HR) =  0.02  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.10  EFFECTIVE AREA(ACRES) =      2.50

****************************************************************************
  FLOW PROCESS FROM NODE     12.00 TO NODE     12.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =    8.27
  RAINFALL INTENSITY(INCH/HR) =   1.70
  AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.10
  EFFECTIVE STREAM AREA(ACRES) =       2.50
  TOTAL STREAM AREA(ACRES) =       3.03
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       3.84

****************************************************************************
  FLOW PROCESS FROM NODE     12.10 TO NODE     12.20 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
```




```
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   270.00
  ELEVATION DATA: UPSTREAM(FEET) =     58.00  DOWNSTREAM(FEET) =     54.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.626
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.926
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 C        2.03      0.25     0.100    50    6.63
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      3.47
  TOTAL AREA(ACRES) =      2.03   PEAK FLOW RATE(CFS) =      3.47

****************************************************************************
  FLOW PROCESS FROM NODE     12.20 TO NODE     12.30 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
==========================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     52.00  DOWNSTREAM(FEET) =    45.00
  FLOW LENGTH(FEET) =   200.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  17.69
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =   6.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.47
  PIPE TRAVEL TIME(MIN.) =   0.19    Tc(MIN.) =    6.81
  LONGEST FLOWPATH FROM NODE     12.10 TO NODE     12.30 =     470.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     12.30 TO NODE     12.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
==========================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     45.00  DOWNSTREAM(FEET) =     29.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   350.00   CHANNEL SLOPE =  0.0457
  CHANNEL BASE(FEET) =   15.00   "Z" FACTOR =   0.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =  10.00
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.683
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 D        1.26      0.20     0.100    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       4.42
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.72
  AVERAGE FLOW DEPTH(FEET) =   0.08   TRAVEL TIME(MIN.) =   1.57
  Tc(MIN.) =    8.38
  SUBAREA AREA(ACRES) =     1.26       SUBAREA RUNOFF(CFS) =    1.89
  EFFECTIVE AREA(ACRES) =      3.29     AREA-AVERAGED Fm(INCH/HR) =   0.02
  AREA-AVERAGED Fp(INCH/HR) =   0.23  AREA-AVERAGED Ap =   0.10
  TOTAL AREA(ACRES) =        3.3        PEAK FLOW RATE(CFS) =       4.91

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.08   FLOW VELOCITY(FEET/SEC.) =   4.04
  LONGEST FLOWPATH FROM NODE     12.10 TO NODE     12.00 =     820.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     12.00 TO NODE     12.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
==========================================================================
```

```
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    8.38
  RAINFALL INTENSITY(INCH/HR) =   1.68
  AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.23
  AREA-AVERAGED Ap =  0.10
  EFFECTIVE STREAM AREA(ACRES) =       3.29
  TOTAL STREAM AREA(ACRES) =       3.29
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       4.91

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        3.82    6.27    1.987  0.20( 0.02) 0.10       2.1      10.00
      1        3.84    8.27    1.695  0.20( 0.02) 0.10       2.5      11.50
      1        3.64   12.54    1.336  0.20( 0.02) 0.10       3.0      11.10
      2        4.91    8.38    1.683  0.23( 0.02) 0.10       3.3      12.10

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        8.18    6.27    1.987  0.22( 0.02) 0.10       4.6      10.00
      2        8.73    8.27    1.695  0.22( 0.02) 0.10       5.7      11.50
      3        8.75    8.38    1.683  0.22( 0.02) 0.10       5.8      12.10
      4        7.53   12.54    1.336  0.22( 0.02) 0.10       6.3      11.10

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       8.75    Tc(MIN.) =     8.38
  EFFECTIVE AREA(ACRES) =       5.80   AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.22  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =        6.3
  LONGEST FLOWPATH FROM NODE     11.10 TO NODE     12.00 =     879.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     12.00 TO NODE     13.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     29.00  DOWNSTREAM(FEET) =     26.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   134.00   CHANNEL SLOPE =  0.0224
  CHANNEL BASE(FEET) =   15.00   "Z" FACTOR =   0.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =  10.00
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.624
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                D        0.80      0.20     0.100    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       9.32
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   4.15
  AVERAGE FLOW DEPTH(FEET) =   0.15   TRAVEL TIME(MIN.) =   0.54
  Tc(MIN.) =    8.92
  SUBAREA AREA(ACRES) =     0.80       SUBAREA RUNOFF(CFS) =    1.15
  EFFECTIVE AREA(ACRES) =      6.60     AREA-AVERAGED Fm(INCH/HR) =   0.02
  AREA-AVERAGED Fp(INCH/HR) =   0.22  AREA-AVERAGED Ap =   0.10
  TOTAL AREA(ACRES) =        7.1         PEAK FLOW RATE(CFS) =       9.52

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.15   FLOW VELOCITY(FEET/SEC.) =   4.24
  LONGEST FLOWPATH FROM NODE     11.10 TO NODE     13.00 =    1013.00 FEET.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
```

```
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)        (ACRES)    NODE
      1        9.07    6.83    1.892  0.21( 0.02) 0.10       5.4      10.00
      2        9.50    8.81    1.635  0.22( 0.02) 0.10       6.5      11.50
      3        9.52    8.92    1.624  0.22( 0.02) 0.10       6.6      12.10
      4        8.21   13.10    1.302  0.21( 0.02) 0.10       7.1      11.10
  NEW PEAK FLOW DATA ARE:
  PEAK FLOW RATE(CFS) =       9.52  Tc(MIN.) =    8.92
  AREA-AVERAGED Fm(INCH/HR) =  0.02  AREA-AVERAGED Fp(INCH/HR) =  0.22
  AREA-AVERAGED Ap =  0.10  EFFECTIVE AREA(ACRES) =       6.60

+--------------------------------------------------------------------------+
| SUBAREA B                                                                |
|                                                                          |
|                                                                          |
+--------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE     20.00 TO NODE     21.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   122.00
  ELEVATION DATA: UPSTREAM(FEET) =     30.00  DOWNSTREAM(FEET) =     15.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.000
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  2.264
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 D        0.09      0.20     0.100     57    5.00
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      0.18
  TOTAL AREA(ACRES) =      0.09   PEAK FLOW RATE(CFS) =      0.18

+--------------------------------------------------------------------------+
| SUBAREA C                                                                |
|                                                                          |
|                                                                          |
+--------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE     30.00 TO NODE     31.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   266.00
  ELEVATION DATA: UPSTREAM(FEET) =     31.00  DOWNSTREAM(FEET) =     22.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.870
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.886
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"      D        0.69      0.20     0.400     57    6.87
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.400
  SUBAREA RUNOFF(CFS) =      1.12
  TOTAL AREA(ACRES) =      0.69   PEAK FLOW RATE(CFS) =      1.12

+--------------------------------------------------------------------------+
| SUBAREA D                                                                |
|                                                                          |
|                                                                          |
```

```
+--------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE     40.00 TO NODE     41.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   278.00
  ELEVATION DATA: UPSTREAM(FEET) =     54.00  DOWNSTREAM(FEET) =     31.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   11.038
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.437
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  URBAN FAIR COVER
  "TURF"                     C        2.13      0.25     1.000    59   11.04
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA RUNOFF(CFS) =      2.28
  TOTAL AREA(ACRES) =      2.13   PEAK FLOW RATE(CFS) =      2.28

****************************************************************************
  FLOW PROCESS FROM NODE     41.00 TO NODE     42.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    29.00  DOWNSTREAM(FEET) =    21.40
  FLOW LENGTH(FEET) =   218.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.52
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =   8.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       2.28
  PIPE TRAVEL TIME(MIN.) =   0.56    Tc(MIN.) =   11.60
  LONGEST FLOWPATH FROM NODE     40.00 TO NODE     42.00 =     496.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     42.00 TO NODE     42.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   11.60
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.397
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  URBAN FAIR COVER
  "TURF"                     D        1.25      0.20     1.000    66
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA AREA(ACRES) =    1.25      SUBAREA RUNOFF(CFS) =    1.35
  EFFECTIVE AREA(ACRES) =      3.38   AREA-AVERAGED Fm(INCH/HR) =  0.23
  AREA-AVERAGED Fp(INCH/HR) =  0.23   AREA-AVERAGED Ap =  1.00
  TOTAL AREA(ACRES) =        3.4       PEAK FLOW RATE(CFS) =       3.54

****************************************************************************
  FLOW PROCESS FROM NODE     42.00 TO NODE     43.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    21.40  DOWNSTREAM(FEET) =    18.00
  FLOW LENGTH(FEET) =   354.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  10.15
```

```
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =   8.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.54
  PIPE TRAVEL TIME(MIN.) =   0.58    Tc(MIN.) =   12.18
  LONGEST FLOWPATH FROM NODE     40.00 TO NODE     43.00 =     850.00 FEET.

+--------------------------------------------------------------------------+
| SUBAREA E                                                                |
|                                                                          |
|                                                                          |
+--------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE     50.00 TO NODE     51.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   150.00
  ELEVATION DATA: UPSTREAM(FEET) =     27.00  DOWNSTREAM(FEET) =     18.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    9.196
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.596
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  URBAN FAIR COVER
  "TURF"                     D        0.36      0.20     1.000    66    9.20
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA RUNOFF(CFS) =      0.45
  TOTAL AREA(ACRES) =      0.36   PEAK FLOW RATE(CFS) =      0.45

****************************************************************************
  FLOW PROCESS FROM NODE     51.00 TO NODE     52.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     18.00  DOWNSTREAM(FEET) =     17.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   161.00   CHANNEL SLOPE =  0.0062
  CHANNEL BASE(FEET) =    5.00   "Z" FACTOR =   2.500
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =  10.00
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.385
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  URBAN FAIR COVER
  "TURF"                     D        0.72      0.20     1.000    66
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      0.84
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.04
  AVERAGE FLOW DEPTH(FEET) =   0.15   TRAVEL TIME(MIN.) =   2.58
  Tc(MIN.) =   11.77
  SUBAREA AREA(ACRES) =     0.72       SUBAREA RUNOFF(CFS) =    0.77
  EFFECTIVE AREA(ACRES) =      1.08     AREA-AVERAGED Fm(INCH/HR) =   0.20
  AREA-AVERAGED Fp(INCH/HR) =   0.20  AREA-AVERAGED Ap =   1.00
  TOTAL AREA(ACRES) =        1.1         PEAK FLOW RATE(CFS) =      1.15

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.18   FLOW VELOCITY(FEET/SEC.) =   1.17
  LONGEST FLOWPATH FROM NODE     50.00 TO NODE     52.00 =     311.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     52.00 TO NODE     52.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
```

```
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   11.77
  RAINFALL INTENSITY(INCH/HR) =   1.38
  AREA-AVERAGED Fm(INCH/HR) =  0.20
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  1.00
  EFFECTIVE STREAM AREA(ACRES) =       1.08
  TOTAL STREAM AREA(ACRES) =       1.08
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       1.15

****************************************************************************
  FLOW PROCESS FROM NODE     53.00 TO NODE     54.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   330.00
  ELEVATION DATA: UPSTREAM(FEET) =     54.00  DOWNSTREAM(FEET) =     37.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   12.996
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.308
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  URBAN FAIR COVER
  "TURF"                     C        1.20      0.25     1.000    59   13.00
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA RUNOFF(CFS) =      1.14
  TOTAL AREA(ACRES) =      1.20   PEAK FLOW RATE(CFS) =      1.14

****************************************************************************
  FLOW PROCESS FROM NODE     54.00 TO NODE     55.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     37.00  DOWNSTREAM(FEET) =     32.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   204.00   CHANNEL SLOPE =  0.0245
  CHANNEL BASE(FEET) =   15.00   "Z" FACTOR =   0.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =  10.00
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.191
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  URBAN FAIR COVER
  "TURF"                     C        1.80      0.25     1.000    59
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.91
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.46
  AVERAGE FLOW DEPTH(FEET) =   0.09   TRAVEL TIME(MIN.) =   2.32
  Tc(MIN.) =   15.32
  SUBAREA AREA(ACRES) =     1.80       SUBAREA RUNOFF(CFS) =    1.52
  EFFECTIVE AREA(ACRES) =      3.00     AREA-AVERAGED Fm(INCH/HR) =   0.25
  AREA-AVERAGED Fp(INCH/HR) =   0.25  AREA-AVERAGED Ap =   1.00
  TOTAL AREA(ACRES) =        3.0         PEAK FLOW RATE(CFS) =       2.54

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.10   FLOW VELOCITY(FEET/SEC.) =   1.66
  LONGEST FLOWPATH FROM NODE     53.00 TO NODE     55.00 =     534.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     55.00 TO NODE     56.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
```

```
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     32.00  DOWNSTREAM(FEET) =     19.50
  CHANNEL LENGTH THRU SUBAREA(FEET) =   261.00   CHANNEL SLOPE =  0.0479
  CHANNEL BASE(FEET) =   15.00   "Z" FACTOR =   0.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =  10.00
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.110
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  URBAN FAIR COVER
  "TURF"                     D        1.35      0.20     1.000    66
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.09
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.18
  AVERAGE FLOW DEPTH(FEET) =   0.09   TRAVEL TIME(MIN.) =   1.99
  Tc(MIN.) =   17.31
  SUBAREA AREA(ACRES) =     1.35       SUBAREA RUNOFF(CFS) =    1.11
  EFFECTIVE AREA(ACRES) =      4.35     AREA-AVERAGED Fm(INCH/HR) =   0.23
  AREA-AVERAGED Fp(INCH/HR) =   0.23  AREA-AVERAGED Ap =   1.00
  TOTAL AREA(ACRES) =        4.3         PEAK FLOW RATE(CFS) =       3.43

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.10   FLOW VELOCITY(FEET/SEC.) =   2.24
  LONGEST FLOWPATH FROM NODE     53.00 TO NODE     56.00 =     795.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     56.00 TO NODE     52.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     19.50  DOWNSTREAM(FEET) =     17.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   110.00   CHANNEL SLOPE =  0.0227
  CHANNEL BASE(FEET) =   15.00   "Z" FACTOR =   0.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =  10.00
  CHANNEL FLOW THRU SUBAREA(CFS) =       3.43
  FLOW VELOCITY(FEET/SEC.) =   1.83   FLOW DEPTH(FEET) =   0.12
  TRAVEL TIME(MIN.) =   1.00   Tc(MIN.) =   18.31
  LONGEST FLOWPATH FROM NODE     53.00 TO NODE     52.00 =     905.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     52.00 TO NODE     52.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   18.31
  RAINFALL INTENSITY(INCH/HR) =   1.07
  AREA-AVERAGED Fm(INCH/HR) =  0.23
  AREA-AVERAGED Fp(INCH/HR) =  0.23
  AREA-AVERAGED Ap =  1.00
  EFFECTIVE STREAM AREA(ACRES) =       4.35
  TOTAL STREAM AREA(ACRES) =       4.35
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       3.43

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       1.15   11.77    1.385  0.20( 0.20) 1.00       1.1      50.00
      2       3.43   18.31    1.075  0.23( 0.23) 1.00       4.3      53.00

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
```

```
  STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
  NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
     1       4.17   11.77    1.385  0.22( 0.22) 1.00       3.9      50.00
     2       4.28   18.31    1.075  0.23( 0.23) 1.00       5.4      53.00

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =       4.28    Tc(MIN.) =    18.31
 EFFECTIVE AREA(ACRES) =       5.43   AREA-AVERAGED Fm(INCH/HR) =  0.23
 AREA-AVERAGED Fp(INCH/HR) =  0.23  AREA-AVERAGED Ap =  1.00
 TOTAL AREA(ACRES) =       5.4
 LONGEST FLOWPATH FROM NODE     53.00 TO NODE     52.00 =     905.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     52.00 TO NODE     57.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =     17.00  DOWNSTREAM(FEET) =     16.00
 CHANNEL LENGTH THRU SUBAREA(FEET) =   253.00   CHANNEL SLOPE =  0.0040
 CHANNEL BASE(FEET) =    5.00   "Z" FACTOR =   2.500
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =  10.00
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  0.997
 SUBAREA LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 URBAN FAIR COVER
 "TURF"                     D        1.44      0.20     1.000    66
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       4.79
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.65
 AVERAGE FLOW DEPTH(FEET) =   0.47   TRAVEL TIME(MIN.) =   2.55
 Tc(MIN.) =   20.87
 SUBAREA AREA(ACRES) =     1.44       SUBAREA RUNOFF(CFS) =    1.03
 EFFECTIVE AREA(ACRES) =      6.87     AREA-AVERAGED Fm(INCH/HR) =   0.22
 AREA-AVERAGED Fp(INCH/HR) =   0.22  AREA-AVERAGED Ap =   1.00
 TOTAL AREA(ACRES) =       6.9        PEAK FLOW RATE(CFS) =       4.79

 END OF SUBAREA CHANNEL FLOW HYDRAULICS:
 DEPTH(FEET) =  0.47   FLOW VELOCITY(FEET/SEC.) =   1.65
 LONGEST FLOWPATH FROM NODE     53.00 TO NODE     57.00 =    1158.00 FEET.

 ** PEAK FLOW RATE TABLE **
  STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
  NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
     1       4.87   14.34    1.236  0.22( 0.22) 1.00       5.3      50.00
     2       4.79   20.87    0.997  0.22( 0.22) 1.00       6.9      53.00
 NEW PEAK FLOW DATA ARE:
 PEAK FLOW RATE(CFS) =       4.87  Tc(MIN.) =   14.34
 AREA-AVERAGED Fm(INCH/HR) =  0.22  AREA-AVERAGED Fp(INCH/HR) =  0.22
 AREA-AVERAGED Ap =  1.00  EFFECTIVE AREA(ACRES) =       5.32

****************************************************************************
 FLOW PROCESS FROM NODE     57.00 TO NODE     58.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =     16.00  DOWNSTREAM(FEET) =     15.50
 CHANNEL LENGTH THRU SUBAREA(FEET) =   107.00   CHANNEL SLOPE =  0.0047
 CHANNEL BASE(FEET) =    5.00   "Z" FACTOR =   2.500
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =  10.00
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.190
 SUBAREA LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 URBAN FAIR COVER
 "TURF"                     D        1.22      0.20     1.000    66
```

```
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       5.42
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.80
  AVERAGE FLOW DEPTH(FEET) =   0.48   TRAVEL TIME(MIN.) =   0.99
  Tc(MIN.) =   15.33
  SUBAREA AREA(ACRES) =     1.22       SUBAREA RUNOFF(CFS) =    1.09
  EFFECTIVE AREA(ACRES) =      6.54     AREA-AVERAGED Fm(INCH/HR) =   0.21
  AREA-AVERAGED Fp(INCH/HR) =   0.21  AREA-AVERAGED Ap =   1.00
  TOTAL AREA(ACRES) =        8.1         PEAK FLOW RATE(CFS) =       5.74

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.50   FLOW VELOCITY(FEET/SEC.) =   1.84
  LONGEST FLOWPATH FROM NODE     53.00 TO NODE     58.00 =    1265.00 FEET.

  ** PEAK FLOW RATE TABLE **
   STREAM      Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       5.74   15.33    1.190  0.21( 0.21) 1.00       6.5      50.00
      2       5.48   21.86    0.971  0.22( 0.22) 1.00       8.1      53.00
  NEW PEAK FLOW DATA ARE:
  PEAK FLOW RATE(CFS) =       5.74  Tc(MIN.) =   15.33
  AREA-AVERAGED Fm(INCH/HR) =  0.21  AREA-AVERAGED Fp(INCH/HR) =  0.21
  AREA-AVERAGED Ap =  1.00  EFFECTIVE AREA(ACRES) =      6.54
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        8.1  TC(MIN.) =     15.33
  EFFECTIVE AREA(ACRES) =      6.54  AREA-AVERAGED Fm(INCH/HR)=  0.21
  AREA-AVERAGED Fp(INCH/HR) =  0.21  AREA-AVERAGED Ap = 1.000
  PEAK FLOW RATE(CFS)   =       5.74

  ** PEAK FLOW RATE TABLE **
   STREAM      Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       5.74   15.33    1.190  0.21( 0.21) 1.00       6.5      50.00
      2       5.48   21.86    0.971  0.22( 0.22) 1.00       8.1      53.00
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************
           NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
                     AND LOW LOSS FRACTION ESTIMATIONS
============================================================================
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             Ver. 23.0  Release Date: 07/01/2016  License ID 1355

                          Analysis prepared by:

                         Fuscoe Engineering, Inc.
                          15535 Sand Canyon Ave.
                                Suite 100
                             Irvine, CA 92618

****************************************************************************
----------------------------------------------------------------------------

 Problem Descriptions:
  SNUG HARBOR
  EXISTING CONDITION
  2 YR HYDROGRAPH
============================================================================
*** NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
    AND LOW LOSS FRACTION ESTIMATIONS FOR AMC I:

    TOTAL 24-HOUR DURATION RAINFALL DEPTH =     2.05 (inches)

    SOIL-COVER     AREA      PERCENT OF    SCS CURVE    LOSS RATE
       TYPE      (Acres)   PERVIOUS AREA     NUMBER    Fp(in./hr.)    YIELD
         1         10.30       67.00       82.(AMC II)     0.200       0.349
         2          5.13      100.00       82.(AMC II)     0.250       0.082

    TOTAL AREA (Acres) =     15.43

    AREA-AVERAGED LOSS RATE, Fm (in./hr.) =  0.173

    AREA-AVERAGED LOW LOSS FRACTION, Y = 0.740
============================================================================

 Problem Descriptions:
  SNUG HARBOR
  EXISTING CONDITION
  2 YR HYDROGRAPH
----------------------------------------------------------------------------


    RATIONAL METHOD CALIBRATION COEFFICIENT = 0.89
    TOTAL CATCHMENT AREA(ACRES) =   15.43
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.173
    LOW LOSS FRACTION = 0.740
    TIME OF CONCENTRATION(MIN.) = 15.33
    SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
    ORANGE COUNTY "VALLEY" RAINFALL VALUES ARE USED
    RETURN FREQUENCY(YEARS) =   2
       5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.19
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.40
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  0.53
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  0.89
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  1.22
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  2.05

----------------------------------------------------------------------------

    TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     0.85
    TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     1.78

****************************************************************************
  TIME     VOLUME       Q    0.        5.0      10.0      15.0      20.0
 (HOURS)    (AF)       (CFS)
----------------------------------------------------------------------------
  0.16     0.0000      0.00  Q         .         .         .         .
  0.41     0.0012      0.12  Q         .         .         .         .
```
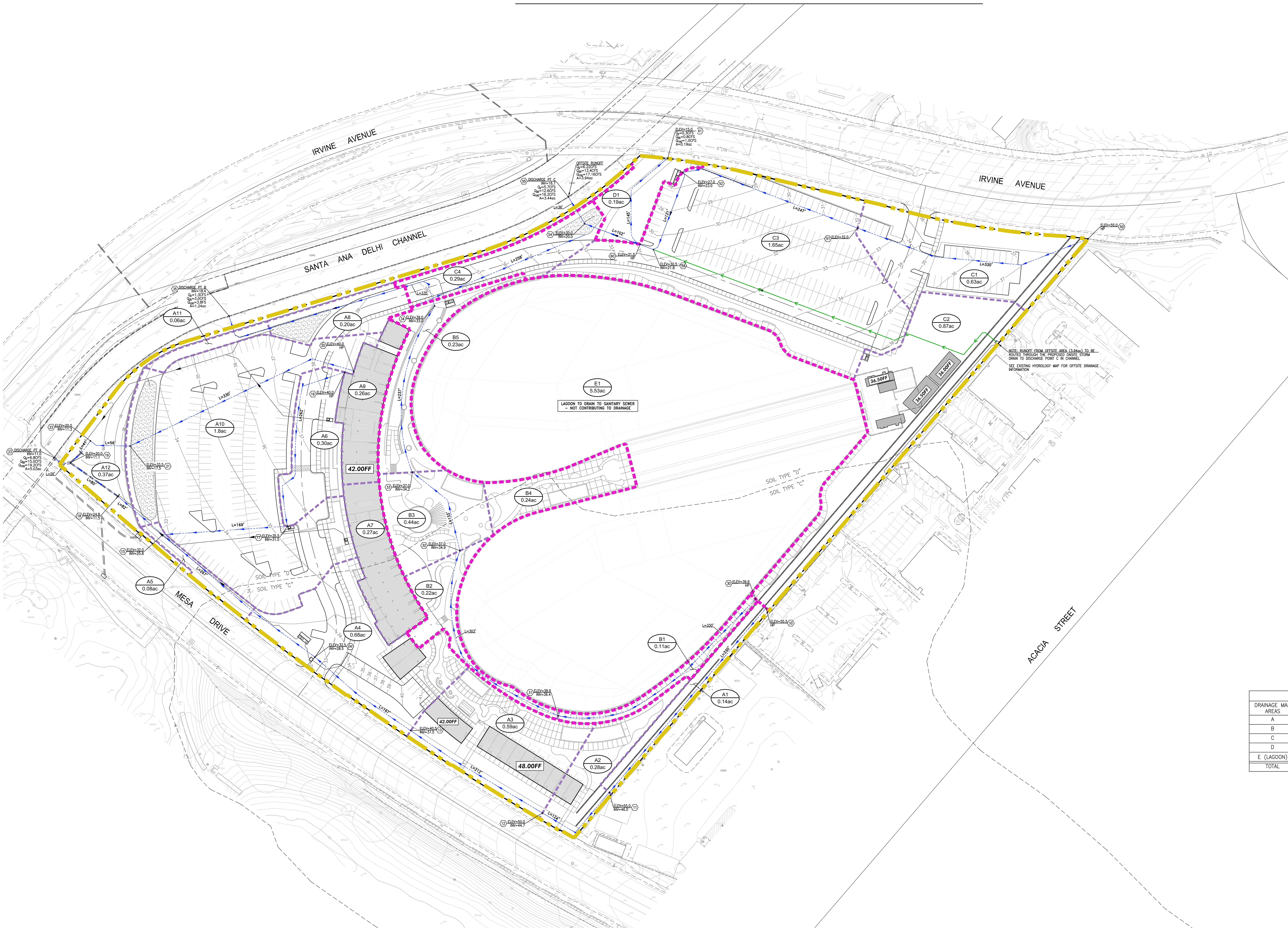

```
   0.67       0.0037       0.12  Q         .         .         .         .
   0.93       0.0061       0.12  Q         .         .         .         .
   1.18       0.0086       0.12  Q         .         .         .         .
   1.44       0.0111       0.12  Q         .         .         .         .
   1.69       0.0137       0.12  Q         .         .         .         .
   1.95       0.0163       0.12  Q         .         .         .         .
   2.20       0.0189       0.12  Q         .         .         .         .
   2.46       0.0215       0.13  Q         .         .         .         .
   2.71       0.0242       0.13  Q         .         .         .         .
   2.97       0.0268       0.13  Q         .         .         .         .
   3.22       0.0296       0.13  Q         .         .         .         .
   3.48       0.0323       0.13  Q         .         .         .         .
   3.74       0.0351       0.13  Q         .         .         .         .
   3.99       0.0380       0.14  Q         .         .         .         .
   4.25       0.0408       0.14  Q         .         .         .         .
   4.50       0.0437       0.14  Q         .         .         .         .
   4.76       0.0467       0.14  Q         .         .         .         .
   5.01       0.0497       0.14  Q         .         .         .         .
   5.27       0.0527       0.14  Q         .         .         .         .
   5.52       0.0558       0.15  Q         .         .         .         .
   5.78       0.0589       0.15  Q         .         .         .         .
   6.04       0.0621       0.15  Q         .         .         .         .
   6.29       0.0653       0.15  Q         .         .         .         .
   6.55       0.0686       0.16  Q         .         .         .         .
   6.80       0.0719       0.16  Q         .         .         .         .
   7.06       0.0753       0.16  Q         .         .         .         .
   7.31       0.0788       0.16  Q         .         .         .         .
   7.57       0.0823       0.17  Q         .         .         .         .
   7.82       0.0858       0.17  Q         .         .         .         .
   8.08       0.0895       0.17  Q         .         .         .         .
   8.34       0.0932       0.18  Q         .         .         .         .
   8.59       0.0970       0.18  Q         .         .         .         .
   8.85       0.1009       0.18  Q         .         .         .         .
   9.10       0.1048       0.19  Q         .         .         .         .
   9.36       0.1089       0.19  Q         .         .         .         .
   9.61       0.1130       0.20  Q         .         .         .         .
   9.87       0.1173       0.20  Q         .         .         .         .
  10.12       0.1216       0.21  Q         .         .         .         .
  10.38       0.1261       0.21  Q         .         .         .         .
  10.63       0.1307       0.22  Q         .         .         .         .
  10.89       0.1354       0.23  Q         .         .         .         .
  11.15       0.1403       0.24  Q         .         .         .         .
  11.40       0.1453       0.24  Q         .         .         .         .
  11.66       0.1505       0.25  Q         .         .         .         .
  11.91       0.1559       0.26  Q         .         .         .         .
  12.17       0.1618       0.30  Q         .         .         .         .
  12.42       0.1685       0.34  Q         .         .         .         .
  12.68       0.1758       0.36  Q         .         .         .         .
  12.93       0.1834       0.37  Q         .         .         .         .
  13.19       0.1914       0.39  Q         .         .         .         .
  13.45       0.1997       0.40  Q         .         .         .         .
  13.70       0.2084       0.43  Q         .         .         .         .
  13.96       0.2177       0.45  Q         .         .         .         .
  14.21       0.2277       0.50  .Q        .         .         .         .
  14.47       0.2386       0.53  .Q        .         .         .         .
  14.72       0.2504       0.59  .Q        .         .         .         .
  14.98       0.2634       0.63  .Q        .         .         .         .
  15.23       0.2779       0.75  .Q        .         .         .         .
  15.49       0.2946       0.83  .Q        .         .         .         .
  15.74       0.3192       1.50  .  Q      .         .         .         .
  16.00       0.3673       3.05  .     Q   .         .         .         .
  16.26       0.5460      13.88  .         .         .      Q  .         .
  16.51       0.7013       0.83  .Q        .         .         .         .
  16.77       0.7173       0.68  .Q        .         .         .         .
  17.02       0.7304       0.56  .Q        .         .         .         .
  17.28       0.7412       0.47  Q         .         .         .         .
  17.53       0.7505       0.41  Q         .         .         .         .
  17.79       0.7589       0.38  Q         .         .         .         .
  18.04       0.7665       0.35  Q         .         .         .         .
  18.30       0.7729       0.26  Q         .         .         .         .
  18.56       0.7783       0.25  Q         .         .         .         .
  18.81       0.7834       0.23  Q         .         .         .         .
  19.07       0.7881       0.22  Q         .         .         .         .
```

```
  19.32      0.7926      0.21  Q        .         .         .         .
  19.58      0.7968      0.20  Q        .         .         .         .
  19.83      0.8009      0.19  Q        .         .         .         .
  20.09      0.8047      0.18  Q        .         .         .         .
  20.34      0.8084      0.17  Q        .         .         .         .
  20.60      0.8120      0.17  Q        .         .         .         .
  20.85      0.8155      0.16  Q        .         .         .         .
  21.11      0.8188      0.16  Q        .         .         .         .
  21.37      0.8220      0.15  Q        .         .         .         .
  21.62      0.8251      0.15  Q        .         .         .         .
  21.88      0.8282      0.14  Q        .         .         .         .
  22.13      0.8311      0.14  Q        .         .         .         .
  22.39      0.8340      0.13  Q        .         .         .         .
  22.64      0.8368      0.13  Q        .         .         .         .
  22.90      0.8395      0.13  Q        .         .         .         .
  23.15      0.8422      0.12  Q        .         .         .         .
  23.41      0.8448      0.12  Q        .         .         .         .
  23.67      0.8473      0.12  Q        .         .         .         .
  23.92      0.8498      0.12  Q        .         .         .         .
  24.18      0.8523      0.11  Q        .         .         .         .
  24.43      0.8535      0.00  Q        .         .         .         .
 -----------------------------------------------------------------------------
-------------------------------------------------------------------------------
    TIME DURATION(minutes) OF PERCENTILES OF ESTIMATED PEAK FLOW RATE:
    (Note: 100% of Peak Flow Rate estimate assumed to have
    an instantaneous time duration)

    Percentile of Estimated                 Duration
        Peak Flow Rate                      (minutes)
    =======================                 =========
               0%                            1441.0
              10%                              46.0
              20%                              30.7
              30%                              15.3
              40%                              15.3
              50%                              15.3
              60%                              15.3
              70%                              15.3
              80%                              15.3
              90%                              15.3
```

PROPOSED CONDITION HYDROLOGY



SOIL TYPE "C" & "D"

ABBREVATIONS

AC	ACRE
AC-FT	ACRE-FOOT
CFS	CUBIC FEET PER SECOND
ELEV	SURFACE ELEVATION
HP	HIGH POINT
INV	PIPE INVERT ELEVATION
L	LENGTH
MIN	MINUTES
Q	FLOW RATE
S	SLOPE
T_c	TIME OF CONCENTRATION
CB	CATCH BASIN

LEGEND

- PROPERTY LINE
- EXISTING STORM DRAIN
- DRAINAGE BOUNDARY
- DRAINAGE SUB-BOUNDARY
- DRAINAGE SUB-AREAS
- XX NODE
- ON-SITE AREA DRAIN LINE
- TIME OF CONCENTRATION FLOW PATH
- OFFSITE FLOW PATH
- L=XXX' FLOW PATH LENGTH
- SOIL TYPE DELINEATION
- X / X.XX DRAINAGE BOUNDARY DESIGNATION AND AREA

PROPOSED CONDITION SUMMARY TABLE

DRAINAGE MAP AREAS	AREA (ACRES)	Q2 (CFS)	Q25 (CFS)	Q100 (CFS)
A	5.03	6.8	15.0	19.2
B	1.24	1.3	3.0	3.8
C	3.44	5.7	12.6	16.2
D	0.19	0.3	0.8	1.0
E (LAGOON)	5.53	–	–	–
TOTAL	15.43	14.1	31.4	40.2

N

50' 0' 25' 50'
SCALE: 1" = 50'

SNUG HARBOR
NEWPORT BEACH, CA 92660

BACK BAY BARRELS, LLC
3857 BIRCH STREET, SUITE 521
NEWPORT BEACH, CA 92660

FUSCOE ENGINEERING
15535 Sand Canyon Ave, Suite 100
Irvine, California 92618
949.474.1960
fuscoe.com

11/05/2024

```
****************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
         (c) Copyright 1983-2016 Advanced Engineering Software (aes)
             Ver. 23.0  Release Date: 07/01/2016  License ID 1355

                           Analysis prepared by:
```

Note: Area E1 consists of the proposed lagoons (5.5 acres), and will be self-contained, draining to sanitary sewer system. Therefore the total on-site area to be discharged is 9.9 acres (15.4 - 5.5)

```
 ************************** DESCRIPTION OF STUDY **************************
* Snug Harbor Surf Park                                                     *
* Proposed Condition Hydrology                                              *
* 2-year storm event                                                        *
 **************************************************************************

  FILE NAME: PRSH2.DAT
  TIME/DATE OF STUDY: 14:16 11/05/2024
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =    2.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   4.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) I ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE     10.00 TO NODE     11.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<              A-1
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   330.00
  ELEVATION DATA: UPSTREAM(FEET) =     55.50  DOWNSTREAM(FEET) =     55.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   11.329
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.416
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
```

```
     LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 COMMERCIAL                C       0.14      0.25     0.100     50   11.33
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA RUNOFF(CFS) =      0.18
 TOTAL AREA(ACRES) =      0.14   PEAK FLOW RATE(CFS) =      0.18
```

A-1

```
****************************************************************************
 FLOW PROCESS FROM NODE     11.00 TO NODE     12.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    46.00  DOWNSTREAM(FEET) =    44.70
 FLOW LENGTH(FEET) =   124.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN   6.0 INCH PIPE IS   2.3 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   2.49
 ESTIMATED PIPE DIAMETER(INCH) =   6.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       0.18
 PIPE TRAVEL TIME(MIN.) =   0.83    Tc(MIN.) =   12.16
 LONGEST FLOWPATH FROM NODE     10.00 TO NODE     12.00 =     454.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     12.00 TO NODE     12.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
```

A-2

```
============================================================================
 MAINLINE Tc(MIN.) =   12.16
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.359
 SUBAREA LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
     LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                C       0.28      0.25     0.100     50
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA AREA(ACRES) =    0.28      SUBAREA RUNOFF(CFS) =    0.34
 EFFECTIVE AREA(ACRES) =      0.42   AREA-AVERAGED Fm(INCH/HR) =  0.02
 AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.10
 TOTAL AREA(ACRES) =        0.4       PEAK FLOW RATE(CFS) =       0.50

****************************************************************************
 FLOW PROCESS FROM NODE     12.00 TO NODE     13.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    44.70  DOWNSTREAM(FEET) =    37.50
 FLOW LENGTH(FEET) =   212.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN   6.0 INCH PIPE IS   3.1 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   5.00
 ESTIMATED PIPE DIAMETER(INCH) =   6.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       0.50
 PIPE TRAVEL TIME(MIN.) =   0.71    Tc(MIN.) =   12.87
 LONGEST FLOWPATH FROM NODE     10.00 TO NODE     13.00 =     666.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     13.00 TO NODE     13.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
```

A-3

```
============================================================================
 MAINLINE Tc(MIN.) =   12.87
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.316
```

```
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 C        0.59      0.25     0.100    50
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.59      SUBAREA RUNOFF(CFS) =    0.69
  EFFECTIVE AREA(ACRES) =      1.01   AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =        1.0       PEAK FLOW RATE(CFS) =      1.17
```

A-3

```
****************************************************************************
  FLOW PROCESS FROM NODE     13.00 TO NODE     14.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    37.50  DOWNSTREAM(FEET) =    28.50
  FLOW LENGTH(FEET) =   167.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN   6.0 INCH PIPE IS   4.7 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.17
  ESTIMATED PIPE DIAMETER(INCH) =   6.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       1.17
  PIPE TRAVEL TIME(MIN.) =   0.39    Tc(MIN.) =   13.25
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     14.00 =     833.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     14.00 TO NODE     14.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
```

A-4

```
============================================================================
  MAINLINE Tc(MIN.) =   13.25
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.294
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 C        0.66      0.25     0.100    50
  COMMERCIAL                 D        0.02      0.20     0.100    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.68      SUBAREA RUNOFF(CFS) =    0.78
  EFFECTIVE AREA(ACRES) =      1.69   AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =        1.7       PEAK FLOW RATE(CFS) =      1.93

****************************************************************************
  FLOW PROCESS FROM NODE     14.00 TO NODE     15.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    28.50  DOWNSTREAM(FEET) =    25.80
  FLOW LENGTH(FEET) =   267.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   6.5 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.47
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       1.93
  PIPE TRAVEL TIME(MIN.) =   1.00    Tc(MIN.) =   14.25
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     15.00 =    1100.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     15.00 TO NODE     15.00 IS CODE =  81
```

```
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<        A-5
============================================================================
  MAINLINE Tc(MIN.) =   14.25
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.241
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 C        0.02      0.25     0.100    50
  COMMERCIAL                 D        0.06      0.20     0.100    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.21
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.08      SUBAREA RUNOFF(CFS) =    0.09
  EFFECTIVE AREA(ACRES) =      1.77   AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =        1.8       PEAK FLOW RATE(CFS) =       1.94

****************************************************************************
  FLOW PROCESS FROM NODE     15.00 TO NODE     15.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   14.25
  RAINFALL INTENSITY(INCH/HR) =   1.24
  AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.25
  AREA-AVERAGED Ap =  0.10
  EFFECTIVE STREAM AREA(ACRES) =       1.77
  TOTAL STREAM AREA(ACRES) =       1.77
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       1.94

****************************************************************************
  FLOW PROCESS FROM NODE     16.00 TO NODE     17.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<      A-6
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   262.00
  ELEVATION DATA: UPSTREAM(FEET) =     40.00  DOWNSTREAM(FEET) =     35.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.356
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.972
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 D        0.30      0.20     0.100    57    6.36
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      0.53
  TOTAL AREA(ACRES) =      0.30    PEAK FLOW RATE(CFS) =      0.53

****************************************************************************
  FLOW PROCESS FROM NODE     17.00 TO NODE     17.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<            A-7
============================================================================
  MAINLINE Tc(MIN.) =    6.36
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.972
  SUBAREA LOSS RATE DATA(AMC  I ):
```

```
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp        Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                 D       0.14      0.20     0.100    57
 COMMERCIAL                 C       0.14      0.25     0.100    50
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.22
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA AREA(ACRES) =    0.28      SUBAREA RUNOFF(CFS) =    0.49
 EFFECTIVE AREA(ACRES) =      0.58   AREA-AVERAGED Fm(INCH/HR) =  0.02
 AREA-AVERAGED Fp(INCH/HR) =  0.21  AREA-AVERAGED Ap =  0.10
 TOTAL AREA(ACRES) =        0.6       PEAK FLOW RATE(CFS) =      1.02

****************************************************************************
 FLOW PROCESS FROM NODE     17.00 TO NODE     17.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN.) =    6.36
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.972
 SUBAREA LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp        Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                 D       0.20      0.20     0.100    57
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA AREA(ACRES) =    0.20      SUBAREA RUNOFF(CFS) =    0.35
 EFFECTIVE AREA(ACRES) =      0.78   AREA-AVERAGED Fm(INCH/HR) =  0.02
 AREA-AVERAGED Fp(INCH/HR) =  0.21  AREA-AVERAGED Ap =  0.10
 TOTAL AREA(ACRES) =        0.8       PEAK FLOW RATE(CFS) =      1.37

****************************************************************************
 FLOW PROCESS FROM NODE     17.00 TO NODE     17.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN.) =    6.36
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.972
 SUBAREA LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp        Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                 D       0.26      0.20     0.100    57
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA AREA(ACRES) =    0.26      SUBAREA RUNOFF(CFS) =    0.46
 EFFECTIVE AREA(ACRES) =      1.04   AREA-AVERAGED Fm(INCH/HR) =  0.02
 AREA-AVERAGED Fp(INCH/HR) =  0.21  AREA-AVERAGED Ap =  0.10
 TOTAL AREA(ACRES) =        1.0       PEAK FLOW RATE(CFS) =      1.83

****************************************************************************
 FLOW PROCESS FROM NODE     17.00 TO NODE     15.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    31.50  DOWNSTREAM(FEET) =    25.80
 FLOW LENGTH(FEET) =   169.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN   9.0 INCH PIPE IS   5.2 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   6.91
 ESTIMATED PIPE DIAMETER(INCH) =   9.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =        1.83
 PIPE TRAVEL TIME(MIN.) =   0.41    Tc(MIN.) =    6.76
 LONGEST FLOWPATH FROM NODE     16.00 TO NODE     15.00 =     431.00 FEET.
```

A-7

A-8

A-9

```
****************************************************************************
  FLOW PROCESS FROM NODE     15.00 TO NODE     15.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    6.76
  RAINFALL INTENSITY(INCH/HR) =   1.90
  AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.21
  AREA-AVERAGED Ap =  0.10
  EFFECTIVE STREAM AREA(ACRES) =       1.04
  TOTAL STREAM AREA(ACRES) =       1.04
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       1.83

  ** CONFLUENCE DATA **
   STREAM      Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       1.94   14.25    1.241  0.25( 0.02) 0.10       1.8      10.00
      2       1.83    6.76    1.903  0.21( 0.02) 0.10       1.0      16.00

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM      Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       3.25    6.76    1.903  0.23( 0.02) 0.10       1.9      16.00
      2       3.12   14.25    1.241  0.23( 0.02) 0.10       2.8      10.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       3.25    Tc(MIN.) =     6.76
  EFFECTIVE AREA(ACRES) =       1.88   AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.23  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =       2.8
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     15.00 =    1100.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     15.00 TO NODE     18.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    25.80  DOWNSTREAM(FEET) =    11.50
  FLOW LENGTH(FEET) =    82.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN   9.0 INCH PIPE IS   4.5 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  14.80
  ESTIMATED PIPE DIAMETER(INCH) =   9.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.25
  PIPE TRAVEL TIME(MIN.) =   0.09    Tc(MIN.) =    6.86
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     18.00 =    1182.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     18.00 TO NODE     19.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    11.50  DOWNSTREAM(FEET) =    11.10
  FLOW LENGTH(FEET) =    80.00   MANNING'S N =  0.013
```

```
  DEPTH OF FLOW IN  15.0 INCH PIPE IS   9.7 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   3.88
  ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.25
  PIPE TRAVEL TIME(MIN.) =   0.34    Tc(MIN.) =    7.20
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     19.00 =    1262.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     19.00 TO NODE     19.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =    7.20
  RAINFALL INTENSITY(INCH/HR) =   1.84
  AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.23
  AREA-AVERAGED Ap =  0.10
  EFFECTIVE STREAM AREA(ACRES) =       1.88
  TOTAL STREAM AREA(ACRES) =       2.81
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       3.25

****************************************************************************
  FLOW PROCESS FROM NODE     20.00 TO NODE     21.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<             A-10
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   330.00
  ELEVATION DATA: UPSTREAM(FEET) =     40.00  DOWNSTREAM(FEET) =     33.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.783
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.900
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 D       1.60      0.20     0.100     57    6.78
  COMMERCIAL                 C       0.20      0.25     0.100     50    6.78
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.21
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      3.05
  TOTAL AREA(ACRES) =      1.80   PEAK FLOW RATE(CFS) =      3.05

****************************************************************************
  FLOW PROCESS FROM NODE     21.00 TO NODE     22.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    17.50  DOWNSTREAM(FEET) =    11.30
  FLOW LENGTH(FEET) =    56.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN   9.0 INCH PIPE IS   4.9 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  12.28
  ESTIMATED PIPE DIAMETER(INCH) =   9.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.05
  PIPE TRAVEL TIME(MIN.) =   0.08    Tc(MIN.) =    6.86
  LONGEST FLOWPATH FROM NODE     20.00 TO NODE     22.00 =     386.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     22.00 TO NODE     22.00 IS CODE =  81
```

```
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<          A-11
============================================================================
  MAINLINE Tc(MIN.) =    6.86
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.888
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp        Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  NATURAL FAIR COVER
  "GRASS"                    D        0.06      0.20     1.000    69
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA AREA(ACRES) =    0.06      SUBAREA RUNOFF(CFS) =    0.09
  EFFECTIVE AREA(ACRES) =      1.86   AREA-AVERAGED Fm(INCH/HR) =  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.13
  TOTAL AREA(ACRES) =        1.9       PEAK FLOW RATE(CFS) =       3.12

****************************************************************************
  FLOW PROCESS FROM NODE     22.00 TO NODE     19.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    11.30  DOWNSTREAM(FEET) =    11.10
  FLOW LENGTH(FEET) =    41.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  15.0 INCH PIPE IS   9.5 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   3.81
  ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.12
  PIPE TRAVEL TIME(MIN.) =  0.18    Tc(MIN.) =    7.04
  LONGEST FLOWPATH FROM NODE     20.00 TO NODE     19.00 =     427.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     19.00 TO NODE     19.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<      A-12
============================================================================
  MAINLINE Tc(MIN.) =    7.04
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.860
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp        Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  NATURAL FAIR COVER
  "GRASS"                    D        0.37      0.20     1.000    69
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA AREA(ACRES) =    0.37      SUBAREA RUNOFF(CFS) =    0.55
  EFFECTIVE AREA(ACRES) =      2.23   AREA-AVERAGED Fm(INCH/HR) =  0.06
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.27
  TOTAL AREA(ACRES) =        2.2       PEAK FLOW RATE(CFS) =       3.62

****************************************************************************
  FLOW PROCESS FROM NODE     19.00 TO NODE     19.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =     7.04
  RAINFALL INTENSITY(INCH/HR) =   1.86
  AREA-AVERAGED Fm(INCH/HR) =  0.06
```

```
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.27
  EFFECTIVE STREAM AREA(ACRES) =       2.23
  TOTAL STREAM AREA(ACRES) =       2.23
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       3.62

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        3.25    7.20    1.836  0.23( 0.02) 0.10       1.9      16.00
      1        3.12   14.69    1.219  0.23( 0.02) 0.10       2.8      10.00
      2        3.62    7.04    1.860  0.20( 0.06) 0.27       2.2      20.00

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        6.84    7.04    1.860  0.21( 0.04) 0.20       4.1      20.00
      2        6.82    7.20    1.836  0.21( 0.04) 0.19       4.1      16.00
      3        5.46   14.69    1.219  0.21( 0.04) 0.18       5.0      10.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       6.84    Tc(MIN.) =     7.04
  EFFECTIVE AREA(ACRES) =       4.07   AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.21  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =       5.0
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     19.00 =    1262.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     19.00 TO NODE     23.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    11.10  DOWNSTREAM(FEET) =    11.00
  FLOW LENGTH(FEET) =    26.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  21.0 INCH PIPE IS  13.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.24
  ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       6.84
  PIPE TRAVEL TIME(MIN.) =   0.10    Tc(MIN.) =    7.14
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     23.00 =    1288.00 FEET.
```

Area A

```
****************************************************************************
  FLOW PROCESS FROM NODE     30.00 TO NODE     31.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
```

B-1

```
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   330.00
  ELEVATION DATA: UPSTREAM(FEET) =     39.90  DOWNSTREAM(FEET) =     38.90

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    9.862
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.533
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                  C        0.11      0.25     0.100    50    9.86
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
```

```
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100                  B-1
  SUBAREA RUNOFF(CFS) =      0.15
  TOTAL AREA(ACRES) =      0.11   PEAK FLOW RATE(CFS) =      0.15

****************************************************************************
  FLOW PROCESS FROM NODE     31.00 TO NODE     32.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    36.40  DOWNSTREAM(FEET) =    34.90
  FLOW LENGTH(FEET) =   303.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN   6.0 INCH PIPE IS   2.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   1.79
  ESTIMATED PIPE DIAMETER(INCH) =   6.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       0.15
  PIPE TRAVEL TIME(MIN.) =   2.82    Tc(MIN.) =   12.68
  LONGEST FLOWPATH FROM NODE     30.00 TO NODE     32.00 =     633.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     32.00 TO NODE     32.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<           B-2
============================================================================
  MAINLINE Tc(MIN.) =   12.68
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.327
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 C        0.22      0.25     0.100    50
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.22      SUBAREA RUNOFF(CFS) =    0.26
  EFFECTIVE AREA(ACRES) =      0.33   AREA-AVERAGED Fm(INCH/HR) =  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =        0.3       PEAK FLOW RATE(CFS) =       0.39

****************************************************************************
  FLOW PROCESS FROM NODE     32.00 TO NODE     33.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    34.90  DOWNSTREAM(FEET) =    34.20
  FLOW LENGTH(FEET) =   133.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN   9.0 INCH PIPE IS   3.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   2.34
  ESTIMATED PIPE DIAMETER(INCH) =   9.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       0.39
  PIPE TRAVEL TIME(MIN.) =   0.95    Tc(MIN.) =   13.63
  LONGEST FLOWPATH FROM NODE     30.00 TO NODE     33.00 =     766.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     33.00 TO NODE     33.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<            B-3
============================================================================
  MAINLINE Tc(MIN.) =   13.63
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.273
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
```

```
  COMMERCIAL                 C        0.14      0.25     0.100    50
  COMMERCIAL                 D        0.30      0.20     0.100    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.22
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.44      SUBAREA RUNOFF(CFS) =    0.50
  EFFECTIVE AREA(ACRES) =      0.77   AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.23  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =        0.8       PEAK FLOW RATE(CFS) =       0.87

****************************************************************************
  FLOW PROCESS FROM NODE     33.00 TO NODE     33.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   13.63
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.273
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 C        0.08      0.25     0.100    50
  COMMERCIAL                 D        0.16      0.20     0.100    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.22
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.24      SUBAREA RUNOFF(CFS) =    0.27
  EFFECTIVE AREA(ACRES) =      1.01   AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.23  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =        1.0       PEAK FLOW RATE(CFS) =       1.14

****************************************************************************
  FLOW PROCESS FROM NODE     33.00 TO NODE     34.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    34.20  DOWNSTREAM(FEET) =    33.00
  FLOW LENGTH(FEET) =   237.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   5.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   3.02
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       1.14
  PIPE TRAVEL TIME(MIN.) =   1.31    Tc(MIN.) =   14.94
  LONGEST FLOWPATH FROM NODE     30.00 TO NODE     34.00 =    1003.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     34.00 TO NODE     34.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   14.94
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.208
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 D        0.23      0.20     0.100    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.23      SUBAREA RUNOFF(CFS) =    0.25
  EFFECTIVE AREA(ACRES) =      1.24   AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.22  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =        1.2       PEAK FLOW RATE(CFS) =       1.32
****************************************************************************
```

B-3

B-4

B-5

Area B

```
 FLOW PROCESS FROM NODE     34.00 TO NODE     35.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    33.00  DOWNSTREAM(FEET) =    18.40
 FLOW LENGTH(FEET) =   335.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN   9.0 INCH PIPE IS   4.0 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   7.02
 ESTIMATED PIPE DIAMETER(INCH) =   9.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       1.32
 PIPE TRAVEL TIME(MIN.) =   0.80    Tc(MIN.) =   15.73
 LONGEST FLOWPATH FROM NODE     30.00 TO NODE     35.00 =    1338.00 FEET.
```

Area B

```
****************************************************************************
 FLOW PROCESS FROM NODE     50.00 TO NODE     51.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   330.00
 ELEVATION DATA: UPSTREAM(FEET) =     55.00  DOWNSTREAM(FEET) =     32.00

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.268
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  2.197
 SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 COMMERCIAL                 D        0.63      0.20      0.100     57    5.27
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA RUNOFF(CFS) =      1.23
 TOTAL AREA(ACRES) =      0.63   PEAK FLOW RATE(CFS) =      1.23
```

C-1

```
****************************************************************************
 FLOW PROCESS FROM NODE     51.00 TO NODE     51.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN.) =    5.27
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  2.197
 SUBAREA LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                 D        0.87      0.20      0.100     57
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA AREA(ACRES) =    0.87      SUBAREA RUNOFF(CFS) =    1.70
 EFFECTIVE AREA(ACRES) =      1.50   AREA-AVERAGED Fm(INCH/HR) =  0.02
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
 TOTAL AREA(ACRES) =        1.5       PEAK FLOW RATE(CFS) =       2.94
```

C-2

```
****************************************************************************
 FLOW PROCESS FROM NODE     51.00 TO NODE     52.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =     32.00  DOWNSTREAM(FEET) =     27.00
 CHANNEL LENGTH THRU SUBAREA(FEET) =   247.00    CHANNEL SLOPE =  0.0202
 CHANNEL BASE(FEET) =    2.00    "Z" FACTOR =  20.000
```

C-3

C-3

```
 MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =  10.00
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.960
 SUBAREA LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                 D        1.65      0.20     0.100    57
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       4.38
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.56
 AVERAGE FLOW DEPTH(FEET) =   0.20   TRAVEL TIME(MIN.) =   1.16
 Tc(MIN.) =    6.43
 SUBAREA AREA(ACRES) =     1.65       SUBAREA RUNOFF(CFS) =    2.88
 EFFECTIVE AREA(ACRES) =      3.15     AREA-AVERAGED Fm(INCH/HR) =   0.02
 AREA-AVERAGED Fp(INCH/HR) =   0.20  AREA-AVERAGED Ap =   0.10
 TOTAL AREA(ACRES) =        3.2         PEAK FLOW RATE(CFS) =      5.50

 END OF SUBAREA CHANNEL FLOW HYDRAULICS:
 DEPTH(FEET) =  0.23   FLOW VELOCITY(FEET/SEC.) =   3.73
 LONGEST FLOWPATH FROM NODE     50.00 TO NODE     52.00 =     577.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     52.00 TO NODE     53.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =     23.00  DOWNSTREAM(FEET) =    21.80
 FLOW LENGTH(FEET) =   121.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  15.0 INCH PIPE IS  11.1 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   5.63
 ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       5.50
 PIPE TRAVEL TIME(MIN.) =   0.36    Tc(MIN.) =    6.78
 LONGEST FLOWPATH FROM NODE     50.00 TO NODE     53.00 =     698.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     53.00 TO NODE     54.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =     21.80  DOWNSTREAM(FEET) =    20.00
 FLOW LENGTH(FEET) =   102.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  15.0 INCH PIPE IS   9.0 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   7.12
 ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       5.50
 PIPE TRAVEL TIME(MIN.) =   0.24    Tc(MIN.) =    7.02
 LONGEST FLOWPATH FROM NODE     50.00 TO NODE     54.00 =     800.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     54.00 TO NODE     54.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
```

C-4

```
============================================================================
 MAINLINE Tc(MIN.) =    7.02
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.863
 SUBAREA LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                 D        0.29      0.20     0.100    57
```

```
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20              C-4
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.29      SUBAREA RUNOFF(CFS) =    0.48
  EFFECTIVE AREA(ACRES) =      3.44   AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =        3.4       PEAK FLOW RATE(CFS) =       5.70

****************************************************************************
  FLOW PROCESS FROM NODE     54.00 TO NODE     55.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    20.00  DOWNSTREAM(FEET) =    16.70
  FLOW LENGTH(FEET) =    36.00   MANNING'S N =  0.013                       Area C
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   6.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  13.37
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       5.70
  PIPE TRAVEL TIME(MIN.) =   0.04    Tc(MIN.) =    7.07
  LONGEST FLOWPATH FROM NODE     50.00 TO NODE     55.00 =     836.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     54.00 TO NODE     55.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    20.00  DOWNSTREAM(FEET) =    16.70
  FLOW LENGTH(FEET) =    45.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   6.9 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  12.29
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       5.70
  PIPE TRAVEL TIME(MIN.) =   0.06    Tc(MIN.) =    7.13
  LONGEST FLOWPATH FROM NODE     50.00 TO NODE     55.00 =     881.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     60.00 TO NODE     61.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<                 D-1
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   145.00
  ELEVATION DATA: UPSTREAM(FEET) =     31.50  DOWNSTREAM(FEET) =     15.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =     5.461
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  2.152
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  PUBLIC PARK                D        0.19      0.20     0.850     57    5.46
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  SUBAREA RUNOFF(CFS) =      0.34
  TOTAL AREA(ACRES) =      0.19   PEAK FLOW RATE(CFS) =      0.34
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        0.2  TC(MIN.) =      5.46
  EFFECTIVE AREA(ACRES) =      0.19  AREA-AVERAGED Fm(INCH/HR)=  0.17      Area D
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap = 0.850
```

```
 PEAK FLOW RATE(CFS)   =      0.34
```

Area D

```
============================================================================
============================================================================
 END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************
           NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
                     AND LOW LOSS FRACTION ESTIMATIONS
============================================================================
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                           Analysis prepared by:






****************************************************************************
----------------------------------------------------------------------------

 Problem Descriptions:
  Snug Harbor
  Proposed Condition Hydrograph
  2-year storm event
============================================================================
*** NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
    AND LOW LOSS FRACTION ESTIMATIONS FOR AMC I:

    TOTAL 24-HOUR DURATION RAINFALL DEPTH =     2.05 (inches)

    SOIL-COVER     AREA      PERCENT OF    SCS CURVE    LOSS RATE
       TYPE       (Acres)   PERVIOUS AREA    NUMBER    Fp(in./hr.)    YIELD
         1          2.60       10.00       69.(AMC II)     0.250       0.801
         2          6.70       10.00       75.(AMC II)     0.200       0.803
         3          0.40      100.00       75.(AMC II)     0.200       0.018
         4          0.20       85.00       75.(AMC II)     0.200       0.148

    TOTAL AREA (Acres) =      9.90
                                   _
    AREA-AVERAGED LOSS RATE, Fm (in./hr.) =  0.032
                                    _
    AREA-AVERAGED LOW LOSS FRACTION, Y = 0.243
============================================================================

 Problem Descriptions:
  Snug Harbor
  Proposed Condition Hydrograph
  2-year storm event  (calibration coefficient = 0.7735)
----------------------------------------------------------------------------


    RATIONAL METHOD CALIBRATION COEFFICIENT = 0.77
    TOTAL CATCHMENT AREA(ACRES) =     9.90
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.032
    LOW LOSS FRACTION = 0.243
    TIME OF CONCENTRATION(MIN.) =  7.00
    SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
    ORANGE COUNTY "VALLEY" RAINFALL VALUES ARE USED
    RETURN FREQUENCY(YEARS) =    2
       5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.19
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.40
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  0.53
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  0.89
```

Total Area except for the lagoon, which will not contribute to storm drain system

Used avg Tc except outlier Areas B and D

6-HOUR POINT RAINFALL VALUE(INCHES) = 1.22
24-HOUR POINT RAINFALL VALUE(INCHES) = 2.05

TOTAL CATCHMENT RUNOFF VOLUME(ACRE-FEET) = 1.06
TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) = 0.63

TIME (HOURS)	VOLUME (AF)	Q (CFS)	0.	5.0	10.0	15.0	20.0
0.02	0.0000	0.00	Q	.	.	.	.
0.13	0.0009	0.19	Q	.	.	.	.
0.25	0.0027	0.19	Q	.	.	.	.
0.37	0.0045	0.19	Q	.	.	.	.
0.48	0.0063	0.19	Q	.	.	.	.
0.60	0.0081	0.19	Q	.	.	.	.
0.72	0.0099	0.19	Q	.	.	.	.
0.83	0.0118	0.19	Q	.	.	.	.
0.95	0.0136	0.19	Q	.	.	.	.
1.07	0.0155	0.19	Q	.	.	.	.
1.18	0.0173	0.19	Q	.	.	.	.
1.30	0.0192	0.19	Q	.	.	.	.
1.42	0.0211	0.20	Q	.	.	.	.
1.53	0.0230	0.20	Q	.	.	.	.
1.65	0.0249	0.20	Q	.	.	.	.
1.77	0.0268	0.20	Q	.	.	.	.
1.88	0.0287	0.20	Q	.	.	.	.
2.00	0.0307	0.20	Q	.	.	.	.
2.12	0.0326	0.20	Q	.	.	.	.
2.23	0.0345	0.20	Q	.	.	.	.
2.35	0.0365	0.20	Q	.	.	.	.
2.47	0.0385	0.20	Q	.	.	.	.
2.58	0.0405	0.21	Q	.	.	.	.
2.70	0.0424	0.21	Q	.	.	.	.
2.82	0.0444	0.21	Q	.	.	.	.
2.93	0.0465	0.21	Q	.	.	.	.
3.05	0.0485	0.21	Q	.	.	.	.
3.17	0.0505	0.21	Q	.	.	.	.
3.28	0.0526	0.21	Q	.	.	.	.
3.40	0.0546	0.21	Q	.	.	.	.
3.52	0.0567	0.22	Q	.	.	.	.
3.63	0.0588	0.22	Q	.	.	.	.
3.75	0.0609	0.22	Q	.	.	.	.
3.87	0.0630	0.22	Q	.	.	.	.
3.98	0.0651	0.22	Q	.	.	.	.
4.10	0.0672	0.22	Q	.	.	.	.
4.22	0.0694	0.22	Q	.	.	.	.
4.33	0.0715	0.22	Q	.	.	.	.
4.45	0.0737	0.23	Q	.	.	.	.
4.57	0.0759	0.23	Q	.	.	.	.
4.68	0.0781	0.23	Q	.	.	.	.
4.80	0.0803	0.23	Q	.	.	.	.
4.92	0.0826	0.23	Q	.	.	.	.
5.03	0.0848	0.23	Q	.	.	.	.
5.15	0.0871	0.24	Q	.	.	.	.
5.27	0.0893	0.24	Q	.	.	.	.
5.38	0.0916	0.24	Q	.	.	.	.
5.50	0.0939	0.24	Q	.	.	.	.
5.62	0.0962	0.24	Q	.	.	.	.

```
  5.73      0.0986      0.24  Q        .        .        .        .
  5.85      0.1009      0.25  Q        .        .        .        .
  5.97      0.1033      0.25  Q        .        .        .        .
  6.08      0.1057      0.25  Q        .        .        .        .
  6.20      0.1081      0.25  Q        .        .        .        .
  6.32      0.1105      0.25  Q        .        .        .        .
  6.43      0.1130      0.25  Q        .        .        .        .
  6.55      0.1154      0.26  Q        .        .        .        .
  6.67      0.1179      0.26  Q        .        .        .        .
  6.78      0.1204      0.26  Q        .        .        .        .
  6.90      0.1229      0.26  Q        .        .        .        .
  7.02      0.1255      0.26  Q        .        .        .        .
  7.13      0.1280      0.27  Q        .        .        .        .
  7.25      0.1306      0.27  Q        .        .        .        .
  7.37      0.1332      0.27  Q        .        .        .        .
  7.48      0.1358      0.27  Q        .        .        .        .
  7.60      0.1385      0.28  Q        .        .        .        .
  7.72      0.1411      0.28  Q        .        .        .        .
  7.83      0.1438      0.28  Q        .        .        .        .
  7.95      0.1465      0.28  Q        .        .        .        .
  8.07      0.1493      0.28  Q        .        .        .        .
  8.18      0.1520      0.29  Q        .        .        .        .
  8.30      0.1548      0.29  Q        .        .        .        .
  8.42      0.1576      0.29  Q        .        .        .        .
  8.53      0.1605      0.30  Q        .        .        .        .
  8.65      0.1633      0.30  Q        .        .        .        .
  8.77      0.1662      0.30  Q        .        .        .        .
  8.88      0.1692      0.31  Q        .        .        .        .
  9.00      0.1721      0.31  Q        .        .        .        .
  9.12      0.1751      0.31  Q        .        .        .        .
  9.23      0.1781      0.31  Q        .        .        .        .
  9.35      0.1812      0.32  Q        .        .        .        .
  9.47      0.1843      0.32  Q        .        .        .        .
  9.58      0.1874      0.33  Q        .        .        .        .
  9.70      0.1905      0.33  Q        .        .        .        .
  9.82      0.1937      0.33  Q        .        .        .        .
  9.93      0.1970      0.34  Q        .        .        .        .
 10.05      0.2002      0.34  Q        .        .        .        .
 10.17      0.2035      0.34  Q        .        .        .        .
 10.28      0.2069      0.35  Q        .        .        .        .
 10.40      0.2103      0.35  Q        .        .        .        .
 10.52      0.2137      0.36  Q        .        .        .        .
 10.63      0.2172      0.36  Q        .        .        .        .
 10.75      0.2207      0.37  Q        .        .        .        .
 10.87      0.2243      0.37  Q        .        .        .        .
 10.98      0.2279      0.38  Q        .        .        .        .
 11.10      0.2316      0.38  Q        .        .        .        .
 11.22      0.2353      0.39  Q        .        .        .        .
 11.33      0.2391      0.39  Q        .        .        .        .
 11.45      0.2429      0.40  Q        .        .        .        .
 11.57      0.2468      0.41  Q        .        .        .        .
 11.68      0.2508      0.42  Q        .        .        .        .
 11.80      0.2548      0.42  Q        .        .        .        .
 11.92      0.2589      0.43  Q        .        .        .        .
 12.03      0.2631      0.44  Q        .        .        .        .
 12.15      0.2678      0.54  .Q       .        .        .        .
 12.27      0.2731      0.55  .Q       .        .        .        .
 12.38      0.2784      0.56  .Q       .        .        .        .
 12.50      0.2839      0.57  .Q       .        .        .        .
 12.62      0.2894      0.58  .Q       .        .        .        .
 12.73      0.2950      0.59  .Q       .        .        .        .
```

```
12.85      0.3008      0.60  .Q        .         .         .         .
12.97      0.3066      0.61  .Q        .         .         .         .
13.08      0.3126      0.63  .Q        .         .         .         .
13.20      0.3187      0.64  .Q        .         .         .         .
13.32      0.3249      0.66  .Q        .         .         .         .
13.43      0.3313      0.67  .Q        .         .         .         .
13.55      0.3378      0.69  .Q        .         .         .         .
13.67      0.3445      0.70  .Q        .         .         .         .
13.78      0.3514      0.73  .Q        .         .         .         .
13.90      0.3585      0.74  .Q        .         .         .         .
14.02      0.3658      0.77  .Q        .         .         .         .
14.13      0.3734      0.82  .Q        .         .         .         .
14.25      0.3816      0.88  .Q        .         .         .         .
14.37      0.3902      0.91  .Q        .         .         .         .
14.48      0.3992      0.96  .Q        .         .         .         .
14.60      0.4087      1.00  .Q        .         .         .         .
14.72      0.4186      1.07  . Q       .         .         .         .
14.83      0.4291      1.11  . Q       .         .         .         .
14.95      0.4403      1.21  . Q       .         .         .         .
15.07      0.4522      1.26  . Q       .         .         .         .
15.18      0.4650      1.39  . Q       .         .         .         .
15.30      0.4788      1.48  . Q       .         .         .         .
15.42      0.4933      1.53  .  Q      .         .         .         .
15.53      0.5081      1.54  .  Q      .         .         .         .
15.65      0.5247      1.90  .  Q      .         .         .         .
15.77      0.5444      2.19  .   Q     .         .         .         .
15.88      0.5707      3.26  .     Q   .         .         .         .
16.00      0.6084      4.54  .        Q.         .         .         .
16.12      0.6982     14.10  .         .         .       Q .         .
16.23      0.7789      2.63  .    Q    .         .         .         .
16.35      0.7997      1.70  .  Q      .         .         .         .
16.47      0.8155      1.57  .  Q      .         .         .         .
16.58      0.8294      1.32  . Q       .         .         .         .
16.70      0.8414      1.16  . Q       .         .         .         .
16.82      0.8519      1.03  . Q       .         .         .         .
16.93      0.8614      0.93  .Q        .         .         .         .
17.05      0.8700      0.85  .Q        .         .         .         .
17.17      0.8778      0.75  .Q        .         .         .         .
17.28      0.8848      0.71  .Q        .         .         .         .
17.40      0.8915      0.68  .Q        .         .         .         .
17.52      0.8979      0.65  .Q        .         .         .         .
17.63      0.9040      0.62  .Q        .         .         .         .
17.75      0.9099      0.60  .Q        .         .         .         .
17.87      0.9155      0.57  .Q        .         .         .         .
17.98      0.9210      0.55  .Q        .         .         .         .
18.10      0.9259      0.48  Q         .         .         .         .
18.22      0.9303      0.43  Q         .         .         .         .
18.33      0.9344      0.41  Q         .         .         .         .
18.45      0.9383      0.40  Q         .         .         .         .
18.57      0.9420      0.39  Q         .         .         .         .
18.68      0.9457      0.38  Q         .         .         .         .
18.80      0.9493      0.37  Q         .         .         .         .
18.92      0.9528      0.36  Q         .         .         .         .
19.03      0.9562      0.35  Q         .         .         .         .
19.15      0.9595      0.34  Q         .         .         .         .
19.27      0.9627      0.33  Q         .         .         .         .
19.38      0.9658      0.32  Q         .         .         .         .
19.50      0.9689      0.32  Q         .         .         .         .
19.62      0.9720      0.31  Q         .         .         .         .
19.73      0.9749      0.30  Q         .         .         .         .
19.85      0.9778      0.30  Q         .         .         .         .
```

```
 19.97      0.9807      0.29  Q          .         .         .         .
 20.08      0.9834      0.29  Q          .         .         .         .
 20.20      0.9862      0.28  Q          .         .         .         .
 20.32      0.9889      0.28  Q          .         .         .         .
 20.43      0.9915      0.27  Q          .         .         .         .
 20.55      0.9941      0.27  Q          .         .         .         .
 20.67      0.9967      0.26  Q          .         .         .         .
 20.78      0.9992      0.26  Q          .         .         .         .
 20.90      1.0017      0.26  Q          .         .         .         .
 21.02      1.0041      0.25  Q          .         .         .         .
 21.13      1.0065      0.25  Q          .         .         .         .
 21.25      1.0089      0.24  Q          .         .         .         .
 21.37      1.0112      0.24  Q          .         .         .         .
 21.48      1.0135      0.24  Q          .         .         .         .
 21.60      1.0158      0.23  Q          .         .         .         .
 21.72      1.0180      0.23  Q          .         .         .         .
 21.83      1.0203      0.23  Q          .         .         .         .
 21.95      1.0224      0.23  Q          .         .         .         .
 22.07      1.0246      0.22  Q          .         .         .         .
 22.18      1.0267      0.22  Q          .         .         .         .
 22.30      1.0289      0.22  Q          .         .         .         .
 22.42      1.0309      0.21  Q          .         .         .         .
 22.53      1.0330      0.21  Q          .         .         .         .
 22.65      1.0350      0.21  Q          .         .         .         .
 22.77      1.0370      0.21  Q          .         .         .         .
 22.88      1.0390      0.21  Q          .         .         .         .
 23.00      1.0410      0.20  Q          .         .         .         .
 23.12      1.0430      0.20  Q          .         .         .         .
 23.23      1.0449      0.20  Q          .         .         .         .
 23.35      1.0468      0.20  Q          .         .         .         .
 23.47      1.0487      0.20  Q          .         .         .         .
 23.58      1.0506      0.19  Q          .         .         .         .
 23.70      1.0524      0.19  Q          .         .         .         .
 23.82      1.0543      0.19  Q          .         .         .         .
 23.93      1.0561      0.19  Q          .         .         .         .
 24.05      1.0579      0.19  Q          .         .         .         .
 24.17      1.0588      0.00  Q          .         .         .         .
----------------------------------------------------------------------------
--------------------------------------------------------------------------------
    TIME DURATION(minutes) OF PERCENTILES OF ESTIMATED PEAK FLOW RATE:
    (Note: 100% of Peak Flow Rate estimate assumed to have
    an instantaneous time duration)

    Percentile of Estimated                 Duration
        Peak Flow Rate                      (minutes)
    =======================                 =========
               0%                             1442.0
              10%                               77.0
              20%                               21.0
              30%                               14.0
              40%                                7.0
              50%                                7.0
              60%                                7.0
              70%                                7.0
              80%                                7.0
              90%                                7.0
```