Appendix K WQMP

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WQ XX-XXXX

County of Orange/Santa Ana Region
Priority Project
Water Quality Management Plan
(WQMP)

Project Name:

The Hub at Fullerton

2601/2651 East Chapman Avenue, CA 92831.
APN: 338-091-05, 338-091-06, 338-091-07

Prepared for:

11401 Century Oaks Terrace #400

Austin, Tx, 78758

(630) 730-9453

Prepared by:

Kimley Horn and Associates

765 The City Drive

Orange, CA. 92868

(714) 705-1305, Brian.Gillis@kimley-horn.com

REGISTERED PROFESSIONAL ENGINEER
BRIAN GILLIS
RCE NO. 63021
CIVIL
STATE OF CALIFORNIA

Prepared on: 2/16/2021

Project Owner's Certification			
Planning Application No. (If applicable)		Grading Permit No.	
Tract/Parcel Map and Lot(s) No.	PM-67-15	Building Permit No.	
Address of Project Site and APN (If no address, specify Tract/Parcel Map and Lot Numbers)			APN: 338-091-05 338-091-06 338-091-07

This Water Quality Management Plan (WQMP) has been prepared for Core Campus Manager, LLC by Kimley Horn and Associates. 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:			
Title	Rob Bak, Development Manager		
Company	Core Campus Manager, LLC		
Address	11401 Century Oaks Terrace, #400. Austin TX. 78758		
Email	robb@corespaces.com		
Telephone #	(630) 730-9453		
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	

Preparer (Engineer):			
Title	Brian Gillis, Professional Engineer	PE Registration #	63021
Company	Kimley Horn and Associates		
Address	765 The City Drive. Orange, CA. 92868		
Email	Brian.Gillis@kimley-horn.com		
Telephone #	(714) 705-1305		
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.			
Preparer Signature		Date	02/16/2021
Place Stamp Here	REGISTERED PROFESSIONAL ENGINEER BRIAN GILLIS RCE NO. 63021 CIVIL STATE OF CALIFORNIA		

Contents

Attachments

Section I Permit(s) and Water Quality Conditions of Approval or Issuance

Provide discretionary or grading/building permit information and water quality conditions of approval, or permit issuance, applied to the project. If conditions are unknown, please request applicable conditions from staff. *Refer to Section 2.1 in the Technical Guidance Document (TGD) available on the OC Planning website (ocplanning.net).*

Project Infomation			
Permit/Application No. (If applicable)		Grading or Building Permit No. (If applicable)	
Address of Project Site (or Tract Map and Lot Number if no address) and APN	P.M. 67-15. 2601-2651 East Chapman Avenue, CA 92831. APN: 338-091-(05,06,07)		

Water Quality Conditions of Approval or Issuance	
Water Quality Conditions of Approval or Issuance applied to this project. (Please list verbatim.)	Water quality conditions of approval will be provided in final WQMP report.

Conceptual WQMP	
Was a Conceptual Water Quality Management Plan previously approved for this project?	There was no conceptual water quality management previously approved for this project.

Watershed-Based Plan Conditions	
Provide applicable conditions from watershed - based plans including WIHMPs and TMDLS.	Heavy Metals (Technical TMDL[1]) [1]This TMDL has been adoped for Coyote Creek/San Gabriel River by the Los Angeles Regional Water Quality Control Board (Region 4); however, it applies to the areas of Orange County that drain to Coyote Creek and San Gabriel River.

Section II Project Description

II.1 Project Description

<table>
<tr><th colspan="5">Description of Proposed Project</th></tr>
<tr><td>Development Category (From Model WQMP, Table 7.11-2; or -3):</td><td colspan="4">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.</td></tr>
<tr><td>Project Area (ft^2): 154638</td><td colspan="2">Number of Dwelling Units: 360</td><td colspan="2">SIC Code: N/A</td></tr>
<tr><td rowspan="2">Project Area</td><td colspan="2">Pervious</td><td colspan="2">Impervious</td></tr>
<tr><td>Area (acres or sq ft)</td><td>Percentage</td><td>Area (acres or sq ft)</td><td>Percentage</td></tr>
<tr><td>Pre-Project Conditions</td><td>0.42 Acres</td><td>11.9</td><td>3.13 Acres</td><td>88.1</td></tr>
<tr><td>Post-Project Conditions</td><td>0.14 Acres</td><td>3.9</td><td>3.30 Acres</td><td>96.1</td></tr>
<tr><td>Drainage Patterns/Connections</td><td colspan="4">The existing site is developed with topography ranging from 224.79-227.59. The site is primarily impervious. The drainage flows along a gutter to one of two driveways, exiting along either East Chapman Ave. or North Commonwealth Ave. Both drainage patterns flow towards the southwest corner of the intersection where they enter one of two curb inlets.
In the proposed condition, one connection point to the existing 18” curb inlet at the south west corner adjacent to East Chapman is proposed. In general, roof drains and area drains will be treated by one of seven Modular Wetland proprietary biofiltration units. The drains will then connect to the on-site Storm drain system that discharges to the aforementioned connection point.</td></tr>
</table>

Narrative Project Description: (Use as much space as necessary.)	The 3.55-acre project site is located immediately west of the 57 Freeway, north of East Chapman Ave, East of North Commonwealth, and South of Pointe at College Place. In addition, this project is one block south of California State University, Fullerton. The proposed development consists of commercial shops and single family town homes at the street level with 4 levels of multi-family apartments above them. Adjacent to these buildings will be a 6 level parking structure. This projects also contains two additional driveways off of East Chapman Ave. and North Commonwealth Ave. This project has outdoor courtyards for each of the town-homes where a hot hub is located. The site consists of 63% Building, 0.3% Pervious Area, and 37.3% Impervious Area. The project is proposed 7 modular wetlands scattered across the Project Site to treat on-site drainage. DMA 1 includes a commercial area and apartment complexes. DMA 1 is 0.86 acres consisting of 44.5% Building, 2.6% Pervious Area, and 52.9% Impervious Area. DMA 2 includes a commercial area and apartment complexes. DMA 2 is 0.47 acres consisting of 66% Building, 3.8% Pervious Area, and 30.2% Impervious Area. DMA 3 includes town homes and apartment complexes. DMA 3 is 0.27 acres consisting of 55.6% Building, 3.6% Pervious Area, and 40.8% Impervious Area. DMA 4 includes town homes and apartment complexes. DMA 4 is 0.38 acres consisting of 35.9% Building, 5.8% Pervious Area, and 58.3% Impervious Area. DMA 5 includes a parking structure, town homes and apartment complexes. DMA 5 is 0.88 acres consisting of 77.8% Building, 1.8% Pervious Area, and 20.4% Impervious Area. DMA 6 includes town homes and apartment complexes. DMA 6 is 0.31 acres consisting of 45.1% Building, 5.8% Pervious Area, and 49.1% Impervious Area. DMA 7 includes town homes and apartment complexes. DMA 7 is 0.35 acres consisting of 58.9% Building, 5.9% Pervious Area, and 35.2% Impervious Area. The project will fall under a Specific Plan District (FMC 15.21). The current general plan land use will be changed from Office Professional to Urban Center Mixed-Use and the zone will be changed from Office Professional (O-P) to Specific Plan District (FMC 15.72).

II.2 Potential Stormwater Pollutants

Determine and list expected stormwater pollutants based on land uses and site activities. *Refer to Section 2.2.2 and Table 2.1 in the Technical Guidance Document (TGD) for guidance.*

Pollutants of Concern			
Pollutant	Check One for each: E=Expected to be of concern N=Not Expected to be of concern		Additional Information and Comments
Suspended-Solid / Sediment	E ☒	N ☐	Tributary by uncovered parking areas and residential development, and commercial development.
Nutrients	E ☒	N ☐	Tributary by uncovered parking areas and residential development, and commercial development.
Heavy Metals	E ☒	N ☐	Tributary by uncovered parking areas.
Pathogens (Bacteria / Virus)	E ☒	N ☐	Tributary by uncovered parking areas and residential development, and commercial development.
Pesticides	E ☒	N ☐	Tributary by uncovered parking areas and residential development, and commercial development.
Oil and Grease	E ☒	N ☐	Tributary by uncovered parking areas.
Toxic Organic Compounds	E ☒	N ☐	Tributary by uncovered parking areas.
Trash and Debris	E ☒	N ☐	Tributary by uncovered parking areas and residential development, and commercial development.

II.3 Hydrologic Conditions of Concern

Determine if streams located downstream from the project area are potentially susceptible to hydromodification impacts. *Refer to Section 2.2.3.1 in the Technical Guidance Document (TGD) for North Orange County or Section 2.2.3.2 for South Orange County.*

☒ No – Show map

☐ Yes – Describe applicable hydrologic conditions of concern below. *Refer to Section 2.2.3 in the Technical Guidance Document (TGD).*

The project site is not located in an area potentially susceptible to hydromodification impacts.

II.4 Post Development Drainage Characteristics

Describe post development drainage characteristics. *Refer to Section 2.2.4 in the Technical Guidance Document (TGD).*

In the proposed condition, one connection point to the existing 18” curb inlet at the south west corner adjacent to East Chapman is proposed. In general, roof drains and area drains will be treated by one of seven Modular Wetland proprietary biofiltration units. The drains will then connect to the on-site Storm drain system that discharges to the aforementioned connection point. A more detailed drainage map will be provided in the appendix.

The storm drain will discharge into Carbon Creek. According to the California Waterboard, the drainage will continue through Coyote Creek, San Gabriel River Estuary, and finally the Pacific Ocean.

II.5 Property Ownership/Management

Describe property ownership / management. *Refer to Section 2.2.5 in the Technical Guidance Document (TGD).*

The proposed project will be maintained by an appoint Property Management Company (PMC) selected by the developer, Core Campus Manager, LLC. The PMC will be responsible for maintaining and provide regular inspections on all the post-construction BMPs as well as all private onsite utility infrastructure. All public off-site utility infrastructure maintenance responsibilities will be deferred to the City of Fullerton where applicable.

Section III Site Description

III.1 Physical Setting

Fill out table with relevant information. *Refer to Section 2.3.1 in the Technical Guidance Document (TGD).*

Name of Planned Community / Planning Area (if applicable)	N / A
Location / Address	2601 and 2651 East Chapman Ave, Fullerton CA 92831
	APN: 338-091-05,338-091-06,338-091-07
General Plan Land Use Designation	Existing: Office Professional, Proposed: Urban Center Mixed-Use
Zoning	Existing: Office-Professional, Proposed: Specific Plan District (FMC 15.72)
Acreage of Project Site	3.55 Acres
Predominant Soil Type	Hydrological Soil Type B

III.2 Site Characteristics

Fill out table with relevant information and include information regarding BMP sizing, suitability, and feasibility, as applicable. *Refer to Section 2.3.2 in the Technical Guidance Document (TGD).*

Site Characteristics	
Precipitation Zone	0.90” (Refer to Figure XVI-1 of the TGD located in Attachment B this report for reference of rainfall zone.
Topography	The site is generally flat with slopes ranging from 0.5% to 2%. Existing elevations on site range from 224.79’-228.01’.

Drainage Patterns/Connections	The existing site is developed and exists as 4 separate office buildings. The existing topography ranges from 224.79-228.01 and the site is primarily impervious. The drainage flows through a gutter to one of two driveways, exiting along either East Chapman Ave. or North Commonwealth Ave. Both drainage patterns flow towards the southwest corner of the intersection where they enter one of two curb inlets. In the proposed condition, there will be one connection point to the existing curb inlet at the south west corner along East Chapman is proposed. In general, roof drains and area drains will be treated by one of seven Modular Wetland proprietary biofiltration units. The drains will then connect to the on-site Storm drain system that discharges to the aforementioned connection point. A more detailed drainage map will be provided in the appendix.
Soil Type, Geology, and Infiltration Properties	The site consists on entirely type B soils. Based on preliminary infiltration testing and calculated infiltration rates, infiltration of storm water into the site soils is not feasible.
Hydrogeologic (Groundwater) Conditions	Groundwater was not observed during the exploration to a maximum depth of 61.5 feet below the existing grade. The historical high depth to groundwater is reportedly deeper than 70 feet below existing grade. Groundwater is unlikely to impact the proposed development.
Geotechnical Conditions (relevant to infiltration)	Infiltration is deemed infeasible with the existing soil conditions.
Off-Site Drainage	A small portion of each driveway entrances prior to the ridge line will drain offsite. This water will drain along the curb and gutter to the two curb inlets at the intersection of East Chapman Ave. and North Commonwealth Ave.
Utility and Infrastructure Information	The site has two proposed domestic water, sewer, and irrigation connections. There is one fire loop.

III.3 Watershed Description

Fill out table with relevant information and include information regarding BMP sizing, suitability, and feasibility, as applicable. *Refer to Section 2.3.3 in the Technical Guidance Document (TGD).*

Receiving Waters	Fullerton Creek, Coyote Creek, San Gabriel River Reach 1, San Gabriel River Estuary, and the Pacific Ocean
303(d) Listed Impairments	Coyote Creek: Ammonia, Copper (Dissolved), Diazinon, Indicator Bacteria, Lead, pH, and Toxicity. San Gabriel River (Reach 1): Coliform Bacteria and pH San Gabriel River Estuary: Copper, Dioxin, Nickel, Oxygen (Dissolved)
Applicable TMDLs	Alkalinity as CaCO3, Benthic Community Effects, Chlorides, Specific Conductivity, Sulfates, Abnormal Fish Histology (Lesions), Aluminum, Ammonia, Chloride, Copper Dissolved, Cyanide, Diazinon, Excess Algal Growth, Fluoride, Indicator Bacteria, Lead, Gamma-HCH, Nitrogen(Total Ammonia), Nitrogen, Nitrate/Nitrite, Oxygen Dissolved, pH, Selenium, Toxicity, Zinc
Pollutants of Concern for the Project	Per the TGD, Table 2.2, pollutants of concern for North Orange County, Coyote Creek and San Gabriel River (Reach 1), include Bacteria Indicators/Pathogens, Nutrients, Pesticides, and Toxicity.
Environmentally Sensitive and Special Biological Significant Areas	The Project will not be considered environmentally sensitive because it is not discharging directly into a 303(d) impaired body of water according to table 2.2 of the TGD.

Section IV Best Management Practices (BMPs)

IV. 1 Project Performance Criteria

Describe project performance criteria. Several steps must be followed in order to determine what performance criteria will apply to a project. These steps include:

- If the project has an approved WIHMP or equivalent, then any watershed specific criteria must be used and the project can evaluate participation in the approved regional or sub-regional opportunities. (Please ask your assigned planner or plan checker regarding whether your project is part of an approved WIHMP or equivalent.)
- Determine applicable hydromodification control performance criteria. *Refer to Section 7.II-2.4.2.2 of the Model WQMP.*
- Determine applicable LID performance criteria. *Refer to Section 7.II-2.4.3 of the Model WQMP.*
- Determine applicable treatment control BMP performance criteria. *Refer to Section 7.II-*3.2.2 *of the Model WQMP.*
- Calculate the LID design storm capture volume for the project. *Refer to Section 7.II-2.4.3 of the Model WQMP.*

(NOC Permit Area only) 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 ☒
If yes, describe WIHMP feasibility criteria or regional/sub-regional LID opportunities.	N/A	

Project Performance Criteria	
If HCOC exists, list applicable hydromodification control performance criteria (Section 7.II-2.4.2.2 in MWQMP)	N/A
List applicable LID performance criteria (Section 7.II-2.4.3 from MWQMP)	Infiltrate, harvest, and reuse, evapotranspiration, or biotreat/biofilter the 85th percentile, 24-hour storm even (DVC).
List applicable treatment control BMP performance criteria (Section 7.II-3.2.2 from MWQMP)	Per 7.II-3.2.2 of the Model WQMP, 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 and as calculated in TGD Appendix VI. If treatment control BMPs can treat all the remaining unmet volume and have a medium to high effectiveness for reducing the primary POCs, the project is considered to be in compliance; a waiver application and participation in an alternative program is not required
Calculate LID design storm capture volume for Project.	Traditional site design BMPs that encourage localized infiltration could not be used due to poor soil conditions and a high groundwater table on-site. The site will use a flow-based BMP to treat runoff. Since the entire volume for each drainage area will be treated by its respective Modular Wetland or Bioretention as a flow-based BMP, the following equation applies: $Q = C*i*A$ Where: Q = Design Flow Rate (cfs) C = Runoff Coefficient (0.75 x imp + 0.15) i = Design Intensity (inches/hour) A = Tributary Area

A reduction of 20% has been applied to the calculations due to the development being classified as vertical density. See 7-II-3.1.1 for the Model WQMP for more information about water quality credits. This reference has been included in Attachment J for review.

A table in Section IV.2 and Attachment E summarizes the calculations. Calculations for each DMA area can be found in Attachment E.

IV.2. Site Design and Drainage

Describe site design and drainage including

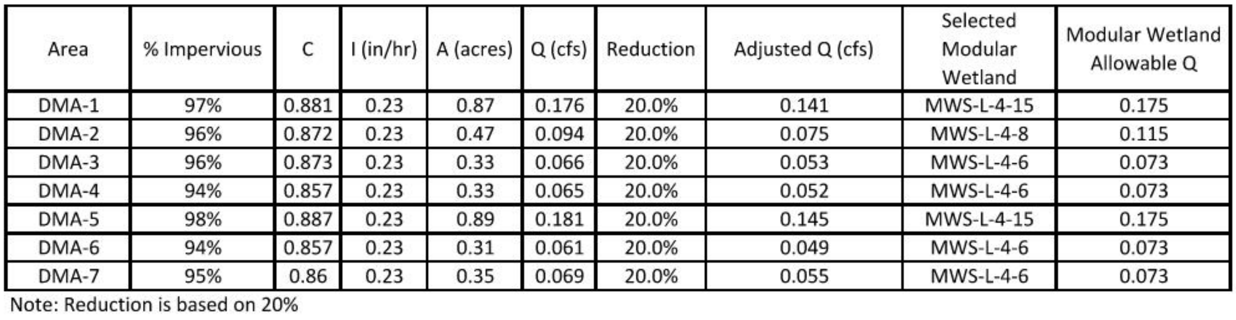
- A narrative of site design practices utilized or rationale for not using practices;
- A narrative of how site is designed to allow BMPs to be incorporated to the MEP
- A table of DMA characteristics and list of LID BMPs proposed in each DMA.
- Reference to the WQMP “BMP Exhibit.”
- Calculation of Design Capture Volume (DCV) for each drainage area.
- A listing of GIS coordinates for LID and Treatment Control BMPs.

Refer to Section 2.4.2 in the Technical Guidance Document (TGD).

Per the geotechnical report, infiltration is not recommended. Through preliminary testing, groundwater was not found 65 feet below existing grade, and historically has a high of 70 feet below existing grade.

The proposed site will utilize a total of seven Bio Clean Modular Wetland Systems. Flow will drain from the roof through pipes into the system. Surface flow will be directed to the systems, which will also act as inlets for the site.

Flow will leave the modular wetlands and bioretention with underdrain unit and be piped to the back of existing curb inlet and storm drain that runs along East Chapman Ave.



Area	% Impervious	C	I (in/hr)	A (acres)	Q (cfs)	Reduction	Adjusted Q (cfs)	Selected Modular Wetland	Modular Wetland Allowable Q
DMA-1	97%	0.881	0.23	0.87	0.176	20.0%	0.141	MWS-L-4-15	0.175
DMA-2	96%	0.872	0.23	0.47	0.094	20.0%	0.075	MWS-L-4-8	0.115
DMA-3	96%	0.873	0.23	0.33	0.066	20.0%	0.053	MWS-L-4-6	0.073
DMA-4	94%	0.857	0.23	0.33	0.065	20.0%	0.052	MWS-L-4-6	0.073
DMA-5	98%	0.887	0.23	0.89	0.181	20.0%	0.145	MWS-L-4-15	0.175
DMA-6	94%	0.857	0.23	0.31	0.061	20.0%	0.049	MWS-L-4-6	0.073
DMA-7	95%	0.86	0.23	0.35	0.069	20.0%	0.055	MWS-L-4-6	0.073

Note: Reduction is based on 20%

IV.3 LID BMP Selection and Project Conformance Analysis

IV.3.1 Hydrologic Source Controls (HSCs)

HSC's will not be utilities on this project due to poor infiltration.

IV.3.2 Infiltration BMPs

Infiltration BMPs will not be used on this project for reasons outlined in Section III.2 of this report.

IV.3.3 Evapotranspiration, Rainwater Harvesting BMPs

Evapotranspiration and rainwater harvesting BMPs are not feasible because there is not sufficient landscape area on-site to irrigate with harvest storm water.

IV.3.4 Biotreatment BMPs

If the full Design Storm Capture Volume cannot be met with infiltration BMPs, and/or evapotranspiration and rainwater harvesting BMPs, describe biotreatment BMPs included. Include sections for selection, suitability, sizing, and infeasibility, as applicable.

Name	Included?
Bioretention with underdrains	☒
Stormwater planter boxes with underdrains	☐
Rain gardens with underdrains	☐
Constructed wetlands	☐
Vegetated swales	☐
Vegetated filter strips	☐
Proprietary vegetated biotreatment systems	☐
Wet extended detention basin	☐
Dry extended detention basins	☐
Other:	☐
Other:	☐

See Section IV.2 for subarea and BMP sizing calculations along with a description of the proprietary units proposed. The full DCV is treated with the BMPs.

IV.3.5 Hydromodification Control BMPs

Hydromodification control BMPs are not required for this project.

IV.3.6 Regional/Sub-Regional LID BMPs

There will be no regional or sub-regional BMPs required.

IV.3.7 Treatment Control BMPs

Treatment is provided in full by the LID biotreatment BMPs. Treatment BMPs are not proposed.

IV.3.8 Non-structural Source Control BMPs

Fill out non-structural source control check box forms or provide a brief narrative explaining if non-structural source controls were not used.

Non-Structural Source Control BMPs

Identifier	Name	Check One		If not applicable, state brief reason
		Included	Not Applicable	
N1	Education for Property Owners, Tenants and Occupants	☒	☐	
N2	Activity Restrictions	☒	☐	
N3	Common Area Landscape Management	☒	☐	
N4	BMP Maintenance	☒	☐	
N5	Title 22 CCR Compliance (How development will comply)	☐	☒	No hazardous waste will be handled on-site.
N6	Local Industrial Permit Compliance	☐	☒	Industrial users are not present on-site.
N7	Spill Contingency Plan	☐	☒	No hazardous waste will be handled on-site.
N8	Underground Storage Tank Compliance	☐	☒	No USTs are proposed.
N9	Hazardous Materials Disclosure	☐	☒	No hazardous waste will be

	Compliance			handled on-site.
N10	Uniform Fire Code Implementation	☐	☒	No hazardous waste will be handled on-site.
N11	Common Area Litter Control	☒	☐	
N12	Employee Training	☒	☐	
N13	Housekeeping of Loading Docks	☐	☒	No proposed loading docks.
N14	Common Area Catch Basin Inspection	☒	☐	
N15	Street Sweeping Private Streets and Parking Lots	☒	☐	
N16	Retail Gasoline Outlets	☐	☒	Fueling stations are not proposed.

Implementation of Non-Structural BMPS

N1. Education of Property Owners, Tenants and Occupants.

Responsible Party for Implementation of BMP: Core Campus will be responsible for the implementation of BMPs.

Implementation Frequency: Ongoing. Orientation shall be given to new owners, tenants, and occupants within 30 days of startup.

Educational material and information shall be provided by the property owner to new owners/tenants/occupants on general good housekeeping BMPs and other practices that contribute to protection of storm water quality. This WQMP shall be provided with emphasis placed on the materials included in, but not limited to, Sections V, VI and VII of this report. For additional information, see the BMP Maintenance Responsibility /Frequency Matrix in Section V. Educational Materials to be used include, but are not limited to, SC-10, Non-Stormwater Discharges, SC- 30, Outdoor Loading/Unloading, SC-34, Waste Handling & Disposal, SC-41, Building & Grounds Maintenance, SC-43, Parking/Storage Area Maintenance, The Ocean Begins at Your Front Door, After the Storm, Protecting Water Quality from Urban Runoff, Preventing Pollution Through Efficient Water Use, and Your Business and the County- Partners in Protecting the Ocean. In addition to the attachments, the following resource can be contacted to obtain updated educational information free of charge http://ocwatersheds.com/PublicEd. See Table V.1 in Section V for inspection and maintenance activity requirements.

N2. Activity Restrictions.

Responsible Party for Implementation of BMP: Core Campus Manager will be responsible for the implementation of BMPs.

Implementation Frequency: Daily management of operation. Orientation shall be given to new owners, tenants, and occupants within 30 days of startup. Refreshing orientation shall be given annually. Onsite activities shall be restricted to those currently granted by the City of Santa Ana and as stated in the Conditions, Covenants, and Restrictions (CCRs), which will be available in the near future. Parking restrictions include, but are not limited to, provisions regulating vehicle and truck deliveries, vehicle and truck parking, loading and unloading activities, etc. Some other common restrictions to be adhered to are as follows:

- No discharges of fertilizer, pesticides, and wastes to streets or storm drains
- No blowing or sweeping of debris into streets or storm drains
- No hosing down of paved surfaces
- No vehicle washing or maintenance.
- Do not perform paint cleanup activities in paved areas or allow rinse water from these
- activities to enter the storm drain system. Clean brushes containing water-based paint in a
- sink that is connected to the sanitary sewer system.
- Do not use detergents or other chemical additives when washing concrete sidewalks or
- building exteriors, use potable water only and collect wash water runoff using a
- vacuum truck, for proper offsite disposal.
- Keep premises, as well as trash container areas, free of litter. See Table V -1 in Section V for inspection and maintenance activity requirements.

In addition, onsite activities shall be limited to the requirements of this WQMP as described herein.

N3. Common Area Landscape Management.

Responsible Party for Implementation of BMP: Core Campus Manager will be responsible for the implementation of BMPs.

Implementation Frequency: Landscape areas shall be maintained on a weekly basis through Grounds and Maintenance personnel.

All maintenance shall be consistent with the Fullerton Ana Water Quality Ordinance and Fullerton Code General guidelines include the following: Plant vegetation that reduces water, fertilizer, herbicide, and pesticide use. Waste shall be disposed of by composting or at a permitted landfill and shall not be raked or blown into the street, gutter, or storm drains. Irrigation systems shall be inspected monthly for leaks. Leaks shall be repaired as soon as they are observed. A void over-watering of vegetation. If excessive runoff is observed, automatic timers shall be adjusted. Fertilizers, herbicides, and pesticides shall be used as directed on the label. If fertilizer is spilled on a paved surface it should be swept up immediately and placed in its container. Water shall not be used to clean fertilizer spills unless necessary and only after the area has been thoroughly cleaned using dry cleaning methods. Pesticides, herbicides, and fertilizers shall not be applied within 48 hours prior to rain or if wind speeds exceed 5 mph. For additional information, see Help Prevent Ocean Pollution - Proper Maintenance Practices for Your Business included in Section VII of this report. Also refer to BMP SC-41, Building & Grounds Maintenance, included in Section VII and the BMP Maintenance Responsibility / Frequency Matrix in Section V for details.

N4. BMP Maintenance.

Responsible Party for Implementation of BMP: Core Campus Manager will be responsible for the implementation of BMPs.

Implementation Frequency: Individual BMPs shall be inspected based on the required frequency of each BMP as suggested in the Maintenance Responsibility / Frequency Matrix. See the BMP Maintenance Responsibility / Frequency Matrix in Section V for details.

N11. Common Area Litter Control

Responsible Party for Implementation of BMP: Core Campus Manager will be responsible for the implementation of BMPs.

Implementation Frequency: On a weekly basis through a maintenance firm.

In order to reduce the likelihood of polluting storm water runoff, regular maintenance will be conducted. This will consist of, at a minimum, site-wide litter control, emptying of trash receptacles in common areas, sweeping of dumpster enclosure areas, and reporting trash disposal violations to the owner or POA for investigation. The landscape maintenance may be contracted for common area litter control as well. See Table V.1 in Section V for inspection and maintenance activity requirements. Trash enclosures will include roofs.

N12 Employee Training

Responsible Party for Implementation of BMP: Core Campus Manager will be responsible for the implementation of BMPs.

Implementation Frequency: Education of applicable employees for the tenants shall continue on an ongoing basis and shall be done within 30 days of startup. Each new applicable onsite employee shall be given a water quality orientation within 30 days of hire using this WQMP

Report as a reference. At a minimum, each applicable onsite employee shall have an annual review of the provisions of the WQMP Report for this project

See Table V -1 in Section V for inspection and maintenance activity requirements.

N14. Common Area Catch Basin Inspection.

Responsible Party for Implementation of BMP: Core Campus Manager will be responsible for the implementation of BMPs.

Implementation Frequency: Twice a month to remove debris and after every major storm event.

The site's proposed drainage is picked up in catch basins at various places and is transported underground to the main storm drain. These catch basins are to be maintained a at the frequency

N15. Street Sweeping Private Streets and Parking Lots.

Responsible Party for Implementation of BMP: Core Campus Manager will be responsible for the implementation of BMPs.

Implementation Frequency: Twice a month to remove debris.

The Property Owners' Association shall be responsible for sweeping the surrounding parking lot on a regular basis to remove debris. At minimum, the streets and parking lots will be required to be swept prior to the storm season, in late summer or early fall, prior to the start of the rainy season, or equivalent as required by the governing jurisdiction. For additional information, see BMP SC-34, Waste Handling and· Disposal and BMP SC-43, Parking/Storage Area Maintenance, included in Section VII, and the BMP Maintenance Responsibility /Frequency Matrix in Section V.

IV.3.9 Structural Source Control BMPs

Fill out structural source control check box forms or provide a brief narrative explaining if structural source controls were not used.

Structural Source Control BMPs				
Identifier	Name	Check One		If not applicable, state brief reason
		Included	Not Applicable	
S1	Provide storm drain system stenciling and signage	☒	☐	
S2	Design and construct outdoor material storage areas to reduce pollution introduction	☐	☒	Outdoor material storage areas are not proposed.
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	☐	☒	There are no slopes or channels on the project site.
	Incorporate requirements applicable to individual priority project categories (from SDRWQCB NPDES Permit)	☐	☒	Project is in North Orange County
S6	Dock areas	☐	☒	No proposed loading docks.
S7	Maintenance bays	☐	☒	No proposed maintenance bays.
S8	Vehicle wash areas	☐	☒	No proposed vehicle wash areas
S9	Outdoor processing areas	☐	☒	No proposed outdoor processing areas
S10	Equipment wash areas	☐	☒	No proposed equipment wash areas
S11	Fueling areas	☐	☒	No proposed fueling areas
S12	Hillside landscaping	☐	☒	No proposed hillside landscaping. Project is not located on a hillside
S13	Wash water control for food preparation areas	☐	☒	No proposed food preparation areas on-site.
S14	Community car wash racks	☐	☒	No proposed car wash area.

Implementation of Structural BMPs

S1. Storm Drain System Stenciling and Signage

Responsible Party: Core Campus Manager will be responsible for the implementation of BMPs.

Implementation Frequency: Minimum once per year and repair as necessary.

Phrase "No-Dumping- Drains to Oceans" or equally effective phrase is to be placed on each catch basin and storm drain inlet to inform the public of the destination of pollutants discharged into stormwater. Catch basin signage shall be inspected for legibility no less than once per year. The catch basin stencil shall be kept onsite. Catch basins shall be re-stenciled when phrase is no longer legible Locations of stenciling can be found on the BMP Location Map in Section VI. All onsite private catch basins will remain the property of the Core Campus Manager. See BMP SD-13, Storm Drain Signage, in Section VII for more information.

S3. Design and construct trash and waste storage areas

Responsible Party: Core Campus Manager will be responsible for the implementation of BMPs.

Maintenance Implementation Frequency: Loose trash will be picked up daily and placed in containers. Trash dumpster pickup shall be a minimum of once a week.

The trash storage areas will be paved with an impervious surface. No drainage will be directed toward the trash areas and the enclosures will be walled on all four sides to minimize spillage of trash into the Site. For additional information, see BMP SD-32, Trash Storage Areas, in Section VII and the BMP Maintenance Responsibility /Frequency Matrix in Section V.

Storm drain inlets near or adjacent to trash enclosures must be checked and cleared of debris on a regular basis, and before and after storms.

S4. Use efficient irrigation systems & landscape design

Responsible Party: Core Campus Manager will be responsible for the implementation of BMPs.

Implementation Frequency: Inspect irrigation equipment on a monthly basis. Check water sensors and adjust irrigation heads and timing monthly.

The proposed landscape and irrigation system shall group plants with similar water requirements in order to reduce excess irrigation runoff and promote surface filtration and shall comply with the City of Santa Ana Water Quality Ordinance and Santa Ana Municipal Code. Monthly inspection of the irrigation system shall be conducted to insure efficient water uses. See BMPs SC-41, Building and Grounds Maintenance, SD-10~ Site Design and Landscape Planning, and SD-12, Efficient Irrigation, in Section VII. Also refer to the BMP Maintenance Responsibility /Frequency Matrix in Section V.

IV.4 Alternative Compliance Plan (If Applicable)

IV.4.1 Water Quality Credits

<table>
<tr><th colspan="6">Description of Proposed Project</th></tr>
<tr><td colspan="6">Project Types that Qualify for Water Quality Credits (Select all that apply):</td></tr>
<tr><td>☐Redevelopment projects that reduce the overall impervious footprint of the project site.</td><td colspan="3">☐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 WQ if not redeveloped.</td><td colspan="2">☒ 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).</td></tr>
<tr><td colspan="2">☒ 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).</td><td colspan="3">☐ 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</td><td>☐ 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).</td></tr>
<tr><td>☐Developments with dedication of undeveloped portions to parks, preservation areas and other pervious uses.</td><td>☐ Developments in a city center area.</td><td>☐ Developments in historic districts or historic preservation areas.</td><td colspan="2">☐ 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.</td><td>☐In-fill projects, the conversion of empty lots and other underused spaces into more beneficially used spaces, such as residential or commercial areas.</td></tr>
<tr><td>Calculation of Water Quality Credits
(if applicable)</td><td colspan="5">The proposed project qualifies for a 20% water quality credit because the project meets the vertical density development requirement of having more than 18 units per acre and the mixed use development requirement as stated in the Orange County Model WQMP. The proposed project will have 390 units on a 3.55 acre site, providing 109 units per acre.</td></tr>
</table>

EXHIBIT 7.II, MODEL WATER QUALITY MANAGEMENT PLAN (WQMP)

7.II–3.1 Water Quality Credits

For certain types of development projects, LID BMPs may be more difficult to incorporate due to the nature of the development, but the development practices may provide other environmental benefits to communities. For example, infiltration BMPs may not desirable for a Brownfield redevelopment site where infiltrated stormwater could cause an adverse impact to groundwater supply, but redevelopment of the site would be expected to have other environmental benefits such as accelerated site clean-up. Development in city centers, historic districts, or historic preservation areas often follows land-use patterns that existed before the introduction of the automobile and subsequent urban sprawl. New development or redevelopment in these areas is expected to follow those same patterns in order to be compatible with the surrounding area and thereby mimic many LID principles. Redevelopment project could be implemented in a way that reduces the overall impervious footprint of the project site rather than increasing it.

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. In order to determine if a project falls into any of the following categories, local jurisdictions will use the descriptions provided below as well as descriptions or definitions in local planning documents. If any of these descriptions or definitions is inadequate to determine a project’s eligibility for credits, local jurisdictions will use published and generally accepted descriptions or definitions.

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. For Projects in the NOC Permit Area, credits can be applied before other alternative programs are evaluated and/or a Waiver request submitted. Also in the NOC Permit Area, the Permit allows for credits to be applied for hydromodification requirements. Permittee may develop a credit system for hydromodification at a future date and submit this to the Executive Officer for approval. For projects in the SOC Permit Area, credits can be applied as part of the LID Waiver Program.

Projects potentially eligible for consideration for credits include:

- 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 WQ 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);
- 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.

Other categories of projects listed in the Santa Ana Permit include:

- Developments where a regional treatment system has a capacity to treat flows
- Developments that contribute to an urban runoff fund
- Developments with offsite mitigation or dedications within the same watershed are accounted for under other provisions of this Model WQMP.

These categories address other types of alternative opportunities or compliance approaches that are described in other sections of this MWQMP. This provision does not exempt the project proponent from first conducting the investigations to determine if is feasible to fulfill the full LID, treatment control, and hydromodification requirements through a combination of site design practices and LID BMPs consistent with the permit hierarchy.

7.II–3.1.1 Applying Water Quality Credits to LID Performance Criteria

To determine the amount of credit a project would qualify for, the first step is to calculate the volume that would need to be satisfied in the absence of any credits as described in Section 7.II-3.1. Any credits would then be taken as a reduction to this remaining volume. The credits would be calculated in one of two ways:

- For redevelopment projects that reduce the overall impervious footprint of the project site compared to current use, the credits would be calculated as follows:
    - Calculate an equivalent “existing” Design Capture Volume for the site (DCVE) using the LID BMP Performance Criteria defined in Section 7.II-2.4.3 and current site conditions
    - Calculate the full Design Capture Volume for the site under the proposed development plan (DCVp)
    - Subtract to obtain a “credit” volume: (DCVE) - (DCVp) = Credit Volume

- For all other categories of projects noted above, the remaining volume to be treated or mitigated would be reduced in accordance with the following portions of the design capture volume :
    - Historic district, historic preservation area, or similar areas – 10 percent
    - Brownfield redevelopment – 25 percent
    - Higher density development
        - 7 units/acre – 5 percent
        - Vertical density as defined – 20 percent
    - Mixed use development, transit oriented development or live-work development – 20 percent
    - In-fill development – 10 percent

If more than one category applies to a particular project, the credit percentages would be additive. Applicable performance criteria depend on the number of LID water quality credits claimed by the proposed project. Water quality credits can be additive up to a 50 percent reduction (50 percent reduction maximum) from a proposed project's obligation for sizing LID BMPs, contributing to an urban runoff / mitigation fund, or off-site mitigation projects. The volume credit would be calculated as the design capture volume of the proposed condition multiplied by the sum of the percentages claimed above.

7.II–3.1.2 Applying Water Quality Credits to Hydromodification Performance Criteria in North

Orange County

To calculate the credit to be applied to the hydromodification control performance criteria in the NOC Permit Area, the sum of percentages determined above would be applied as a reduction to the 2-year, 24-hour storm depth which is used to calculate performance criteria. Water Quality Credits are not available for hydromodification control performance criteria in the SOC Permit Area.

IV.4.2 Alternative Compliance Plan Information

An alternative compliance plan is not being pursued for this project.

Section V Inspection/Maintenance Responsibility for BMPs

The following tables indicate BMP inspection and maintenance responsibility. These tables identify the party responsible for inspection and maintenance, a description of the inspection and/or maintenance activity, and a frequency for the inspection and/or maintenance activity. Records of maintenance and inspections shall be kept for a period of five years and shall be made available for review by government agencies.

Responsible part details as indicated in the table are as follows:

Property Management Company

Name: TBD

Title: TBD

Company: TBD

Address: TBD

Phone Number: TBD

Table V.1: BMP Inspection/Maintenance

BMP Inspection/Maintenance			
BMP	Reponsible Party(s)	Inspection/ Maintenance Activities Required	Minimum Frequency of Activities
N1. Education for Property Owners, Tenants and Occupants	Core Campus Manager	Educational material shall be provided to all employees and tenants.	Upon Tenant Occupancy, Annually Thereafter

N2. Activity Restriction	Core Campus Manager	The owner shall develop activity restrictions to minimize the threat of hazardous waste or contamination into the storm drainage system. Car washing is not allowed on-site at any time.	Daily
N3. Common Area Landscape Management	Core Campus Manager	Training on landscape management consistent with County Water Conservation Resolution or City equivalent, plus Management Guidelines for Fertilizers (DAMP Section 5.5) shall be conducted for all new field landscape maintenance personnel.	Weekly
N4. BMP Maintenance	Core Campus Manager	Maintenance of BMPs implemented at the project site shall be performed at the frequency prescribed in this WQMP. (See Attachment G Operations and Maintenance Manual)	Bi-Annual

N11. Common Area Litter Control	Core Campus Manager	Litter patrol, violations investigation, reporting and other litter control activities shall be performed in conjunction with maintenance activities.	Daily
N12. Employee Training	Core Campus Manager	Education programs shall be implemented as they apply to future employees and training of current employees.	Yearly for all employees and within 6 months of hire date for new employees.
N14. Common Area Catch Basin Inspection	Core Campus Manager	Maintain and inspect catch basins for obstructions and/or build up. Inspect catch basin stenciling	Twice a month to remove debris and after every major storm event
N15. Street Sweeping Private Streets	Core Campus Manager	Streets and parking area within the project shall be swept at a minimum frequency of once a month.	Biweekly
S1 Provide Storm Drain System Stencilling and Signage	Core Campus Manager	All proposed inlets shall be marked with the appropriate "No Dumping. Drains to Ocean." Stencil. The stencils must be repainted when they	Yearly

		becomes illegible, but at a minimum once every five years.	
S3. Design and Construct Outdoor Material Storage Areas to Reduce Pollutant Introduction	Core Campus Manager	All receptacles shall have solid lids and kept closed at all times. Trash receptacles shall be placed on a paved area. Sweep trash area at least once per week. Maintain area clean of trash and debris.	Weekly
S4. Use Efficient Irrigation Systems & Landscape Design	Core Campus Manager	Verify that landscape design continues to function properly by correctly adjusting 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, and day or night time temperatures.	Monthly
Bio-7: Proprietary Biotreatment (Modular Wetland System)	Core Campus Manager	Remove trash from screening device, trim vegetation	Bi-Annual

Section VI BMP Exhibit (Site Plan)

VI.1 BMP Exhibit (Site Plan)

See Attachment H for the WQMP Site Plan

VI.2 Submittal and Recordation of Water Quality Management Plan

Following approval of the Final Project-Specific WQMP, three copies of the approved WQMP (including BMP Exhibit, Operations and Maintenance (O&M) Plan, and Appendices) shall be submitted. In addition, these documents shall be submitted in a PDF format.

Each approved WQMP (including BMP Exhibit, Operations and Maintenance (O&M) Plan, and Appendices) shall be recorded in the Orange County Clerk-Recorder's Office, prior to close-out of grading and/or building permit. Educational Materials are not required to be included.

Section VII Educational Materials

See Attachment F for applicable educational materials

Education Materials

Residential Material (http://www.ocwatersheds.com)	Check If Applicable	Business Material (http://www.ocwatersheds.com)	Check If Applicable
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 Material	Check If Attached
Proper Disposal of Household Hazardous Waste	☒		
Recycle at Your Local Used Oil Collection Center (North County)	☐		☐
Recycle at Your Local Used Oil Collection Center (Central County)	☒		☐
Recycle at Your Local Used Oil Collection Center (South County)	☐		☐
Tips for Maintaining a Septic Tank System	☐		☐
Responsible Pest Control	☒		☐
Sewer Spill	☐		☐
Tips for the Home Improvement Projects	☒		☐
Tips for Horse Care	☐		☐
Tips for Landscaping and Gardening	☒		☐
Tips for Pet Care	☒		☐
Tips for Pool Maintenance	☐		☐
Tips for Residential Pool, Landscape and Hardscape Drains	☐		☐
Tips for Projects Using Paint	☒		☐

ATTACHMENT A

303d LIST OF IMPAIRED WATER BODIES

Table 2.2: Summary of the Approved 2010 303(d) Listed Water Bodies and Associated Pollutants of Concern for North Orange County

Region	Water Body	Bacteria Indicators/ Pathogens	Metals	Nutrients	Pesticides	Toxicity	Trash	Salinity/ TDS/ Chlorides	Turbidity	Other Organics
Region 8 Santa Ana	Anaheim Bay		X		X	X				X
	Bolsa Chica Channel		X							
	Buck Gully Creek	X								
	Coyote Creek	X		X	X	X				
	Huntington Beach State Park									X
	Huntington Harbor	X	X		X	X				X
	Los Trancos Creek (Crystal Cove Creek)	X								
	Newport Bay, Lower					X				X
	Newport Bay, Upper (Ecological Reserve)					X				X
	San Diego Creek, Reach 1	X								
	San Diego Creek, Reach 2									
	San Gabriel River, Reach 1	X								
	Seal Beach	X								X
	Silverado Creek	X						X		

On October 11, 2011, the 2010 303(d) list was approved by USEPA Region 9. Project proponents should consult the most recent 303(d) list located on the State Water Resources Control Board website[10].

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[10] http://www.swrcb.ca.gov/water_issues/programs/#wqassessment

Final California 2014 and 2016 Integrated Report (303(d) List/305(b) Report)

Supporting Information

Regional Board 8 - Santa Ana Region

Water Body Name:	Santa Ana Delhi Channel
Water Body ID:	**CAR8011100020011107125249**
Water Body Type:	**River & Stream**

DECISION ID 44427 Region 8
Santa Ana Delhi Channel

Pollutant:	**Indicator Bacteria**
Final Listing Decision:	**Delist from 303(d) list (TMDL required list)**
Last Listing Cycle's Final Listing Decision:	List on 303(d) list (TMDL required list)(2012)
Revision Status	Revised
Reason for Delisting:	Other
Impairment from Pollutant or Pollution:	Pollutant

Regional Board Conclusion:

The REC-1 Beneficial Use was removed from this waterbody segment through an approved UAA under Resolution No. R8-2012-0001, that was approved by State Board and USEPA.

However, the REC-2 use still applies which has the antidegradation target of 1,104 cfu/100mL for a SSM or STV based on the 75th percentile density for samples collected during the dry weather months April - October.

There is one line of evidence available for E.Coli that shows 4 of 21 dry weather SSM samples exceed 1,104 cfu/100ml antidegradation target for REC-2 waters.

Based on the readily available data and information, the weight of evidence indicates that there is sufficient justification in favor of removing this water segment-pollutant combination from the CWA section 303(d) List. This conclusion is based on the staff findings that:
1. The data used satisfies the data quality requirements of section 6.1.4 of the Policy.
2. The data used satisfies the data quantity requirements of section 6.1.5

of the Policy.
3. 4 of 21 samples exceed the REC-2 objective and this does not exceed the allowable frequency listed in Table 3.2 of the Listing Policy.
4. Pursuant to section 3.11 of the Listing Policy, no additional data and information are available indicating that standards are not met.
5. The applicable beneficial uses have changed since this water body was originally listed, and therefore the previous reason for listing no longer stands.

Regional Board Decision Recommendation:	After review of the available data and information, RWQCB staff concludes that the water body-pollutant combination should be removed from the section 303(d) list because applicable water quality standards for the pollutant are not being exceeded.
State Board Review of Regional Board Conclusion and Recommendation:	
State Board Decision Recommendation:	After review of this Regional Board decision, SWRCB staff recommend the decision be approved by the State Board.

Line of Evidence (LOE) for Decision ID 44427, Indicator Bacteria Region 8
Santa Ana Delhi Channel

LOE ID:	82369
Pollutant:	Total Coliform
LOE Subgroup:	Pollutant-Water
Matrix:	Water
Fraction:	None
Beneficial Use:	Water Contact Recreation
Number of Samples:	28
Number of Exceedances:	6
Data and Information Type:	PATHOGEN MONITORING
Data Used to Assess Water Quality:	Water Board staff assessed BeachWatch data for Santa Ana Delhi Channel to determine beneficial use support and results are as follows: 6 of 28 samples exceed the criterion for Coliform, Total.
Data Reference:	Data for Region 8 Beach Watch.
SWAMP Data:	Non-SWAMP

Water Quality Objective/Criterion:	California Ocean Plan (2009) single sample maximum states that total coliform density shall not exceed 10,000 per 100 mL
Objective/Criterion Reference:	California Ocean Plan Water Quality Control Plan Ocean Waters of California 2009
Evaluation Guideline:	
Guideline Reference:	
Spatial Representation:	Data for this line of evidence for Santa Ana Delhi Channel was collected at 1 monitoring site [SANTA ANA DELHI]
Temporal Representation:	Data was collected over the time period 2/9/2009-1/4/2010.
Environmental Conditions:	Staff is not aware of any special conditions that might affect interpretation of the data.
QAPP Information:	The samples were collected for the Beach Watch program.
QAPP Information Reference(s):	

Line of Evidence (LOE) for Decision ID 44427, Indicator Bacteria Region 8 Santa Ana Delhi Channel

LOE ID:	82370
Pollutant:	Total Coliform
LOE Subgroup:	Pollutant-Water
Matrix:	Water
Fraction:	None
Beneficial Use:	Water Contact Recreation
Number of Samples:	18
Number of Exceedances:	18
Data and Information Type:	Not Specified
Data Used to Assess Water Quality:	Eighteen of the 18 geomeans exceeded the objective.
Data Reference:	Data for Region 8 Beach Watch.
SWAMP Data:	Non-SWAMP
Water Quality Objective/Criterion:	The standard for total coliform states that the coliform density shall not exceed 1000 per 100 mL. Water Quality Control Plan for Ocean Waters 2009.
Objective/Criterion Reference:	California Ocean Plan Water Quality Control Plan Ocean Waters of California 2009
Evaluation Guideline:	

Guideline Reference:

Spatial Representation:	Samples were collected at SANTA ANA DELHI.
Temporal Representation:	Samples were collected approximately twice a month from February 2009 to January 2010.
Environmental Conditions:	
QAPP Information:	The samples were collected for the beach watch program.
QAPP Information Reference(s):	

Line of Evidence (LOE) for Decision ID 44427, Indicator Bacteria Region 8
Santa Ana Delhi Channel

LOE ID:	82364
Pollutant:	Fecal Coliform
LOE Subgroup:	Pollutant-Water
Matrix:	Water
Fraction:	None
Beneficial Use:	Water Contact Recreation
Number of Samples:	30
Number of Exceedances:	5
Data and Information Type:	PATHOGEN MONITORING
Data Used to Assess Water Quality:	Water Board staff assessed BeachWatch data for Santa Ana Delhi Channel to determine beneficial use support and results are as follows: 5 of 30 samples exceed the criterion for Coliform, Fecal.
Data Reference:	Data for Region 8 Beach Watch.
SWAMP Data:	Non-SWAMP
Water Quality Objective/Criterion:	California Ocean Plan (SWRCB 2009) single sample maximum states that fecal coliform density shall not exceed 400 per 100ml
Objective/Criterion Reference:	California Ocean Plan Water Quality Control Plan Ocean Waters of California 2009
Evaluation Guideline:	
Guideline Reference:	
Spatial Representation:	Data for this line of evidence for Santa Ana Delhi Channel was collected at 1 monitoring site [SANTA ANA DELHI]
Temporal Representation:	Data was collected over the time period 2/9/2009-1/4/2010.
Environmental Conditions:	Staff is not aware of any special conditions that might affect interpretation of the data.

QAPP Information: The samples were collected for the Beach Watch program.
QAPP Information Reference(s):

Line of Evidence (LOE) for Decision ID 44427, Indicator Bacteria Region 8
Santa Ana Delhi Channel

LOE ID: 82365

Pollutant: Fecal Coliform
LOE Subgroup: Pollutant-Water
Matrix: Water
Fraction: None

Beneficial Use: Water Contact Recreation

Number of Samples: 20
Number of Exceedances: 12

Data and Information Type: Not Specified
Data Used to Assess Water Quality: Twelve of the 20 geomeans exceeded the objective.
Data Reference: Data for Region 8 Beach Watch.

SWAMP Data: Non-SWAMP

Water Quality Objective/Criterion: The standard for fecal coliform states that the coliform density shall not exceed 400 per 100 mL. Water Quality Control Plan for Ocean Waters 2009.
Objective/Criterion Reference: California Ocean Plan Water Quality Control Plan Ocean Waters of California 2009

Evaluation Guideline:
Guideline Reference:

Spatial Representation: Samples were collected at SANTA ANA DELHI.
Temporal Representation: Samples were collected approximately twice a month from February 2009 to January 2010.
Environmental Conditions:
QAPP Information: The samples were collected for the beach watch program.
QAPP Information Reference(s):

Line of Evidence (LOE) for Decision ID 44427, Indicator Bacteria Region 8
Santa Ana Delhi Channel

LOE ID: 21465

Pollutant: Escherichia coli (E. coli)
LOE Subgroup: Pollutant-Water
Matrix: Water
Fraction: None

Beneficial Use: Water Contact Recreation

Number of Samples: 62
Number of Exceedances: 39

Data and Information Type: PATHOGEN MONITORING
Data Used to Assess Water Quality: Of the 62 samples taken by Orange County Coast Keeper Coastal Watersheds Project, 39 exceeded USEPA's recommended single sample standard and 33 samples exceeded the Basin Plan fecal coliform objective.
The exceedances took place at both stations Delhi 1 and Delhi 2.
Data Reference: Orange County Coast Keeper Coastal Watersheds Project
USEPA Partial Approval Disapproval Letter and enclosures for California's 2008-2010 303(d) List
USEPA Final Decision Letter with enclosures and responsiveness summary regarding waters added to California's 2008-2010 303(d) List
USEPA Region 9 data summary for addition of indicator bacteria to California 2010 303(d) list for some Santa Ana River - Region 8 water bodies

SWAMP Data: Non-SWAMP

Water Quality Objective/Criterion: USEPA Recommended Ambient Water Quality Criteria for Bacteria -1986: E. coli: log mean less than 126 organisms/100 mL based on five or more samples per 30-day period, and single sample shall not exceed 235 organisms/100mL.

Santa Ana Region Basin Plan objective for Fecal coliform: log mean less than 200 organisms/100 mL based on five or more samples/30 day period, and not more than 10% of the samples exceed 400 organisms/100 mL for any 30-day period. (RWQCB Santa Ana Region, 2008, pp.4-9)
Objective/Criterion Reference: Water Quality Control Plan for the Santa Ana River Basin
Ambient Water Quality Criteria for Bacteria - 1986. EPA440/5-84-002

Evaluation Guideline:
Guideline Reference:

Spatial Representation: The samples were collected at two stations Delhi 1 and Delhi 2 (del1 and del2):

del1 is Located in Santa Ana in the upper Delhi Channel at the Macarthur intersection with Flower Street.

del2 is Located in Costa Mesa in the lower Delhi Channel on Mesa Dr. next to the intersection with Irvine Dr.

Temporal Representation: The samples were collected monthly starting on March 18, 2004 through March 29, 2006.

Environmental Conditions: Staff is not aware of any special conditions that might effect interpretation of the data.

QAPP Information: The data's quality is deemed appropriate because it was obtained under the auspices of a QAPP approved by the Regional Board.

QAPP Information Reference(s):

Line of Evidence (LOE) for Decision ID 44427, Indicator Bacteria Region 8 Santa Ana Delhi Channel

LOE ID: 96208

Pollutant: Escherichia coli (E. coli)
LOE Subgroup: Pollutant-Water
Matrix: Water
Fraction: None

Beneficial Use: Non-Contact Recreation

Number of Samples: 21
Number of Exceedances: 4

Data and Information Type: PATHOGEN MONITORING
Data Used to Assess Water Quality: Of the 21 samples taken by Orange County Coast Keeper Coastal Watersheds Project, 4 exceeded the evaluation guideline for REC-2 waters.
Data Reference: Orange County Coast Keeper Coastal Watersheds Project

SWAMP Data: Non-SWAMP

Water Quality Objective/Criterion: The concentrations of toxic substances in the water column, sediments or biota shall not adversely affect beneficial uses.
Objective/Criterion Reference: Water Quality Control Plan, Santa Ana River Basin

Evaluation Guideline: The freshwater REC-2 only anti-degradation target is 1,104 cfu/100ml of E.coli based on a 75th percentile density calculation for Santa Ana Delhi Channel Reach 2. Footnote 3 of the antidegredation targets specifies that only samples collected during dry weather months (April - October) shall be compared to the numeric target.

Guideline Reference: Water Quality Control Plan, Santa Ana River Basin

Spatial Representation: The samples were collected at two stations Delhi 1 and Delhi 2 (del1 and del2): del1 is Located in Santa Ana in the upper Delhi Channel at the Macarthur intersection with Flower Street. del2 is Located in Costa Mesa in the lower Delhi Channel on Mesa Dr. next to the intersection with Irvine Dr.

Temporal Representation: The samples were collected monthly starting on March 18, 2004 through March 29, 2006, but only samples collected during the dry weather months (April- October) were included in the assessment.

Environmental Conditions: Staff is not aware of any special conditions that might effect interpretation of the data.

QAPP Information: The data quality is deemed appropriate because it was obtained under the auspices of a QAPP approved by the Regional Board.

QAPP Information Reference(s):

Line of Evidence (LOE) for Decision ID 44427, Indicator Bacteria Region 8 Santa Ana Delhi Channel

LOE ID: 82363

Pollutant: Enterococcus
LOE Subgroup: Pollutant-Water
Matrix: Water
Fraction: None

Beneficial Use: Water Contact Recreation

Number of Samples: 20
Number of Exceedances: 20

Data and Information Type: Not Specified
Data Used to Assess Water Quality: Twenty of the 20 geomeans exceeded the objective.
Data Reference: Data for Region 8 Beach Watch.

SWAMP Data: Non-SWAMP

Water Quality Objective/Criterion: The standard for enterococcus states that the density shall not exceed 35 per 100 mL. Water Quality Control Plan for Ocean Waters 2009.

Objective/Criterion Reference:	California Ocean Plan Water Quality Control Plan Ocean Waters of California 2009
Evaluation Guideline:	
Guideline Reference:	
Spatial Representation:	Samples were collected at SANTA ANA DELHI.
Temporal Representation:	Samples were collected approximately twice a month from February 2009 to January 2010.
Environmental Conditions:	
QAPP Information:	The samples were collected for the beach watch program.
QAPP Information Reference(s):	

Line of Evidence (LOE) for Decision ID 44427, Indicator Bacteria Santa Ana Delhi Channel **Region 8**

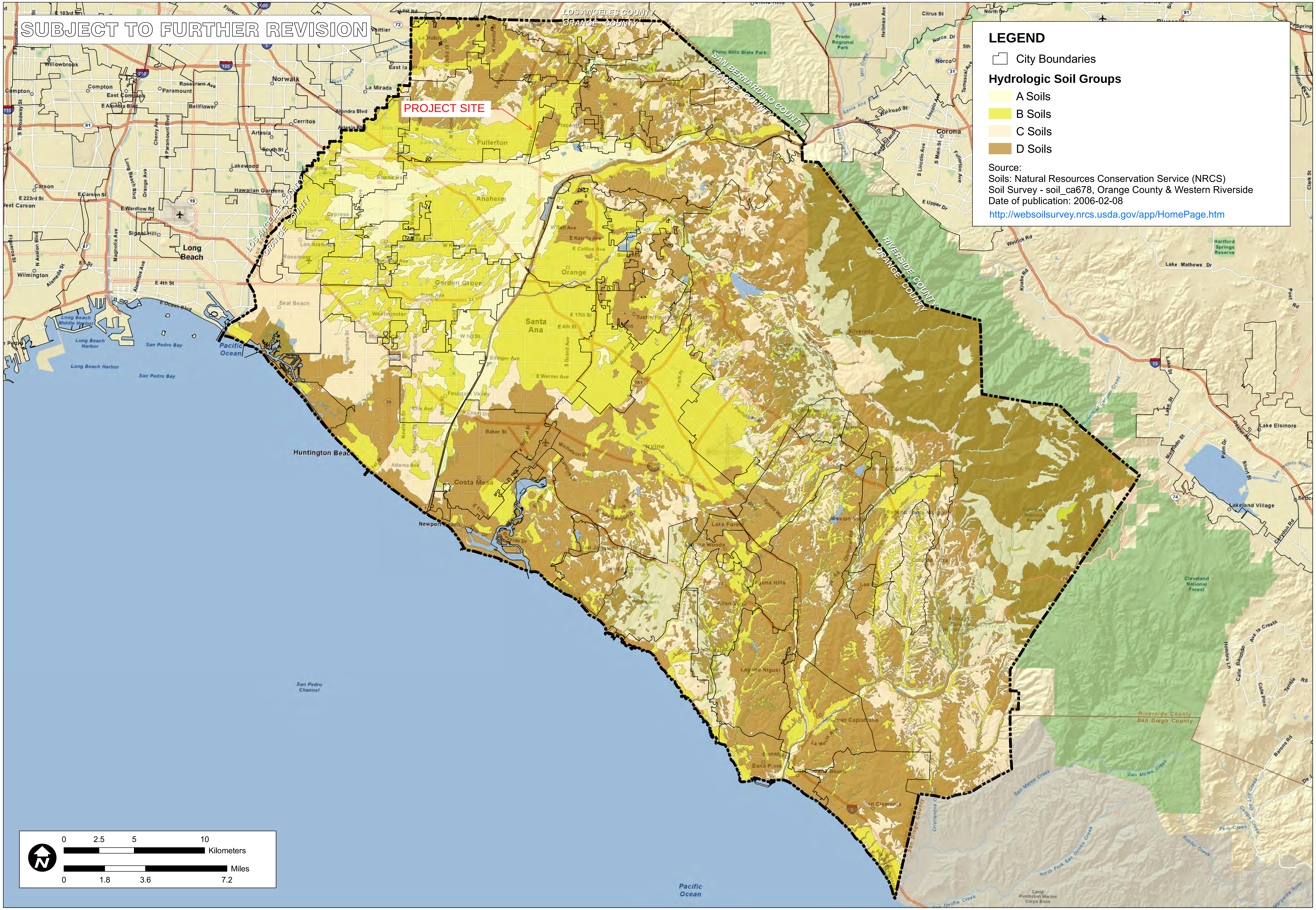
LOE ID:	82362
Pollutant:	Enterococcus
LOE Subgroup:	Pollutant-Water
Matrix:	Water
Fraction:	None
Beneficial Use:	Water Contact Recreation
Number of Samples:	30
Number of Exceedances:	25
Data and Information Type:	PATHOGEN MONITORING
Data Used to Assess Water Quality:	Water Board staff assessed BeachWatch data for Santa Ana Delhi Channel to determine beneficial use support and results are as follows: 25 of 30 samples exceed the criterion for Enterococci.
Data Reference:	Data for Region 8 Beach Watch.
SWAMP Data:	Non-SWAMP
Water Quality Objective/Criterion:	California Ocean Plan (SWRCB 2009) single sample maximum states that enterococcus density shall not exceed 104 per 100 mL.
Objective/Criterion Reference:	California Ocean Plan Water Quality Control Plan Ocean Waters of California 2009
Evaluation Guideline:	
Guideline Reference:	

Spatial Representation: Data for this line of evidence for Santa Ana Delhi Channel was collected at 1 monitoring site [SANTA ANA DELHI]
Temporal Representation: Data was collected over the time period 2/9/2009-1/4/2010.
Environmental Conditions: Staff is not aware of any special conditions that might affect interpretation of the data.
QAPP Information: The samples were collected for the Beach Watch program.
QAPP Information Reference(s):

ATTACHMENT B

COUNTY SOILS AND RAINFALL MAPS

SUBJECT TO FURTHER REVISION



TITLE
NRCS HYDROLOGIC SOILS GROUPS

JOB
ORANGE COUNTY INFILTRATION STUDY
ORANGE CO. CA

SCALE 1" = 1.8 miles
DESIGNED TH
DRAWING TH
CHECKED BMP
DATE 02/09/11
JOB NO. 9526-E

PACE
Advanced Water Engineering

FIGURE
XVI-2a

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Hydrologic Soil Group—Orange County and Part of Riverside County, California
(Hydrologic Soil Group)

Map Scale: 1:1,560 if printed on A landscape (11" x 8.5") sheet.

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

- ▢ Area of Interest (AOI)

Soils

Soil Rating Polygons

- 🟪 A
- 🟩 A/D
- 🟦 B
- 🟫 B/D
- 🟦 C
- 🟨 C/D
- 🟥 D
- ⬜ Not rated or not available

Soil Rating Lines

- 〰 A
- 〰 A/D
- 〰 B
- 〰 B/D
- 〰 C
- 〰 C/D
- 〰 D
- 〰 Not rated or not available

Soil Rating Points

- ■ A
- ■ A/D
- ■ B
- ■ B/D
- ■ C
- ■ C/D
- ■ D
- ▣ Not rated or not available

Water Features

- 〰 Streams and Canals

Transportation

- ┼┼┼ Rails
- 〰 Interstate Highways
- 〰 US Routes
- 〰 Major Roads
- 〰 Local Roads

Background

- ▨ Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Orange County and Part of Riverside County, California
Survey Area Data: Version 14, May 27, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 27, 2020—Mar 30, 2020

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
166	Mocho loam, 0 to 2 percent slopes, warm MAAT, MLRA 19	B	4.8	100.0%
Totals for Area of Interest			**4.8**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

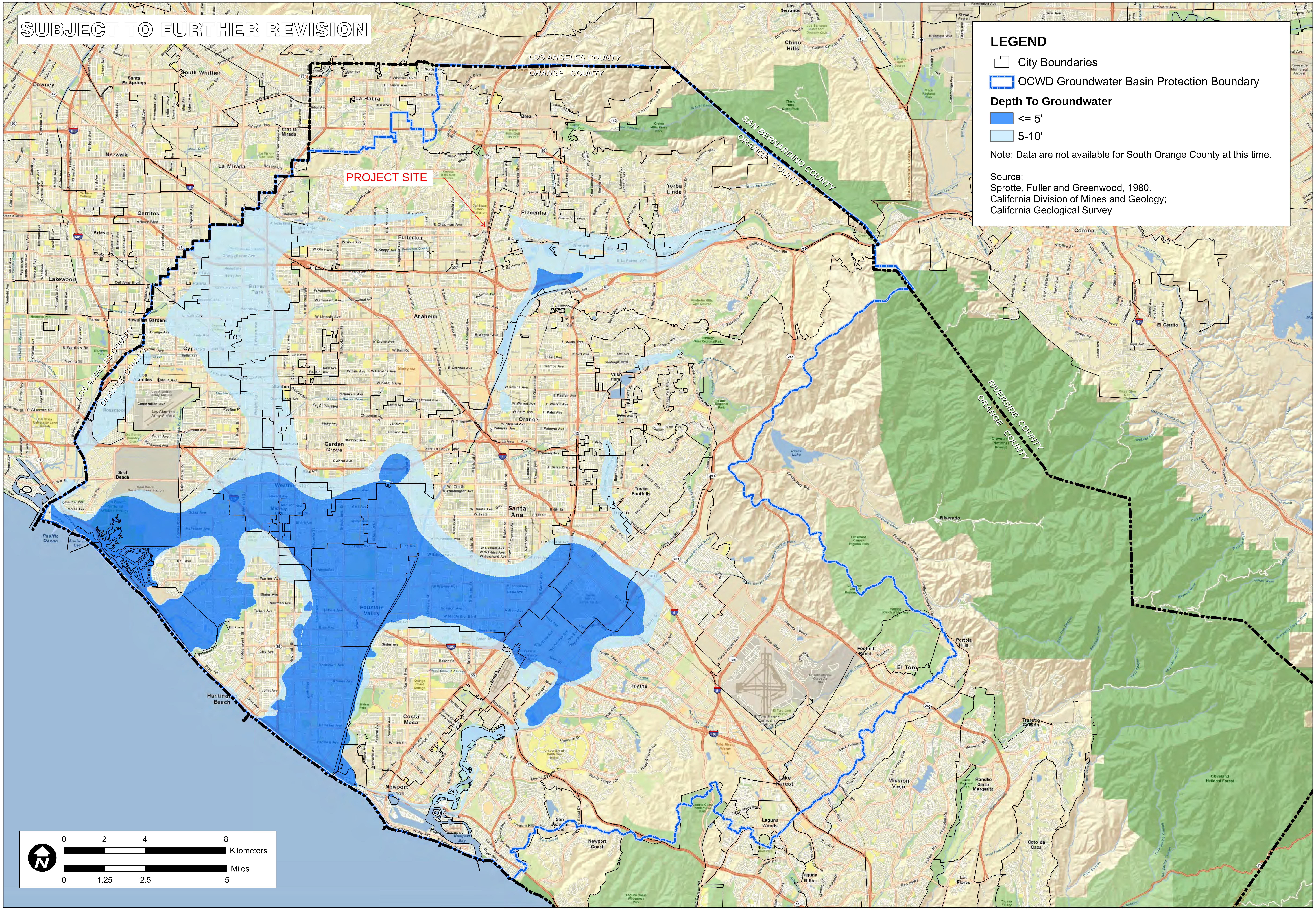
If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher



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TITLE

NORTH ORANGE COUNTY
MAPPED SHALLOW GROUNDWATER

JOB

ORANGE COUNTY
INFILTRATION STUDY

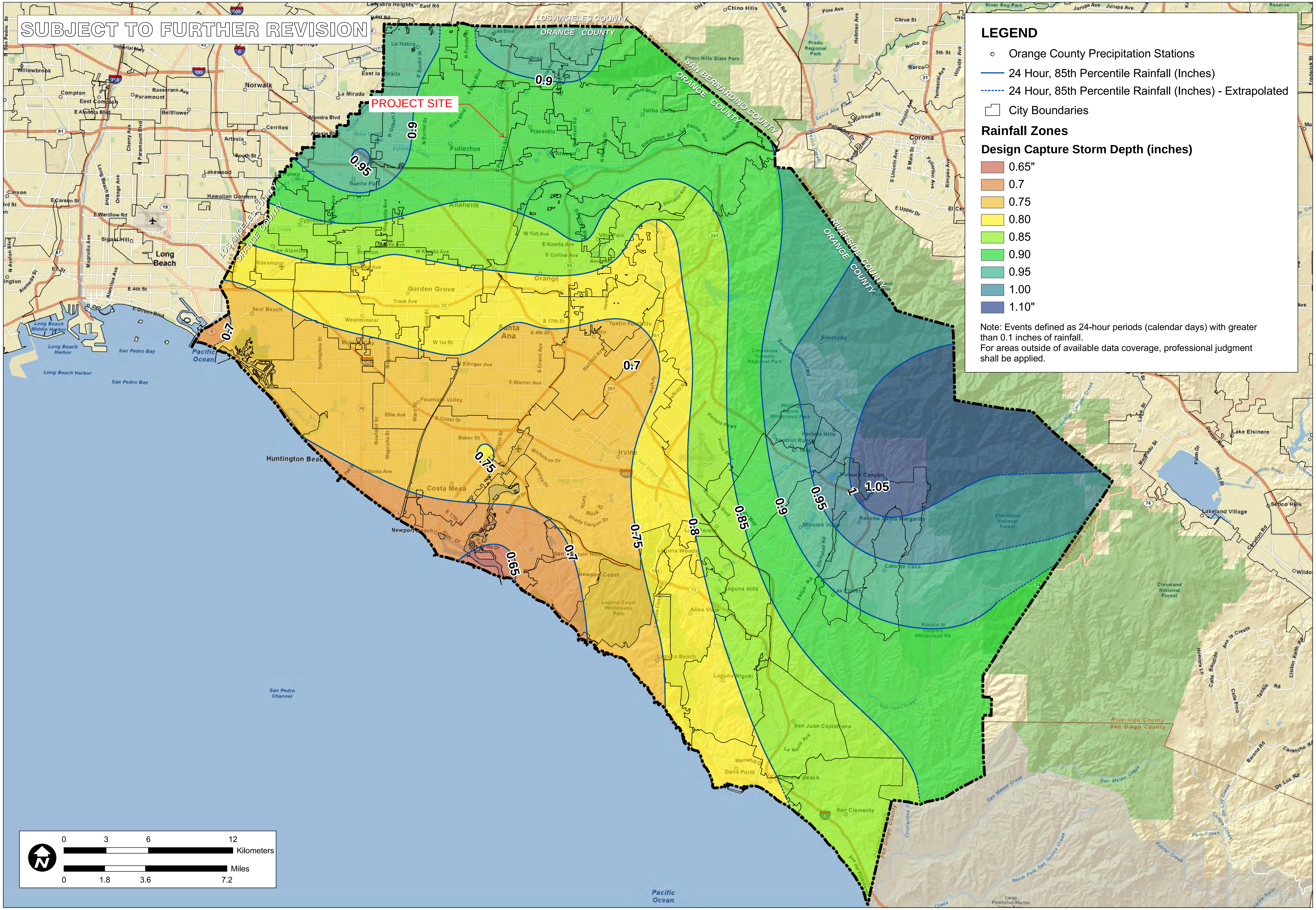
ORANGE CO.
CA

SCALE 1" = 1.25 miles
DESIGNED TH
DRAWING TH
CHECKED BMP
DATE 02/09/11
JOB NO. 9526-E

PACE
Advanced Water Engineering

FIGURE

XVI-2e



TITLE
RAINFALL ZONES

JOB
ORANGE COUNTY
TECHNICAL GUIDANCE
DOCUMENT

ORANGE CO.
CA

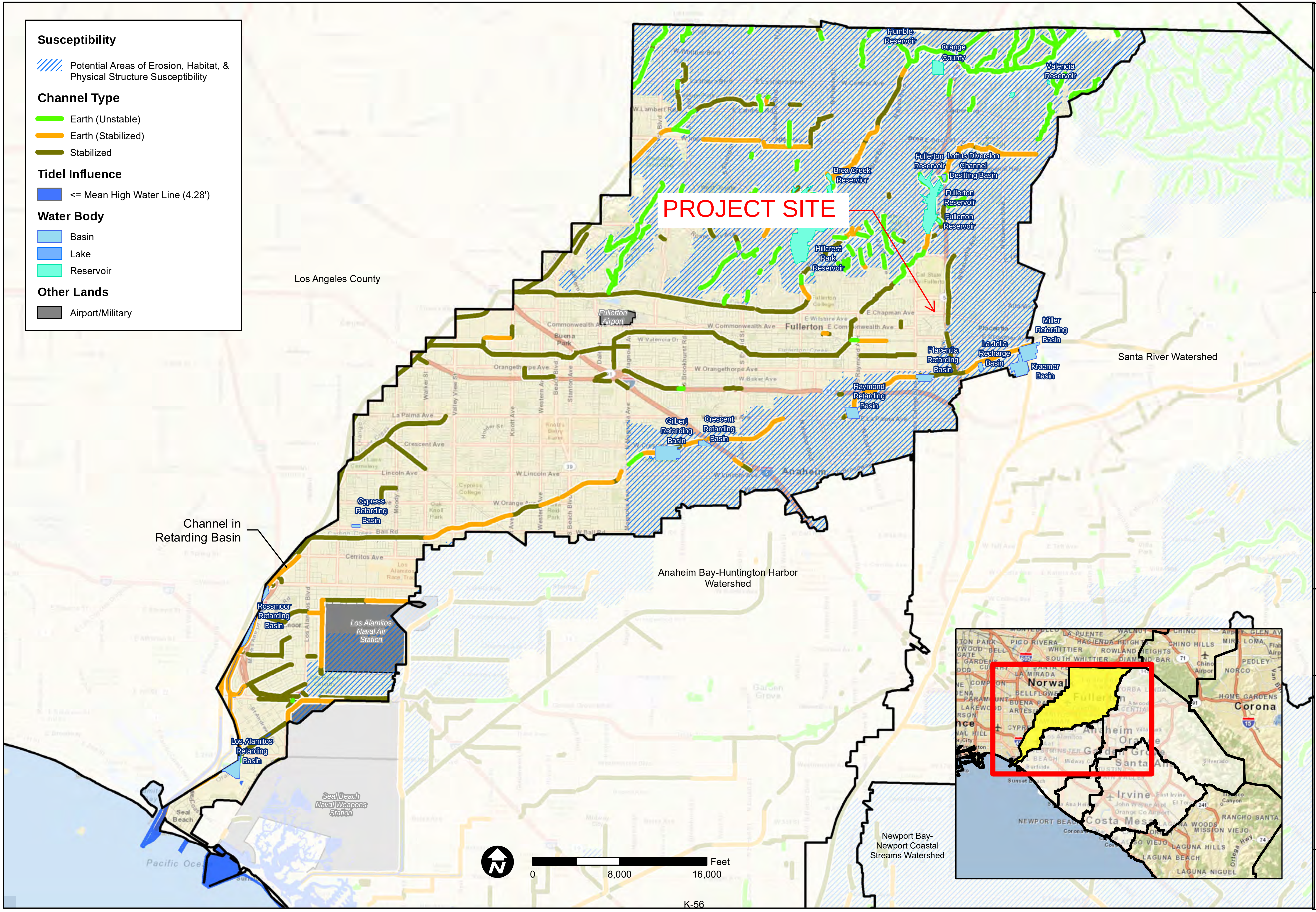
SCALE	1" = 1.8 miles
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	04/22/10
JOB NO.	9526-E

PACE
Advanced Water Engineering

FIGURE
XVI-1

P:\9526E16-GIS\Mxds\Reports\InfiltrationFeasability_20110215\9526E_FigureXVI-1_RainfallZones_20110215.mxd

SUSCEPTIBILITY MAP UPATE (FEB 2013)



K-56

P:\9526E\6-GIS\Mxds\SuceptabilityMaps_20100505\9526E_SanGabrielCoyoteCreekSusceptibility_20100430.mxd

TITLE

SUSCEPTIBILITY ANALYSIS
SAN GABRIEL-COYOTE CREEK

CA

JOB

ORANGE COUNTY
WATERSHED
MASTER PLANNING

ORANGE CO.

SCALE	1" = 8000'
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	04/30/10
JOB NO.	9526-E

PACE
Advanced Water Engineering

1

ATTACHMENT C

GEOTECHNICAL REPORT

NTS GEOTECHNICAL

October 2, 2020

DRAFT

Project No. 20073

Mr. Rob Bak
Core Spaces
1643 N Milwaukee Ave, 5th Floor
Chicago, IL 60647

Subject: Preliminary Geotechnical Engineering Report
The Hub at Fullerton
2601 to 2751 Chapman Avenue, Fullerton, California

Dear Mr. Bak:

In accordance with your request and authorization, we are presenting the results of our geotechnical investigation for the proposed The Hub at Fullerton project located at 2601 to 2751 Chapman Avenue, in the City of Fullerton, California. The purpose of this investigation has been to evaluate the subsurface conditions at the site and to provide geotechnical engineering recommendations for the proposed construction.

Based on our findings, the proposed project is geotechnically feasible, provided that the recommendations in this report are incorporated into the design and are implemented during construction of the project. This report was prepared in accordance with the requirements of the 2019 California Building Code and the City of Fullerton requirements.

We appreciate the opportunity to be of service on this project. Should you have any questions regarding this report or if we can be of further service, please do not hesitate to contact the undersigned at (657) 888-4608 or info@ntsgeo.com.

Respectfully submitted,
NTS GEOTECHNICAL, INC.

Nadim Sunna, M.Sc., Q.S.P, P.E.
Principal Engineer

Table of Contents

Attachment(s):

Plate 1 – Location Map
Plate 2 – Geotechnical Map

Appendix A – Field Exploration
Appendix B – Geotechnical Laboratory Test Result
Appendix C – Liquefaction Analysis
Appendix D – Infiltration Test Result

INTRODUCTION

This report presents the results of our geotechnical engineering evaluation performed for the proposed The Hub at Fullerton project located at 2601 Chapman Avenue, in the City of Fullerton, California. See (Plate 1, Location Map). The purpose of this study has been to evaluate the subsurface conditions at the site and to provide geotechnical recommendations related to the design and construction of the proposed structure.

SITE AND PROJECT DESCRIPTION

The project site is located at 2601 Chapman Avenue in the City of Fullerton, California, and it is bound by an existing apartment complex on the north, existing commercial property on the east, Commonwealth Avenue on the west, and Chapman Avenue on the south. The property currently consists of existing two-story office buildings, asphalt-concrete parking lot, planters and trees, and existing flatwork.

It is our understanding that the proposed project consists of the development of a 6-story residential homes and 5-story parking structure. Based on our review of preliminary conceptual design plans, we understand that the structures are planned to be constructed at-grade.

Based on our correspondence with DCI Engineers, the project structural engineers, we understand that the buildings foundations may experience the following preliminary structural loads:

Preliminary Structural Loads

Maximum Column Loads	Dead: 282 kips Live: 89 kips

We have performed our settlement analysis utilizing these preliminary loads. If the actual loads are greater than what was assumed herein, this office should be contacted for additional evaluation.

SCOPE OF WORK

As part of the preparation of this report, we have performed the following tasks:

Background Review

We reviewed readily available background data including in-house geophysical data, geologic maps, topographic maps, and aerial photographs relevant to the subject site in preparation of this report.

Field Exploration

The subsurface conditions were evaluated on April 2, 3 and August 25, 2020 by advancing nine (9) eight-inch diameter, hollow-stem-auger borings and five (5) Cone Penetration Testing (CPT) soundings at various locations across the subject site. The borings were advanced to depths ranging from 5 and 61.5 feet below the existing grade. The CPTs were pushed a maximum depth of 50 feet below the existing grade. The approximate locations of the borings are shown on Figure 2, Geotechnical Map. Detailed exploration information of soils borings is presented in Appendix A, Field Exploration.

Geotechnical Laboratory Testing

Laboratory tests were performed on selected samples obtained from the boring in order to aid in the soil classification and to evaluate the engineering properties of the foundation soils. NTS Geotechnical, Inc. has reviewed the laboratory test results performed by Hushmand and Associates, Inc. and accepts the results for use in our analysis. The following tests were performed in general accordance with ASTM standards:

- In-situ moisture and density;
- #200 sieve wash;
- Direct shear;
- Consolidation;
- Corrosion; and
- R-Value.

A summary of the laboratory test results are presented in Appendix B of this report.

GEOLOGIC FINDINGS

Regional Geologic Setting

According to the Quaternary Geologic Map of the Anaheim and Newport Beach 7.5-Minute Quadrangle, the project site is underlain by younger alluvial fan deposits (Qyf) that are typically comprised of sands, clays, silts and gravel.

Subsurface Materials

Earth materials encountered during our subsurface investigation consisted of approximately 2 to 5 feet of artificial fill (Af) overlaying the young alluvial fan deposits (Qyf) extending to the total depth of exploration. In general, the artificial fill consists of slightly moist, loose to medium dense, silty sand and clayey sands.

The alluvial fan deposits (Qyf) consisted of moist to very moist, very loose to medium dense to dense clayey sand and sands, and, firm to very stiff, clays and silts. The upper approximately 14 feet of the site soils consist of very loose to loose sandy soils that are collapsible and compressible.

Groundwater

Groundwater was not observed during our exploration to a maximum depth of 61.5 feet below the existing grade. The historical high depth to groundwater is reportedly deeper than 70 feet below the existing grade at the project site (CDMG 1997). Groundwater conditions may vary across the site due to stratigraphic and hydrologic conditions, and may change over time as a consequence of seasonal and meteorological fluctuations, or activities by humans at this site and nearby sites. However, based on the above findings, groundwater is unlikely to impact the proposed development.

GEOLOGIC HAZARDS

Faulting and Seismicity

The site is not located within an Alquist-Priolo Earthquake Fault Zone, and no known active faults are shown on the reviewed geologic maps crossing the site, however, the site is located in the seismically active region of Southern California. The nearest known active faults are the Puente Hills and Elsinore fault systems, which are located approximately 0.9 and 4.1 miles from the site, respectively.

Given the proximity of the site to these and numerous other active and potentially active faults, the site will likely be subject to earthquake ground motions in the future. A site PGAM of 0.78g was calculated for the site in conformance with the 2019 CBC. This PGAM is primarily dominated by earthquakes with a mean magnitude of 6.7 at a mean distance of 7 miles from the site using the USGS 2014 Interactive Deaggregation website.

Liquefaction and Seismic Settlement

Liquefaction occurs when the pore pressures generated within a soil mass approach the effective overburden pressure. Liquefaction of soils may be caused by cyclic loading such as that imposed by ground shaking during earthquakes. The increase in pore pressure results in a loss of strength, and the soil then can undergo both horizontal and vertical movements, depending on the site conditions. Other phenomena associated with soil liquefaction include sand boils, ground oscillation, and loss of foundation bearing capacity. Liquefaction is generally known to occur in loose, saturated, relatively clean, fine-grained cohesionless soils at depths shallower than approximately 50 feet. Factors to consider in the evaluation of soil liquefaction potential include groundwater conditions, soil type, grain size distribution, relative density, degree of saturation, and both the intensity and duration of ground motion.

Based on our review of the State of California Official Map of Seismic Hazard Zones for the Anaheim and Newport Beach Quadrangle (California Department of Conservation, Division of Mines and Geology, 1997), the site is not located within a zone of required investigation for Liquefaction. Based on the lack of shallow groundwater, the presence of extensive amount of fine-grained soil, the relatively uniform soil stratum across the site, and our liquefaction analysis as presented in Appendix C of this report, it is our professional opinion that the liquefaction potential at the site is very low.

Seismically-induced dry sand settlement is the ground settlement due to densification of loose, dry cohesionless soils during strong earthquake shaking. Based on our liquefaction analysis, we estimate that seismic settlement on the order 2 inches with a differential of 1 inch over a span of 40 feet may occur during seismic shaking.

Landslides

Based on our review of the referenced geologic maps, literature, topographic maps, aerial photographs, and our subsurface evaluation, no landslides or related features underlie or are adjacent to the subject site. Due to the relatively level nature of the site and surrounding areas, the potential for landslides at the project site is considered negligible.

Flooding

The Federal Emergency Management Agency (FEMA) has prepared flood insurance rate maps (FIRMs) for use in administering the National Flood Insurance Program. Based on our review of the FEMA flood map, the site is located in an Area of Minimal Flood Hazard (Zone X). The potential for flooding to impact the proposed development is considered low.

Tsunami and Seiches

Tsunamis are waves generated by massive landslides near or under sea water. The site is not located on any State of California – County of Orange Tsunami Inundation Map for Emergency Planning. The potential for the site to be adversely impacted by earthquake-induced tsunamis is considered to be negligible because the site is located several miles inland from the Pacific Ocean shore, at an elevation exceeding the maximum height of potential tsunami inundation.

Seiches are standing wave oscillations of an enclosed water body after the original driving force has dissipated. The potential for the site to be adversely impacted by earthquake-induced seiches is considered to be negligible due to the lack of any significant enclosed bodies of water located in the vicinity of the site.

GEOTECHNICAL ENGINEERING FINDINGS

Expansive Soil

Based on our evaluation and experience with similar material types, and laboratory testing, the soils encountered near the ground surface at the site exhibit a very low to low expansion potential, however, the clay soils encountered at the bottom of the basement level is anticipated to exhibit a medium expansion potential.

Corrosive Soil

Based on laboratory test results performed for pH, soluble chlorides, sulfate, and minimum resistivity, the on-site soils should be considered to have the following:

- A negligible sulfate exposure to concrete per ACI 318-14, Table 19.3.1.1
- A high minimum resistivity indicating conditions that are mildly corrosive to ferrous metals.
- A low chloride content (potentially corrosive).

Metal structures which will be in direct contact with the soil (i.e., underground metal conduits, pipelines, metal sign posts, etc.) and/or in close proximity to the soil (wrought iron fencing, etc.) may be subject to corrosion. The use of special coatings or cathodic protection around buried metal structures has been shown to be beneficial in reducing corrosion potential. Corrosion of ferrous metal reinforcing elements in structural concrete should be reduced by increasing the thickness of concrete cover and the use of the recommended maximum water/cement ratio for concrete.

The laboratory testing program does not address the potential for corrosion to copper piping. In this regard, a corrosion engineer should be consulted to perform more detailed testing and develop appropriate mitigation measures (if necessary). The above discussion is provided for general guidance in regards to the corrosiveness of the on-site soils to typical metal structures used for construction. Detailed corrosion testing and recommendations for protecting buried ferrous metal and/or copper elements are beyond our purview. If detailed recommendations are required, a corrosion engineer should be consulted to develop appropriate mitigation measures.

Preliminary Infiltration Testing

Two (2) preliminary infiltration tests were performed in general conformance with the County of Orange Technical Guidance Document (TGD). The borings are shown on the attached Plate 2 – Geotechnical Map, were excavated to depths of from approximately 10 feet below the existing grade using a hollow-stem-auger drill rig. The calculated unfactored raw observed infiltration rates are presented in the following table:

Unfactored Raw Infiltration Rates Summary

Boring No.	Depth Below Finish Grade (feet)	Unfactored Raw Observed Infiltration Rates (inches/hour) *
P-1	10.0	0.12
P-2	10.0	0.19

**Rates do not incorporate a factor of safety.*

The results of the infiltration testing indicate that the unfactored raw observed infiltration rates within the southern side of the development range from 0.12 to 0.19 inches per hour, with an average unfactored infiltration of 0.16 inches per hour. Thus, we conclude for the entire site that infiltration rates do not meet the minimum requirement of 0.3 inch/hour when a minimum factor of safety of 2 is applied per the County of Orange TGD manual. The results of the infiltration testing are contained in Appendix D of this report.

Excavation Characteristics

The majority of the soil materials underlying the site can be excavated with excavators and other conventional grading equipment.

GEOTECHNICAL ENGINEERING CONLUSIONS AND RECOMMENDATIONS

Conclusions

Based on the results of our field exploration and engineering analyses, it is our opinion that the proposed development is feasible from a geotechnical standpoint, provided that the recommendations in this report are incorporated into the design plans and are implemented during construction.

Based on the geologic and geotechnical findings, the following is a summary of our conclusions:

- The proposed structures may be supported on one of the following:
  - Shallow spread footings underlain by 12 feet of engineered fill.
  - Shallow spread footings supported by Geopier or equivalent gravel piers.
  - A mat foundation system underlain by engineered fill.

- Groundwater is not anticipated to directly impact the planned precise grading or during the installation of shallow underground utilities.
- There are no known active faults crossing the subject site. The site seismicity is typical for the Fullerton area. Structure design should be in accordance with the current 2019 CBC.
- The magnitude of total seismic settlement beneath the structure that is supported by spread footing is on the order of 2.0 inches with differential settlement of approximately 1 inch over a span of 40 feet.
- The magnitude of total seismic settlement beneath the structure that is supported by a mat foundation is on the order of 2.5 inches with differential settlement of approximately 1.5 inches over a span of 40 feet.
- The magnitude of total static settlements beneath the structure is expected to be less than 1.5 inches for a mat foundation or 1 inch for spread footings supported on engineered fill or rammed aggregate piers.
- The on-site soils are mildly corrosive to ferrous metals and have a negligible sulfate exposure to concrete (i.e., as defined by the CBC) and reinforcement.
- Based on preliminary infiltration testing and calculated infiltration rates, infiltration of storm water into the site soils is deemed not feasible.

Our geotechnical engineering analyses performed for this report were based on the earth materials encountered during the subsurface exploration for the site. If the design substantially changes, then our geotechnical engineering recommendations would be subject to revision based on our evaluation of the changes. The following sections present our conclusions and recommendations pertaining to the engineering design for this project.

Site Preparation

Site preparation should begin with the removal of utility lines, asphalt, concrete, vegetation, and other deleterious debris from areas to be graded. Tree stumps and roots should be removed to such a depth that organic material is generally not present. Clearing and grubbing should extend to the outside edges of the proposed excavation and fill areas. We recommend that unsuitable materials such as organic matter or oversized material be selectively removed and disposed offsite. The debris and unsuitable material generated during clearing and grubbing should be removed from areas to be graded and disposed at a legal dump site away from the project area.

Corrective Grading

Corrective grading will serve to create a firm and workable platform for construction of the proposed development, and exterior improvements. Due to the presence of compressible/collapsible soil, we recommend corrective grading be performed in order to densify the site soils within the building pads and site improvements. The depth of corrective grading based on each type of foundation system and site improvements are provided below.

It should be noted that the recommendations provided herein are based on our subsurface exploration and knowledge of the on-site geology. Actual removals may vary in configuration and volume based on observations of geologic materials and conditions encountered during grading. The bottom of all corrective grading removals should be observed by a representative of NTS to verify the suitability of in-place soil prior to performing scarification and recompaction. Corrective grading recommendations are outlined below.

Structures Supported on Spread Footings and Engineered Fill

In order to create a firm and stable platform on which to construct the new building foundations that supported directly on engineered fill and without ground improvement, we recommend the following:

- The building pads should be excavated to a depth of at least 12 feet below the bottom of the foundation.
- The bottom of the over excavation should then be scarified to a depth of at least 8 inches, moisture conditioned to 2 percent above optimum moisture content and recompacted to at least 90 percent relative compaction as determined in accordance with ASTM D1557.
- Following the approval of the over-excavation bottom by a representative of NTS, the onsite material may be used as fill material to achieve the planned pad grade.

- The fill material should then be placed in 6- to- 8-inch-thick lifts, moisture conditioned to 2 percent above optimum moisture content and compacted to achieve 90 percent relative compaction.

Structures Supported on Mat Foundation

For buildings that are planned to be supported on a mat foundation system, we recommend the following:

- The building pads should be excavated to a depth of at least 4 feet below the bottom of the mat foundation.
- The bottom of the over excavation should then be scarified to a depth of at least 8 inches, moisture conditioned to 2 percent above optimum moisture content and recompacted to at least 90 percent relative compaction as determined in accordance with ASTM D1557.
- Following the approval of the over-excavation bottom by a representative of NTS, the onsite material may be used as fill material to achieve the planned pad grade.
- The fill material should then be placed in 6- to- 8-inch-thick lifts, moisture conditioned to 2 percent above optimum moisture content and compacted to achieve 90 percent relative compaction.

Structures Supported on Spread Footings and Geopiers or Equivalent Gravel Piers

For buildings that are planned to be supported on a spread footing and Geopiers or equivalent gravel piers system, we recommend the following:

- The building pads should be excavated to a depth of at least 5 feet from finish pad grade and recompacted prior to installation of the Geopiers or equivalent gravel piers to provide support for the slab-on-grade.
- The bottom of the over excavation should then be scarified to a depth of at least 8 inches, moisture conditioned to 2 percent above optimum moisture content and recompacted to at least 90 percent relative compaction as determined in accordance with ASTM D1557.
- Following the approval of the over-excavation bottom by a representative of NTS, the onsite material may be used as fill material to achieve the planned pad grade.
- The fill material should then be placed in 6- to- 8-inch-thick lifts, moisture conditioned to 2 percent above optimum moisture content and compacted to achieve 90 percent relative compaction.

Pavement / Hardscape

In order to create a firm and stable platform on which to construct the new vehicular pavement and non-vehicular hardscape, we recommend the following:

- The proposed pavement / hardscape should be excavated to the planned subgrade (i.e., bottom of aggregate base for pavement and bottom of concrete for flatwork).
- The bottom of the excavation should then be excavated to a depth of 12 inches below the planned subgrade.
- The bottom of the over excavation should then be scarified to a depth of at least 6 inches, moisture conditioned to 2 percent above optimum moisture content and recompacted to at least 90 percent relative compaction as determined in accordance with ASTM D1557.
- Following the approval of the over-excavation bottom by a representative of NTS, the onsite material may be used as fill material to achieve the planned pad grade.
- The fill material should then be placed in 6- to- 8-inch-thick lifts, moisture conditioned to 2 percent above optimum moisture content and compacted to achieve 90 percent relative compaction.

If the existing loose fill materials are found to be disturbed to depths greater than the proposed remedial grading, then the depth of over-excavation and re-compaction should be increased accordingly in local areas as recommended by a representative of NTS.

Materials for Fill

On-site soils with an organic content of less than 3 percent by volume (or 1 percent by weight) are suitable for use as fill. Soil material to be used as fill should not contain contaminated materials, rocks, or lumps over 6 inches in largest dimension, and not more than 40 percent larger than ¾ inch. Utility trench backfill material should not contain rocks or lumps over 3 inches in largest dimension. Larger chunks, if generated during excavation, may be broken into acceptably sized pieces or may be disposed offsite.

Any imported fill material should consist of granular soil having a “very low” expansion potential (that is, expansion index of 20 or less). Import material should also have low corrosion potential (that is, chloride content less than 500 parts per million [ppm], soluble sulfate content of less than 0.1 percent, and pH of 5.5 or higher). Materials to be used as fill should be evaluated by a representative of NTS prior to importing or filling.

Compacted Fill

Prior to placement of compacted fill, the contractor should request an evaluation of the exposed excavation bottom by NTS. Unless otherwise recommended, the exposed ground surface should then be scarified to a depth of at least 8 inches and watered or dried, as needed, to achieve generally consistent moisture contents approximately 2 percent above the optimum moisture content. The scarified materials should then be compacted to 90 percent relative compaction in accordance with the latest version of ASTM Test Method D1557.

Compacted fill should be placed in horizontal lifts of approximately 6 to 8 inches in loose thickness. Prior to compaction, each lift should be watered or dried as needed to achieve near optimum moisture condition, mixed, and then compacted by mechanical methods, using sheepsfoot rollers, multiple-wheel pneumatic-tired rollers, or other appropriate compacting rollers, to a relative compaction of 95 percent as evaluated by ASTM D1557. Successive lifts should be treated in a like manner until the desired finished grades are achieved. Within pavement areas, the upper 12 inches of subgrade soil should be compacted to 95 percent relative compaction evaluated by ASTM D1557.

Personnel from NTS should observe the excavations so that any necessary modifications based on variations in the encountered soil conditions can be made. All applicable safety requirements and regulations, including CalOSHA requirements, should be met.

Excavation Bottom Stability

Based on our subsurface investigation we anticipate that the bottom of the excavation may expose localized areas of saturated clay material. If encountered and schedule does not allow for drying of the material, unstable bottom conditions may be mitigated by overexcavation of the bottom to suitable depths, and/or replacement with a minimum 2-foot-thick aggregate base, or other options may be recommended based on the field evaluation. Recommendations for stabilizing excavation bottoms should be based on evaluation in the field by NTS at the time of construction.

Temporary Excavations

Temporary excavations for the demolishing, earthwork, footing and utility trench are expected. We anticipate that unsurcharged excavations with vertical side slopes less than 3 feet high will generally be stable; however, sloughing of cohesionless sandy materials encountered at the site should be expected.

Where the space is available, temporary, unsurcharged excavation sides over 3 feet in height should be sloped no steeper than an inclination of 1.5H:1V (horizontal:vertical). Where sloped excavations are created, the tops of the slopes should be barricaded so that vehicles and storage loads do not encroach within 10 feet of the top of the excavated slopes. A greater setback may be necessary when considering heavy vehicles, such as concrete trucks and cranes. NTS should be advised of such heavy vehicle loadings so that specific setback requirements can be established. If the temporary construction slopes are to be maintained during the rainy season, berms are recommended to be graded along the tops of the slopes in order to prevent runoff water from entering the excavation and eroding the slope faces.

Where space for sloped excavations is not available, temporary shoring may be utilized. Geotechnical recommendations for the design and construction of temporary shoring are presented in the “Temporary Shoring” section of this report. Personnel from NTS should observe the excavation so that any necessary modifications based on variations in the encountered soil conditions can be made. All applicable safety requirements and regulations, including CalOSHA requirements, should be met.

Excavations shall not undermine the existing adjacent building footings. Where space for sloped excavations is not available, temporary shoring may be utilized.

Temporary Shoring

Temporary shoring is anticipated to be placed along the perimeter of the proposed site. Based on the depth of excavation depending on the foundation system selected, we anticipate excavation on the order of 15 feet deep.

Where excavations exceed 15 feet or are surcharged, restrained shoring may be necessary to limit deflections and disruption to nearby improvements. The size of the steel beam, the need for lateral bracing, and the acceptable shoring deflection should be determined by the project shoring engineer.

The shoring design should be provided by a California Registered Civil Engineer experienced in the design and construction of shoring under similar conditions. Once the final excavation and shoring plans are complete, the plans and the design should be reviewed by NTS for conformance with the design intent and recommendations. Further, the shoring system should satisfy applicable requirements of CalOSHA.

Lateral Earth Pressures

For design of cantilevered shoring, a triangular distribution of lateral earth pressure may be used. It may be assumed that the drained soils, with a level surface behind the cantilevered shoring, will exert an active equivalent fluid pressure of 40 pcf.

Any surcharge (live, including traffic, or dead load) located within 1:1 plane projected upward from the base of the shored excavation, including adjacent structures, should be added to the lateral earth pressures. The lateral contribution of a uniform surcharge load located immediately behind the temporary shoring may be calculated by multiplying the vertical surcharge pressure by 0.30. Lateral load contributions of surcharges located at a distance behind the shored wall may be provided once the load configurations and layouts are known. As a minimum, a 250 psf vertical uniform surcharge is recommended to account for nominal construction and/or traffic loads. More detailed lateral pressure and loading information can be provided, if needed, for specific loading scenarios as recognized through the design process.

Soldier Pile Design

The design embedment of the shoring pile toes must be maintained during excavation activities. The toes of the perimeter shoring piles should be deepened to take into account any required excavations necessary for foundations grading, installation, or drainage systems.

Drilled cast-in-place soldier piles should be placed no closer than 2.5 diameters on center. The minimum diameter of the piles should be 24 inches. Structural concrete should be used for the soldier piles below the excavations; lean-mix concrete may be employed above that level. As an alternative, lean-mix concrete may be used throughout the pile where the reinforcing consists of a wideflange section. The lean-mix must be sufficient strength to impart the lateral bearing pressured developed by the wideflange section to the earth materials.

For design purposes, an allowable passive resistance value for the earth materials below the bottom of the excavation may be assumed to be 300 pounds per square foot per foot. To develop the full lateral value, provisions should be implemented to assure firm contact between the soldier piles and the undisturbed earth materials.

The frictional resistance between the solider piles and retained earth material may be used to resist the vertical component of the anchor load. The coefficient of friction may be taken as 0.30 based on uniform contact between the steel beam and lean-mix concrete and retained earth. The portion of the soldier piles below the place of excavation may also be employed to resist the downward loads. The downward capacity may be determined using a frictional resistance of 340 pounds per square foot. Final embedment of shoring pile below the bottom of the excavation should be determined by the project shoring engineer.

Drilling of the soldier pile shafts can be accomplished using conventional drilling equipment. Additionally, caving should be anticipated within the upper approximately 15 feet below the existing grade, where layers of loose to medium dense sand was encountered during our drilling program. In the event of soil caving, it may be necessary to use casing and/or drilling mud to permit the installation of the soldier piles. Drilled holes for soldier piles should not be left open overnight. Concrete for piles should be placed immediately after the drilling of the hole is complete. The concrete should be pumped to the bottom of the drilled shaft using a tremie. Once concrete pumping is initiated, the bottom of the tremie should remain below the surface of the concrete to prevent contamination of the concrete by soil inclusions. If steel casing is used, the casing should be removed as the concrete is placed.

Lagging

Lagging should be designed for the full design pressure, but be limited to a maximum of 400 psf. NTS representative should observe the installation of lagging to insure uniform support of the excavated embankment. In addition, backfill behind the lagging should consist of a 2 sack, sand-cement slurry, and should be placed immediately once the lagging is installed.

Monitoring

In conjunction with the shoring installation, a monitoring program should be set up and carried out by the contractor to determine the effects of the construction on adjacent buildings and other improvements such as streets, sidewalks, utilities and parking areas. At minimum, we recommend the following:

- Horizontal and vertical surveying of reference points on the shoring and on adjacent streets and buildings, in addition to an initial pre-construction photographic, video and/or survey of adjacent improvements.
- All supported and/or sensitive utilities should be located and monitored by the contractor.
- Reference points should be set up and read prior to the start of construction activities.
- Points should also be set on the shoring as soon as initial installations are made.
- Alternatively, inclinometers could be installed by the contractor at critical locations for a more detailed monitoring of shoring deflections.
- Surveys should be made at least once a week, and more frequently during critical construction activities, or if significant deflections are noted.

Seismic Design

Based on the average standard penetration resistance (N-value) of the upper 100 feet of subsurface soils, the site is designated as Site Class D (“stiff” soil profile). The seismic design parameters based on ASCE 7-16 and 2019 CBC are listed in the following table.

2019 CBC and ASCE 7-16 Seismic Design Parameters

Seismic Item	Design Value	2016 ASCE 7-16 or 2019 CBC Reference
Site Class based on soil profile (ASCE 7-16 Table 20.3-1)	D[(a)]	ASCE 7-16 Table 20.3-1
Short Period Spectral Acceleration S_s	1.661[(a)]	CBC Figures 1613.2.1 (1-8)
1-sec. Period Spectral Acceleration S_1	0.585[(a)]	CBC Figures 1613.2.1 (1-8)
Site Coefficient F_a (2019 CBC Table 1613.2.3(1))	1.000[(a)]	CBC Table 1613.2.3 (1)
Site Coefficient F_v (2019 CBC Table 1613.2.3(2))	1.715[(b)]	CBC Table 1613.2.3 (2)
Short Period MCE* Spectral Acceleration S_{MS} $S_{MS} = F_a S_s$	1.661[(a)]	CBC Equation 16-36
1-sec. Period MCE Spectral Acceleration S_{M1} $S_{M1} = F_v S_1$	1.003[(b)]	CBC Equation 16-37
Short Period Design Spectral Acceleration S_{DS} $S_{DS} = 2/3S_{MS}$	1.107[(a)]	CBC Equation 16-38
1-sec. Period Design Spectral Acceleration S_{D1} $S_{D1} = 2/3S_{M1}$	0.669[(b)]	CBC Equation 16-39
Short Period Transition Period T_S (sec) $T_S = S_{D1}/S_{DS}$	0.604[(b)]	ASCE 7-16 Section 11.4.6
Long Period Transition Period Tl (sec)	8[(b)]	ASCE 7-16 Figures 22-14 to 22-17
MCE[(c)] Peak Ground Acceleration (PGA)	0.712[(a)]	ASCE 7-16 Figures 22-9 to 22-13
Site Coefficient F_{PGA} (ASCE 7-16 Table 11.8-1)	1.100[(a)]	ASCE 7-16 Table 11.8-1
Modified MCE[(c)] Peak Ground Acceleration (PGA_M)	0.783[(a)]	ASCE 7-16 Equation 11.8-1

(a) Design Values Obtained from USGS Earthquake Hazards Program website that are based on the ASCE-7-16 and 2019 CBC and site coordinates of N33.8744° and W117.8835°.

(b) Design Values Determined per ASCE Table 11.4-2 and CBC Equations 16-36 through 16-39.

(c) MCE: Maximum Considered Earthquake.

Since the Site Class is designated as D and the S1 value is greater than or equal to 0.2, the 2019 CBC requires either a site-specific seismic hazard analysis per Section 21.2 of ASCE 7-16 or the application of Exception 2 of Section 11.4.8 of ASCE 7-16. The project structural engineer should apply all requirements of Section 11.4.8 of ASCE 7-16 to determine if increases to the seismic response coefficient (i.e. increases to the loading of the structure) are required. If increases are required, a site-specific seismic hazard analysis may result in decreased loading and possible cost savings. Please contact NTS if a site-specific seismic hazard analysis is desired.

Per the 2019 CBC and ASCE 7-16, the Design Earthquake peak ground acceleration (PGAD) may be assumed to be equivalent to SDS/2.5; therefore, for the subject site, a PGAD value of 0.44g (1.107/2.5) should be used.

It should be recognized that much of southern California is subject to some level of damaging ground shaking as a result of movement along the major active (and potentially active) fault zones that characterize this region. Design utilizing the 2019 CBC is not meant to completely protect against damage or loss of function. Therefore, the preceding parameters should be considered as minimum design criteria.

Spread Footings on Engineering Fill Design and Construction

A spread/continuous foundation system may be used to support the proposed buildings, provided that the Corrective Grading recommendations are performed and structure can accommodate for the estimate settlement provided below. The spread/continuous footings may be designed using the following recommendations:

Bearing Material	▪ Engineered Fill ▪ 12 feet of compacted fill below bottom of footings
Minimum Footing Dimension	▪ A minimum footing with of 24 inches and footing depth of 24 inches.
Allowable Bearing Capacity	▪ Based on the minimum footing dimension above, an allowable bearing capacity of 2,500 psf may be used. This value may be increased by 100 or each additional footing width, and 400 for each additional footing depth to a maximum allowable of 3,000 psf. ▪ The above value may be increased by 1/3 for temporary loads such as wind or earthquake.
Static Settlement	▪ Total static settlement of 1 inch with differential settlement estimated to be approximately ½ inch over a span of 40 feet.
Seismic Settlement	▪ Total seismic settlement of 2.0 inches with differential settlement of 1.0 inch over a span of 40 feet.
Allowable Lateral Passive Resistance*	• 300 pcf (equivalent fluid pressure)
Allowable Coefficient of Friction *	• 0.35

*These values may be combined without reduction and may be increased by 1/3 for temporary loads such as wind or seismic.

Spread Footings on Geopiers or Equivalent Gravel Piers

Based on the site conditions and depth of excavation and recompaction for shallow spread footings as discussed in the previous sections of this report, it is our opinion that Geopiers or equivalent gravel piers supported shallow foundation may be used for support of the structures. This ground improvement will allow for increase in bearing capacity, typically about 5,000 psf, which result in smaller size of shallow foundations based on assumed structural loads. If this option is selected, we recommend that once a generalized foundation plan is developed, we review the applicability of Geopiers or equivalent gravel piers-supported foundations at this site. We note that the final design of this system is provided by specialty contractor and is reviewed by this office.

Mat Foundation Design and Construction

A mat foundation system may be used for support of the proposed buildings, provided that all the footings are placed on engineered fill prepared as described in the "**Corrective Grading**" section of this report. The preliminary design parameters presented below may be used for foundation structural design.

Bearing Material	▪ Engineered Fill ▪ 4 feet of compacted fill below bottom of footings ▪ A moisture vapor retarder consisting of Stegowrap 15 mil or equivalent should be placed.
Minimum Mat Foundation	▪ Based on an estimated building footprint dimension of 160 feet by 405 feet, estimate that the building load distributed uniformly over the mat foundation footprint may induce an approximate uniform pressure of 400 psf for dead plus live load ▪ Assumed minimum mat thickness of 24 inches. ▪ Final mat foundation thickness should be determined by the structural engineer.
Allowable Bearing Capacity	▪ Based on the assumptions above, the mat foundation estimate of an approximate uniform pressure of 400 psf can also be taken as the allowable bearing capacity. ▪ The above value may be increased by 1/3 for temporary loads such as wind or earthquake.

Static Settlement	▪ Total static settlement of 1.5 inches with differential settlement estimated to be approximately ¾ inch over a span of 40 feet.
Seismic Settlement	▪ Total seismic settlement of 2.5 inches with differential settlement of 1.5 inches over a span of 40 feet.
Allowable Lateral Passive Resistance*	• 300 pcf (equivalent fluid pressure)
Allowable Coefficient of Friction *	• 0.35
Modulus of Subgrade Reaction (k)	• 75 pci (static)

*These values may be combined without reduction and may be increased by 1/3 for temporary loads such as wind or seismic.

The mat slab should be designed by the project structural engineer. In addition, in order to finalize the mat foundation recommendations, we recommend that the structural engineer model the mat foundation with all anticipated point loads utilizing the provided Modulus of Subgrade Reaction (k) in this section, and provide this office with the analyses, including bearing pressure and settlement contour under the slab.

Moisture Vapor Retarder

A vapor retarder, such as a 15-mil-thick moisture vapor retarder that meets the requirements of ASTM E1745 Class C (Stego Wrap or equivalent) should be placed directly over the prepared soil subgrade to provide protection against vapor transmission through concrete floor slabs thatare anticipated to receive carpet, tile or other moisture sensitive coverings. The use of moisture vapor retarder should be determined by the project architect. At minimum, the vapor retarder should be installed as follows:

- Per the manufacture's specifications as well as with the applicable recognized installation procedures such as ASTM E1643;
- Joints between the sheets and the openings for utility piping should be lapped and taped. If the barrier is not continuously placed across footings/ribs, the barrier should at minimum be lapped into the side of the footing/rib trenches down to the bottom of the trench; and,
- Punctures in the vapor retarder should be repaired prior to concrete placement.

It should be noted that the moisture retarder is intended only to reduce moisture vapor transmissions from the soil beneath the concrete and is consistent with the current standard of the industry in the building construction in Southern California. It is not intended to provide a "waterproof" or "vapor proof" barrier or reduce vapor transmission from sources above the retarder (i.e., concrete). The evaluation of water vapor from any source and its effect on any aspect of the proposed building space above the slab (i.e., floor covering applicability, mold growth, etc.) is beyond our purview and the scope of this report.

Structural Concrete

Based on Laboratory test results for the site vicinity, the potential of sulfate attack on concrete in contact with the on-site soils is "negligible" based on ACI 318, Table 19.3.1.1. On this basis, we recommend using:

- Type II/V cement with a maximum water to cement ratio of 0.50.

Utilization of the CBC's moderate sulfate level requirements will also serve to reduce the permeability of the concrete and help reduce the potential of water and/or vapor transmission through the concrete. Wet curing of the concrete per ACI Publication 308 is also recommended.

The aforementioned recommendations in regards to concrete are made from a soils perspective only. Final concrete mix design is beyond our purview. All applicable codes, ordinances, regulations, and guidelines should be followed in regard to the designing a durable concrete with respect to the potential for sulfate exposure from the on-site soils and/or changes in the environment.

Drainage Control

The control of surface water is essential to the satisfactory performance of the building and site improvements. Surface water should be controlled so that conditions of uniform moisture are maintained beneath the improvements, even during periods of heavy rainfall. The following recommendations are considered minimal:

- Ponding and areas of low flow gradients should be avoided.
- If bare soil within 5 feet of the structure is not avoidable, then a gradient of 5 percent or more should be provided sloping away from the improvement. Corresponding paved surfaces should be provided with a gradient of at least 1 percent.
- The remainder of the unpaved areas should be provided with a drainage gradient of at least 2 percent.
- Positive drainage devices, such as graded swales, paved ditches, and/or catch basins should be employed to accumulate and to convey water to appropriate discharge points.
- Concrete walks and flatwork should not obstruct the free flow of surface water.

- Brick flatwork should be sealed by mortar or be placed over an impermeable membrane.
- Area drains should be recessed below grade to allow free flow of water into the basin.
- Enclosed raised planters should be sealed at the bottom and provided with an ample flow gradient to a drainage device. Recessed planters and landscaped areas should be provided with area inlet and subsurface drain pipes.
- Planters should not be located adjacent to the structures wherever possible. If planters are to be located adjacent to the structures, the planters should be positively sealed, should incorporate a subdrain, and should be provided with free discharge capacity to a drainage device.
- Planting areas at grade should be provided with positive drainage. Wherever possible, the grade of exposed soil areas should be established above adjacent paved grades. Drainage devices and curbing should be provided to prevent runoff from adjacent pavement or walks into planted areas.
- Gutter and downspout systems should be provided to capture discharge from roof areas. The accumulated roof water should be conveyed to off-site disposal areas by a pipe or concrete swale system.
- Landscape watering should be performed judiciously to preclude either soaking or desiccation of soils. The watering should be such that it just sustains plant growth without excessive watering. Sprinkler systems should be checked.

Utility Trench Backfill Considerations

New utility line pipeline trenches should be backfilled with select bedding materials beneath and around the pipes (pipe zone) and compacted soil above the pipe bedding. Recommendations for the types of the materials to be used and the proper placement of these materials are provided in the following sections.

Pipe Zone (Bedding and Shading)

The pipe bedding and shading materials should extend from at least 6 inches below the pipes to at least 12 inches above the crown of the pipes. Pipe bedding and shading should consist of either clean sand with a sand equivalent (SE) of at least 30, or crushed rock. If crushed rock is used, it should consist of ¾-inch crushed rock that conforms to Table 200-1.2.1 (A) of the 2018 “Greenbook.” Pipe bedding and shading should also meet the minimum requirements of the City of Los Angeles. If the requirements of the City are more stringent, they should take precedence over the geotechnical recommendations. Sufficient laboratory testing should be performed to verify the bedding and shading meets the minimum requirements of the Greenbook and City of Fullerton grading codes.

Based on our subsurface exploration and knowledge of the onsite materials, the soils that will be excavated from the pipeline trenches will not meet the recommendations for pipe bedding and shading materials; therefore, imported materials will be required for pipe bedding and shading.

Granular pipe bedding and shading material should be properly placed in thicknesses not exceeding 3 feet, and then sufficiently flooded or jetted in place. Crushed rock, if used, should be capped with filter fabric (Mirafi 160N, or equivalent; Mirafi 140N filter fabric is suitable if available) to prevent the migration of fines into the rock.

Trench Backfill

All existing soil material within the limits of the site are considered suitable for use as trench backfill above the pipe bedding and shading zone if care is taken to remove all significant organic and other decomposable debris, moisture condition the soil materials as necessary, and separate and selectively place and/or stockpile any inert materials larger than 6 inches in maximum diameter.

Imported soils are not anticipated for backfill since the on-site soils are suitable. However, if imported soils are used, the soils should consist of clean, granular materials with physical and chemical characteristics similar to or better than those described herein for on-site soils. Any imported soils to be used as backfill should be evaluated and approved by NTS prior to placement.

Soils to be used as trench backfill should be moistened, dried, or blended as necessary to achieve a minimum of 2 percent over optimum moisture content, placed in lifts which, prior to compaction shall not exceed the thickness specified in Section 306-12.3 of the 2018 “Greenbook” for various types of equipment, and mechanically compacted/densified to at least 90 percent relative compaction as determined by ASTM Test Method D 1557. Jetting is not permitted in this trench zone.

No rock or broken concrete greater than 6 inches in maximum diameter should be utilized in the trench backfills.

Asphalt Concrete Pavement Design

In accordance with Chapter 600 of the Caltrans Highway Design Manual, we have performed pavement structural design utilizing assumed traffic indices (TI) of 4 and 5.5 and our laboratory R-value test result of 15. Based on our analysis, we have developed the pavement structural sections presented in the following table. We note that the assumed TI’s should be reviewed by a traffic engineer to confirm their applicability to the project.

Minimum Asphalt Concrete Pavement Structural Sections

Location	Traffic Index	Asphalt Concrete (in.)	Aggregate Base (in.)*
Parking Stalls	4.0	3.0	4.0
Driveway	5.5	4.0	8.0

The above design sections will need to be verified based on additional testing performed at the completion of future precise grading of the specific locations.

The planned pavement structural sections should consist of the following:

- Aggregate Base materials (AB) consisted of either Crushed Aggregate Base (CAB) or Crushed Miscellaneous Base (CMB).
- Asphalt Concrete (AC) material of a type meeting the minimum City of Fullerton standards.
- The subgrade soils should be moisture conditioned to a minimum of 2 percent above optimum moisture content to a depth of at least 18 inches and compacted to 90 percent relative compaction.
- The AB and AC should be compacted to at least 95 percent relative compaction.

Exterior Flatwork/Hardscape Design Considerations

For exterior flatwork and hardscape planned as part of the proposed development, the following design may be considered by the project civil engineer. These recommendations may be considered as minimal design based on the soils conditions encountered during our investigation. Final design of the proposed flatwork and hardscape area should be provided by the project civil engineer. Based on the conditions encountered, we recommend that the subgrade for the subject concrete flatwork and hardscape be moisture conditioned to 2 percent over optimum to a depth of 18 inches below finish subgrade elevation and compacted to 90 percent relative compaction. A Type II/V cement may be used from a geotechnical perspective. Our flatwork and hardscape design considerations are presented in the table below.

Concrete Flatwork Table

Description	Subgrade Preparation (1)	Minimum Concrete Thickness	Cut-Off Barrier Or Edge Thickness	Reinforcement(2)	Joint Spacing (Maximum)	Concrete(3)
Concrete Sidewalks and Walkways (4)	1) 2% over optimum to 18"(1), 2) 2" of sand or well graded rock (i.e., Class II base or equiv.) above moisture conditioned subgrade.	4 inches	Not Required	No. 3 bars @ 18"o.c.b.w. and dowel into building and curb using 9-inch Speed Dowels @ 18"o.c (5)	5 feet	Type II/V
Concrete Driveways(4)	1) 2% over optimum to 18"(1), 2) 2" of sand or well graded rock (i.e., Class II base or equiv.) above moisture conditioned subgrade.	8 inches	Where adjacent to landscape areas – 12" from adjacent finish grade. Min. 8" width	1) Slab – No. 3 bars @ 18" o.c. (2) bent into cut-off; 2) where adjacent to curbs use dowels: No. 3 bars @ 18" o.c. (5)	10 feet	Type II/V

(1) The moisture content of the subgrade must be verified by the geotechnical consultant prior to sand/rock placement.
(2) Reinforcement to be placed at or above the mid-point of the slab (i.e., a minimum of 2.0 to 2.5 inches above the prepared subgrade).
(3) The site has negligible levels of sulfates as defined by the CBC. Concrete mix design is outside the geotechnical engineer's purview.
(4) Where flatwork is adjacent a stucco surface, a ¼" to ½" foam separation/expansion joint should be used.
(5) If dowels are placed in cored holes, the core holes shall be placed at alternating in-plane angles (i.e., not cored straight into slab).

Planters and Trees

Where new trees or large shrubs are to be located in close proximity to new concrete flatwork, rigid moisture/root barriers should be placed around the perimeter of the flatwork to at least 12 inches in depth in order to offer protection to the adjacent flatwork against potential root and moisture damage. Existing mature trees near flatwork areas should also incorporate a rigid moisture/root barrier placed at least 2 feet in depth below the top of the flatwork.

Plans and Specifications Review

The recommendations presented in this report are contingent upon review of final plans and specifications for the project by NTS. NTS Geotechnical, Inc. should review and verify in writing the compliance of the final grading plan and the final foundation plans with the recommendations presented in this report.

Construction Observation and Testing

It is recommended that NTS be retained to provide continuous Geotechnical Consulting services during the earthwork operations (i.e., shoring, rough grading, utility trench backfill, subgrade preparation for slabs-on-grade, finish grading, etc.) and foundation installation process. This is to observe compliance with the design concepts, specifications and recommendations and to allow for design changes in the event that subsurface conditions differ from those anticipated during our subsurface investigation.

LIMITATIONS

All parties reviewing or utilizing this report should recognize that the findings, conclusions, and recommendations presented represent the results of our professional geological and geotechnical engineering efforts and judgments. Due to the inexact nature of the state of the art of these professions and the possible occurrence of undetected variables in subsurface conditions, we cannot guarantee that the conditions actually encountered during grading and site construction will be identical to those observed, sampled, and interpreted during our study, or that there are no unknown subsurface conditions which could have an adverse effect on the use of the property. We have exercised a degree of care comparable to the standard of practice presently maintained by other professionals in the fields of geotechnical engineering and engineering geology, and believe that our findings present a reasonably representative description of geotechnical conditions and their probable influence on the grading and use of the property.

Our conclusions and recommendations are based on the assumption that our firm will act as the geotechnical engineer of record during construction and grading of the project to observe the actual conditions exposed, to verify our design concepts and the grading contractor's general compliance with the project geotechnical specifications, and to provide our revised conclusions and recommendations should subsurface conditions differ significantly from those used as the basis for our conclusions and recommendations presented in this report. Since our conclusions and recommendations are based on a limited amount of current and previous geotechnical exploration and analysis, all parties should recognize the need for possible revisions to our conclusions and recommendations during grading of the project.

It should be further noted that the recommendations presented herein are intended solely to minimize the effects of post-construction soil movements. Consequently, minor cracking and/or distortion of all on-site improvements should be anticipated.

This report has not been prepared for the use by other parties or projects other than those named or described herein. This report may not contain sufficient information for other parties or other purposes.

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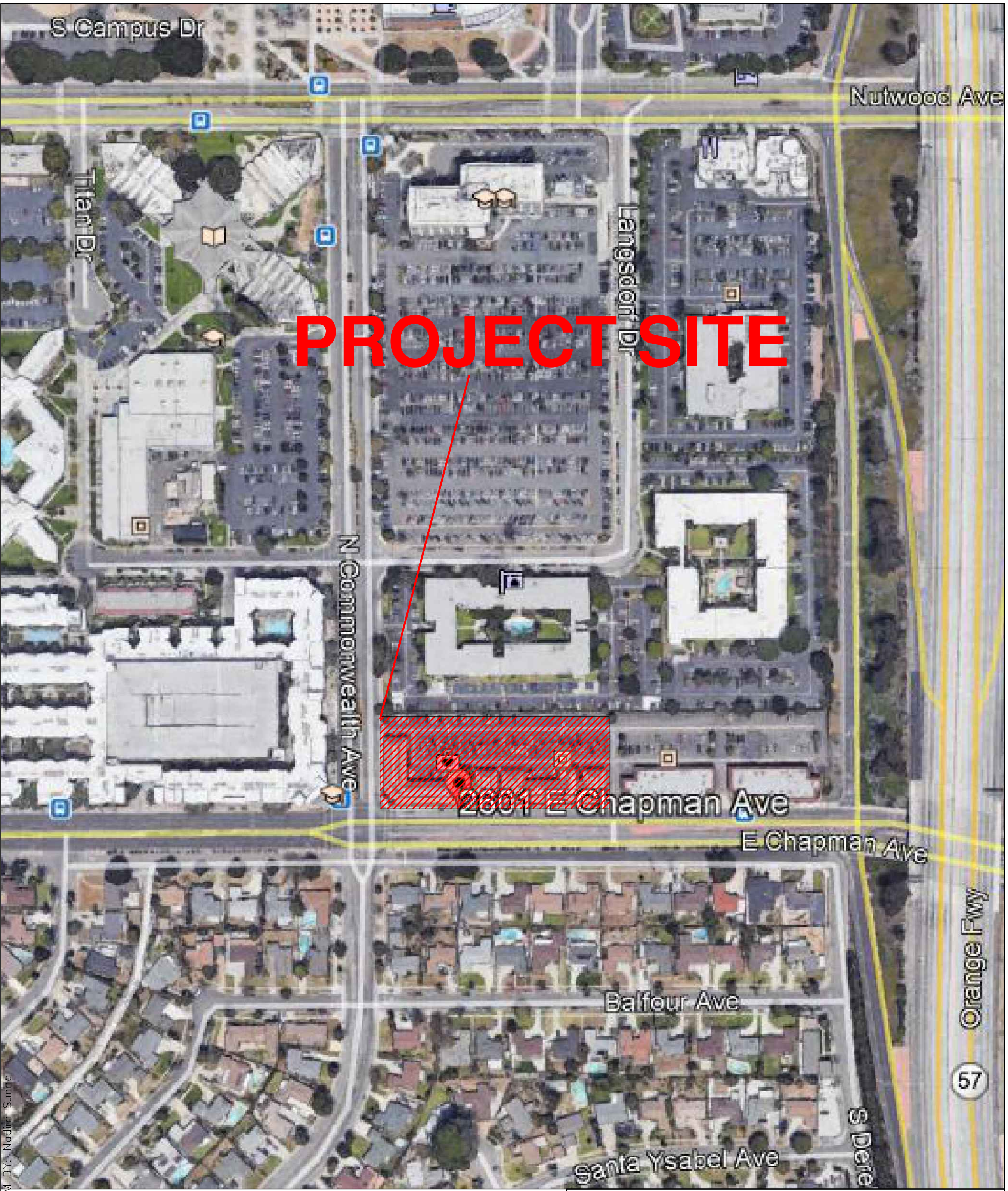

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PLOTTED: 10/2/2020 5:22 PM BY: Nadim Sunna

LOCATION MAP

NTS GEOTECHNICAL

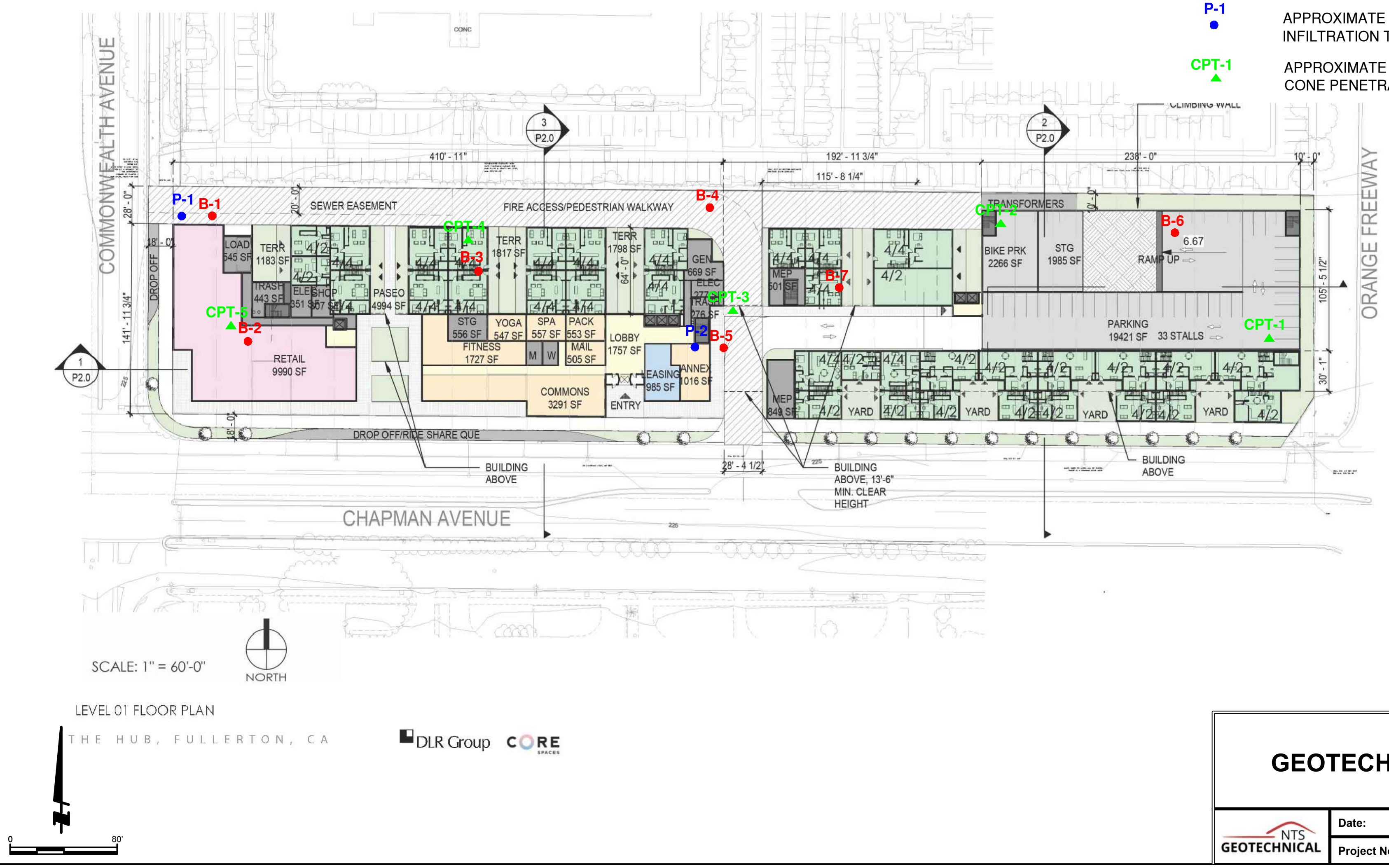
Date: OCTOBER 2, 2020

Project No.: 20073

Plate 1

GEOTECHNICAL LEGEND

B-1 ●	APPROXIMATE LOCATION OF BORING
P-1 ●	APPROXIMATE LOCATION OF INFILTRATION TESTING
CPT-1 ▲	APPROXIMATE LOCATION OF CONE PENETRATION TESTING



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GEOTECHNICAL MAP

NTS GEOTECHNICAL

Date: SEPTEMBER 30, 2020

Project No.: 20073

Plate 2

NTS GEOTECHNICAL

APPENDIX A

Field Exploration

Appendix A
Field Exploration

The subsurface exploration program for the proposed project consisted of advancing seven (7) 8-inch-diameter, hollow-stem-auger drill rig borings and five (5) Cone Penetration Testing (CPT) soundings at the subject site. The borings were advanced to depths ranging from 10 to 61.5 feet below the existing grade and CPT's were advanced to a maximum depth of 50 feet below the existing grade. The CPT logs are presented within Appendix A-1.

The Boring Logs are presented as Figures A-3 to A-11. The Boring Logs describe the earth materials encountered, samples obtained, and show the field and laboratory tests performed. The log also shows the boring number, drilling date, and the name of the logger and drilling subcontractor. The borings were logged by an engineer using the Unified Soil Classification System. The boundaries between soil types shown on the logs are approximate because the transition between different soil layers may be gradual. Drive and bulk samples of representative earth materials were obtained from the borings.

Disturbed samples were obtained using a Standard Penetration Sampler (SPT). This sampler consists of a 2-inch O.D., 1.4-inch I.D. split barrel shaft that is advanced into the soil at the bottom of the drilled hole a total of 18 inches. The number of blows required to drive the sampler 18 inches is presented on the boring logs. Soil samples obtained by the SPT were retained in plastic bags. A California modified sampler was used to obtain drive samples of the soil encountered. This sampler consists of a 3-inch outside diameter (O.D.), 2.4-inch inside diameter (I.D.) split barrel shaft that was driven a total of 12-inches into the soil at the bottom of the boring by a safety hammer weighing 140 pounds at a drop height of approximately 30 inches. The soil was retained in brass rings for laboratory testing. Additional soil from each drive remaining in the cutting shoe was usually discarded after visually classifying the soil. The number of blows required to drive the sampler 18 inches is presented on the boring logs.

Upon completion of the borings, the boreholes were backfilled with soil from the cuttings.

UNIFIED SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)	●	GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
			○	GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)	○	GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
			▨	GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)	⁘	SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
			⋯	SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT 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 NO. 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 OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50	▥	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
			▨	CH	INORGANIC CLAYS OF HIGH PLASTICITY
			≈	OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			⩛	PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

COARSE-GRAINED SOILS | **FINE-GRAINED SOILS**

Relative Density	SPT (blows/ft)	Relative Density (%)	Consistency	SPT (blows/ft)
Very Loose	<4	0 - 15	Very Soft	<2
Loose	4 - 10	15 - 35	Soft	2 - 4
Medium Dense	10 - 30	35 - 65	Medium Stiff	4 - 8
Dense	30 - 50	65 - 85	Stiff	8 - 15
Very Dense	>50	85 - 100	Very Stiff	15 - 30
			Hard	>30

NOTE: SPT blow counts based on 140 lb. hammer falling 30 inches

Sample Symbol	Sample Type	Description
◫	SPT	1.4 in I.D., 2.0 in. O.D. driven sampler
☒	California Modified	2.4 in. I.D., 3.0 in. O.D. driven sampler
⧄	Bulk	Retrieved from soil cuttings
◫	Thin-Walled Tube	Pitcher or Shelby Tube

LABORATORY TESTING ABBREVIATIONS

ATT	Atterberg Limits
C	Consolidation
CORR	Corrosivity Series
DS	Direct Shear
EI	Expansion Index
GS	Grain Size Distribution
K	Permeability
MAX	Moisture/Density (Modified Proctor)
O	Organic Content
RV	Resistance Value
SE	Sand Equivalent
SG	Specific Gravity
TX	Triaxial Compression
UC	Unconfined Compressior

BORING LOGS EXPLANATION

2601 – 2751 Chapman Ave
Fullerton, California

NTS GEOTECHNICAL

FIGURE
A-2

NTS GEOTECHNICAL

SUBSURFACE EXPLORATION LOG
BORING NO. B-1

Project Name:	2601 Chapman Ave	Date:	4/2/2020	Project No.:	20073
				Logged By:	LB
Type of Rig:	Hollow-Stem-Auger	Drive Wt.:	140 lbs	Elevation:	~225 ft. MSL
Drill Hole Dia.:	8"	Drop:	30"	Depth of Boring (ft.):	61.5

Depth (ft.)	Sample Type	No. of Blows per 6"	Soil Classification	Dry Density (lb/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
								ASPHALT CONCRETE / AGGREGATE BASE (~10 inches)
1			SM			Af		**ARTIFICIAL FILL** SILTY SAND, brown, damp to moist, fine-grained sand, loose
2								
3			CL			Qyf		**YOUNG ALLUVIAL FAN DEPOSITS** SANDY CLAY, dark brown, moist, fine-grained sand
4								
5	S	2						
		2						
6		3	ML/SM			Qyf		SANDY SILT TO SILTY SAND, light brown, damp to moist, loose
7								
8								
9								
10	R	4						loose
		4						
11		9	SM			Qyf		light brown, moist, stiff, fine-grained sand, some clay
12								

S - SPT Sample R - Ring Sample B - Bulk Sample D - Disturbed Sample

e A-3 (Sheet 1 of 6)

NTS GEOTECHNICAL

SUBSURFACE EXPLORATION LOG
BORING NO. B-1

				Project No.:	20073
Project Name:	2601 Chapman Ave	Date:	4/2/2020	Logged By:	LB
Type of Rig:	Hollow-Stem-Auger	Drive Wt.:	140 lbs	Elevation:	~225 ft. MSL
Drill Hole Dia.:	8"	Drop:	30"	Depth of Boring (ft.):	61.5

Depth (ft.)	Sample Type	No. of Blows per 6"	Soil Classification	Dry Density (lb/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
13			CL			Qyf		SANDY CLAY, brown, moist to very moist, stif to very stiff
14								
15	S	9	CL			Qyf		stiff
		4						
16		5						
17								
18								
19								
20	R	3	CL	116.2	12.8	Qyf		stiff to very stiff
		6						
21		20						
22								
23								
24								

S - SPT Sample R - Ring Sample B - Bulk Sample D - Disturbed Sample

Figure A-3 (Sheet 2 of 6)

NTS
GEOTECHNICAL

SUBSURFACE EXPLORATION LOG
BORING NO. B-1

				Project No.:	20073
Project Name:	2601 Chapman Ave	Date:	4/2/2020	Logged By:	LB
Type of Rig:	Hollow-Stem-Auger	Drive Wt.:	140 lbs	Elevation:	~225 ft. MSL
Drill Hole Dia.:	8"	Drop:	30"	Depth of Boring (ft.):	61.5

Depth (ft.)	Sample Type	No. of Blows per 6"	Soil Classification	Dry Density (lb/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
25	S	8	CL			Qyf		very stiff
		11						red brown
26		11						
27								
28								
29								
30	R	7	CL	116.0	14.8	Qyf		stiff to very stiff
		17						
31		23						
32								
33			SC			Qyf		CLAYEY SAND, red brown, moist, medium dense, fine-grained sand
34								
35	S	12	SC			Qyf		medium dense
		12						
36		14						

S - SPT Sample R - Ring Sample B - Bulk Sample D - Disturbed Sample

e A-3 (Sheet 3 of 6)

NTS GEOTECHNICAL

SUBSURFACE EXPLORATION LOG
BORING NO. B-1

Project No.: 20073
Project Name: 2601 Chapman Ave
Date: 4/2/2020
Logged By: LB
Type of Rig: Hollow-Stem-Auger
Drive Wt.: 140 lbs
Elevation: ~225 ft. MSL
Drill Hole Dia.: 8"
Drop: 30"
Depth of Boring (ft.): 61.5

Depth (ft.)	Sample Type	No. of Blows per 6"	Soil Classification	Dry Density (lb/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
37								
38								
39								
40	R	4	SC	110.3	15.1	Qyf		medium dense
		4						
41		10	CL			Qyf		SANDY CLAY, brown, moist
42			SC					CLAYEY SAND, brown to light brown, moist
43								
44								
45	S	7	SC			Qyf		medium dense
		9						
46		12						
47			CL					SANDY CLAY, brown, moist
48								

S - SPT Sample R - Ring Sample B - Bulk Sample D - Disturbed Sample

e A-3 (Sheet 4 of 6)

NTS GEOTECHNICAL

SUBSURFACE EXPLORATION LOG
BORING NO. B-1

				Project No.:	20073
Project Name:	2601 Chapman Ave	Date:	4/2/2020	Logged By:	LB
Type of Rig:	Hollow-Stem-Auger	Drive Wt.:	140 lbs	Elevation:	~225 ft. MSL
Drill Hole Dia.:	8"	Drop:	30"	Depth of Boring (ft.):	61.5

Depth (ft.)	Sample Type	No. of Blows per 6"	Soil Classification	Dry Density (lb/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
49								
50	R	9						
		9						
51		16	CL	102.9	21.3	Qyf		brown, very moist, stiff to very stiff
52								
53								
54								
55	S	4	CL			Qyf		
		10						olive brown, moist, fine- to- coarse-grained sand, stiff to very stiff
56		5						
57								
58								
59								
60	R		CL			Qyf		brown, very moist, fine-grained sand

S - SPT Sample R - Ring Sample B - Bulk Sample D - Disturbed Sample

e A-3 (Sheet 5 of 6)

NTS
GEOTECHNICAL

SUBSURFACE EXPLORATION LOG
BORING NO. B-1

Project Name:	2601 Chapman Ave	Date:	4/2/2020	Project No.:	20073
				Logged By:	LB
Type of Rig:	Hollow-Stem-Auger	Drive Wt.:	140 lbs	Elevation:	~225 ft. MSL
Drill Hole Dia.:	8"	Drop:	30"	Depth of Boring (ft.):	61.5

Depth (ft.)	Sample Type	No. of Blows per 6"	Soil Classification	Dry Density (lb/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
61		7 11 18	CL	107.2	18.8	Qyf		very stiff
62								Total Depth = 61.5 feet Groundwater not encountered Backfilled with soil from cuttings and capped with AC cold patch
63								
64								
65								
66								
67								
68								
69								
70								
71								
72								

S - SPT Sample R - Ring Sample B - Bulk Sample D - Disturbed Sample

NTS
GEOTECHNICAL

SUBSURFACE EXPLORATION LOG
BORING NO. B-2

				Project No.:	20073
Project Name:	2601 Chapman Ave	Date:	4/3/2020	Logged By:	LB
Type of Rig:	Hollow-Stem-Auger	Drive Wt.:	140 lbs	Elevation:	~225 ft. MSL
Drill Hole Dia.:	8"	Drop:	30"	Depth of Boring (ft.):	31.5

Depth (ft.)	Sample Type	No. of Blows per 6"	Soil Classification	Dry Density (lb/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
								ASPHALT CONCRETE / AGGREGATE BASE (~10 inches)
1			SC			Af		**ARTIFICIAL FILL** CLAYEY SAND, brown, slightly moist
2								
3								
4								
5	R	4	CL	108.9	15.1	Qyf		**YOUNG ALLUVIAL FAN DEPOSITS** SANDY CLAY, dark brown, moist, firm, fine-grained sand
		5						
6		5						
7			ML					SANDY SILT, olive brown, very moist, firm, fine-grained sand
8								
9								
10	S	2	ML/SM			Qyf		interlayer of sandy silt and silty sand, loose
		2						
11		3						
12								

S - SPT Sample R - Ring Sample B - Bulk Sample D - Disturbed Sample

Figure A-4 (Sheet 1 of 3)

NTS
GEOTECHNICAL

SUBSURFACE EXPLORATION LOG
BORING NO. B-2

Project No.: 20073
Project Name: 2601 Chapman Ave
Date: 4/3/2020
Logged By: LB
Type of Rig: Hollow-Stem-Auger
Drive Wt.: 140 lbs
Elevation: ~225 ft. MSL
Drill Hole Dia.: 8"
Drop: 30"
Depth of Boring (ft.): 31.5

Depth (ft.)	Sample Type	No. of Blows per 6"	Soil Classification	Dry Density (lb/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
13			CL					SANDY CLAY, brown, moist, stiff to very stiff
14								
15	R	4	CL	110.4	19.7	Qyf		dark brown, very moist, stiff
		7						
16		12						
17								
18								
19								
20	S	2	CL			Qyf		
		5						
21		10						
22								
23								
24								

S - SPT Sample R - Ring Sample B - Bulk Sample D - Disturbed Sample

Figure A-4 (Sheet 2 of 3)

NTS
GEOTECHNICAL

SUBSURFACE EXPLORATION LOG
BORING NO. B-2

				Project No.:	20073
Project Name:	2601 Chapman Ave	Date:	4/3/2020	Logged By:	LB
Type of Rig:	Hollow-Stem-Auger	Drive Wt.:	140 lbs	Elevation:	~225 ft. MSL
Drill Hole Dia.:	8"	Drop:	30"	Depth of Boring (ft.):	31.5

Depth (ft.)	Sample Type	No. of Blows per 6"	Soil Classification	Dry Density (lb/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
25	R	5	CL	102.8	25.5	Qyf		very moist, stiff
		6						
26		11						
27								
28								
29								
30	S	2	SC			Qyf		CLAYEY SAND, brown, moist, medium dense
		4						
31		9						
32								Total Depth = 31.5 feet Groundwater not encountered Backfilled with soil from cuttings and capped with AC cold patch
33								
34								
35								
36								

S - SPT Sample R - Ring Sample B - Bulk Sample D - Disturbed Sample

Figure A-4 (Sheet 3 of 3)

NTS
GEOTECHNICAL

SUBSURFACE EXPLORATION LOG
BORING NO. B-3

				Project No.:	20073
Project Name:	2601 Chapman Ave	Date:	4/3/2020	Logged By:	LB
Type of Rig:	Hollow-Stem-Auger	Drive Wt.:	140 lbs	Elevation:	~226 ft. MSL
Drill Hole Dia.:	8"	Drop:	30"	Depth of Boring (ft.):	26.5

Depth (ft.)	Sample Type	No. of Blows per 6"	Soil Classification	Dry Density (lb/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
								ASPHALT CONCRETE / AGGREGATE BASE (~10 inches)
1			SC			Af		**ARTIFICIAL FILL** CLAYEY SAND, brown, slightly moist, loose
2								
3								
4								
5	S	1	SM			Qyf		**YOUNG ALLUVIAL FAN DEPOSITS** SILTY SAND, olive brown, slightly moist, trace clay, very loose to loose
		1						
6		2						
7								
8								
9								
10	R	5	SP-SM	93.3	4.3	Qyf		POORLY GRADED SAND WITH SILT, light brown, damp, fine- to-coarse-grained sand, loose
		6						
11		8						
12								

S - SPT Sample   R - Ring Sample   B - Bulk Sample   D - Disturbed Sample

Figure A-5 (Sheet 1 of 3)

NTS GEOTECHNICAL

SUBSURFACE EXPLORATION LOG
BORING NO. B-3

Project No.: 20073
Project Name: 2601 Chapman Ave
Date: 4/3/2020
Logged By: LB
Type of Rig: Hollow-Stem-Auger
Drive Wt.: 140 lbs
Elevation: ~225 ft. MSL
Drill Hole Dia.: 8"
Drop: 30"
Depth of Boring (ft.): 26.5

Depth (ft.)	Sample Type	No. of Blows per 6"	Soil Classification	Dry Density (lb/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
13								
14								
15	S	1	CL			Qyf		SANDY CLAY, dark brown, very moist, very soft to soft
		1						
16		1						
17								
18								
19								
20	R	5	CL	107.6	20.0	Qyf		stiff
		8						
21		11						
22								
23								
24								

S - SPT Sample R - Ring Sample B - Bulk Sample D - Disturbed Sample

Figure A-5 (Sheet 2 of 3)

NTS GEOTECHNICAL

SUBSURFACE EXPLORATION LOG
BORING NO. B-3

Project Name:	2601 Chapman Ave	Date:	4/3/2020	Project No.:	20073
Type of Rig:	Hollow-Stem-Auger	Drive Wt.:	140 lbs	Logged By:	LB
Drill Hole Dia.:	8"	Drop:	30"	Elevation:	~225 ft. MSL
				Depth of Boring (ft.):	26.5

Depth (ft.)	Sample Type	No. of Blows per 6"	Soil Classification	Dry Density (lb/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
25	S	4	CL			Qyf		stiff to very stiff
		5						
26		10						
27								Total Depth = 26.5 feet Groundwater not encountered Backfilled with soil from cuttings and capped with AC cold patch
28								
29								
30								
31								
32								
33								
34								
35								
36								

S - SPT Sample R - Ring Sample B - Bulk Sample D - Disturbed Sample

Figure A-5 (Sheet 3 of 3)

NTS
GEOTECHNICAL

SUBSURFACE EXPLORATION LOG
BORING NO. B-4

				Project No.:	20073
Project Name:	2601 Chapman Ave	Date:	4/3/2020	Logged By:	LB
Type of Rig:	Hollow-Stem-Auger	Drive Wt.:	140 lbs	Elevation:	~225 ft. MSL
Drill Hole Dia.:	8"	Drop:	30"	Depth of Boring (ft.):	31.5

Depth (ft.)	Sample Type	No. of Blows per 6"	Soil Classification	Dry Density (lb/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
								ASPHALT CONCRETE / AGGREGATE BASE (~10 inches)
1			SM			Af		**ARTIFICIAL FILL** SILTY SAND, brown, slightly moist, loose
2			SC			Qyf		**YOUNG ALLUVIAL FAN DEPOSITS** CLAYEY SAND, brown, slightly moist
3								
4								
5	R	2 2 5	CL	104.3	13.9	Qyf		SANDY CLAY, dark brown, moist, firm, fine-grained sand
6								
7								
8			SP-SM			Qyf		POORLY GRADED SAND WITH SILT, olive brown, slightly moist, loose fine- to- medium coarse-grained sand
9								
10	S	3 4 5	SP-SM			Qyf		loose
11								
12								

S - SPT Sample   R - Ring Sample   B - Bulk Sample   D - Disturbed Sample

Figure A-6 (Sheet 1 of 3)

NTS GEOTECHNICAL

SUBSURFACE EXPLORATION LOG
BORING NO. B-4

				Project No.:	20073
Project Name:	2601 Chapman Ave	Date:	4/3/2020	Logged By:	LB
Type of Rig:	Hollow-Stem-Auger	Drive Wt.:	140 lbs	Elevation:	~225 ft. MSL
Drill Hole Dia.:	8"	Drop:	30"	Depth of Boring (ft.):	31.5

Depth (ft.)	Sample Type	No. of Blows per 6"	Soil Classification	Dry Density (lb/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
13								
14								
15	R	6	ML	108.4	15.9	Qyf		SANDY SILT, olive brown, moist, stiff
		6						
16		14						
17								
18								
19								
20	S	4	CL			Qyf		SANDY CLAY, brown, moist, very stiff
		6						
21		10						
22								
23								
24								

S - SPT Sample R - Ring Sample B - Bulk Sample D - Disturbed Sample

e A-6 (Sheet 2 of 3)

SUBSURFACE EXPLORATION LOG
BORING NO. B-4

NTS GEOTECHNICAL

Project Name:	2601 Chapman Ave	Date:	4/3/2020	Project No.:	20073
Type of Rig:	Hollow-Stem-Auger	Drive Wt.:	140 lbs	Logged By:	LB
Drill Hole Dia.:	8"	Drop:	30"	Elevation:	~225 ft. MSL
				Depth of Boring (ft.):	31.5

Depth (ft.)	Sample Type	No. of Blows per 6"	Soil Classification	Dry Density (lb/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
25	R	8	CL	106.7	13.9	Qyf		very stiff
		12						
26		14						
27								
28								
29								
30	S	8						
		8	SC			Qyf		CLAYEY SAND, brown, moist, medium dense
31		11						
32								Total Depth = 31.5 feet Groundwater not encountered Backfilled with soil from cuttings and capped with AC cold patch
33								
34								
35								
36								

S - SPT Sample R - Ring Sample B - Bulk Sample D - Disturbed Sample

Figure A-6 (Sheet 3 of 3)

NTS
GEOTECHNICAL

SUBSURFACE EXPLORATION LOG
BORING NO. B-5

				Project No.:	20073
Project Name:	2601 Chapman Ave	Date:	4/2/2020	Logged By:	LB
Type of Rig:	Hollow-Stem-Auger	Drive Wt.:	140 lbs	Elevation:	~225 ft. MSL
Drill Hole Dia.:	8"	Drop:	30"	Depth of Boring (ft.):	61.5

Depth (ft.)	Sample Type	No. of Blows per 6"	Soil Classification	Dry Density (lb/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
								ASPHALT CONCRETE / AGGREGATE BASE (~12 inches)
1			SC			Qyf		**ARTIFICIAL FILL** CLAYEY SAND, brown, slightly moist, loose to medium dense
2								
3								
4								
								YOUNG ALLUVIAL FAN DEPOSITS
5	S	2	CL			Qyf		SANDY CLAY, dark brown, moist, soft to firm, fine-grained sand
		3						
6		3						
7								
8								POORLY GRADED SAND WITH SILT, olive brown, slightly moist, medium dense, fine- to- medium coarse-grained sand
9								
10	R	4	SP-SM	93.4	5.9	Qal		loose to medium dense
		7						
11		9						
12								

S - SPT Sample   R - Ring Sample   B - Bulk Sample   D - Disturbed Sample

Figure A-7 (Sheet 1 of 6)

NTS GEOTECHNICAL

SUBSURFACE EXPLORATION LOG
BORING NO. B-5

Project Name:	2601 Chapman Ave	Date:	4/3/2020	Project No.:	20073
Type of Rig:	Hollow-Stem-Auger	Drive Wt.:	140 lbs	Logged By:	LB
Drill Hole Dia.:	8"	Drop:	30"	Elevation:	~225 ft. MSL
				Depth of Boring (ft.):	61.5

Depth (ft.)	Sample Type	No. of Blows per 6"	Soil Classification	Dry Density (lb/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
13								
14								
15	S	1	ML			Qyf		SANDY SILT, olive brown, very moist, soft, fine-grained sand
		1						
16		2	CL			Qyf		SANDY CLAY, brown, moist, stiff
17								
18								
19								
20	R	4						
		6						
21		10	CL	115.3	16.0	Qyf		
22								
23								
24								

S - SPT Sample R - Ring Sample B - Bulk Sample D - Disturbed Sample

Figure A-7 (Sheet 2 of 6)

NTS GEOTECHNICAL

SUBSURFACE EXPLORATION LOG
BORING NO. B-5

				Project No.:	20073
Project Name:	2601 Chapman Ave	Date:	4/3/2020	Logged By:	LB
Type of Rig:	Hollow-Stem-Auger	Drive Wt.:	140 lbs	Elevation:	~225 ft. MSL
Drill Hole Dia.:	8"	Drop:	30"	Depth of Boring (ft.):	61.5

Depth (ft.)	Sample Type	No. of Blows per 6"	Soil Classification	Dry Density (lb/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
25	S	3	CL			Qyf		very moist, stiff to very stiff
		7						
26		10						
27								
28								
29								
30	R	10						
		13	SC	115.0	9.2	Qyf		CLAYEY SAND, brown, moist, medium dense
31		21						
32								
33								
34								
35	S	3	CL			Qyf		SANDY CLAY, brown, moist, stiff
		4						
36		8						

S - SPT Sample   R - Ring Sample   B - Bulk Sample   D - Disturbed Sample

Figure A-7 (Sheet 3 of 6)

NTS
GEOTECHNICAL

SUBSURFACE EXPLORATION LOG
BORING NO. B-5

				Project No.:	20073
Project Name:	2601 Chapman Ave	Date:	4/3/2020	Logged By:	LB
Type of Rig:	Hollow-Stem-Auger	Drive Wt.:	140 lbs	Elevation:	~225 ft. MSL
Drill Hole Dia.:	8"	Drop:	30"	Depth of Boring (ft.):	61.5

Depth (ft.)	Sample Type	No. of Blows per 6"	Soil Classification	Dry Density (lb/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
37								
38								
39								
40	R	5 7 12	CL	98.3	28.0	Qyf		increase in sand, very moist, stiff
41								
42								
43								
44								
45	S	4 4 6	CL			Qyf		very moist, stiff
46								
47								
48								

S - SPT Sample R - Ring Sample B - Bulk Sample D - Disturbed Sample

Figure A-7 (Sheet 4 of 6)

NTS
GEOTECHNICAL

SUBSURFACE EXPLORATION LOG
BORING NO. B-5

				Project No.:	20073
Project Name:	2601 Chapman Ave	Date:	4/3/2020	Logged By:	LB
Type of Rig:	Hollow-Stem-Auger	Drive Wt.:	140 lbs	Elevation:	~225 ft. MSL
Drill Hole Dia.:	8"	Drop:	30"	Depth of Boring (ft.):	61.5

Depth (ft.)	Sample Type	No. of Blows per 6"	Soil Classification	Dry Density (lb/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
49								
50	R	7	CL	105.4	22.5	Qyf		
		14						olive brown, moist, very stiff, fine- to- coarse-grained sand
51		22						
52								
53								
54								
55	S	4	CL			Qyf		stiff
		8						
56		14						
57								
58								
59								
60								

S - SPT Sample R - Ring Sample B - Bulk Sample D - Disturbed Sample

Figure A-7 (Sheet 5 of 6)

NTS GEOTECHNICAL

SUBSURFACE EXPLORATION LOG
BORING NO. B-5

Project Name:	2601 Chapman Ave	Date:	4/3/2020	Project No.:	20073
				Logged By:	LB
Type of Rig:	Hollow-Stem-Auger	Drive Wt.:	140 lbs	Elevation:	~225 ft. MSL
Drill Hole Dia.:	8"	Drop:	30"	Depth of Boring (ft.):	61.5

Depth (ft.)	Sample Type	No. of Blows per 6"	Soil Classification	Dry Density (lb/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
60	R	50/6"	SP	98.2	2.6	Qyf		POORLY GRADED SAND, light brown, dry, very dense coarse-grained sand
61								
62								Total Depth = 61.5 feet Groundwater not encountered Backfilled with soil from cuttings and capped with AC cold patch
63								
64								
65								
66								
67								
68								
69								
70								
71								

S - SPT Sample R - Ring Sample B - Bulk Sample D - Disturbed Sample

Figure A-7 (Sheet 6 of 6)

NTS
GEOTECHNICAL

SUBSURFACE EXPLORATION LOG
BORING NO. B-6

Project No.: 20073
Project Name: 2601 Chapman Ave
Date: 8/25/2020
Logged By: RA
Type of Rig: Hollow-Stem-Auger
Drive Wt.: 140 lbs
Elevation: ~225 ft. MSL
Drill Hole Dia.: 8"
Drop: 30"
Depth of Boring (ft.): 51.5

Depth (ft.)	Sample Type	No. of Blows per 6"	Soil Classification	Dry Density (lb/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
								ASPHALT CONCRETE
			SM			Qaf		**ARTIFICIAL FILL** SILTY SAND, brown, moist, some gravel
1								
2								
	R	4	SM	106.7	7.1	Qaf		loose
3		4						
		5						
4								
5	S	3	SP-SM			Qyf		**YOUNG ALLUVIAL FAN DEPOSITS** POORLY GRADED SAND WITL SILT, light brown, slightly moist, fine- to- coarse-grained sand, loose
		3						
6		3						
7								
	R	7	SP-SM	112.5	8.2	Qyf		loose to medium dense
8		7						
		10						
9								
10	S	2	SP-SM			Qyf		loose
		2						
11		4						
12								

S - SPT Sample R - Ring Sample B - Bulk Sample D - Disturbed Sample

Figure A-8 (Sheet 1 of 5)

NTS GEOTECHNICAL

SUBSURFACE EXPLORATION LOG
BORING NO. B-6

				Project No.:	20073
Project Name:	2601 Chapman Ave	Date:	8/25/2020	Logged By:	RA
Type of Rig:	Hollow-Stem-Auger	Drive Wt.:	140 lbs	Elevation:	~225 ft. MSL
Drill Hole Dia.:	8"	Drop:	30"	Depth of Boring (ft.):	51.5

Depth (ft.)	Sample Type	No. of Blows per 6"	Soil Classification	Dry Density (lb/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
13								
14								
15	R	7	SP-SM	101.7	1.8	Qyf		dry, medium dense
		10						
16		13	CL			Qyf		SANDY CLAY, red brown, moist, fine-grained, stiff
17								
18								
19								
	S	3	CL			Qyf		stiff
20		4						
		5						
21								
22								
23								
24								

S - SPT Sample R - Ring Sample B - Bulk Sample D - Disturbed Sample

Figure A-8 (Sheet 2 of 5)

NTS
GEOTECHNICAL

SUBSURFACE EXPLORATION LOG
BORING NO. B-6

				Project No.:	20073
Project Name:	2601 Chapman Ave	Date:	8/25/2020	Logged By:	RA
Type of Rig:	Hollow-Stem-Auger	Drive Wt.:	140 lbs	Elevation:	~225 ft. MSL
Drill Hole Dia.:	8"	Drop:	30"	Depth of Boring (ft.):	51.5

Depth (ft.)	Sample Type	No. of Blows per 6"	Soil Classification	Dry Density (lb/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
25	R	7	CL	113.6	14.0	Qyf		very stiff to hard
		14						
26		36						
27								
28								
29								
30	S	7	CL			Qyf		very stiff
		8						
31		18						
32								
33			SC			Qyf		CLAYEY SAND, brown, moist
34								
35	R	7	SC	114.3	4.6	Qyf		dry, medium dense
		14						
36		27						

S - SPT Sample R - Ring Sample B - Bulk Sample D - Disturbed Sample

Figure A-8 (Sheet 3 of 5)

NTS GEOTECHNICAL

SUBSURFACE EXPLORATION LOG
BORING NO. B-6

Project Name: 2601 Chapman Ave
Type of Rig: Hollow-Stem-Auger
Drill Hole Dia.: 8"
Date: 8/25/2020
Drive Wt.: 140 lbs
Drop: 30"
Project No.: 20073
Logged By: RA
Elevation: ~225 ft. MSL
Depth of Boring (ft.): 51.5

Depth (ft.)	Sample Type	No. of Blows per 6"	Soil Classification	Dry Density (lb/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
37								
38								
39								
40	S	5	CL			Qyf		SANDY CLAY, brown, moist, fine-grained sand, very stiff
		6						
41		10	SC			Qyf		CLAYEY SAND, brown, moist, medium dense to dense
42								
43								
44								
45	R	8						
		14	CL	105.5	13.6	Qyf		very stiff
46		17						
47								
48								

S - SPT Sample R - Ring Sample B - Bulk Sample D - Disturbed Sample

Figure A-8 (Sheet 4 of 5)

NTS
GEOTECHNICAL

SUBSURFACE EXPLORATION LOG
BORING NO. B-6

				Project No.:	20073
Project Name:	2601 Chapman Ave	Date:	8/25/2020	Logged By:	RA
Type of Rig:	Hollow-Stem-Auger	Drive Wt.:	140 lbs	Elevation:	~225 ft. MSL
Drill Hole Dia.:	8"	Drop:	30"	Depth of Boring (ft.):	51.5

Depth (ft.)	Sample Type	No. of Blows per 6"	Soil Classification	Dry Density (lb/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
49								
50	S	4	CL			Qy		stiff
		6						
51		7						
52								Total Depth = 51.5 feet Groundwater not encountered Backfilled with soil from cuttings
53								
54								
55								
56								
57								
58								
59								
60								

S - SPT Sample R - Ring Sample B - Bulk Sample D - Disturbed Sample

Figure A-8 (Sheet 5 of 5)

NTS GEOTECHNICAL

SUBSURFACE EXPLORATION LOG
BORING NO. B-7

Project Name:	2601 Chapman Ave	Date:	8/25/2020	Project No.:	20073
				Logged By:	RA
Type of Rig:	Hollow-Stem-Auger	Drive Wt.:	140 lbs	Elevation:	~225 ft. MSL
Drill Hole Dia.:	8"	Drop:	30"	Depth of Boring (ft.):	51.5

Depth (ft.)	Sample Type	No. of Blows per 6"	Soil Classification	Dry Density (lb/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
								ASPHALT CONCRETE
1			SC/CL			Qaf		**ARTIFICIAL FILL** SANDY CLAY/CLAYEY SAND, brown, moist
2								
	S	1	SC/CL					very loose
3		1						
		1						
4								**YOUNG ALLUVIAL FAN DEPOSITS** SILTY SAND, brown to dark brown, moist
5	R	2	SM	106.8	9.0	Qyf		loose
		5						
6		5						
7								
	S	3	SM			Qyf		loose
8		3						
		5						
9								
10	R	8	SM	102.2	4.7	Qyf		dry, loose to medium dense
		8						
11		14						
12								

S - SPT Sample R - Ring Sample B - Bulk Sample D - Disturbed Sample

Figure A-9 (Sheet 1 of 5)

SUBSURFACE EXPLORATION LOG
BORING NO. B-7

				Project No.:	20073
Project Name:	2601 Chapman Ave	Date:	8/25/2020	Logged By:	RA
Type of Rig:	Hollow-Stem-Auger	Drive Wt.:	140 lbs	Elevation:	~225 ft. MSL
Drill Hole Dia.:	8"	Drop:	30"	Depth of Boring (ft.):	51.5

Depth (ft.)	Sample Type	No. of Blows per 6"	Soil Classification	Dry Density (lb/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
	S	2						very loose
13		1						
		2						
14								
15	R	5	SM	117.8	11.3	Qyf		
		10						
16		18	CL			Qyf		SANDY CLAY, brown, moist
17								
18								
19								
20	S	8	CL			Qyf		very stiff
		7						
21		12						
22								
23								
24								

S - SPT Sample R - Ring Sample B - Bulk Sample D - Disturbed Sample

Figure A-9 (Sheet 2 of 5)

NTS GEOTECHNICAL

SUBSURFACE EXPLORATION LOG
BORING NO. B-7

				Project No.:	20073
Project Name:	2601 Chapman Ave	Date:	8/25/2020	Logged By:	RA
Type of Rig:	Hollow-Stem-Auger	Drive Wt.:	140 lbs	Elevation:	~225 ft. MSL
Drill Hole Dia.:	8"	Drop:	30"	Depth of Boring (ft.):	51.5

Depth (ft.)	Sample Type	No. of Blows per 6"	Soil Classification	Dry Density (lb/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
25	R	7	CL	124.7	10.3	Qyf		slightly moist, hard
		14						
26		36						
27								
28								
29								
30	S	7	CL			Qyf		very stiff
		8						
31		18						
32								
33								
34								
35	R	7	CL	126.9	9.1	Qyf		very stiff
		14						
36		27						

S - SPT Sample R - Ring Sample B - Bulk Sample D - Disturbed Sample

Figure A-9 (Sheet 3 of 5)

NTS
GEOTECHNICAL

SUBSURFACE EXPLORATION LOG
BORING NO. B-7

Project No.: 20073
Project Name: 2601 Chapman Ave
Date: 8/25/2020
Logged By: RA
Type of Rig: Hollow-Stem-Auger
Drive Wt.: 140 lbs
Elevation: ~225 ft. MSL
Drill Hole Dia.: 8"
Drop: 30"
Depth of Boring (ft.): 51.5

Depth (ft.)	Sample Type	No. of Blows per 6"	Soil Classification	Dry Density (lb/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
			SC			Qy		CLAYEY SAND, brown, moist
37								
38								
39								
40	S	5	SC			Qyf		medium dense
		6						
41		10						
42								
43								
44								
45	R	8	CL	103.4	4.4	Qyf		SANDY CLAY, brown, dry, fine-grained, very stiff
		14						
46		17						
47								
48								

S - SPT Sample R - Ring Sample B - Bulk Sample D - Disturbed Sample

Figure A-9 (Sheet 4 of 5)

SUBSURFACE EXPLORATION LOG
BORING NO. B-7

NTS GEOTECHNICAL

Project Name:	2601 Chapman Ave	Date:	8/25/2020	Project No.:	20073
				Logged By:	RA
Type of Rig:	Hollow-Stem-Auger	Drive Wt.:	140 lbs	Elevation:	~225 ft. MSL
Drill Hole Dia.:	8"	Drop:	30"	Depth of Boring (ft.):	51.5

Depth (ft.)	Sample Type	No. of Blows per 6"	Soil Classification	Dry Density (lb/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
49								
50	S	4	CL			Qyf		stiff
		6						
51		7						
52								Total Depth = 51.5 feet Groundwater not encountered Backfill with soil from cuttings
53								
54								
55								
56								
57								
58								
59								
60								

S - SPT Sample R - Ring Sample B - Bulk Sample D - Disturbed Sample

Figure A-9 (Sheet 5 of 5)

NTS
GEOTECHNICAL

SUBSURFACE EXPLORATION LOG
BORING NO. P-1

				Project No.:	20073
Project Name:	2601 Chapman Ave	Date:	4/2/2020	Logged By:	LB
Type of Rig:	Hollow-Stem-Auger	Drive Wt.:	140 lbs	Elevation:	~225 ft. MSL
Drill Hole Dia.:	8"	Drop:	30"	Depth of Boring (ft.):	10

Depth (ft.)	Sample Type	No. of Blows per 6"	Soil Classification	Dry Density (lb/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
								ASPHALT CONCRETE / AGGREGATE BASE (~10 inches)
1			SM			Af		**ARTIFICIAL FILL** SILTY SAND, brown, damp to moist, fine-grained sand, loose
2								
3			CL			Qyf		**YOUNG ALLUVIAL FAN DEPOSITS** SANDY CLAY, dark brown, moist, fine-grained sand
4								
5								
6			SM			Qyf		SILTY SAND, light brown, damp to moist, loose
7								
8								
9								
			ML			Qyf		SANDY SILT, light brown, moist, stiff, fine-grained sand, some clay
10								
								Total Depth = 10 feet Groundwater not encountered Backfilled with soil from cuttings and capped with AC cold patch
11								
12								

S - SPT Sample   R - Ring Sample   B - Bulk Sample   D - Disturbed Sample

Figure A-10 (Sheet 1 of 1)

NTS
GEOTECHNICAL

SUBSURFACE EXPLORATION LOG
BORING NO. P-2

		Project No.:	20073
Project Name: 2601 Chapman Ave	Date: 4/2/2020	Logged By:	LB
Type of Rig: Hollow-Stem-Auger	Drive Wt.: 140 lbs	Elevation:	~225 ft. MSL
Drill Hole Dia.: 8"	Drop: 30"	Depth of Boring (ft.):	10

Depth (ft.)	Sample Type	No. of Blows per 6"	Soil Classification	Dry Density (lb/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
								TOPSOIL
1			SC			Qyf		CLAYEY SAND, brown, slightly moist, loose to medium dense
2								
3								
4								
5			CL			Qyf		**YOUNG ALLUVIAL FAN DEPOSITS** SANDY CLAY, dark brown, moist, soft to firm, fine-grained sand
6								
7								
8								
9								
10								
11								Total Depth = 10 feet Groundwater not encountered Backfilled with soil from cuttings and capped with AC cold patch
12								

S - SPT Sample R - Ring Sample B - Bulk Sample D - Disturbed Sample

Figure A-11 (Sheet 1 of 1)

NTS
GEOTECHNICAL

APPENDIX A-1

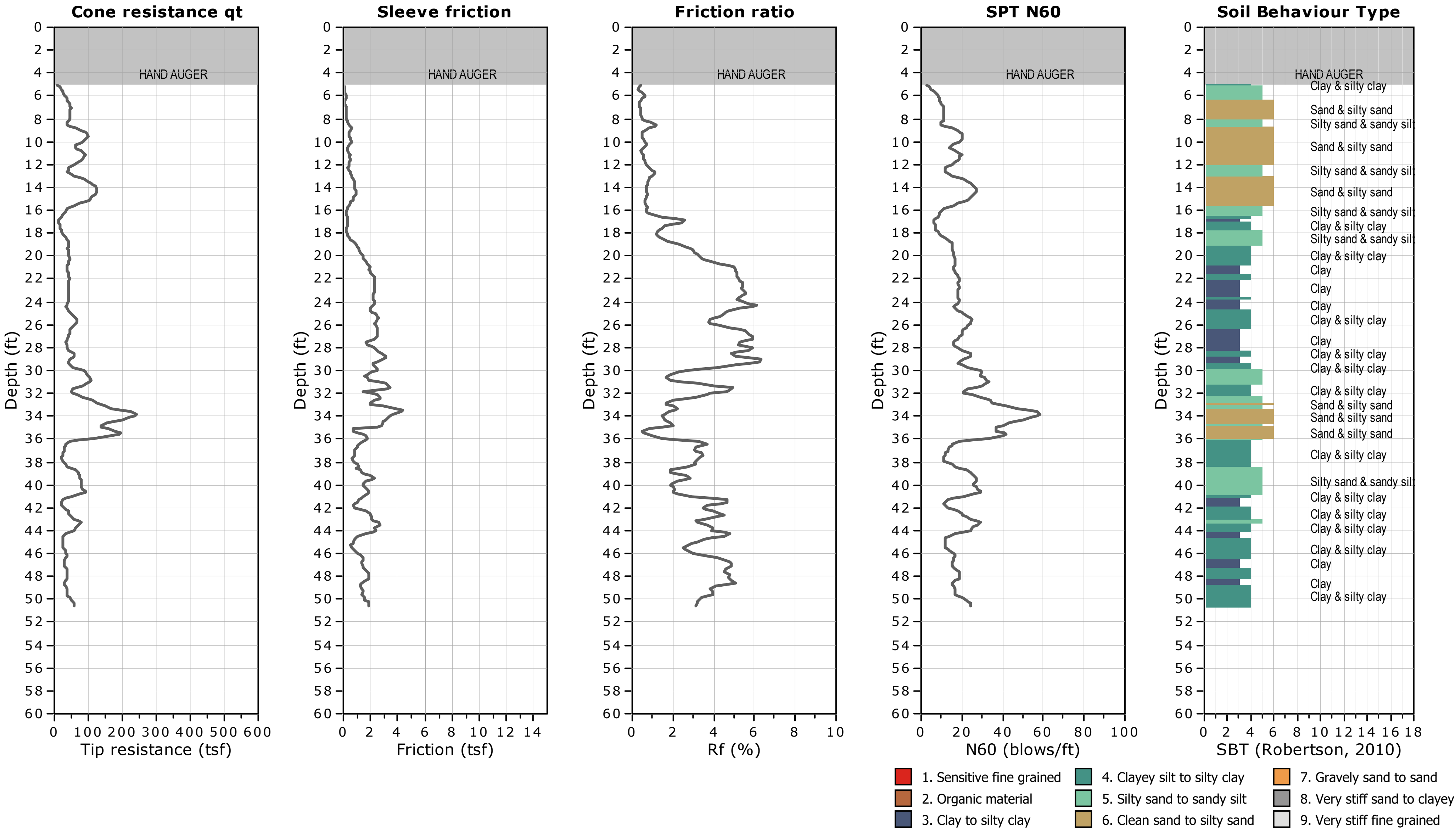
Cone Penetration Testing Logs

GREGG DRILLING, LLC
WWW.GREGGDRILLING.COM

CPT: CPT-1

CLIENT: NTS GEOTECHNICAL
SITE: HUB @ FULLERTON, CA

FIELD REP: NADIM
Total depth: 50.52 ft, Date: 8/25/2020



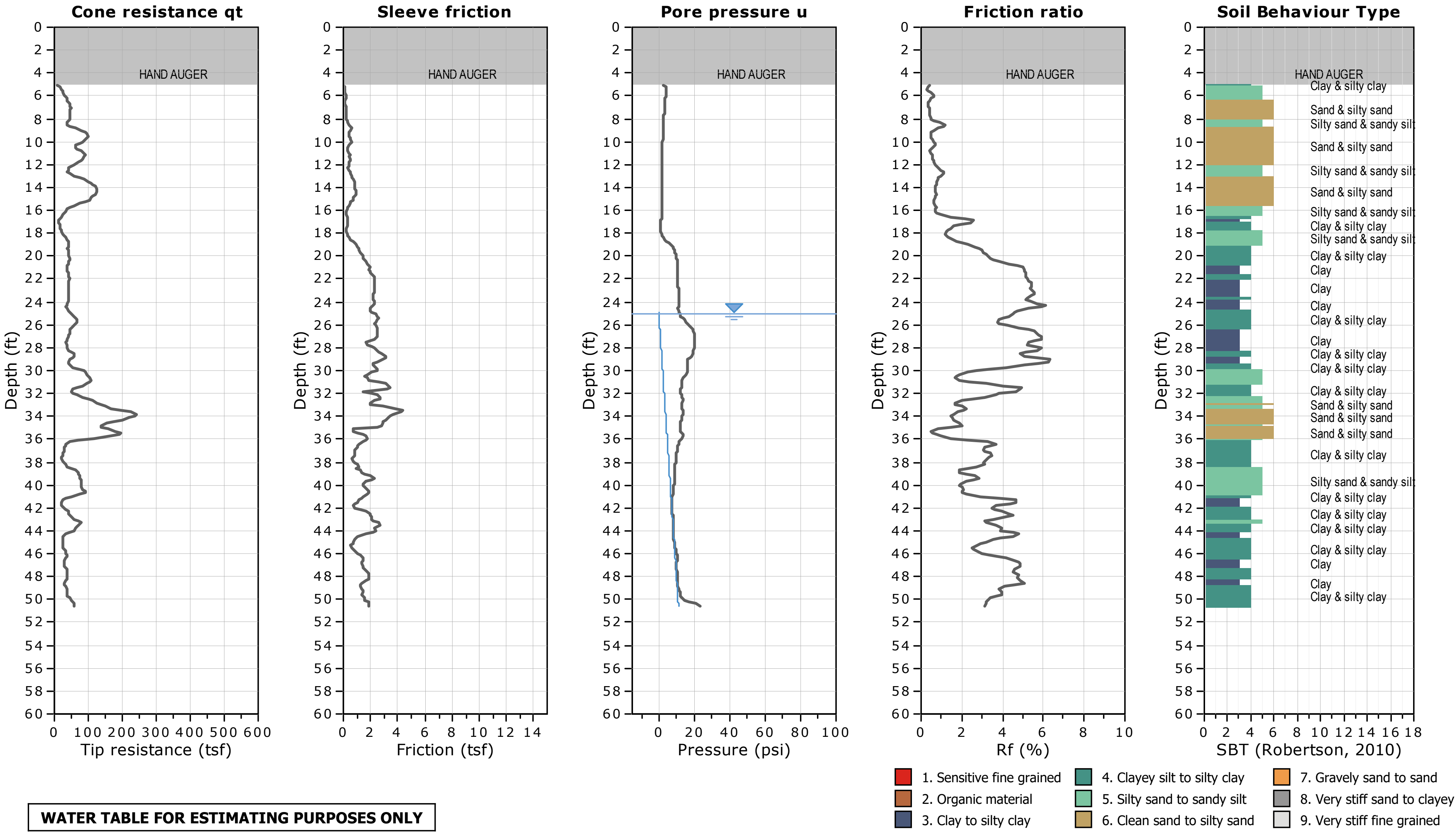
K-126

GREGG DRILLING, LLC
WWW.GREGGDRILLING.COM

CPT: CPT-1

CLIENT: NTS GEOTECHNICAL
SITE: HUB @ FULLERTON, CA

FIELD REP: NADIM
Total depth: 50.52 ft, Date: 8/25/2020



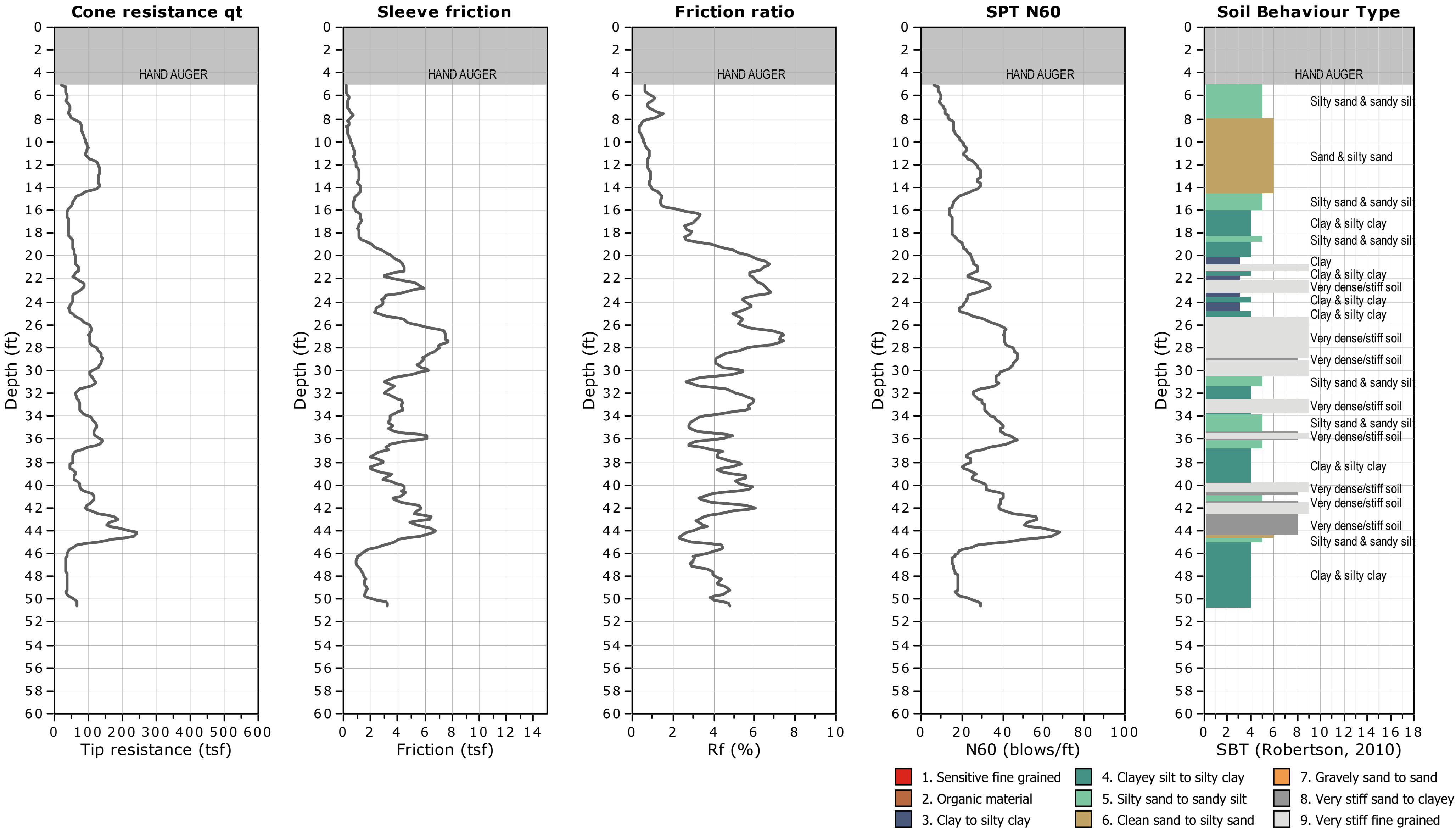
WATER TABLE FOR ESTIMATING PURPOSES ONLY

GREGG DRILLING, LLC
WWW.GREGGDRILLING.COM

CPT: CPT-2

CLIENT: NTS GEOTECHNICAL
SITE: HUB @ FULLERTON, CA

FIELD REP: NADIM
Total depth: 50.52 ft, Date: 8/25/2020

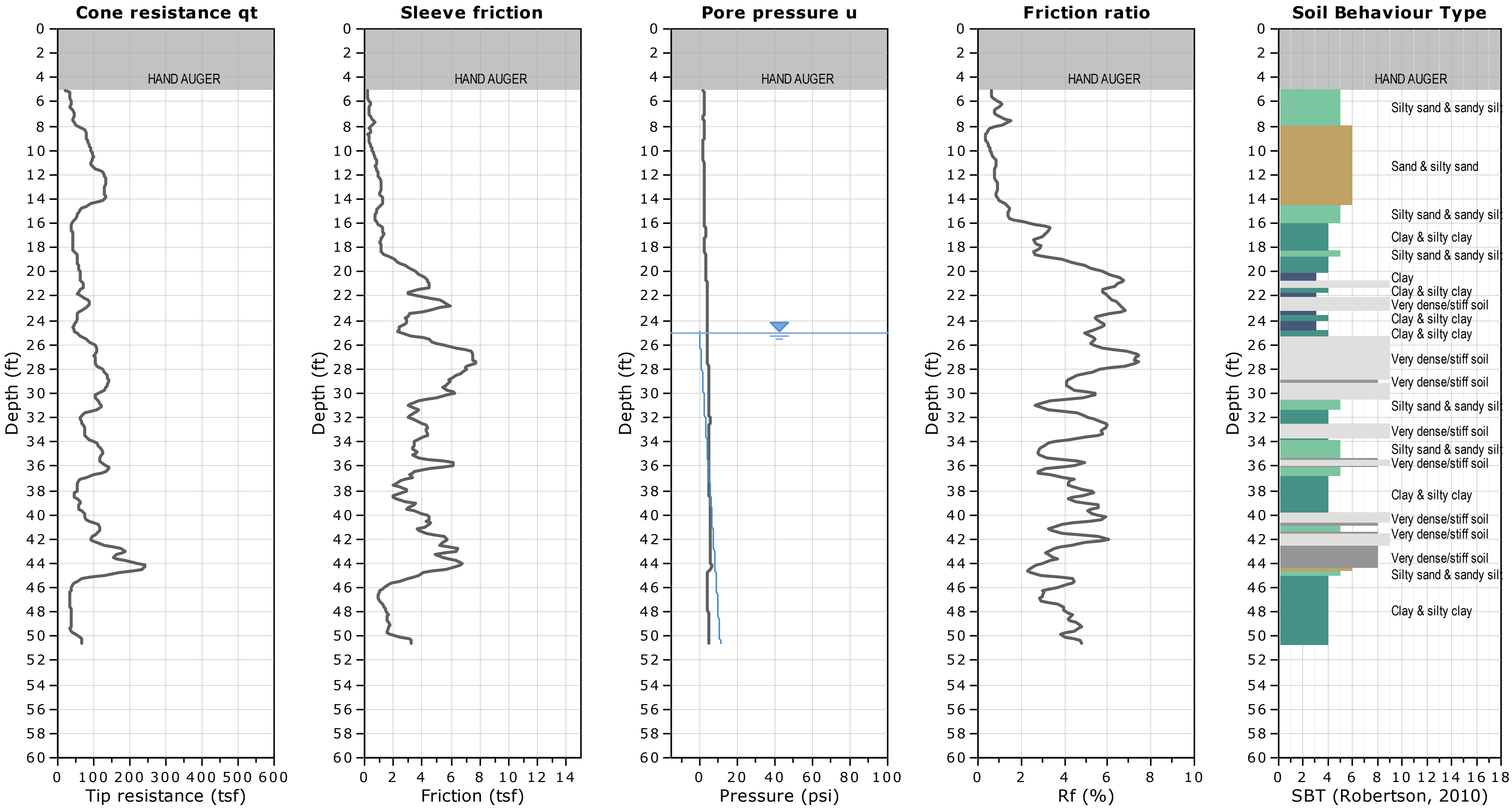


GREGG DRILLING, LLC
WWW.GREGGDRILLING.COM

CPT: CPT-2

CLIENT: NTS GEOTECHNICAL
SITE: HUB @ FULLERTON, CA

FIELD REP: NADIM
Total depth: 50.52 ft, Date: 8/25/2020



🟥 1. Sensitive fine grained
🟫 2. Organic material
🟦 3. Clay to silty clay
🟩 4. Clayey silt to silty clay
🟩 5. Silty sand to sandy silt
🟨 6. Clean sand to silty sand
🟧 7. Gravely sand to sand
⬛ 8. Very stiff sand to clayey
⬜ 9. Very stiff fine grained

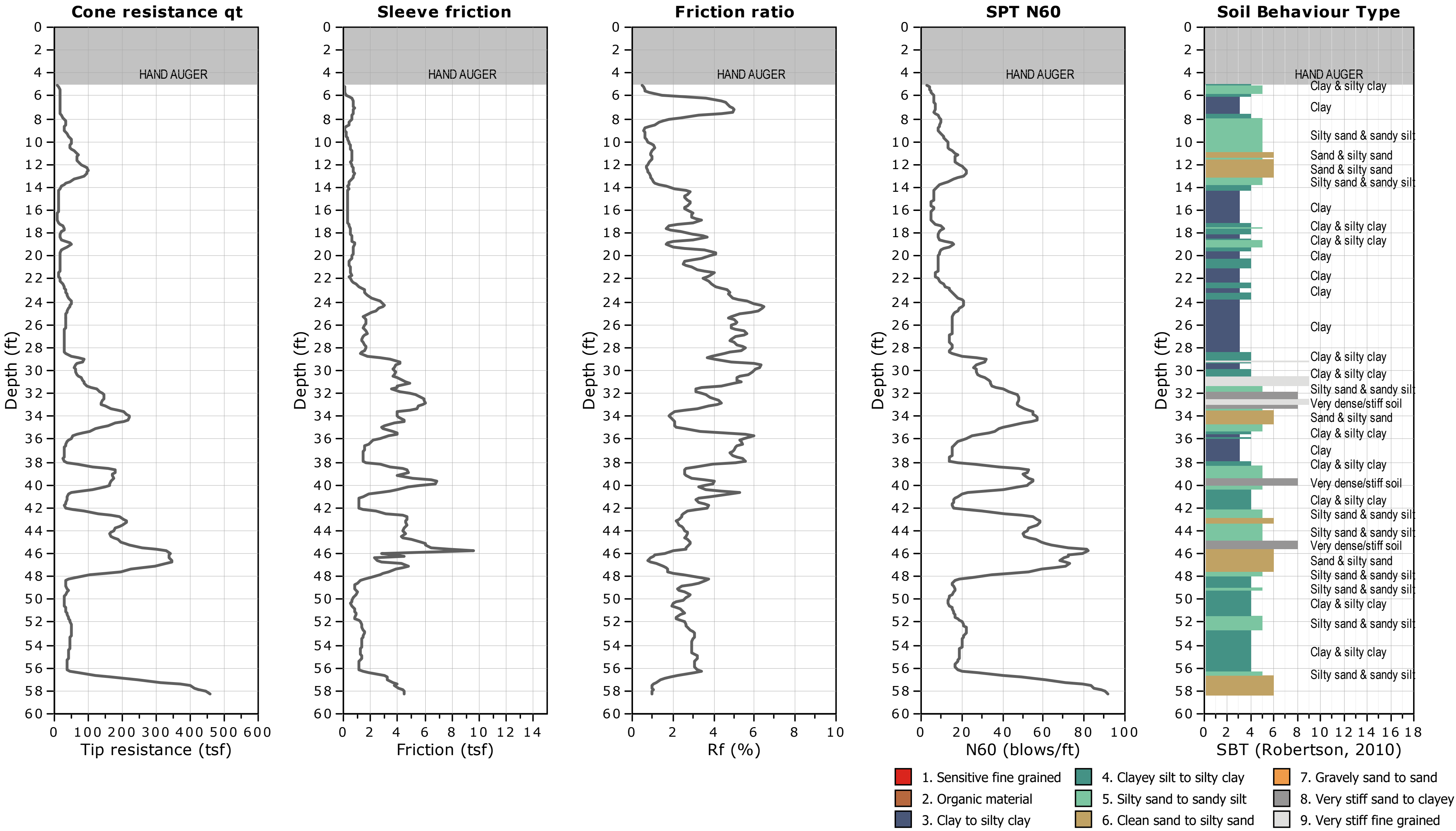
WATER TABLE FOR ESTIMATING PURPOSES ONLY

GREGG DRILLING, LLC
WWW.GREGGDRILLING.COM

CPT: CPT-4

CLIENT: NTS GEOTECHNICAL
SITE: HUB @ FULLERTON, CA

FIELD REP: NADIM
Total depth: 58.23 ft, Date: 8/25/2020



K-130

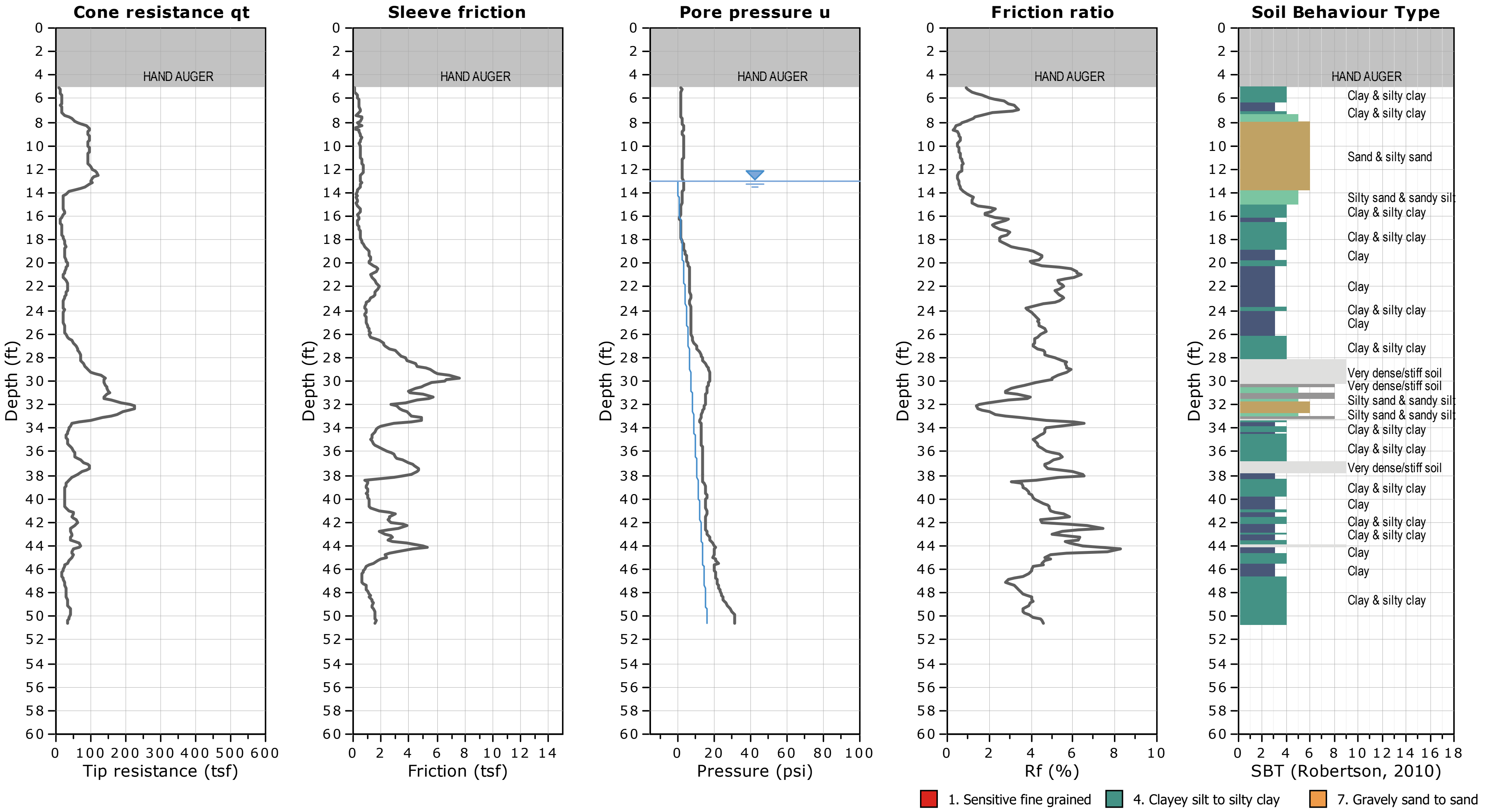
CPT: SCPT-3

CLIENT: NTS GEOTECHNICAL

SITE: HUB @ FULLERTON, CA

FIELD REP: NADIM

Total depth: 50.52 ft, Date: 8/25/2020



WATER TABLE FOR ESTIMATING PURPOSES ONLY

GREGG DRILLING, LLC
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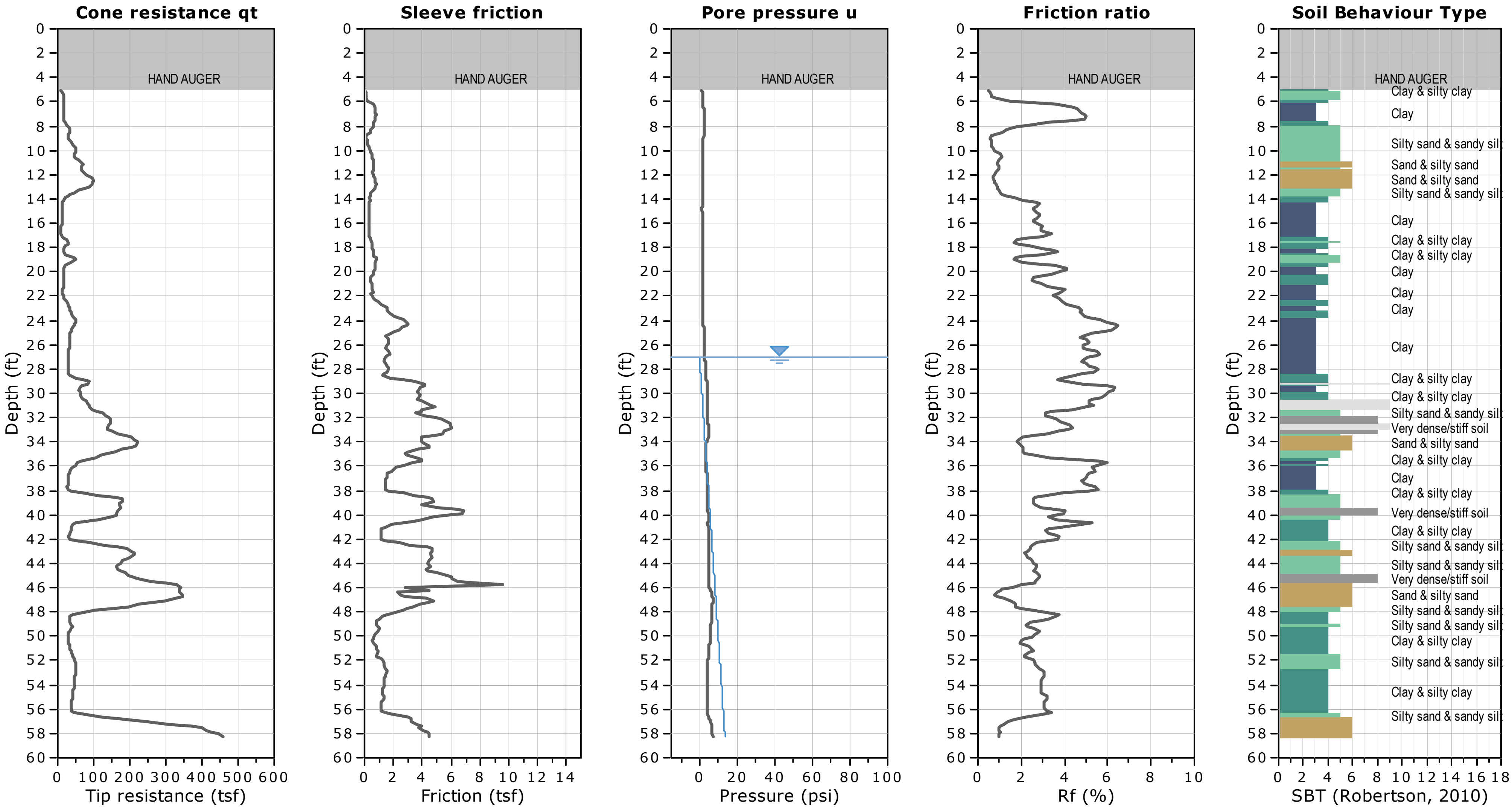
CPT: CPT-4

CLIENT: NTS GEOTECHNICAL
SITE: HUB @ FULLERTON, CA

FIELD REP: NADIM
Total depth: 58.23 ft, Date: 8/25/2020



🟥 1. Sensitive fine grained
🟫 2. Organic material
🟦 3. Clay to silty clay
🟩 4. Clayey silt to silty clay
🟩 5. Silty sand to sandy silt
🟨 6. Clean sand to silty sand
🟧 7. Gravely sand to sand
⬛ 8. Very stiff sand to clayey
⬜ 9. Very stiff fine grained

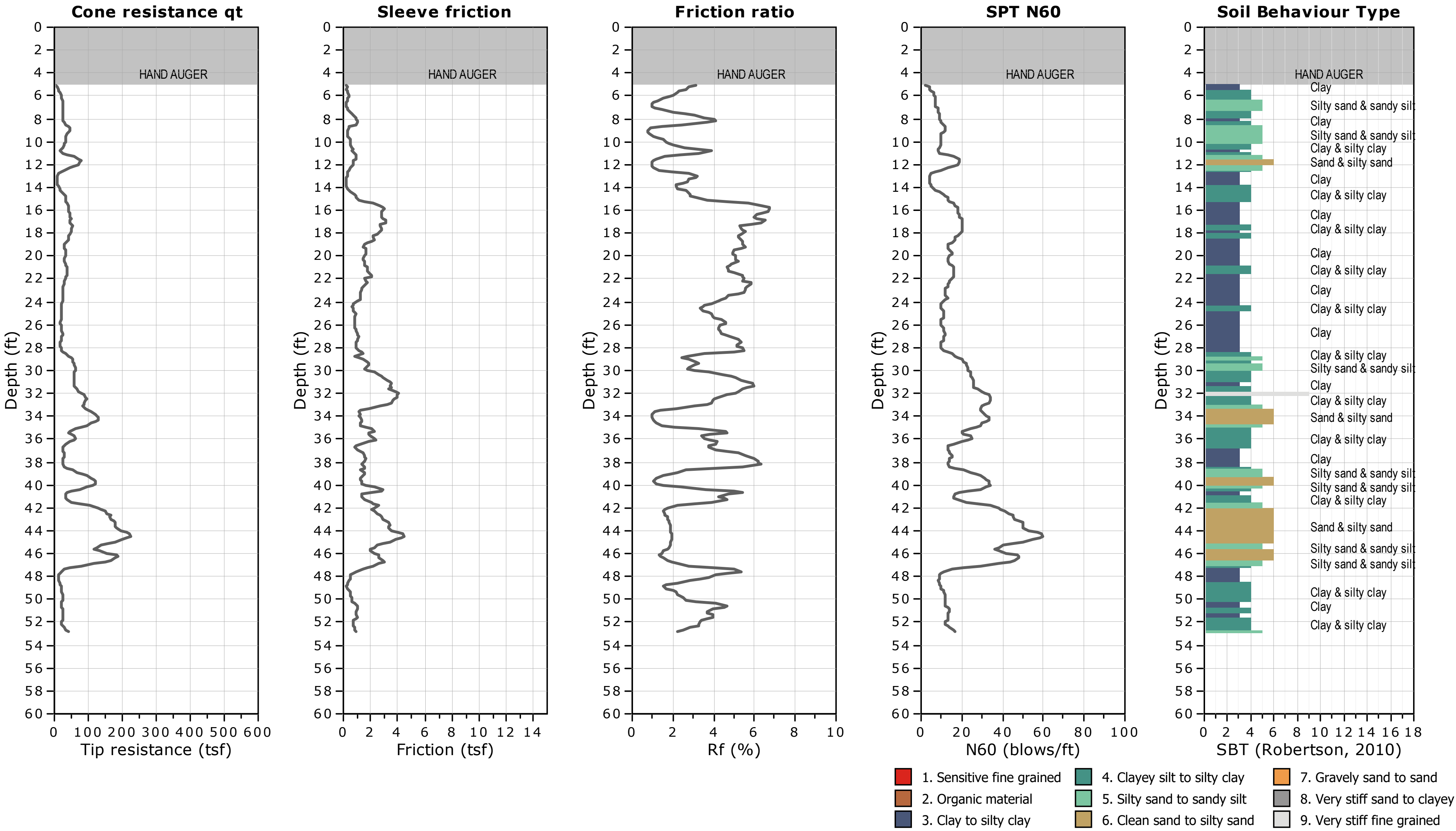
WATER TABLE FOR ESTIMATING PURPOSES ONLY

GREGG DRILLING, LLC
WWW.GREGGDRILLING.COM

CPT: CPT-5

CLIENT: NTS GEOTECHNICAL
SITE: HUB @ FULLERTON, CA

FIELD REP: NADIM
Total depth: 52.82 ft, Date: 8/25/2020

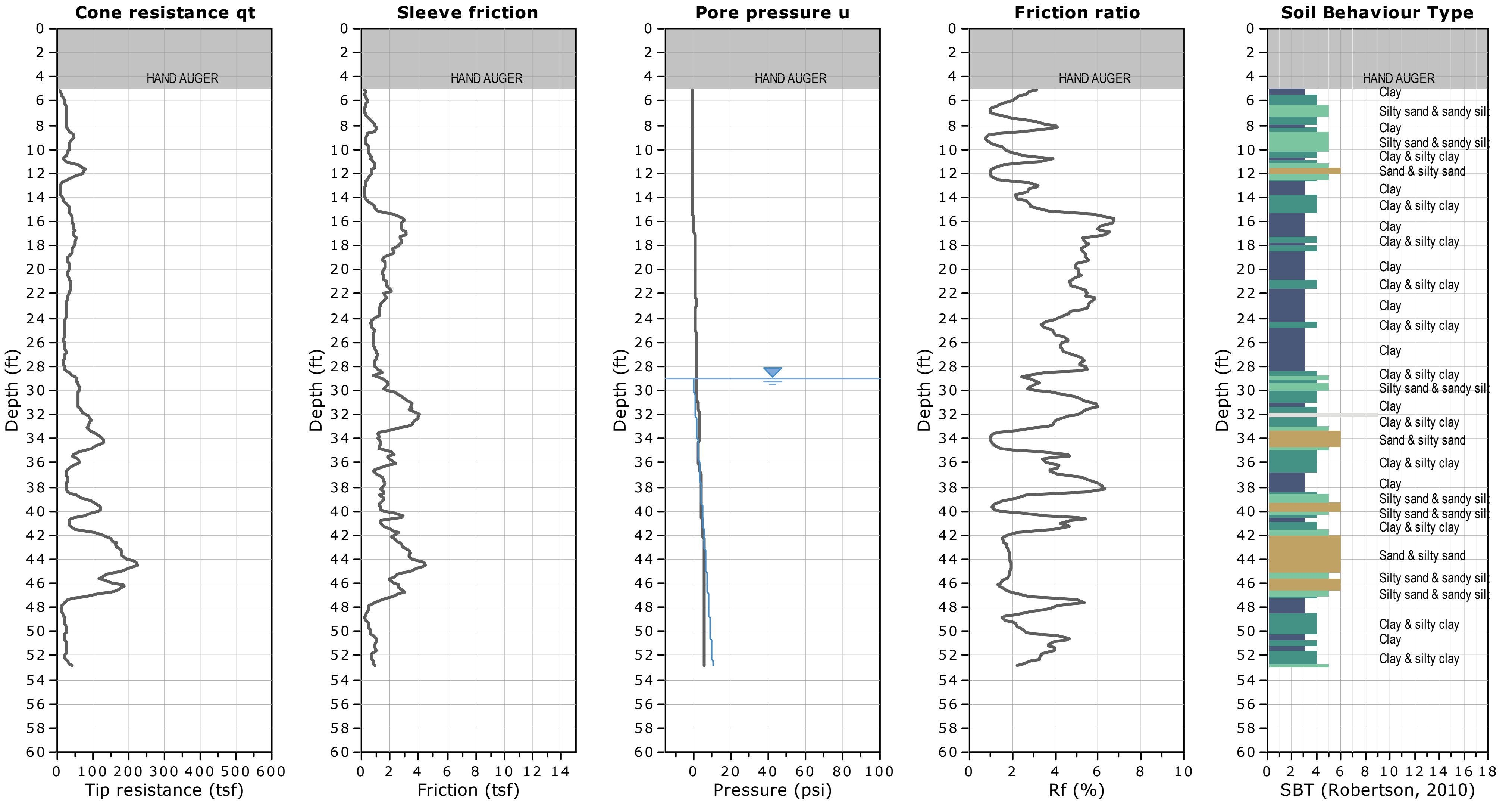


GREGG DRILLING, LLC
WWW.GREGGDRILLING.COM

CPT: CPT-5

CLIENT: NTS GEOTECHNICAL
SITE: HUB @ FULLERTON, CA

FIELD REP: NADIM
Total depth: 52.82 ft, Date: 8/25/2020



🟥 1. Sensitive fine grained
🟫 2. Organic material
🟦 3. Clay to silty clay
🟩 4. Clayey silt to silty clay
🟩 5. Silty sand to sandy silt
🟨 6. Clean sand to silty sand
🟧 7. Gravely sand to sand
⬛ 8. Very stiff sand to clayey
⬜ 9. Very stiff fine grained

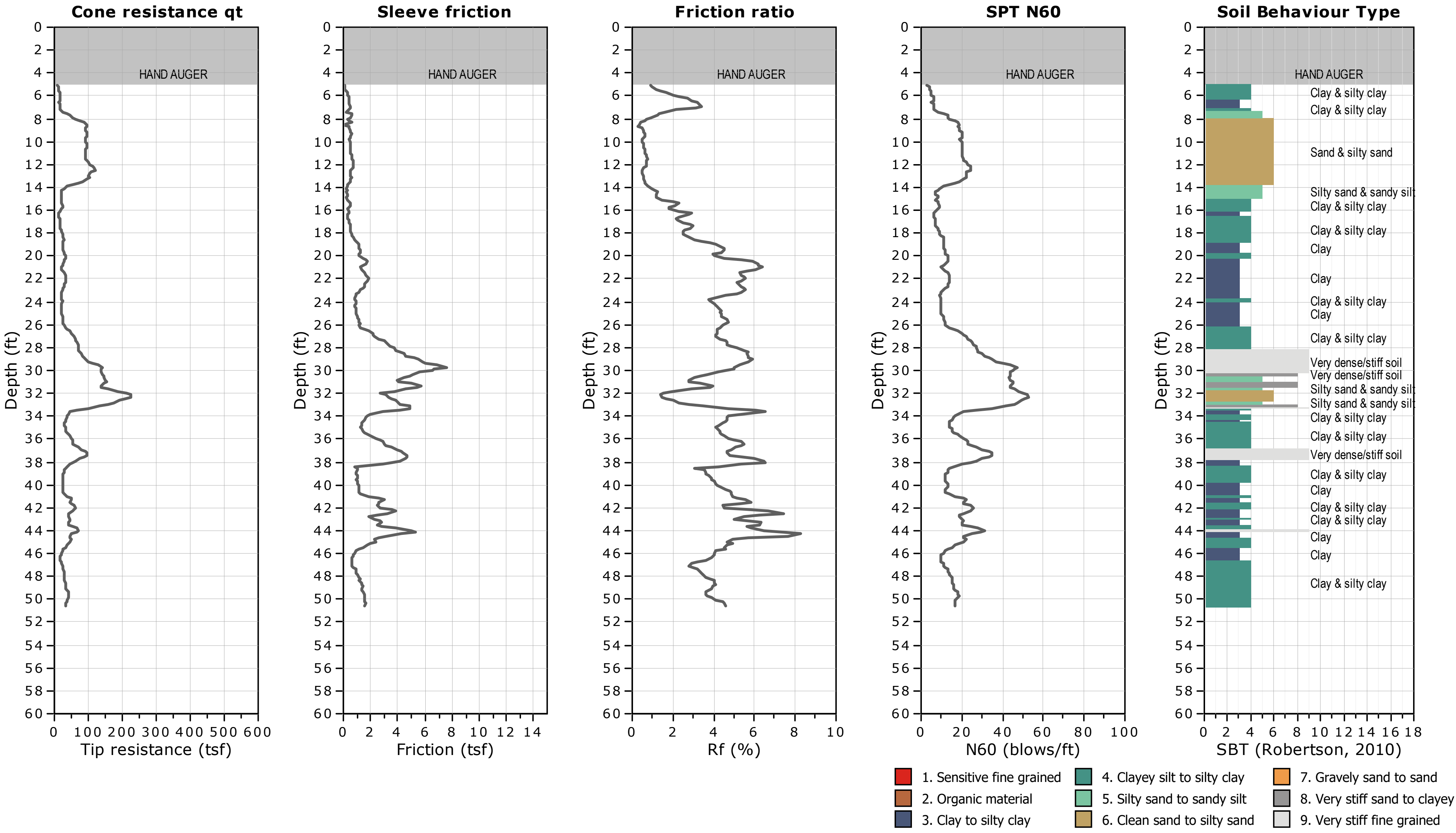
WATER TABLE FOR ESTIMATING PURPOSES ONLY

GREGG DRILLING, LLC
WWW.GREGGDRILLING.COM

CPT: SCPT-3

CLIENT: NTS GEOTECHNICAL
SITE: HUB @ FULLERTON, CA

FIELD REP: NADIM
Total depth: 50.52 ft, Date: 8/25/2020



APPENDIX B

Geotechnical Laboratory Testing

Appendix B
Geotechnical Laboratory Testing

Laboratory Moisture Content and Density Tests

The moisture content and dry densities of selected driven samples obtained from the exploratory borings were evaluated in general accordance with the latest version of ASTM D 2937. The test results are presented on the logs of the exploratory borings in Appendix A

Wash Sieve

The amount of fines passing the No. 200 sieve was evaluated by the wash sieve. The test procedure was in general accordance with ASTM D 1140. The results are presented in the table below:

Boring No.	Depth	Fines Passing No. 200 Sieve
B-1	5.0	53.0
B-1	15.0	54.9
B-1	25.0	49.1
B-1	35.0	25.2
B-1	45.0	30.2
B-1	55.0	82.4
B-2	10.0	77.1
B-2	20.0	69.2
B-2	30.0	37.6
B-3	5.0	41.3
B-3	15.0	26.8
B-3	25.0	21.9
B-4	10.0	5.9
B-4	20.0	55.4
B-4	30.0	49.3
B-5	5.0	55.3
B-5	15.0	59.2
B-5	25.0	74.5
B-5	35.0	55.8
B-5	45.0	87.8
B-5	55.0	23.8
B-6	15.0	6.2
B-6	35.0	14.6

B-6	45.0	31.1
B-7	15.0	31.2

Atterberg Limits

As part of the engineering classification of the soil material, some samples of the on-site soil material were tested to determine relative plasticity. This relative plasticity is based on the Atterberg limits determined in general accordance with ASTM Test Method D 4318. The results of these tests are summarized in the table below:

Boring No.	Depth	LL	PL	PI	USCS Classification
B-1	15.0	30	25	5	ML
B-2	20.0	36	16	20	CL
B-6	20.0	37	15	22	CL
B-7	15.0	32	13	19	CL

Direct Shear Tests

Direct shear tests were performed on selected remolded and relatively undisturbed soil samples in general accordance with ASTM D 3080 to evaluate the shear strength characteristics of the materials. The samples were inundated during shearing to represent adverse field conditions. Direct shear testing was performed by Hushmand Associates and NOVA Geotechnical, and the test results are attached to this Appendix B.

Consolidation Test

Consolidation tests was performed on a selected driven soil sample in general accordance with the latest version of ASTM D2435. The sample was inundated during testing to represent adverse field conditions. The percent consolidation for each load cycle was recorded as a ratio of the amount of vertical compression to the original height of the sample. Consolidation testing was performed by Hushmand Associates and NOVA Geotechnical, and the test results are attached to this Appendix B.

Corrosion Suite

The corrosion potential of typical on-site materials under long-term contact with both metal and concrete was determined by chemical and electrical resistance tests. The soluble sulfate test for potential concrete corrosion was performed in general accordance with California Test Method 417, the minimum resistivity test for potential metal corrosion was performed in general accordance with California Test Method 643, and the concentration of soluble chlorides was determined in general accordance with

California Test Method 422. Test was performed by Anaheim Laboratory and test results are attached to this Appendix B.

R-Value Test

A bulk sample representative of the underlying on-site materials was tested to measure the response of a compacted sample to a vertically applied pressure under specific conditions. The R-value of a material is determined when the material is in a state of saturation such that water will be exuded from the compacted test specimen when a 16.8 kN load (2.07 MPa) is applied. The result of this test is presented in the table below.

Boring No.	Depth	R-Value
B-1	0.0 – 5.0	15

HUSHMAND ASSOCIATES, INC.
Geotechnical and Earthquake Engineers

Hushmand Associates, Inc.
250 Goddard, Irvine,
CA 92618

p. (949) 777-1274
w. haieng.com
e. hai@haieng.com

May 5, 2020

NTS Geotechnical
15333 Culver Dr.,
Suite 340
Irvine, CA 92604

Attention: Mr. Lee Bainer

SUBJECT: Laboratory Test Result
Project Name: 2601 Chapman Ave. Fullerton -
Project No.: NTS 20073
HAI Project No.: TWI-20-005

Dear Mr. Bainer:

Enclosed is the result of the laboratory testing program conducted on samples from the above referenced project. The testing performed for this program was conducted in general accordance with the following test procedure:

Type of Test	Test Procedure
Direct Shear (Consolidated & Drained)	ASTM D3080
Consolidation	ASTM D2435

Attached are: two (2) 3-point Direct shear test results; and two (2) Consolidation test results.

We appreciate the opportunity to provide our testing services to Twining Inc. If you have any questions regarding the test results, please contact us.

Sincerely,

Kang Lin

Kang C. Lin, BS, EIT
Laboratory Manager

Woongju (MJ) Mun, PhD
Senior Staff Engineer

HUSHMAND ASSOCIATES, INC.
Geotechnical and Earthquake Engineers

DIRECT SHEAR TEST

ASTM D3080

HAI Project No.: TWI-20-005

Tested by: KL
Checked by: MJ
Date: 4/27/2020

Client: NTS Geotechnical
Project Name: 2601Chapman Ave. Fullerton
Project Number: -
Boring No.: B1
Sample No.: R
Sample Type: Undistured Tube
Depth (ft): 20
Soil Description: Brown, Sandy Clay (CL)

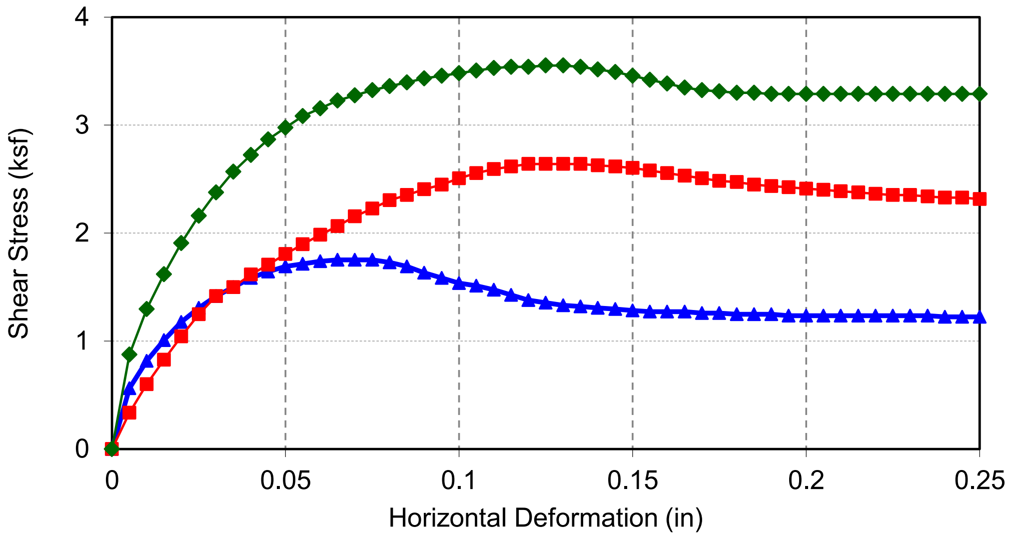
Type of test: **Consolidated, Drained**

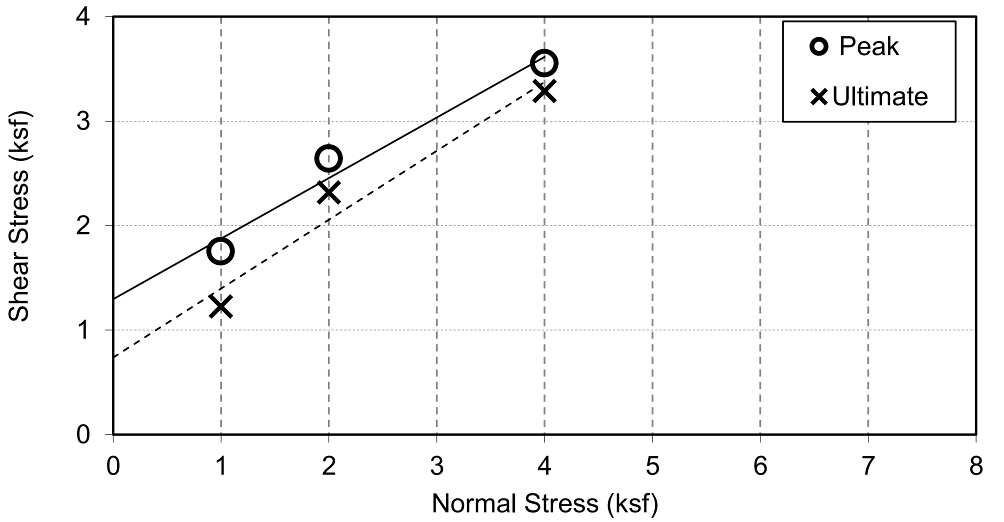
Test No.	1	2	3
Symbol	▲	■	◆
Normal Stress (ksf)	**1**	**2**	**4**
Deformation Rate (in/min)	**0.002**	**0.002**	**0.002**

Peak Shear Stress (ksf)	**O**	**1.75**	**2.64**	**3.55**
Shear Stress @ End of Test (ksf)	**X**	**1.22**	**2.32**	**3.29**

Initial Height of Sample (in)	1.000	1.000	1.000
Height of Sample before Shear (in)	0.9867	0.9765	0.9759
Diameter of Sample (in)	2.416	2.416	2.416
Initial Moisture Content (%)	**11.7**	**11.7**	**11.7**
Final Moisture Content (%)	**14.8**	**14.3**	**14.7**
Dry Density (pcf)	**118.8**	**119.9**	**118.6**

Strength Properties	Peak	Ultimate
Cohesion (psf)	**1300**	**740**
Friction Angle (degrees)	**30**	**33**





HUSHMAND ASSOCIATES, INC.
Geotechnical and Earthquake Engineers

DIRECT SHEAR TEST

ASTM D3080

HAI Project No.: TWI-20-005

Client: NTS Geotechnical

Project Name: 2601 Chapman Ave. Fullerton

Project Number: -

Boring No.: B3

Sample No.: R

Sample Type: Undistured Tube

Depth (ft): 10

Soil Description: Yellowish Brown, Poorly graded Sand With Silt (SP-SM)

Type of test: **Consolidated, Drained**

Tested by: KL

Checked by: MJ

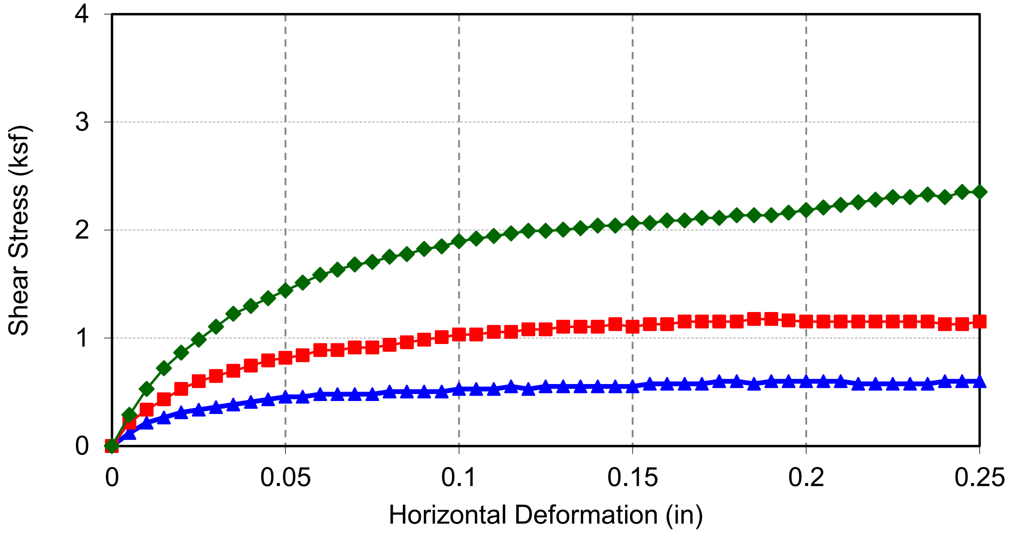
Date: 4/27/2020

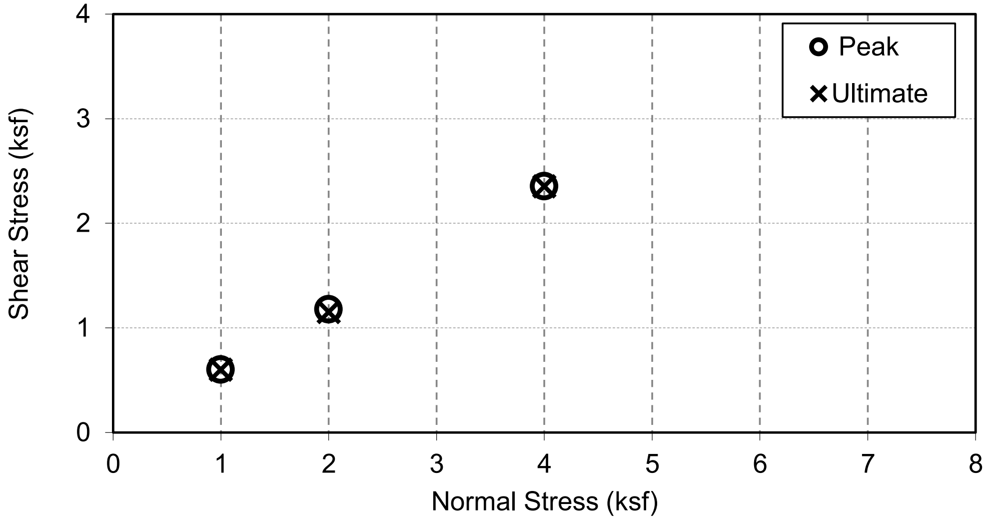
Test No.	1	2	3
Symbol	▲	🟥	◆
Normal Stress (ksf)	**1**	**2**	**4**
Deformation Rate (in/min)	**0.002**	**0.002**	**0.002**

Peak Shear Stress (ksf)	**O**	**0.60**	**1.18**	**2.35**
Shear Stress @ End of Test (ksf)	**X**	**0.60**	**1.15**	**2.35**

Initial Height of Sample (in)	1.000	1.000	1.000
Height of Sample before Shear (in)	0.9717	0.9644	0.9529
Diameter of Sample (in)	2.416	2.416	2.416
Initial Moisture Content (%)	**4.3**	**4.3**	**4.3**
Final Moisture Content (%)	**26.5**	**25.1**	**26.8**
Dry Density (pcf)	**79.8**	**82.6**	**84.3**

Strength Properties	Peak	Ultimate
Cohesion (psf)	**10**	**0**
Friction Angle (degrees)	**30**	**30**





CONSOLIDATION TEST

ASTM D2435

Client :	NTS Geotechnical	*HAI Project No.:*	TWI-20-005
Project Name:	2601 Chapman Ave. Fullerton	*Tested by:*	KL
Project Number:	NTS 20073	*Checked by:*	MJ
Boring No.:	B1	*Date:*	04/27/20
Sample No.:	R		
Type of Sample:	Undisturbed Tube		
Depth (ft):	10		
Soil Description:	Light Brown, Sandy Silt with some clay (ML)		

Initial Total Weight	Final Total Weight	Final Dry Weight
(g)	(g)	(g)
111.47	131.42	98.25

			Initial Conditions	**Final Conditions**
Height	H	(in)	1.027	0.934
Height of Solids	H_s	(in)	0.490	0.490
Height of Water	H_w	(in)	0.176	0.442
Height of Air	H_a	(in)	0.361	0.002
Dry Density		**(pcf)**	**79.5**	**93.6**
Water Content		**(%)**	**13.5**	**33.8**
Saturation		**(%)**	**32.8**	**99.5**

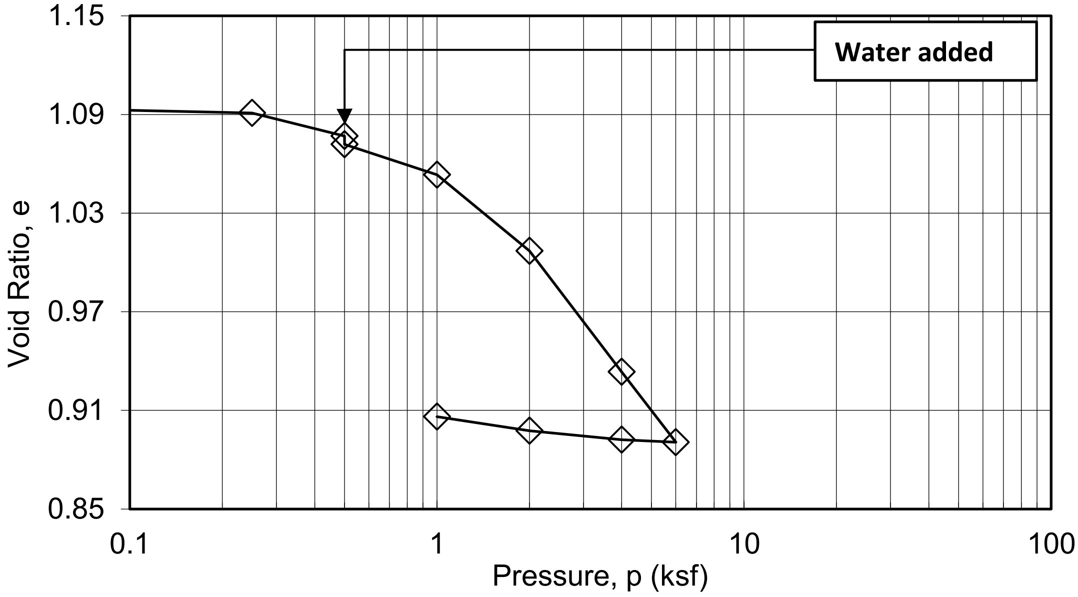
* Saturation is calcualted based on Gs= 2.67

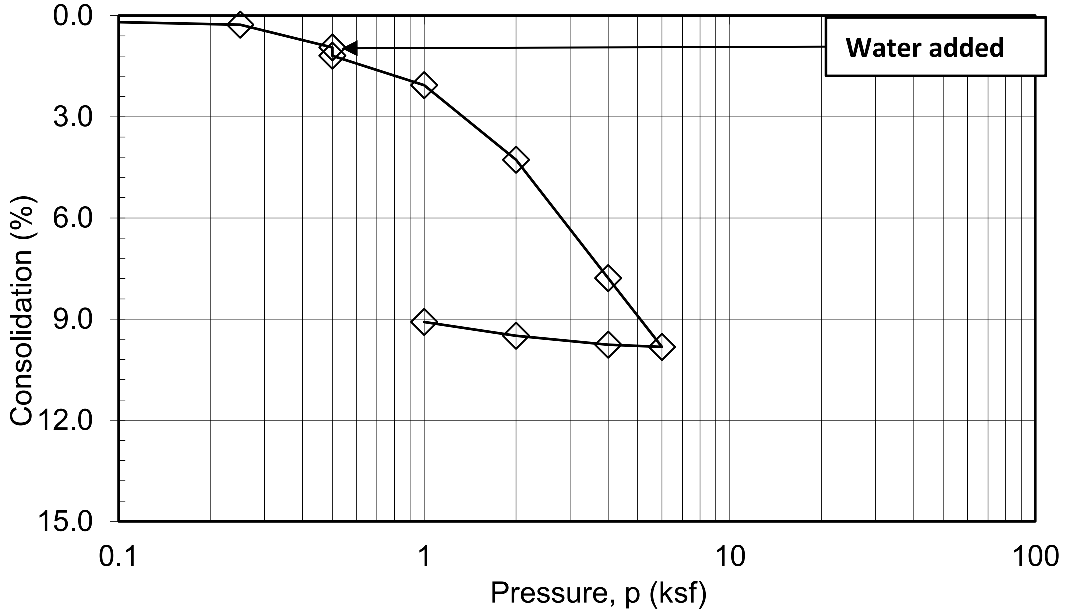
Load (ksf)	**δH (in)**	**H (in)**	**Voids (in)**	**e**	**Consol. (%)**	**a_v (ksf^{-1})**	**M_v (ksf^{-1})**	**Comment**
0.01	-------	1.0270	0.537	1.097	0			
0.25	0.0028	1.0242	0.534	1.091	0.3	2.4E-02	1.1E-02	
0.5	0.0097	1.0173	0.528	1.077	0.9	5.6E-02	2.7E-02	
0.5	0.0122	1.0148	0.525	1.072	1.2	Water Added		
1	0.0212	1.0058	0.516	1.053	2.1	3.7E-02	1.8E-02	
2	0.0439	0.9831	0.493	1.007	4.3	4.6E-02	2.3E-02	
4	0.0800	0.9470	0.457	0.933	7.8	3.7E-02	1.9E-02	
6	0.1009	0.9261	0.436	0.891	9.8	2.1E-02	1.1E-02	
4	0.1002	0.9268	0.437	0.892	9.8	Unloaded		
2	0.0975	0.9295	0.440	0.898	9.5			
1	0.0933	0.9337	0.444	0.906	9.1			

CONSOLIDATION TEST

ASTM D2435

Client :	NTS Geotechnical	*HAI Project No.:*	TWI-20-005
Project Name:	2601 Chapman Ave. Fullerton	*Tested by:*	KL
Project Number:	NTS 20073	*Checked by:*	MJ
Boring No.:	B1	*Date:*	04/27/20
Sample No.:	R		
Type of Sample:	Undisturbed Tube		
Depth (ft):	10		
Soil Description:	Light Brown, Sandy Silt with some clay (CL)		





CONSOLIDATION TEST

ASTM D2435

Client :	NTS Geotechnical	*HAI Project No.:*	TWI-20-005
Project Name:	2601 Chapman Ave. Fullerton NTS 20073	*Tested by:*	KL
Project Number:	B5	*Checked by:*	MJ
Boring No.:	R	*Date:*	04/27/20
Sample No.:	Undisturbed Tube		
Type of Sample:	20		
Depth (ft):	Reddish Brown, Sandy Clay (CL)		
Soil Description:			

Initial Total Weight	Final Total Weight	Final Dry Weight
(g)	(g)	(g)
163.92	164.98	141.80

			Initial Conditions	**Final Conditions**
Height	H	(in)	1.029	1.007
Height of Solids	H_s	(in)	0.697	0.697
Height of Water	H_w	(in)	0.294	0.309
Height of Air	H_a	(in)	0.038	0.002
Dry Density		**(pcf)**	**114.5**	**116.0**
Water Content		**(%)**	**15.6**	**16.3**
Saturation		**(%)**	**88.6**	**99.2**

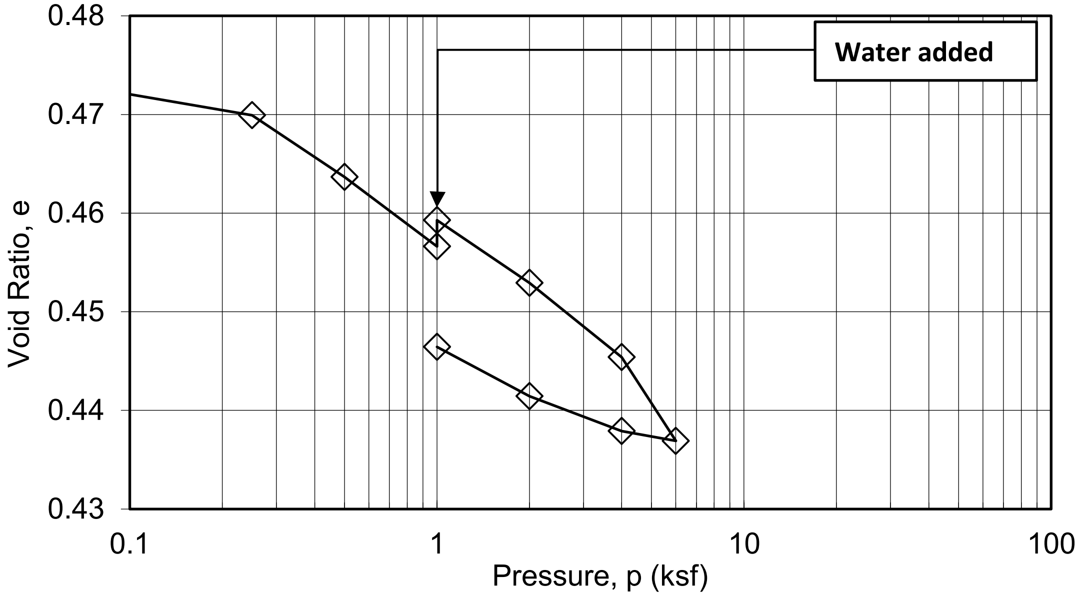
* Saturation is calcualted based on Gs= 2.71

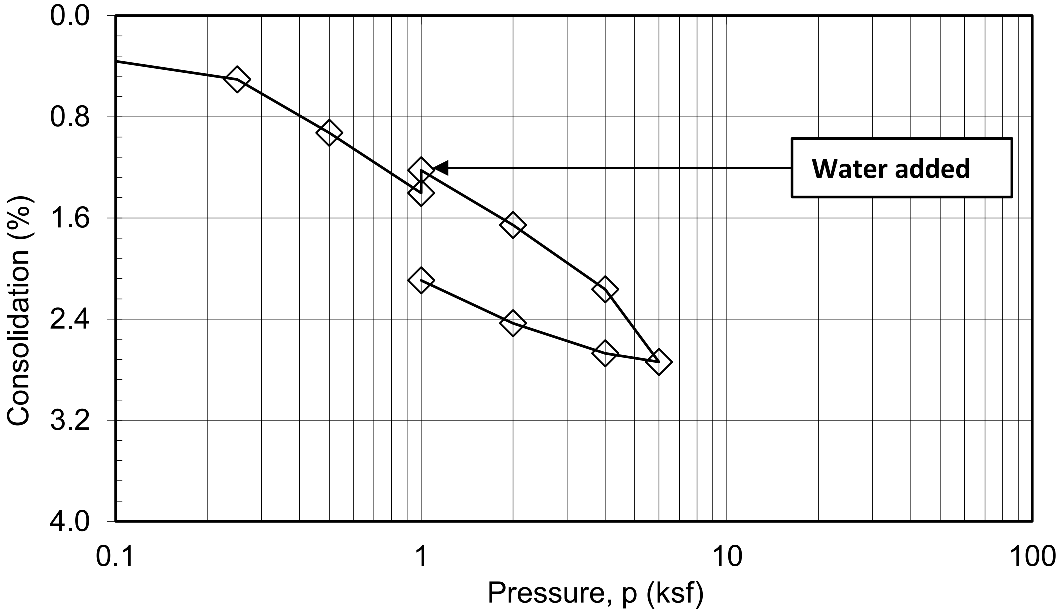
Load (ksf)	**δH (in)**	**H (in)**	**Voids (in)**	**e**	**Consol. (%)**	**a_v (ksf^{-1})**	**M_v (ksf^{-1})**	**Comment**
0.01	-------	1.0290	0.332	0.477	0			
0.25	0.0052	1.0238	0.327	0.470	0.5	3.1E-02	2.1E-02	
0.5	0.0096	1.0195	0.323	0.464	0.9	2.5E-02	1.7E-02	
1	0.0145	1.0146	0.318	0.457	1.4	1.4E-02	9.7E-03	
1	0.0126	1.0164	0.320	0.459	1.2	Water Added		
2	0.0170	1.0120	0.315	0.453	1.7	6.4E-03	4.4E-03	
4	0.0223	1.0067	0.310	0.445	2.2	3.8E-03	2.6E-03	
6	0.0282	1.0008	0.304	0.437	2.7	4.2E-03	2.9E-03	
4	0.0275	1.0015	0.305	0.438	2.7	Unloaded		
2	0.0250	1.0040	0.307	0.441	2.4			
1	0.0216	1.0075	0.311	0.446	2.1			

CONSOLIDATION TEST

ASTM D2435

Client :	NTS Geotechnical	*HAI Project No.:*	TWI-20-005
Project Name:	2601 Chapman Ave. Fullerton	*Tested by:*	KL
Project Number:	NTS 20073	*Checked by:*	MJ
Boring No.:	B5	*Date:*	04/27/20
Sample No.:	R		
Type of Sample:	Undisturbed Tube		
Depth (ft):	20		
Soil Description:	Reddish Brown, Sandy Clay (CL)		





Job No.: SCG-20-028
Sample No.: B-6 @ 7.5
Client Name: NTS Geotechnical
Sampled By: R.A

☒ Split Sieve ☐ Total Wash Sieve

Sieve Analysis- ASTM C117, C136

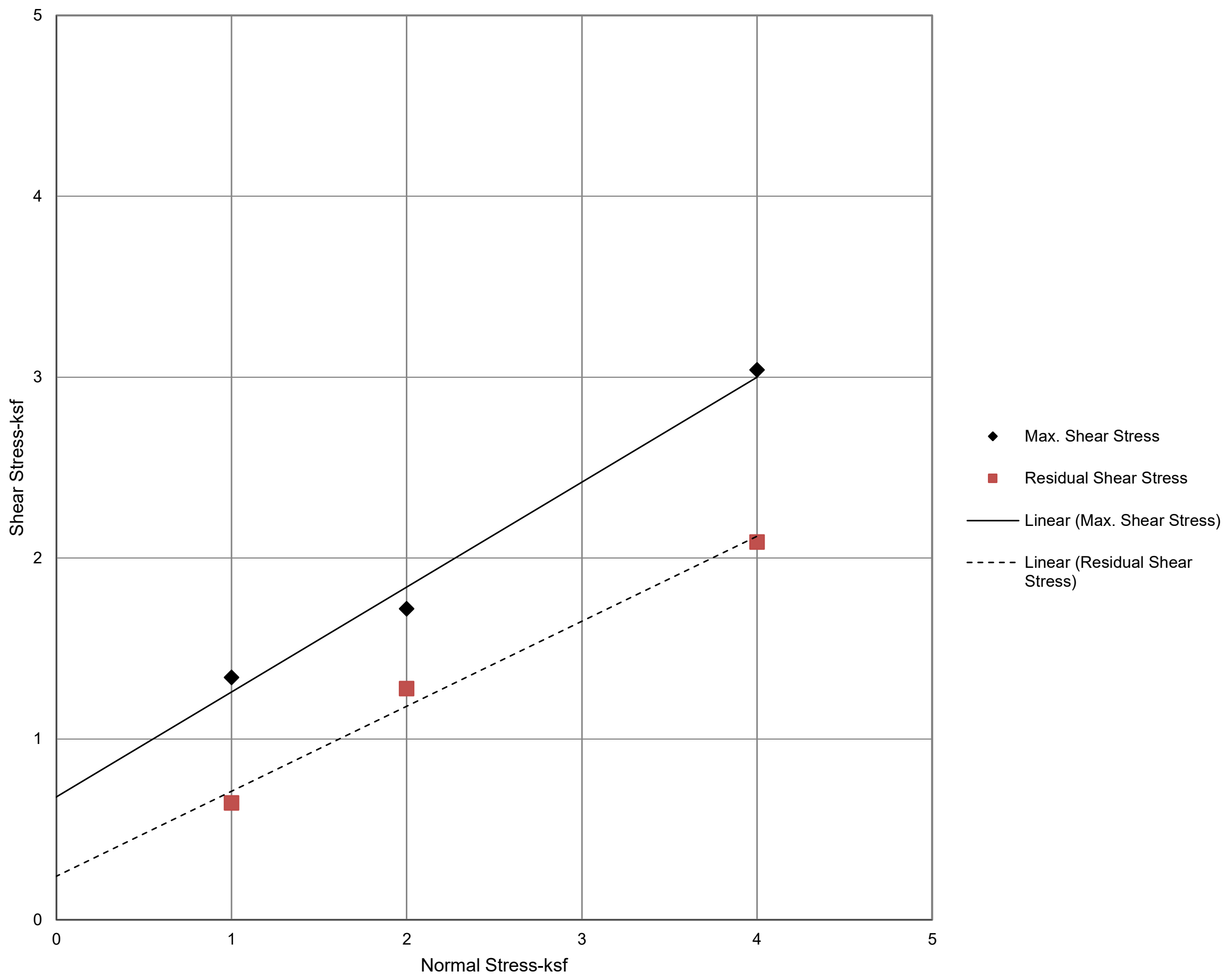
Sieve Passing	Indiv. Wt. Retained	Accum. Wt. Retained	Accum. % Retained	Accum. % Passing	Specifications min.	 max.
6-inch						
4-inch						
3 1/2-inch						
3-inch						
2 1/2-inch						
2-inch						
1 1/2-inch						
1-inch						
3/4inch						
1/2-inch						
3/8-inch						
No. 4	0.0	0.0	0.0	100.0		
WW of -NO.4	172.2	▨	W,W, Bef. Wash		172.2	
DW of -No.4	159.1	▨	D.W. Bef, Wash		159.1	
DW of Total	159.1	▨	D.W. Aft. Wash		101.5	
WW of Total	172.2	▨	%Loss *	1.43	min	max
No. 8	0.0	0.0	0.0	100		
No. 10	0.1	0.1	0.0	100		
No. 16	0.0	0.1	0.1	100		
No. 30	0.3	0.4	0.2	100		
No. 40	4.0	4.3	2.7	97		
No. 50	10.6	14.9	9.4	91		
No.100	46.4	61.4	38.6	61		
No. 200	36.1	97.5	61.3	37.3		
Pan	1.7	99.2	▨	Moisture Data:		
☐ Fineness Modulus:			▨	Wet Wt.	90.8	
		Results	Maximum	Dry Wt.	83.9	
	Liquid Limit			Wt of Water	6.9	
	Plasticity Index			% Moisture	8.2	

% Gravel	0.0
% Sand	62.7
% Silt & Clay	37.3
Total	100.0%

Note: NDOT Dense Graded Plantmix must have #10 and #40 Sieves

*Loss must be less than or equal to 0.3% of sample.

Friction Angle Determination



Maximum Density= pcf Optimum Moisture %

Sample No.	Normal Stress (ksf)	Maximum Shear Stress (ksf)	Residual Shear Stress (ksf)	Wet Density (psf)	Moisture Content (%)	Dry Density (psf)	Compaction (%)
B-1 @ 5	1.0	1.3	0.6	118.5	N/A	N/A	N/A
B-1 @ 5	2.0	1.7	1.3	118.5	N/A	N/A	N/A
B-1 @ 5	4.0	3.0	2.1	118.5	N/A	N/A	N/A

Sample Type: CAL RING Samples **Test Condition:** In-situ **Sample Location:** B-6@2.5 ft.

Maximum Shear Stress Test Results

Cohesion (psf):	680
Friction Angle (degrees):	30
Shear Rate (in/min)	**0.02**

Residual Shear Stress Test Results

Cohesion (psf):	241
Friction Angle (degrees):	25
Shear Rate (in/min)	**0.02**

Lab ID: B-1 @ 5 ft.

Sample Date: 8-25-2020

Project No.

SCG-20-028

NOVA GEOTECHNICAL & inspection services

16 Technology Dr. Ste 139
Irvine, CA 92618
949-537-3222

Reviewed By:______________________________

Rouzbeh Afshar, Ph.D., P.E.
Geotechnical Department Manager

Project: 2601-2751 Chapman Ave

Boring No: B-6

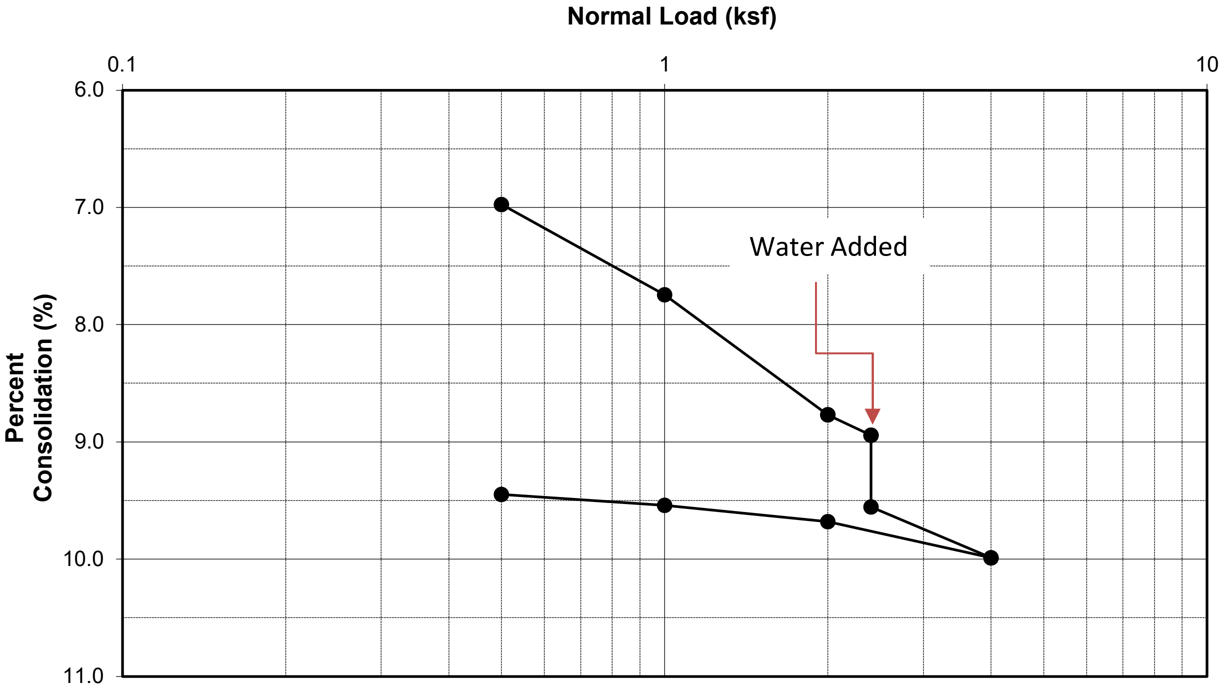
Soil Type: CL

Tested By: RA

Project No. SCG-20-028

Depth: 15 feet

Date: 9/7/2020



Project: 2601-2751 Chapman Ave

Boring No: B-7

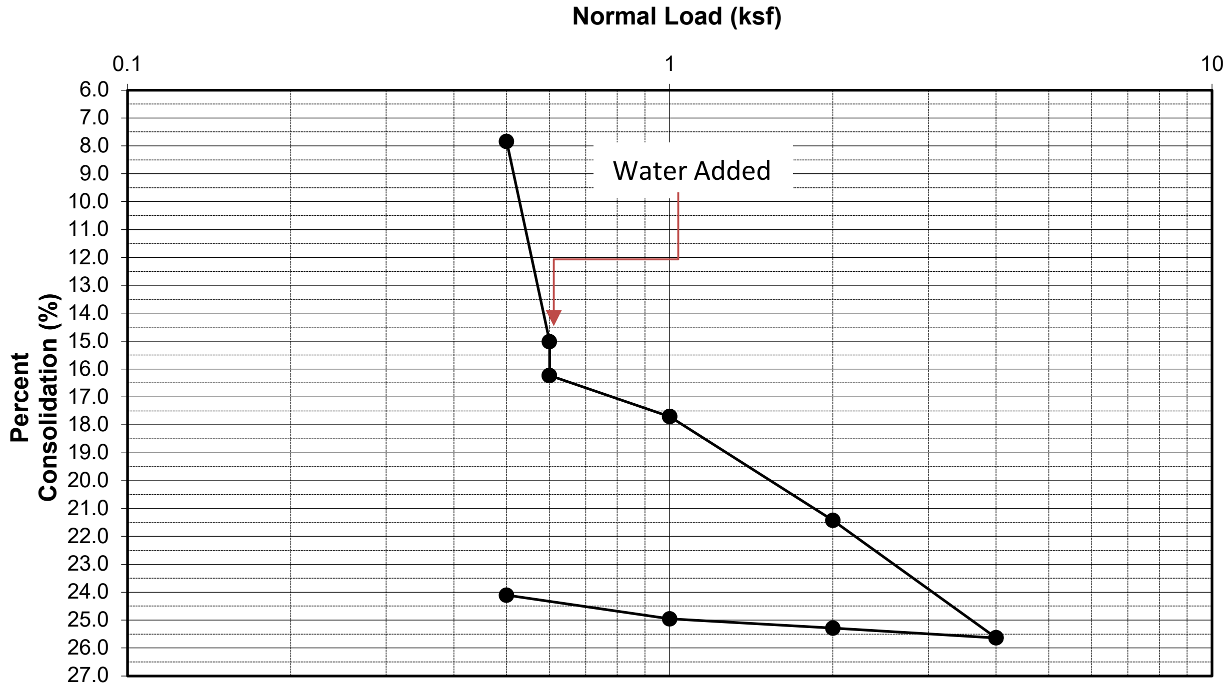
Soil Type: SM

Tested By: RA

Project No. SCG-20-028

Depth: 5 feet

Date: 9/8/2020



Project: 2601-2751 Chapman Ave

Boring No: B-7

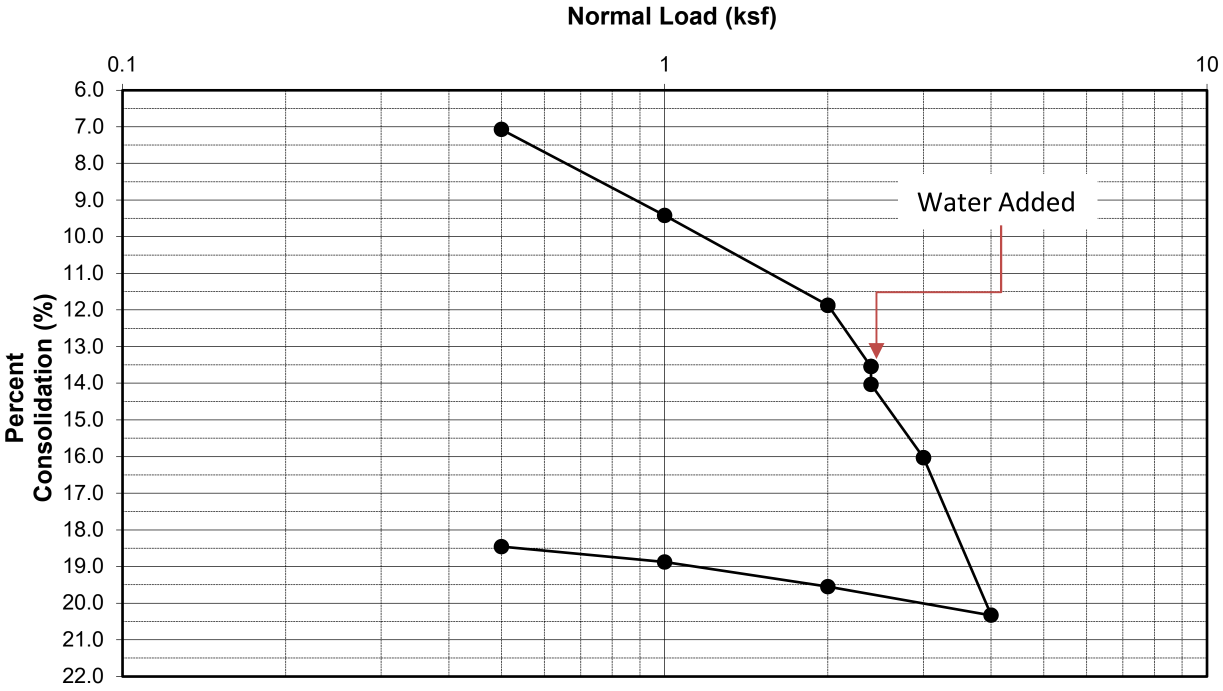
Soil Type: CL

Tested By: RA

Project No. SCG-20-028

Depth: 25 feet

Date: 9/8/2020



APPENDIX C

CPT Liquefaction Analysis

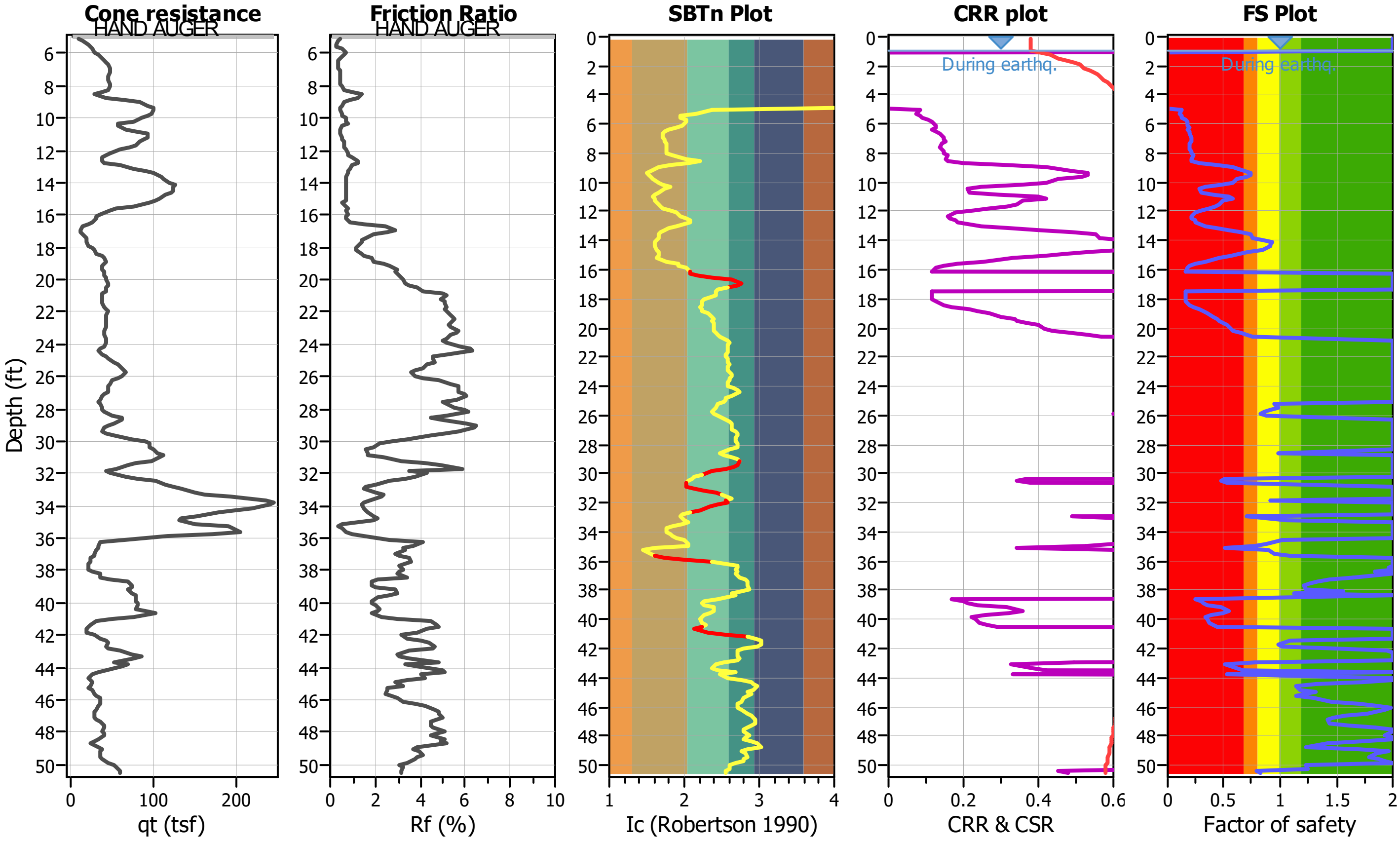
LIQUEFACTION ANALYSIS REPORT

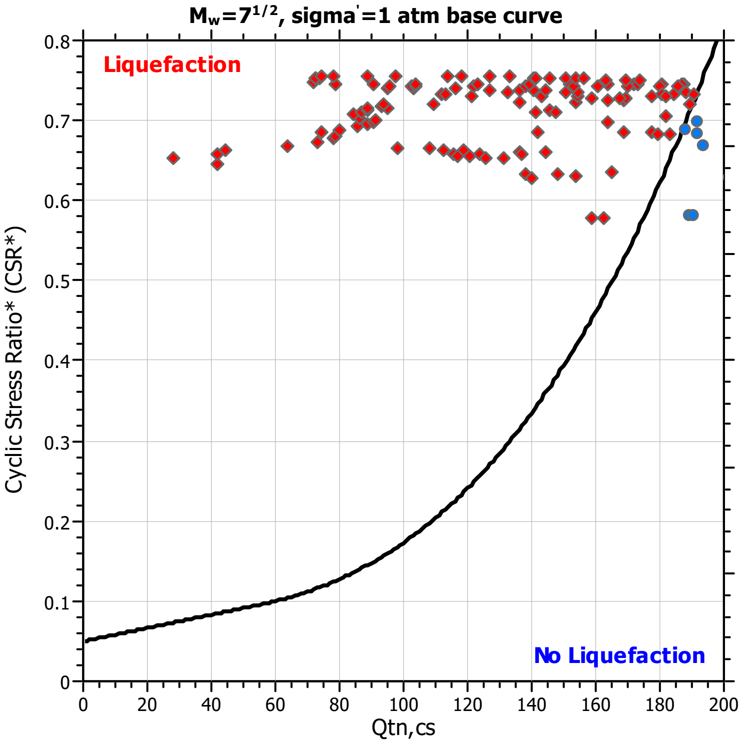
Project title : **Location :**

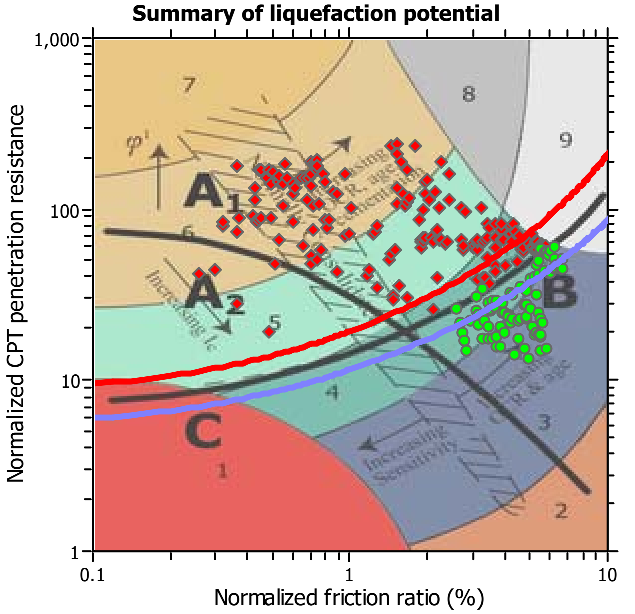
CPT file : CPT-01

Input parameters and analysis data

Analysis method:	Robertson (2009)	G.W.T. (in-situ):	1.00 ft	Use fill:	No	Clay like behavior applied:	All soils
Fines correction method:	Robertson (2009)	G.W.T. (earthq.):	1.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	1	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.70	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.78	Unit weight calculation:	Based on SBT	K_σ applied:	No		

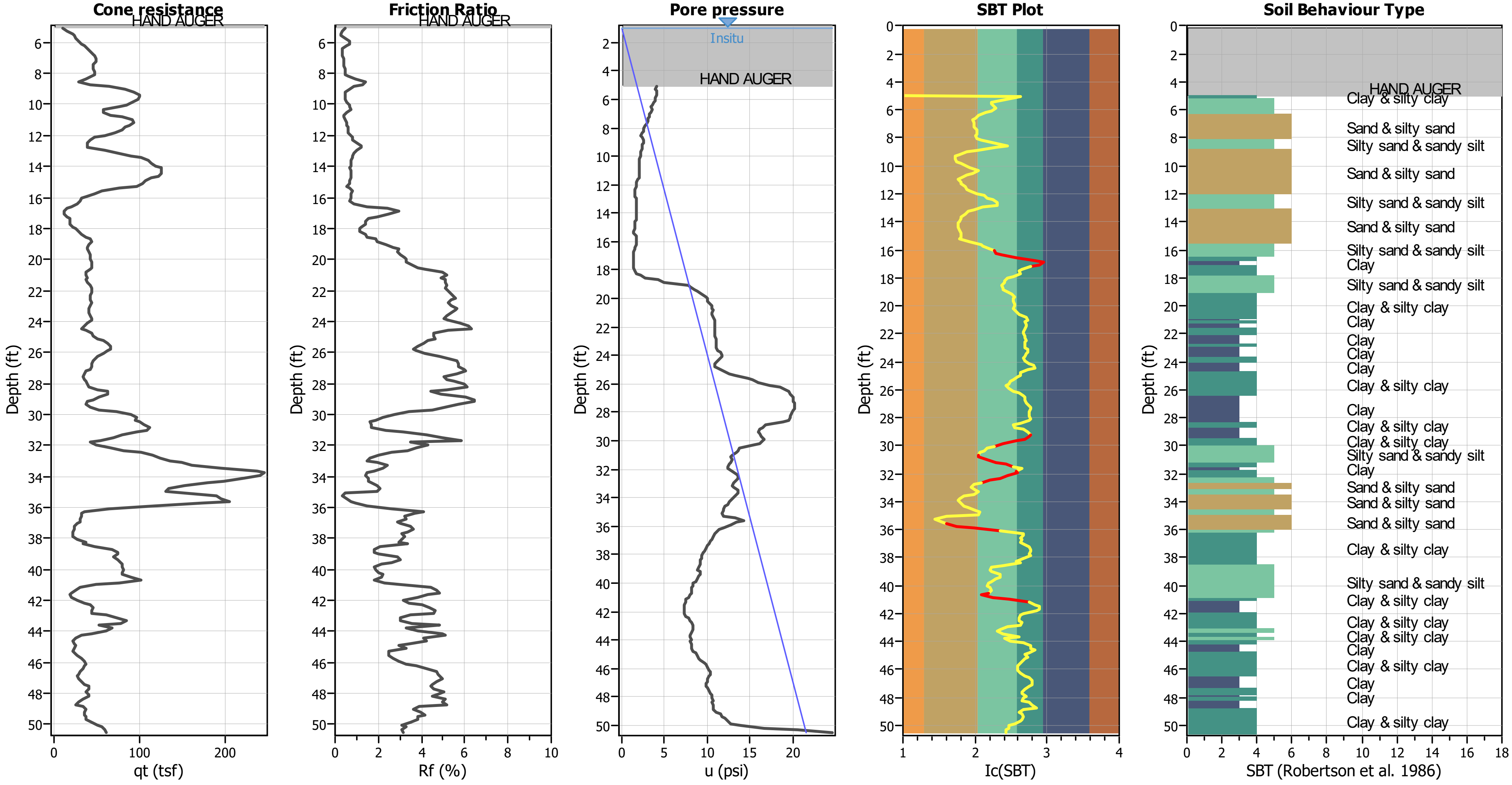






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



Input parameters and analysis data

Analysis method: Robertson (2009)
Fines correction method: Robertson (2009)
Points to test: Based on Ic value
Earthquake magnitude M_w: 6.70
Peak ground acceleration: 0.78
Depth to water table (insitu): 1.00 ft

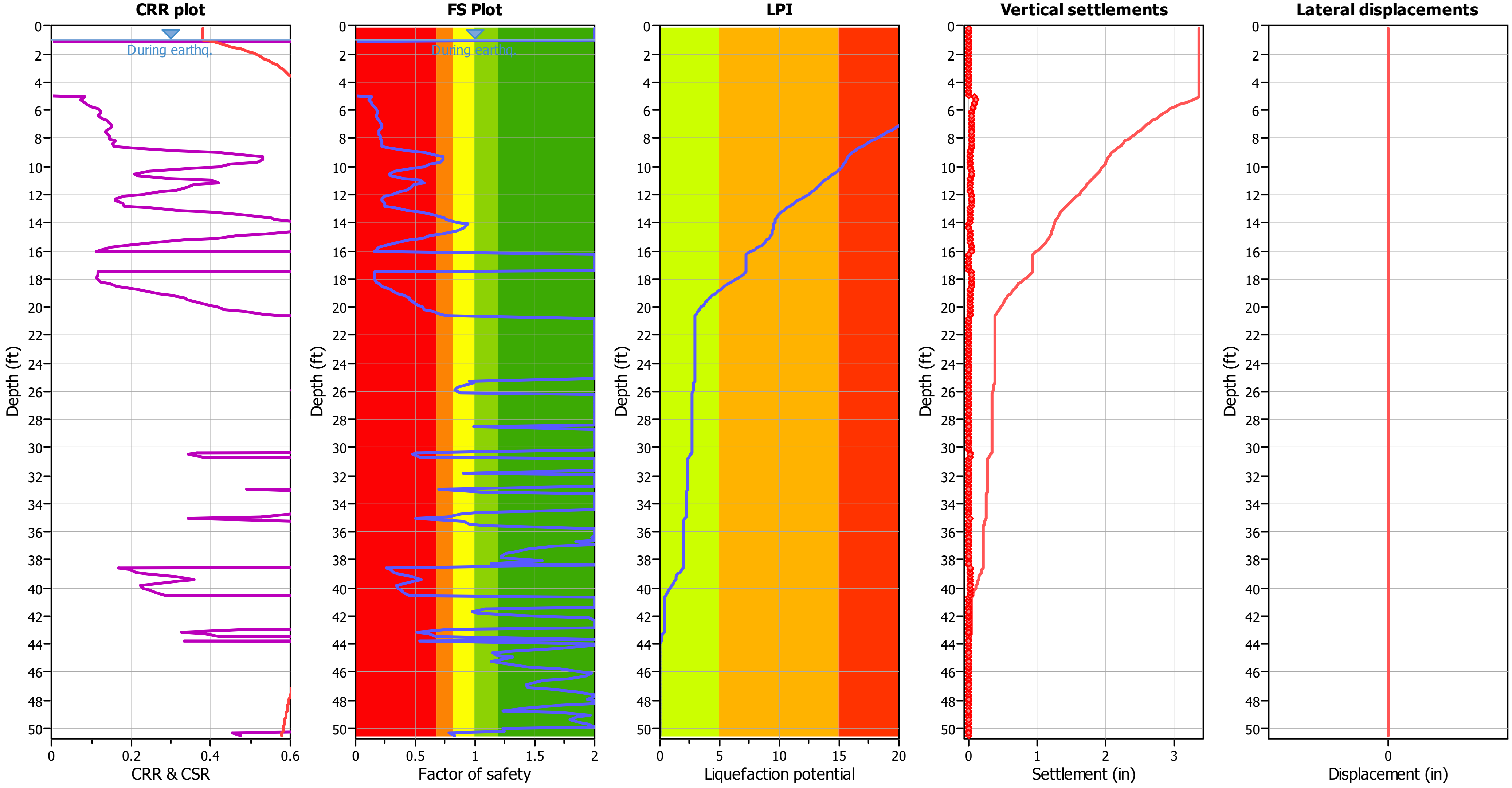
Depth to water table (erthq.): 1.00 ft
Average results interval: 1
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT
Use fill: No
Fill height: N/A

Fill weight: N/A
Transition detect. applied: Yes
K_σ applied: No
Clay like behavior applied: All soils
Limit depth applied: No
Limit depth: N/A

SBT legend

- 🟥 1. Sensitive fine grained
- 🟫 2. Organic material
- 🟦 3. Clay to silty clay
- 🟩 4. Clayey silt to silty
- 🟩 5. Silty sand to sandy silt
- 🟨 6. Clean sand to silty sand
- 🟧 7. Gravely sand to sand
- ⬛ 8. Very stiff sand to
- ⬜ 9. Very stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	1.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.78	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 ft	Fill height:	N/A	Limit depth:	N/A

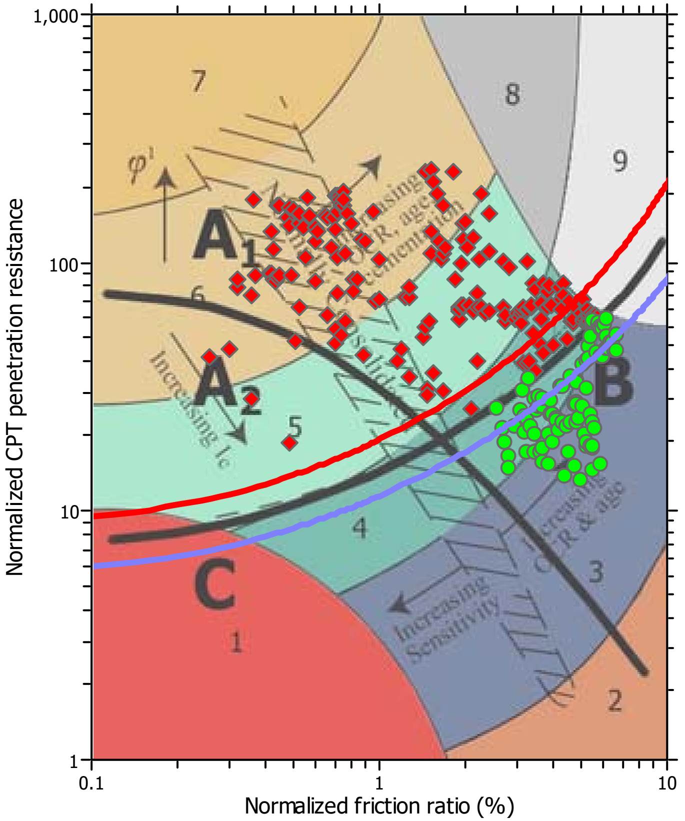
F.S. color scheme

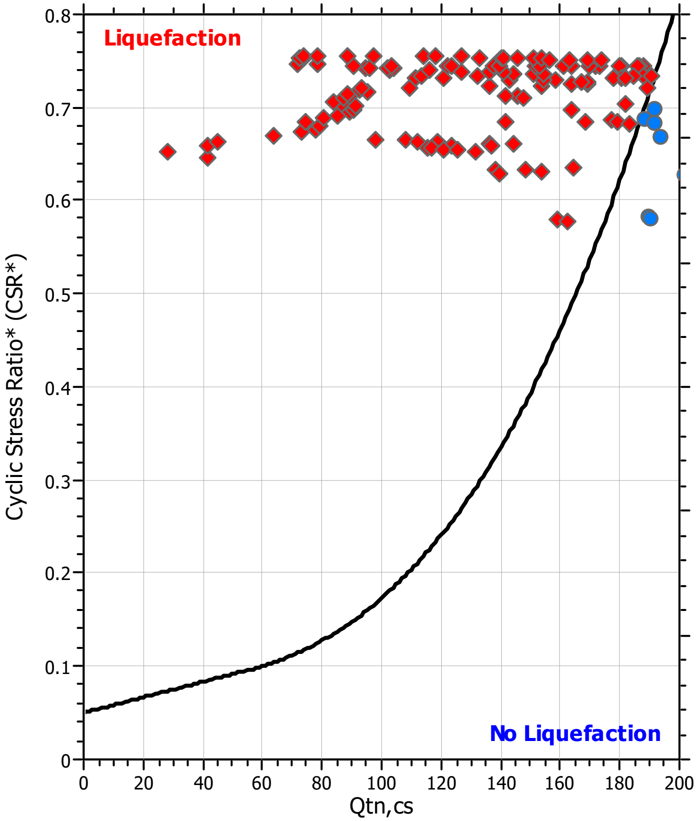
- 🟥 Almost certain it will liquefy
- 🟧 Very likely to liquefy
- 🟨 Liquefaction and no liq. are equally likely
- 🟩 Unlike to liquefy
- 🟩 Almost certain it will not liquefy

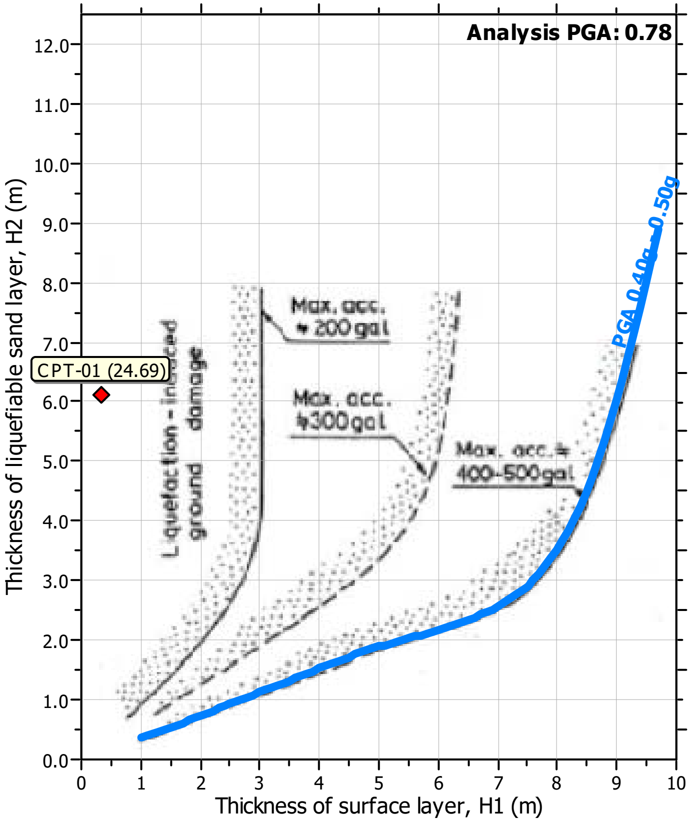
LPI color scheme

- 🟥 Very high risk
- 🟧 High risk
- 🟨 Low risk

Liquefaction analysis summary plots



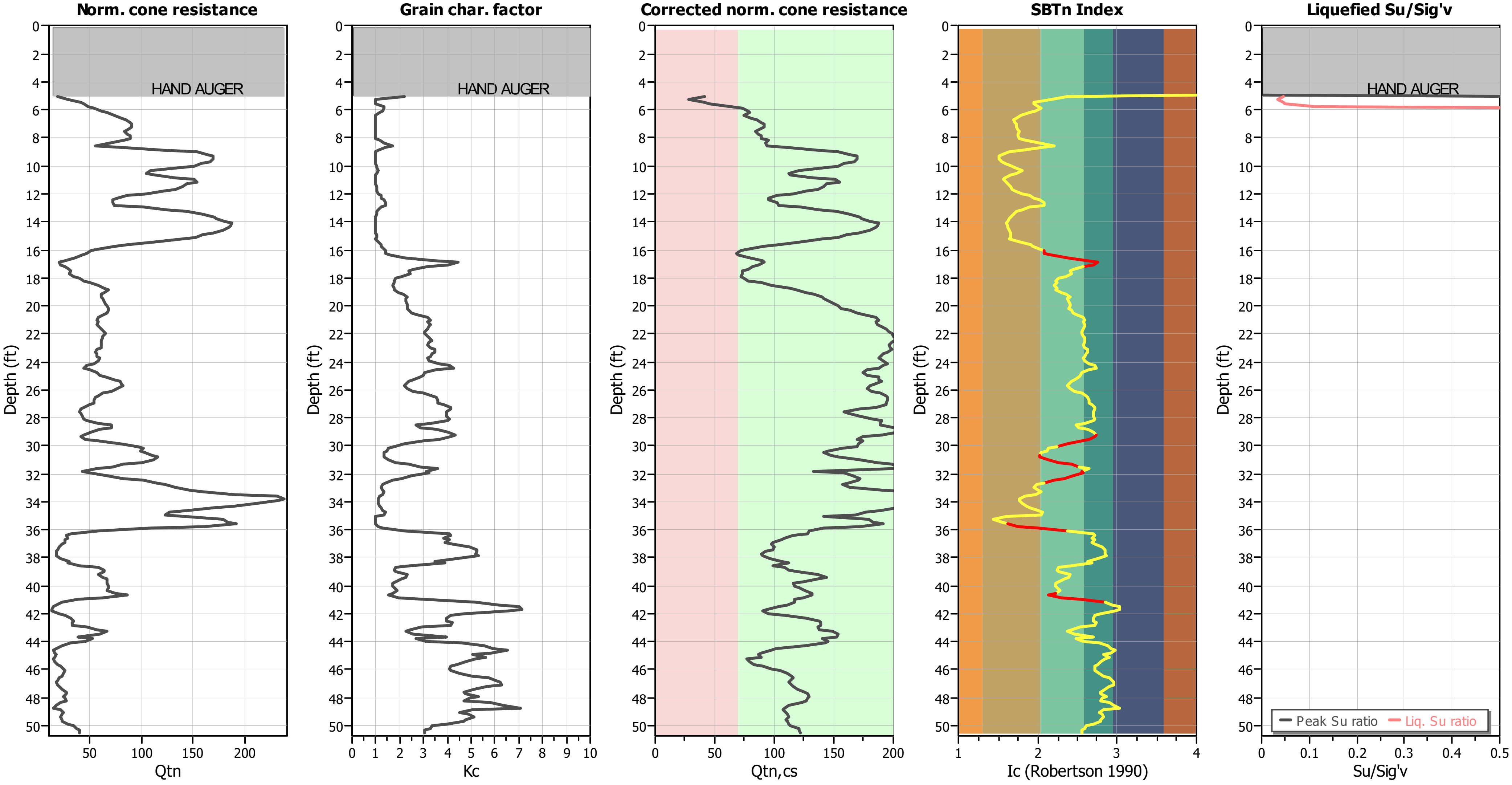




Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	1.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.78	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 ft	Fill height:	N/A	Limit depth:	N/A

Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	1.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.78	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 ft	Fill height:	N/A	Limit depth:	N/A

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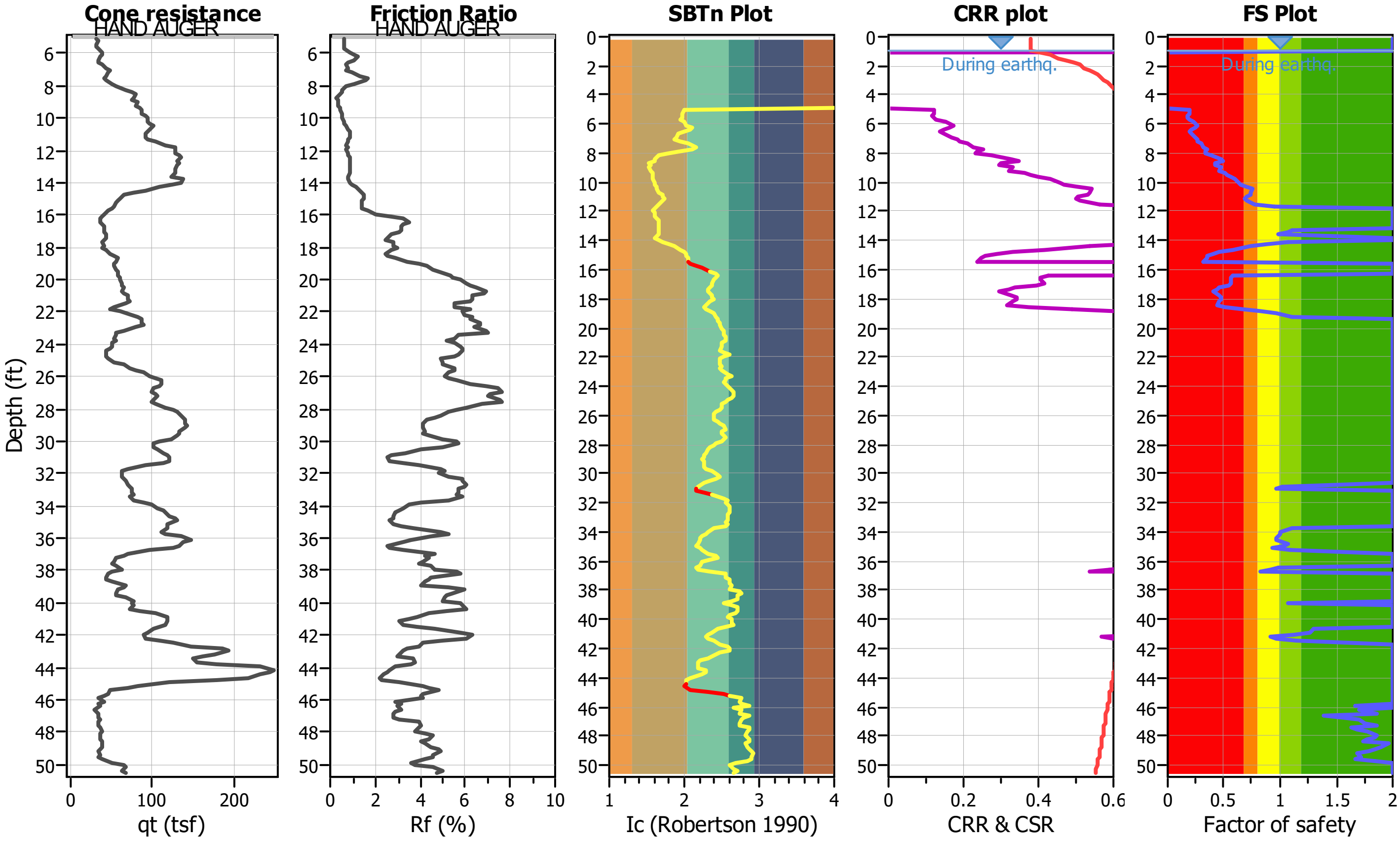
LIQUEFACTION ANALYSIS REPORT

Project title : **Location :**

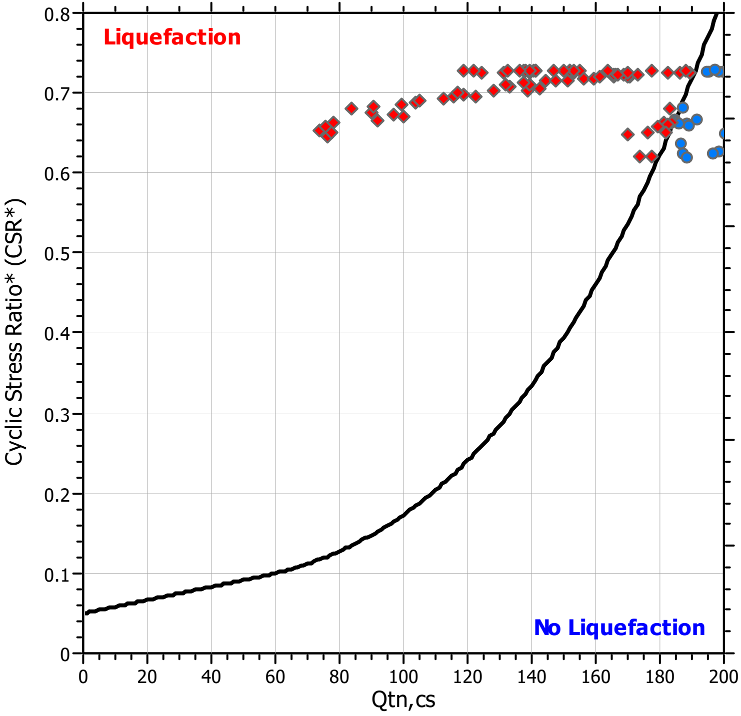
CPT file : CPT-02

Input parameters and analysis data

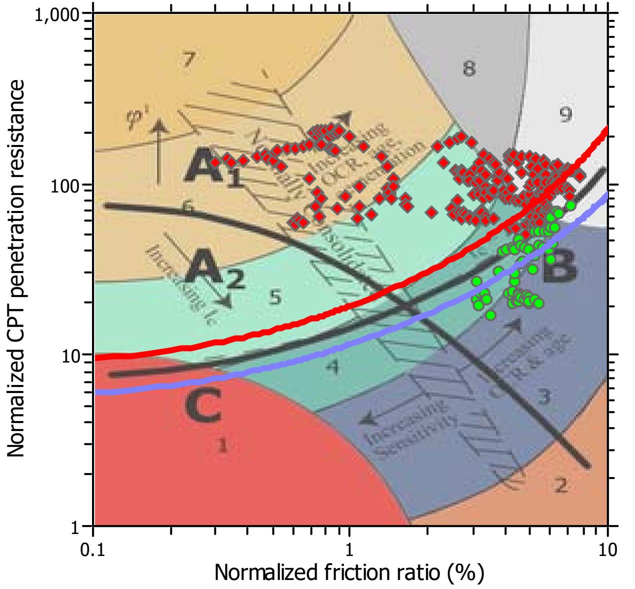
Analysis method:	Robertson (2009)	G.W.T. (in-situ):	1.00 ft	Use fill:	No	Clay like behavior applied:	All soils
Fines correction method:	Robertson (2009)	G.W.T. (earthq.):	1.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	1	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.70	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.78	Unit weight calculation:	Based on SBT	K_σ applied:	No		



$M_w=7^{1/2}$, sigma'=1 atm base curve

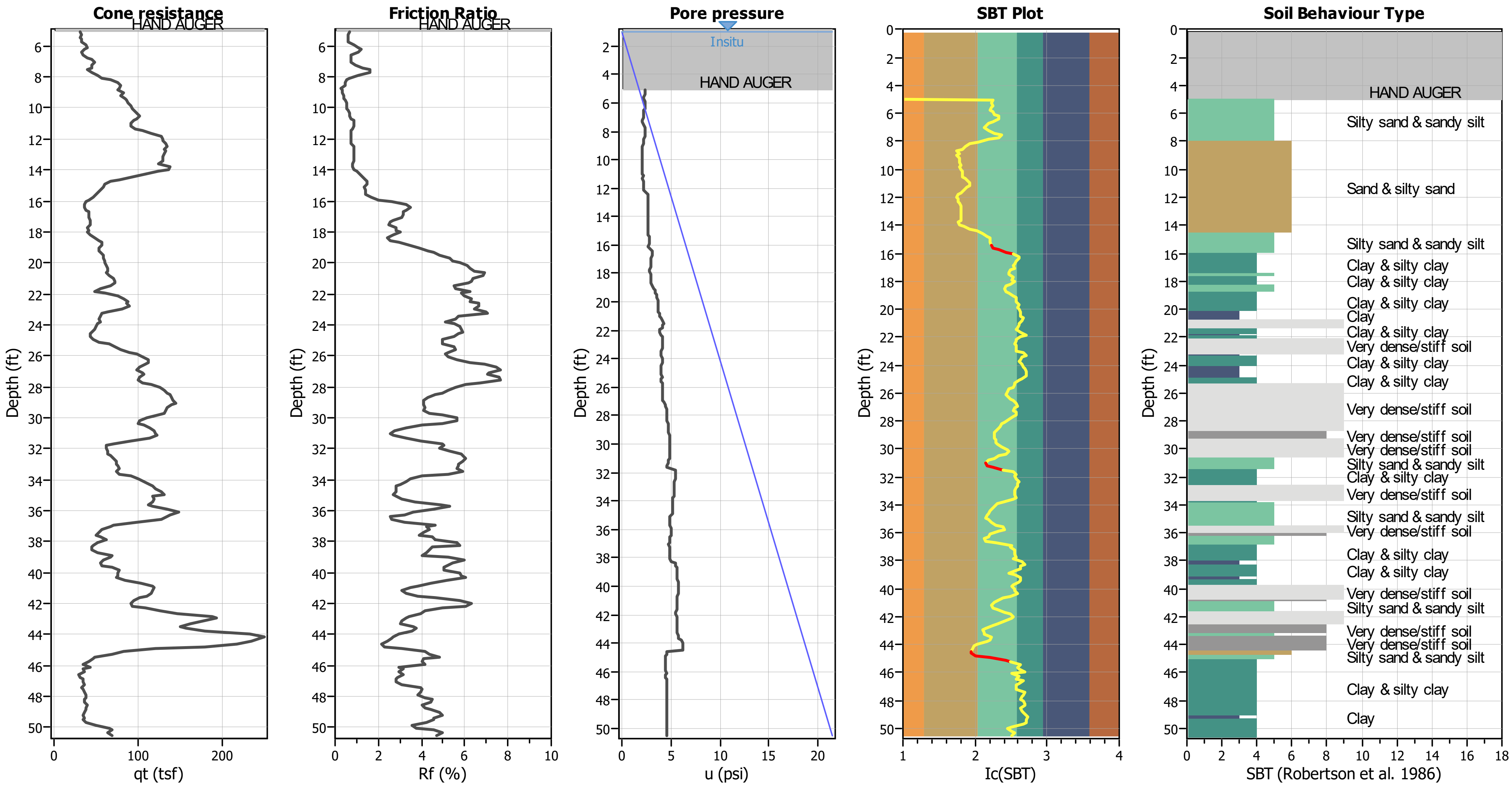


Summary of liquefaction potential



Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



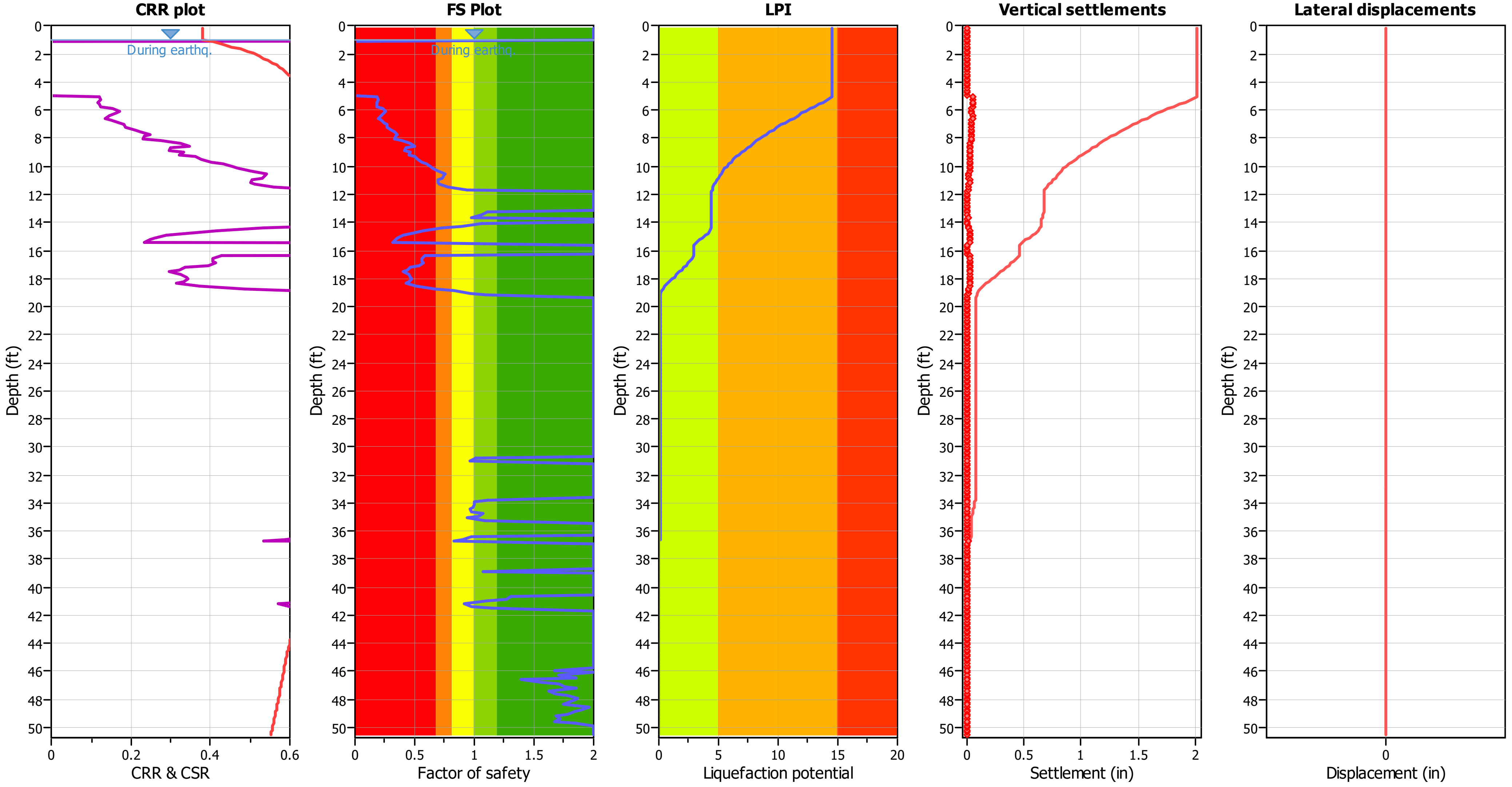
Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	1.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.78	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

🟥	1. Sensitive fine grained	■	4. Clayey silt to silty	🟧	7. Gravely sand to sand
🟫	2. Organic material	🟩	5. Silty sand to sandy silt	■	8. Very stiff sand to
🟦	3. Clay to silty clay	🟨	6. Clean sand to silty sand	⬜	9. Very stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	1.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.78	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 ft	Fill height:	N/A	Limit depth:	N/A

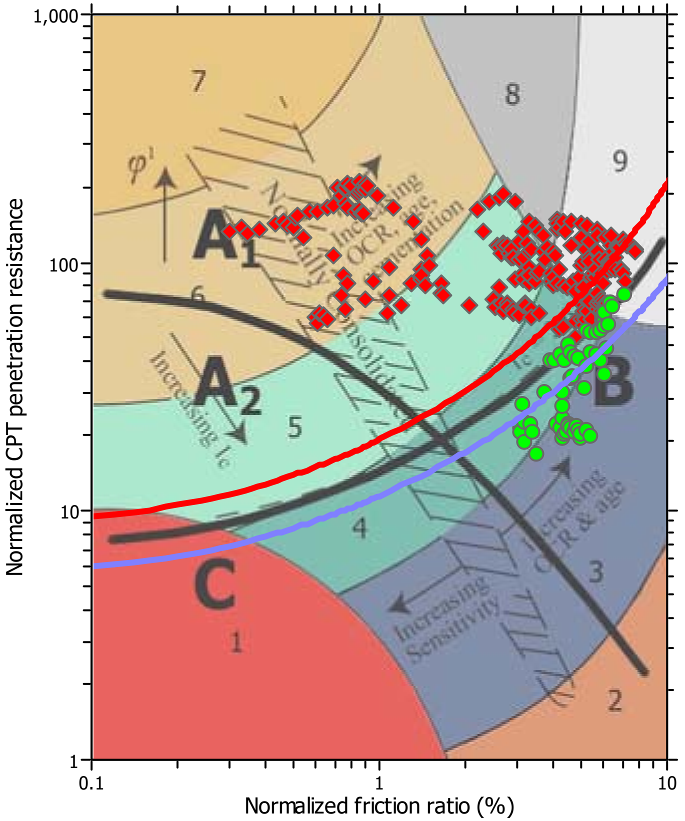
F.S. color scheme

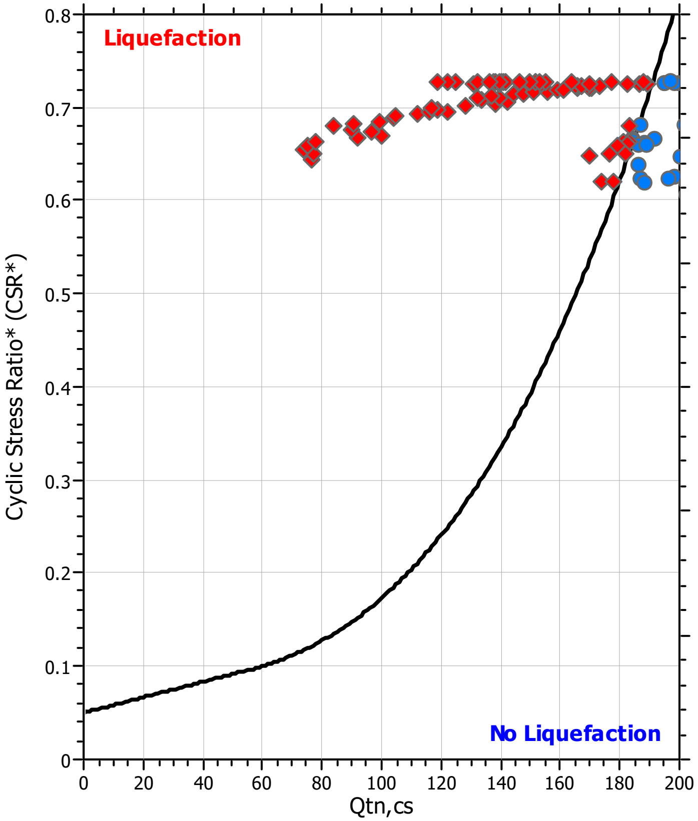
- 🟥 Almost certain it will liquefy
- 🟧 Very likely to liquefy
- 🟨 Liquefaction and no liq. are equally likely
- 🟩 Unlike to liquefy
- 🟩 Almost certain it will not liquefy

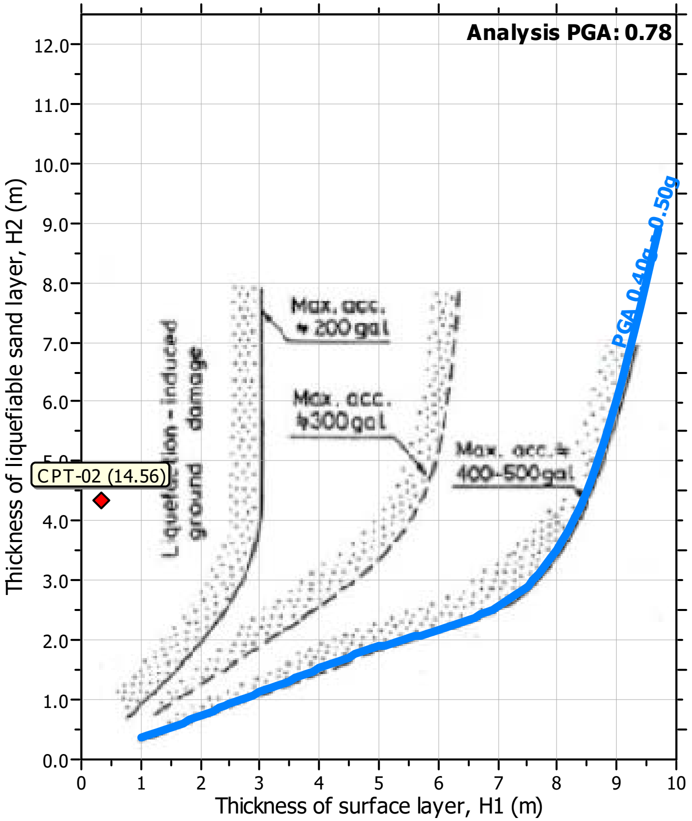
LPI color scheme

- 🟥 Very high risk
- 🟧 High risk
- 🟨 Low risk

Liquefaction analysis summary plots



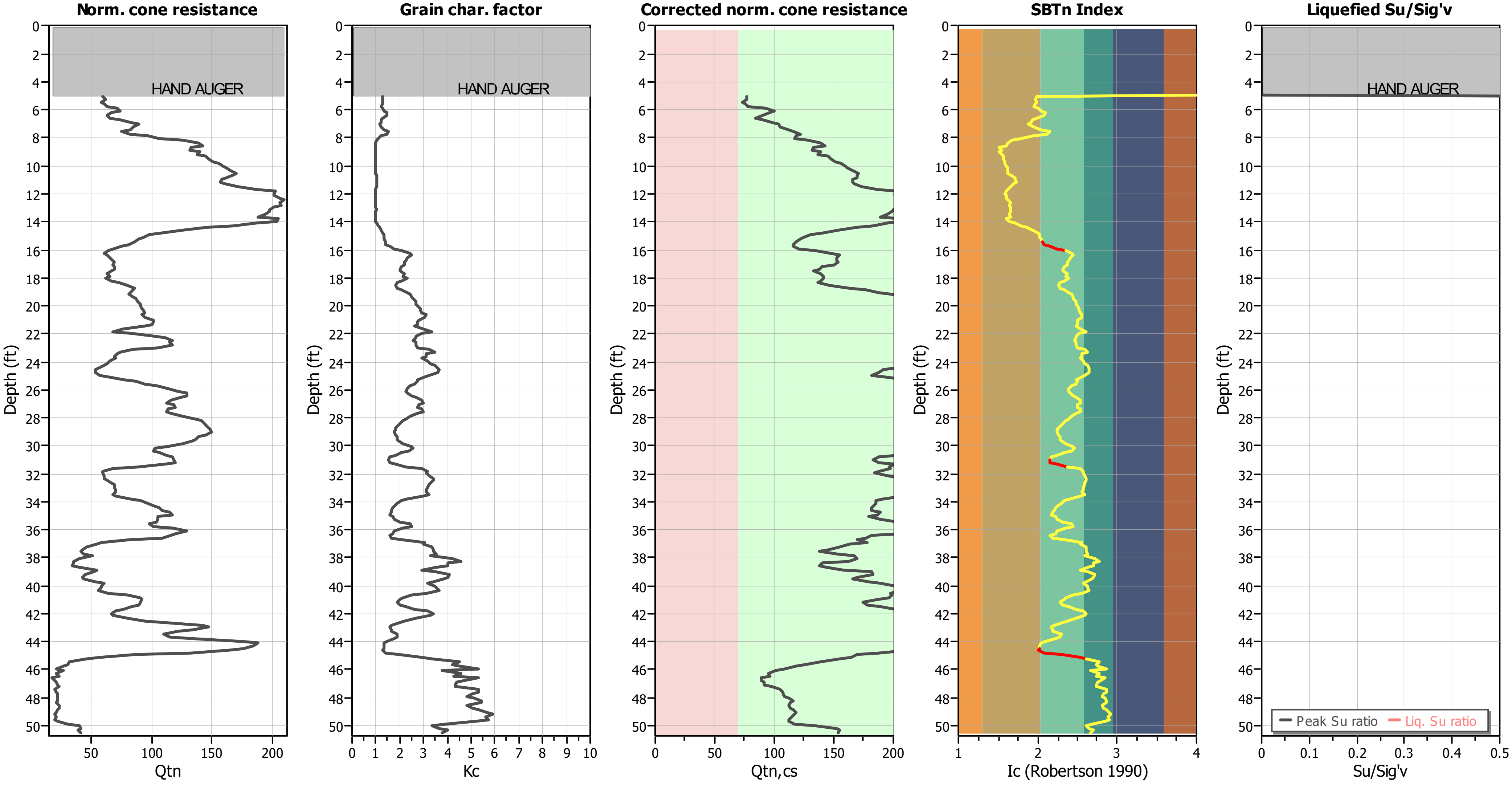




Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	1.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.78	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 ft	Fill height:	N/A	Limit depth:	N/A

Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	1.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.78	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 ft	Fill height:	N/A	Limit depth:	N/A

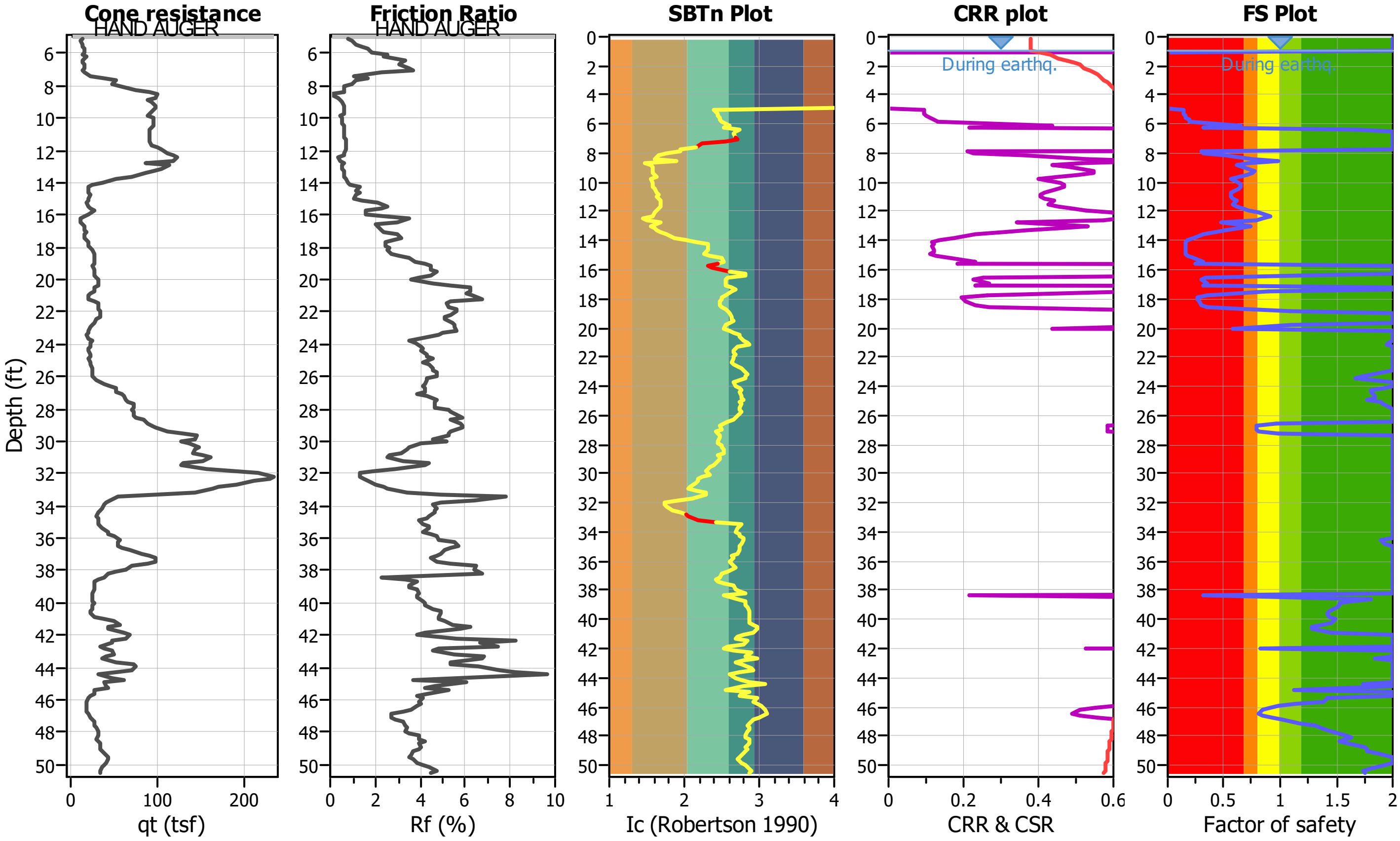
LIQUEFACTION ANALYSIS REPORT

Project title : **Location :**

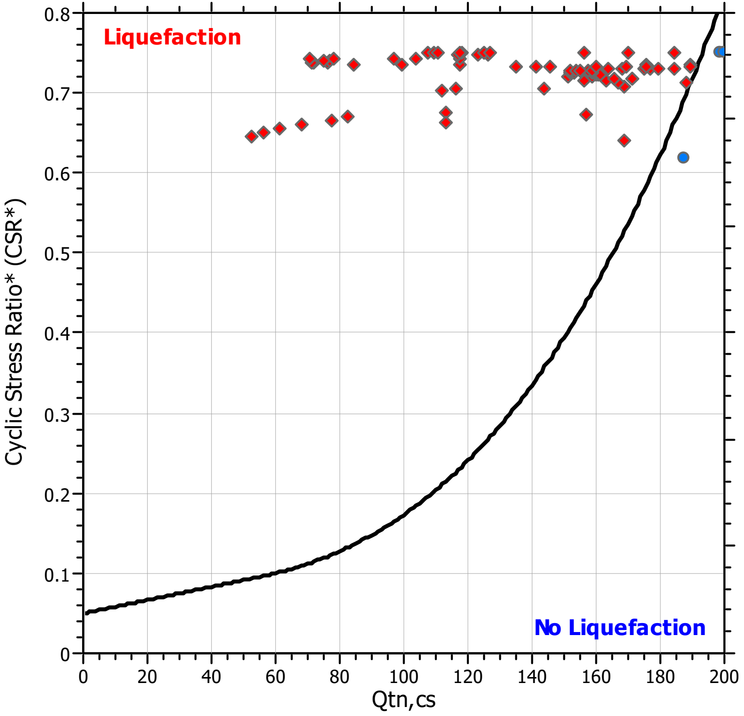
CPT file : CPT-03

Input parameters and analysis data

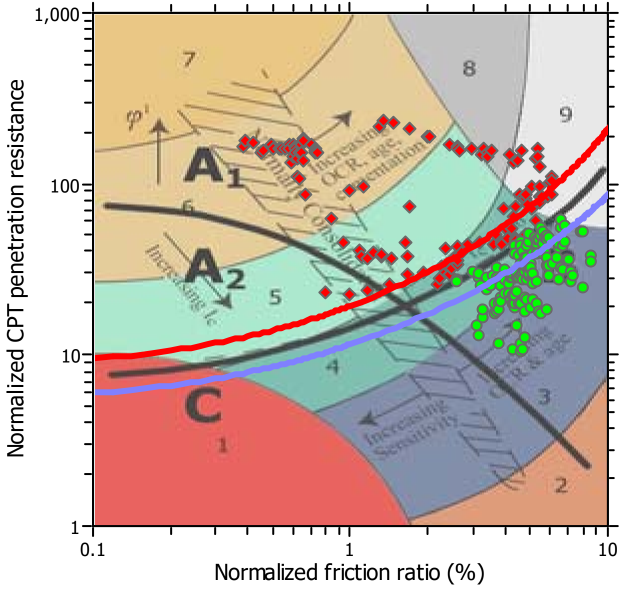
Analysis method:	Robertson (2009)	G.W.T. (in-situ):	1.00 ft	Use fill:	No	Clay like behavior applied:	All soils
Fines correction method:	Robertson (2009)	G.W.T. (earthq.):	1.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	1	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.70	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.78	Unit weight calculation:	Based on SBT	K_σ applied:	No		



$M_w=7^{1/2}$, sigma'=1 atm base curve

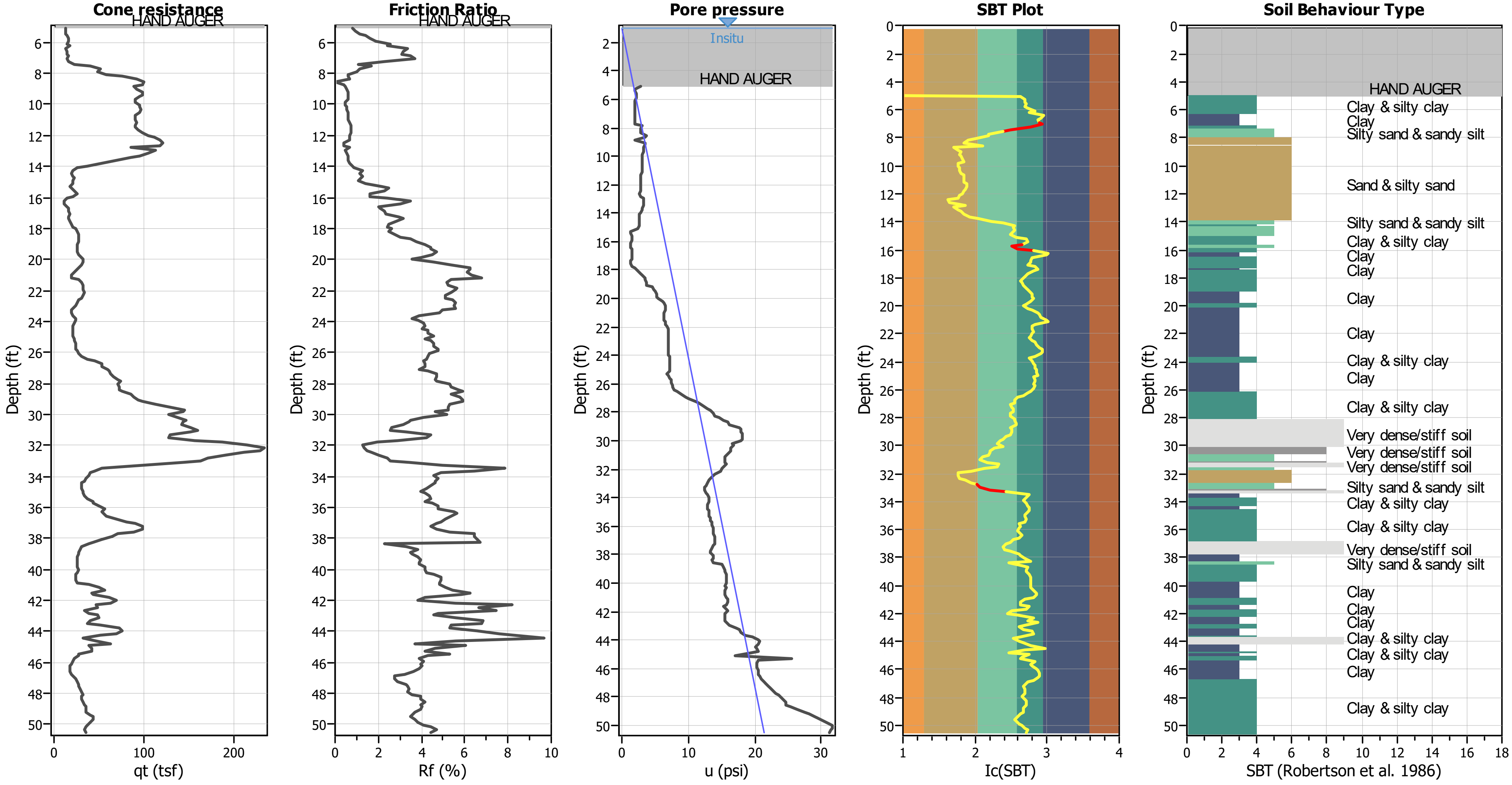


Summary of liquefaction potential



Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



Input parameters and analysis data

Analysis method: Robertson (2009)
Fines correction method: Robertson (2009)
Points to test: Based on Ic value
Earthquake magnitude M_w: 6.70
Peak ground acceleration: 0.78
Depth to water table (insitu): 1.00 ft

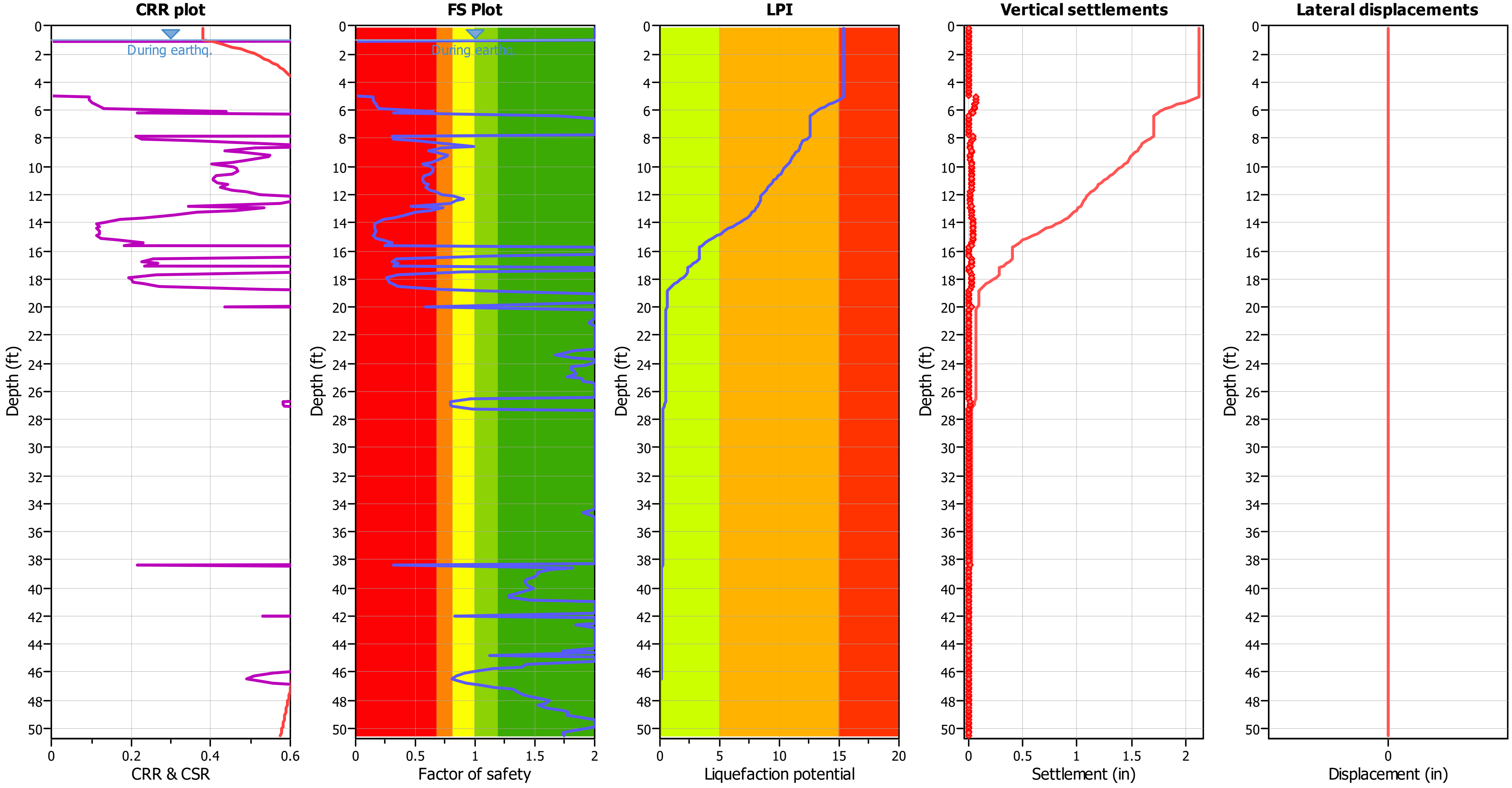
Depth to water table (erthq.): 1.00 ft
Average results interval: 1
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT
Use fill: No
Fill height: N/A

Fill weight: N/A
Transition detect. applied: Yes
K_σ applied: No
Clay like behavior applied: All soils
Limit depth applied: No
Limit depth: N/A

SBT legend

- 🟥 1. Sensitive fine grained
- 🟫 2. Organic material
- 🟦 3. Clay to silty clay
- 🟩 4. Clayey silt to silty
- 🟩 5. Silty sand to sandy silt
- 🟨 6. Clean sand to silty sand
- 🟧 7. Gravely sand to sand
- ⬛ 8. Very stiff sand to
- ⬜ 9. Very stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	1.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.78	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 ft	Fill height:	N/A	Limit depth:	N/A

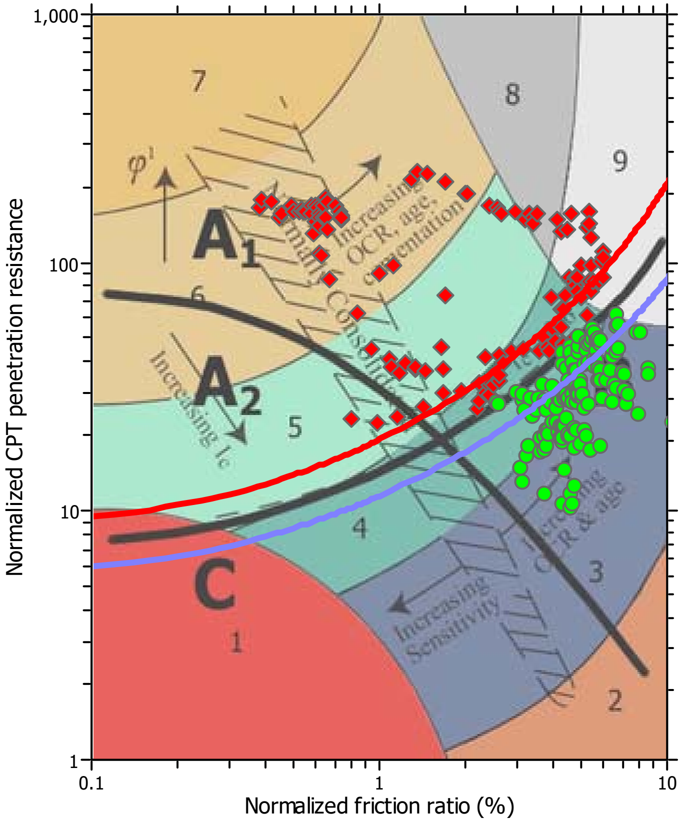
F.S. color scheme

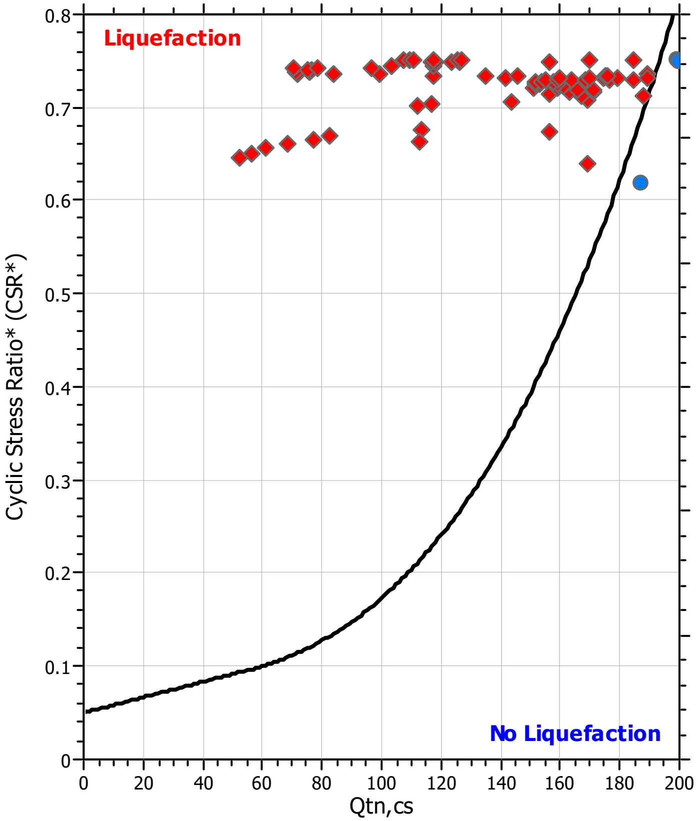
- 🟥 Almost certain it will liquefy
- 🟧 Very likely to liquefy
- 🟨 Liquefaction and no liq. are equally likely
- 🟩 Unlike to liquefy
- 🟩 Almost certain it will not liquefy

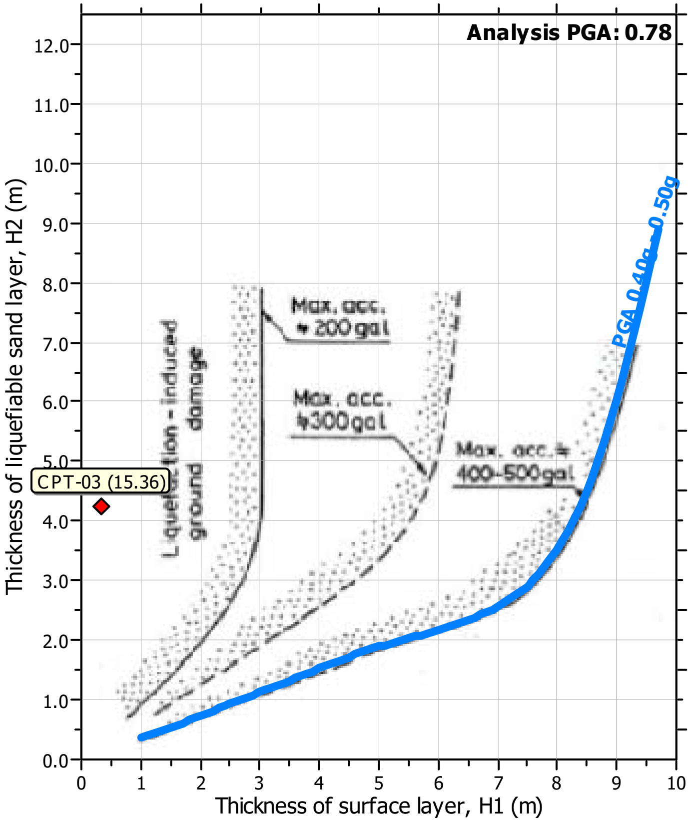
LPI color scheme

- 🟥 Very high risk
- 🟧 High risk
- 🟨 Low risk

Liquefaction analysis summary plots



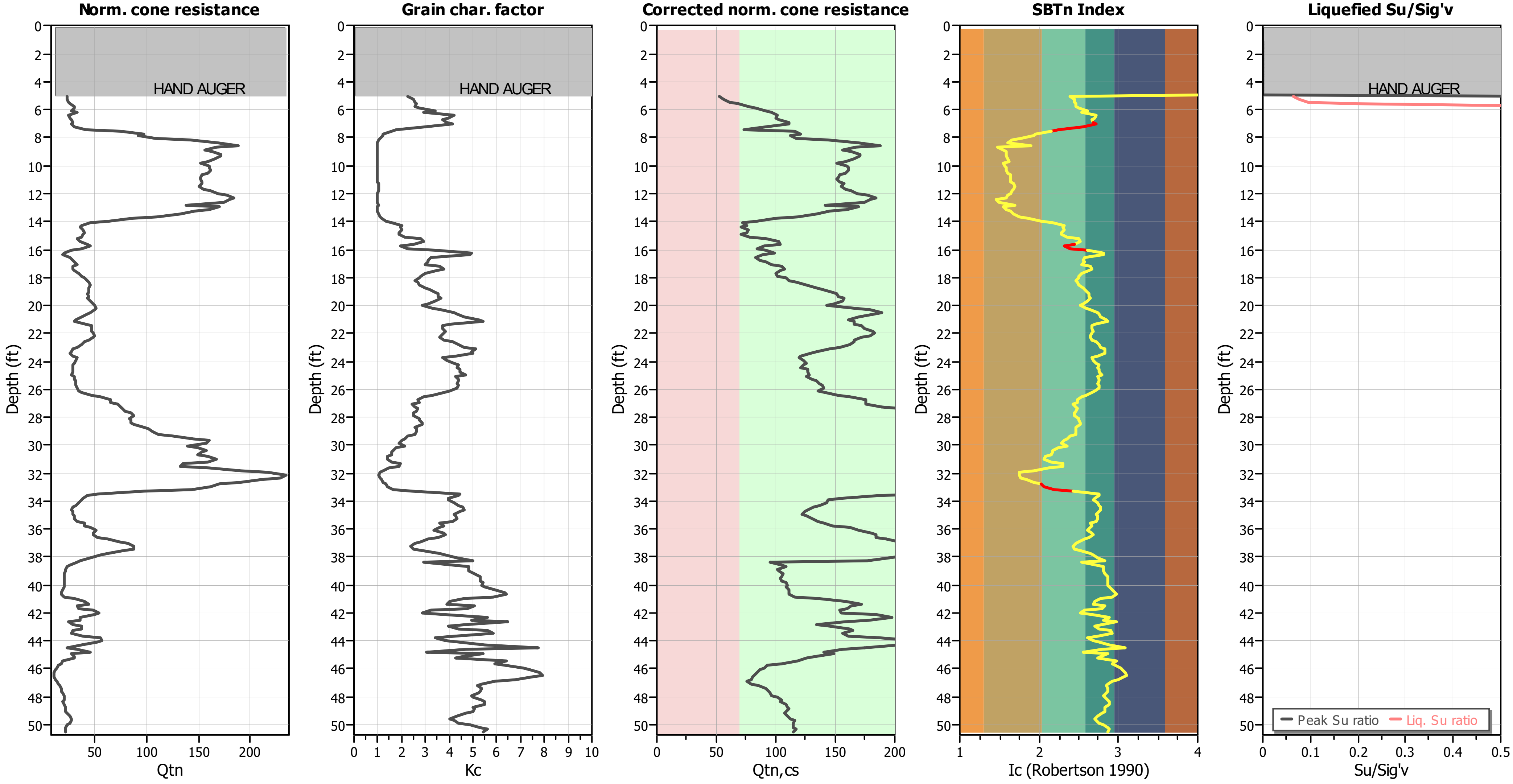




Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	1.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.78	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 ft	Fill height:	N/A	Limit depth:	N/A

Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	1.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.78	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 ft	Fill height:	N/A	Limit depth:	N/A

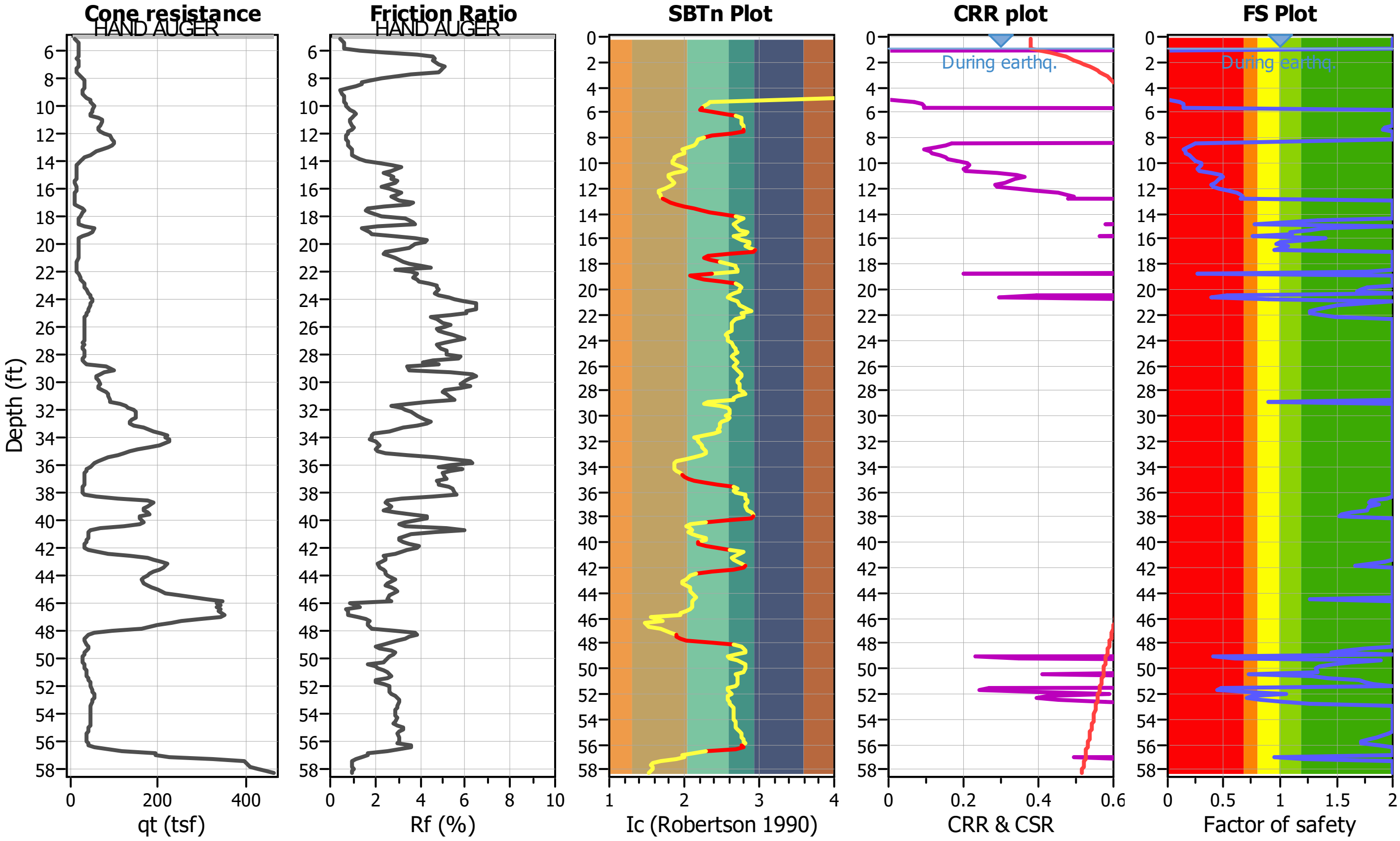
LIQUEFACTION ANALYSIS REPORT

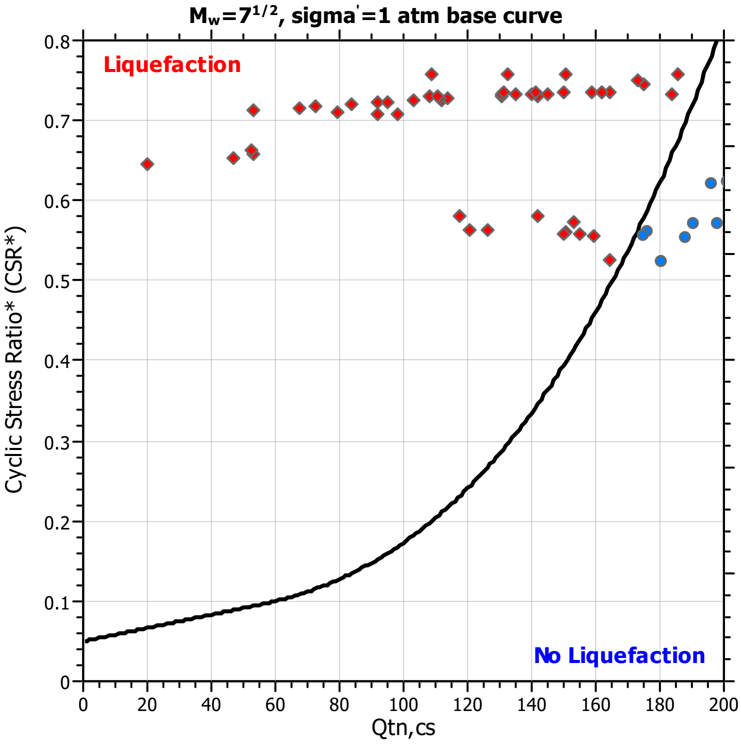
Project title : **Location :**

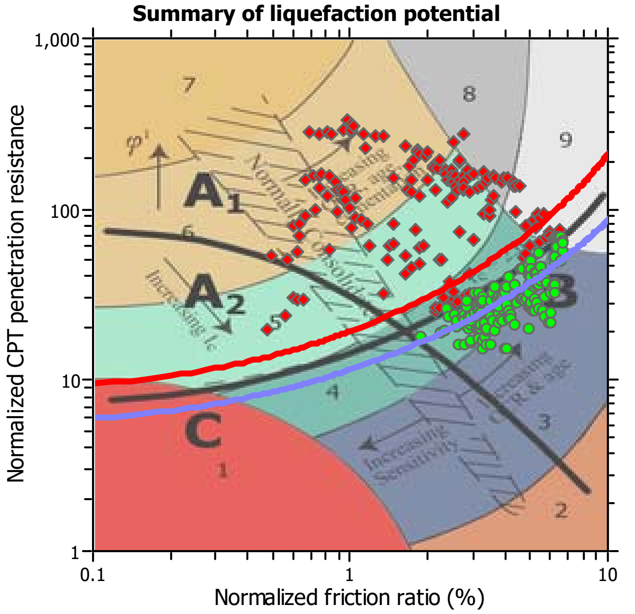
CPT file : CPT-04

Input parameters and analysis data

Analysis method:	Robertson (2009)	G.W.T. (in-situ):	1.00 ft	Use fill:	No	Clay like behavior applied:	All soils
Fines correction method:	Robertson (2009)	G.W.T. (earthq.):	1.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	1	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.70	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.78	Unit weight calculation:	Based on SBT	K_σ applied:	No		

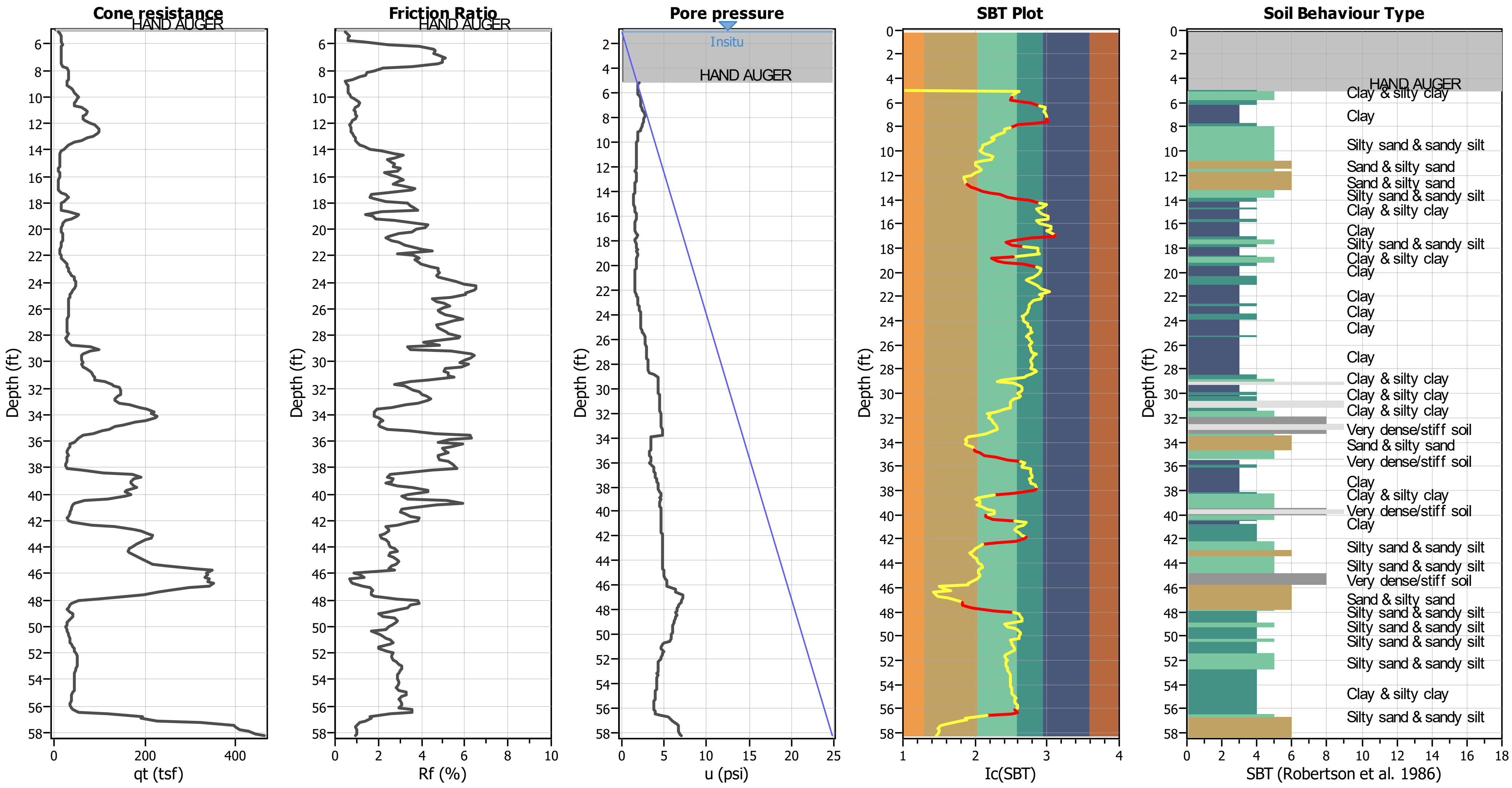






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



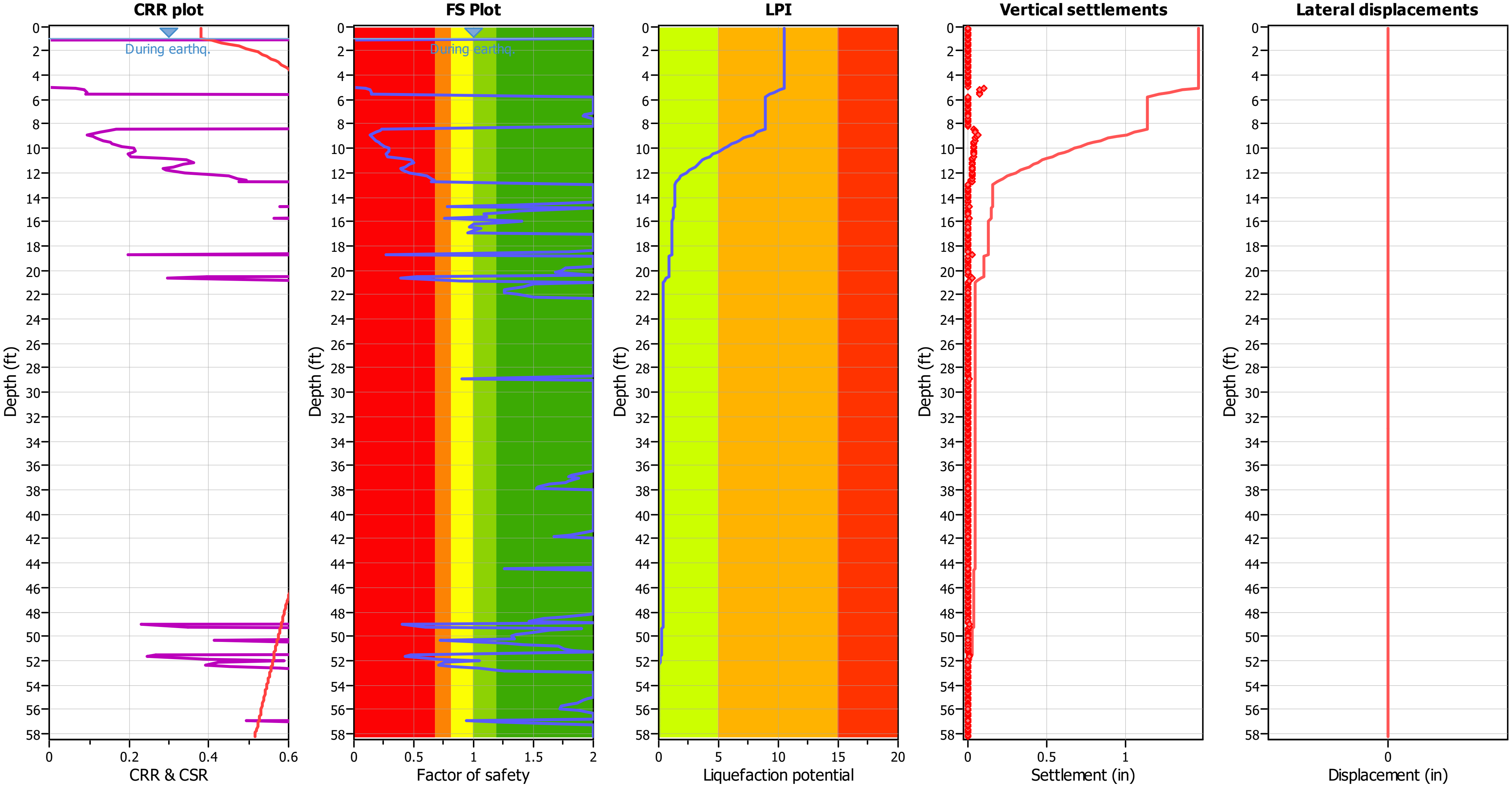
Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	1.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.78	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

🟥 1. Sensitive fine grained	🟩 4. Clayey silt to silty	🟧 7. Gravely sand to sand
🟫 2. Organic material	🟩 5. Silty sand to sandy silt	⬛ 8. Very stiff sand to
🟦 3. Clay to silty clay	🟫 6. Clean sand to silty sand	⬜ 9. Very stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method: Robertson (2009)
Fines correction method: Robertson (2009)
Points to test: Based on Ic value
Earthquake magnitude M_w: 6.70
Peak ground acceleration: 0.78
Depth to water table (insitu): 1.00 ft

Depth to water table (erthq.): 1.00 ft
Average results interval: 1
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT
Use fill: No
Fill height: N/A

Fill weight: N/A
Transition detect. applied: Yes
K_σ applied: No
Clay like behavior applied: All soils
Limit depth applied: No
Limit depth: N/A

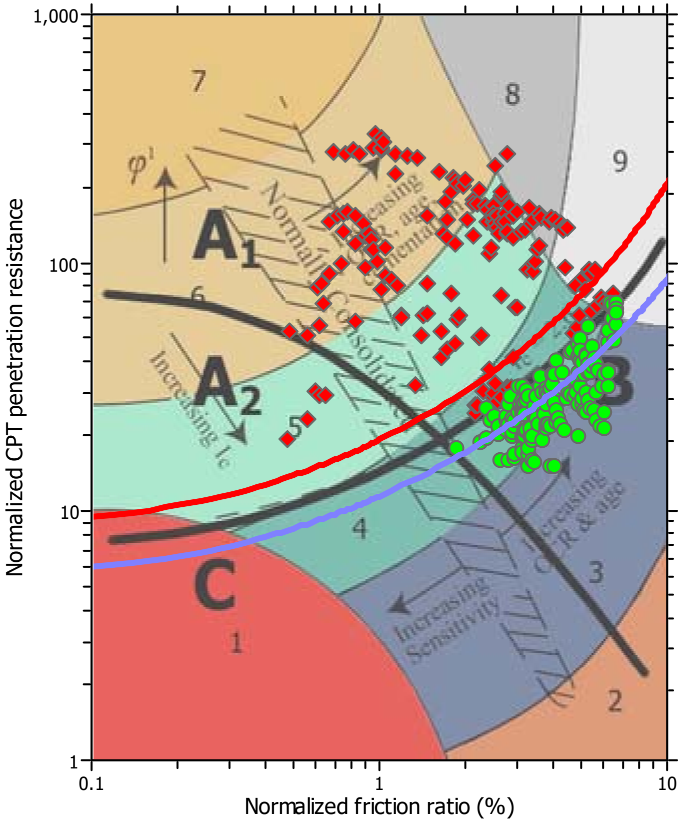
F.S. color scheme

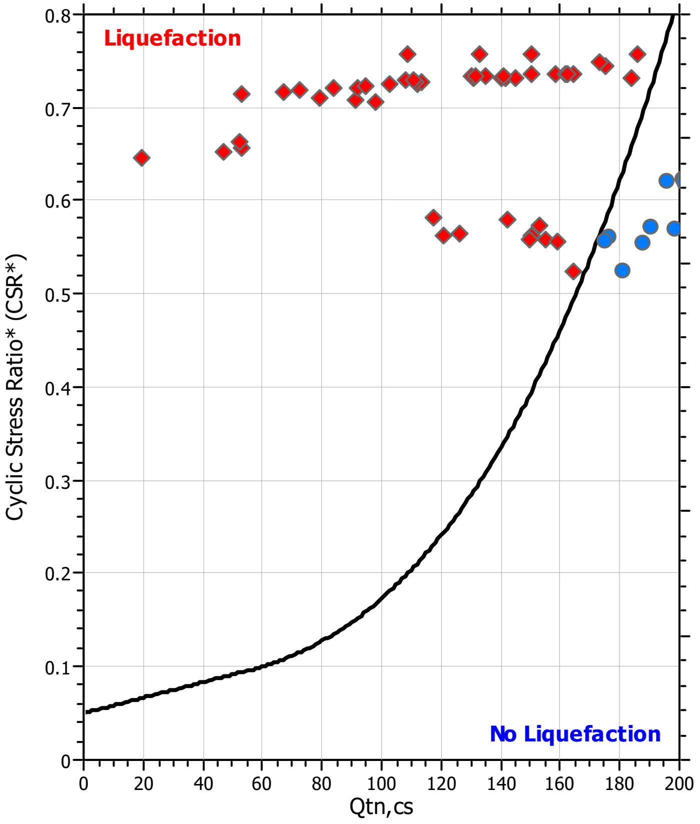
- 🟥 Almost certain it will liquefy
- 🟧 Very likely to liquefy
- 🟨 Liquefaction and no liq. are equally likely
- 🟩 Unlike to liquefy
- 🟩 Almost certain it will not liquefy

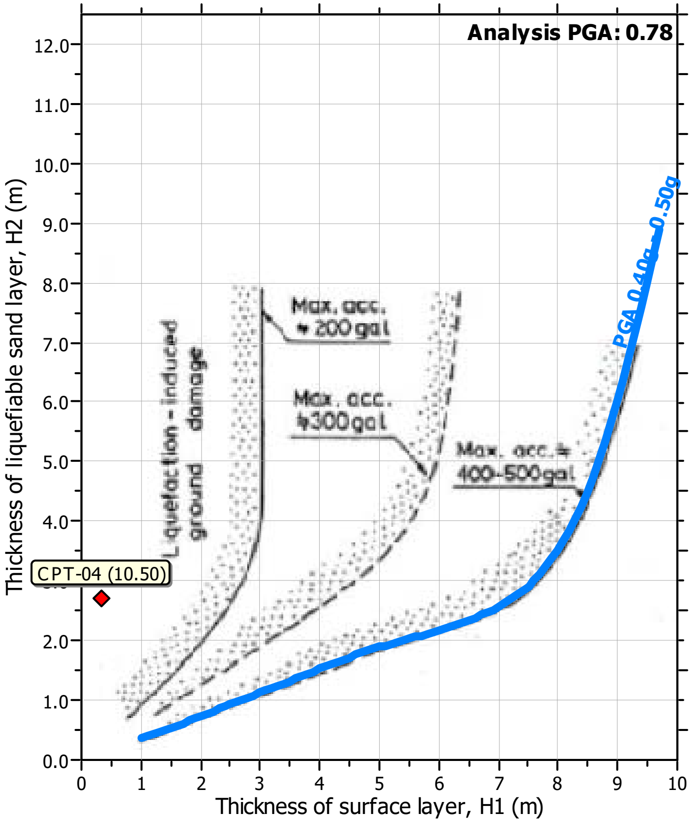
LPI color scheme

- 🟥 Very high risk
- 🟧 High risk
- 🟨 Low risk

Liquefaction analysis summary plots



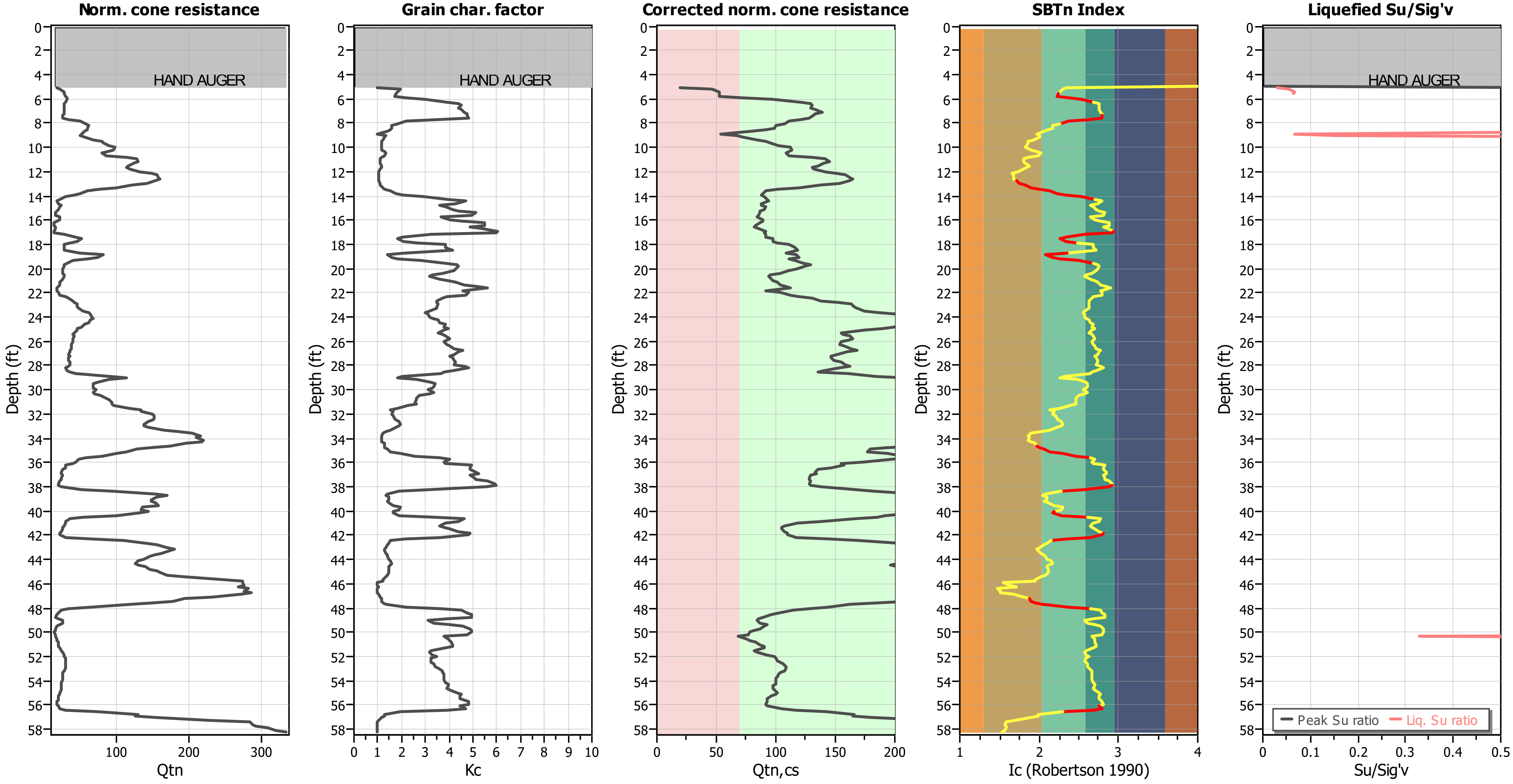




Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	1.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.78	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 ft	Fill height:	N/A	Limit depth:	N/A

Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	1.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.78	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 ft	Fill height:	N/A	Limit depth:	N/A

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Geotechnical Engineers
Merarhias 56
http://www.geologismiki.gr

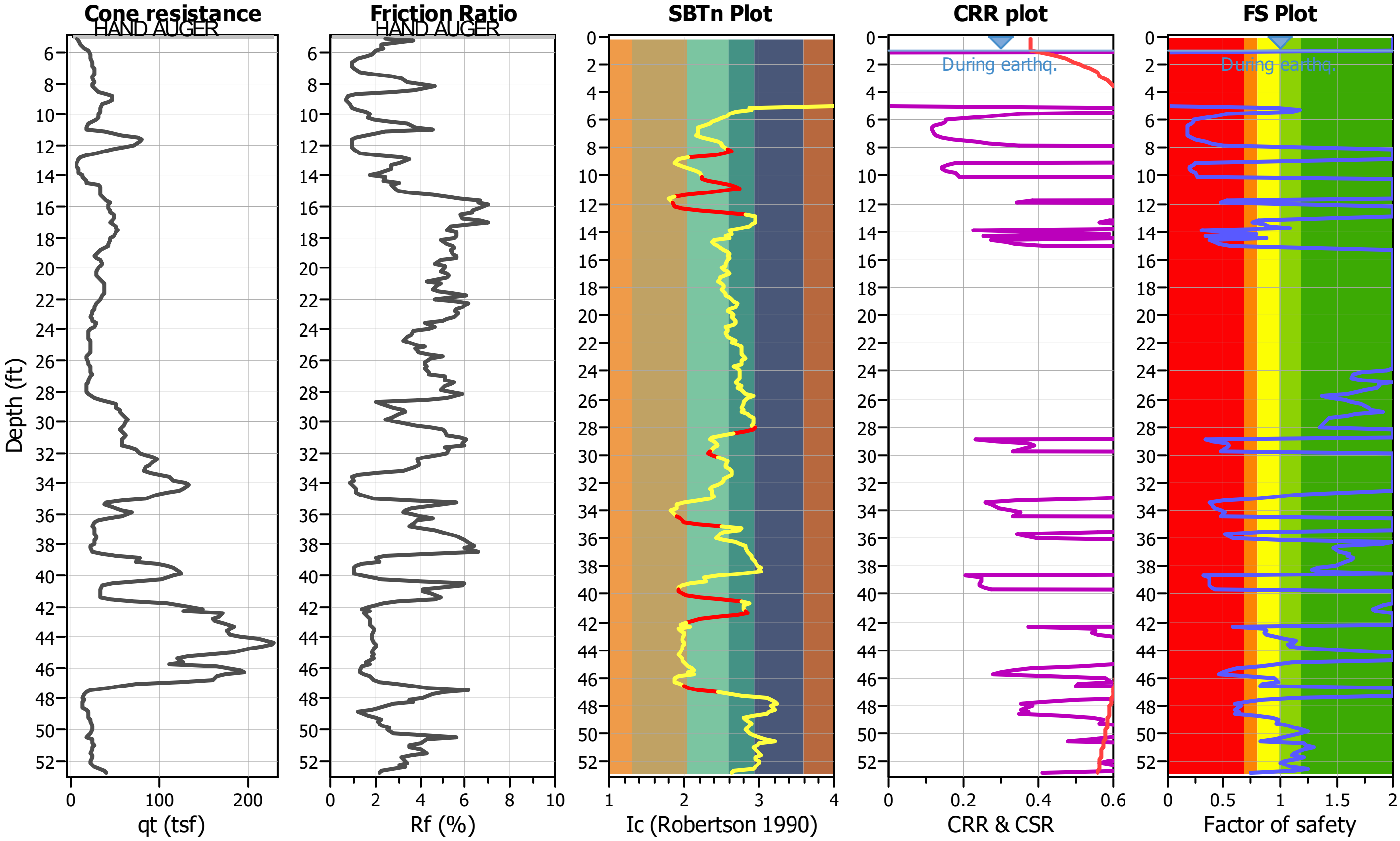
LIQUEFACTION ANALYSIS REPORT

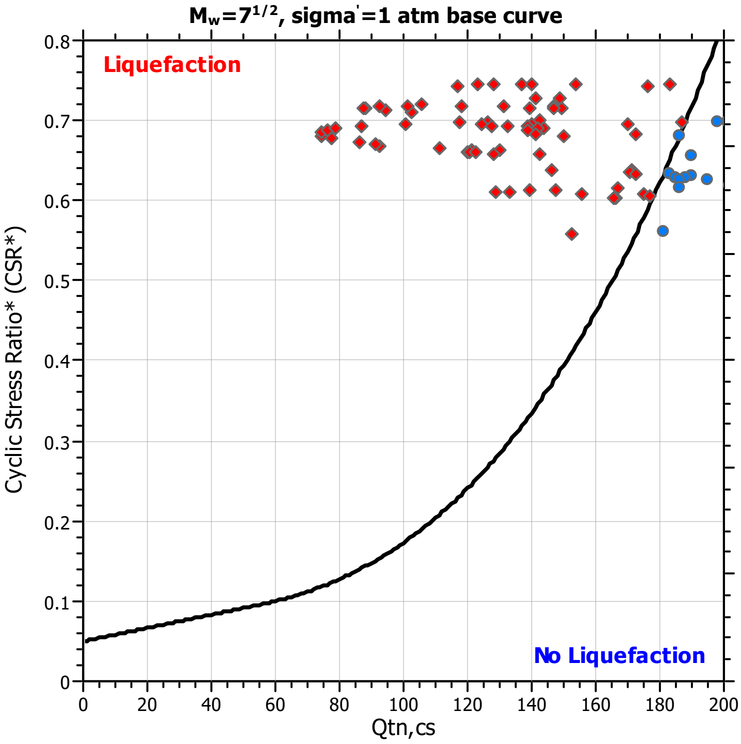
Project title : **Location :**

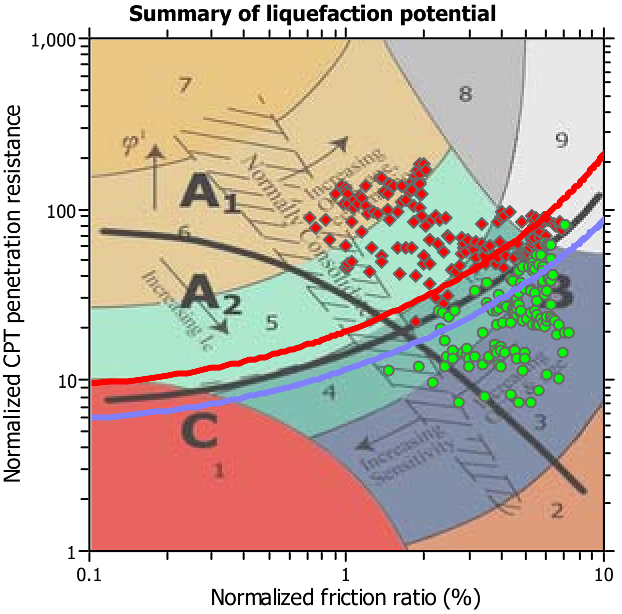
CPT file : CPT-05

Input parameters and analysis data

Analysis method:	Robertson (2009)	G.W.T. (in-situ):	1.00 ft	Use fill:	No	Clay like behavior applied:	All soils
Fines correction method:	Robertson (2009)	G.W.T. (earthq.):	1.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	1	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.70	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.78	Unit weight calculation:	Based on SBT	K_σ applied:	No		

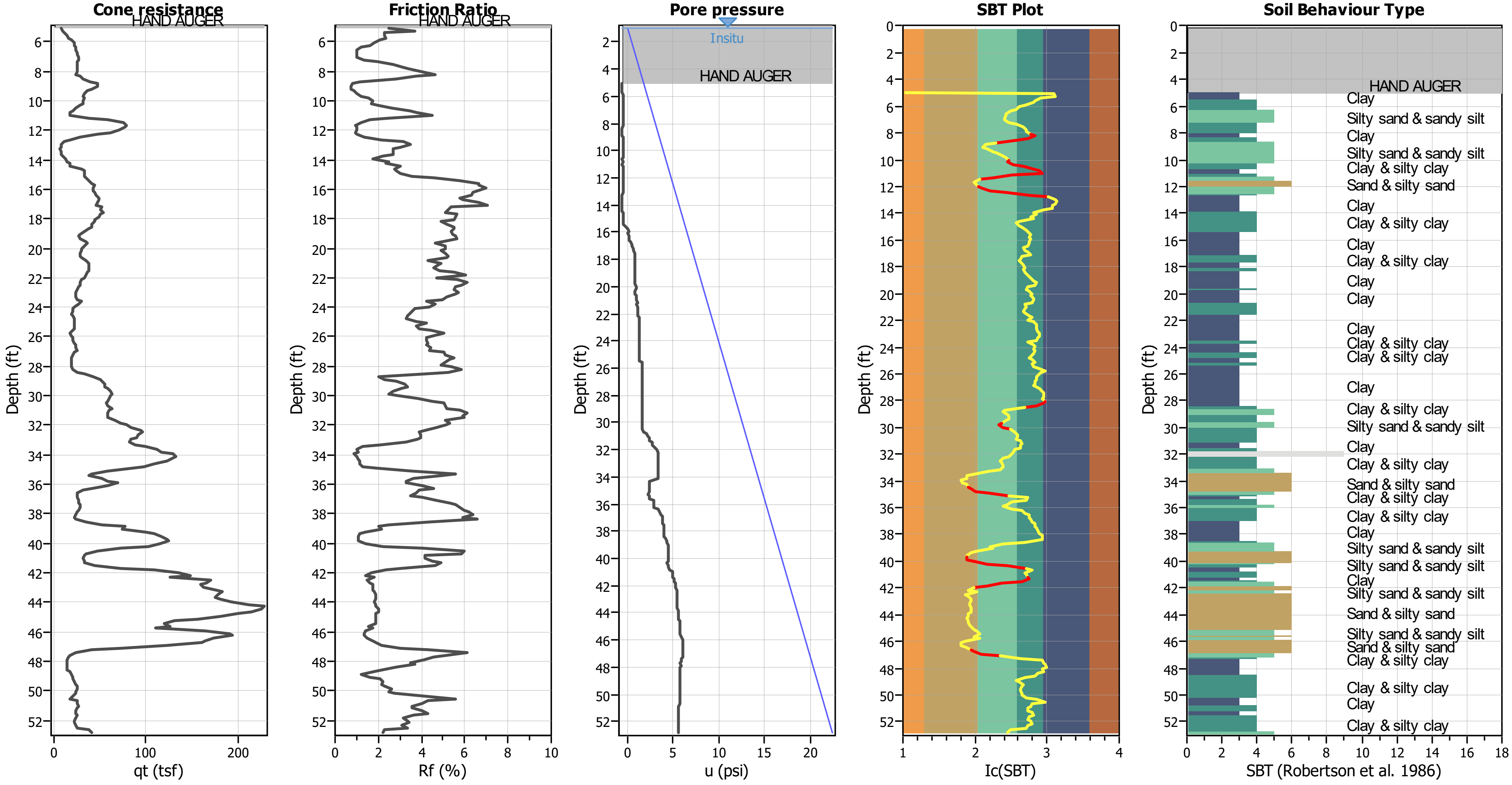






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



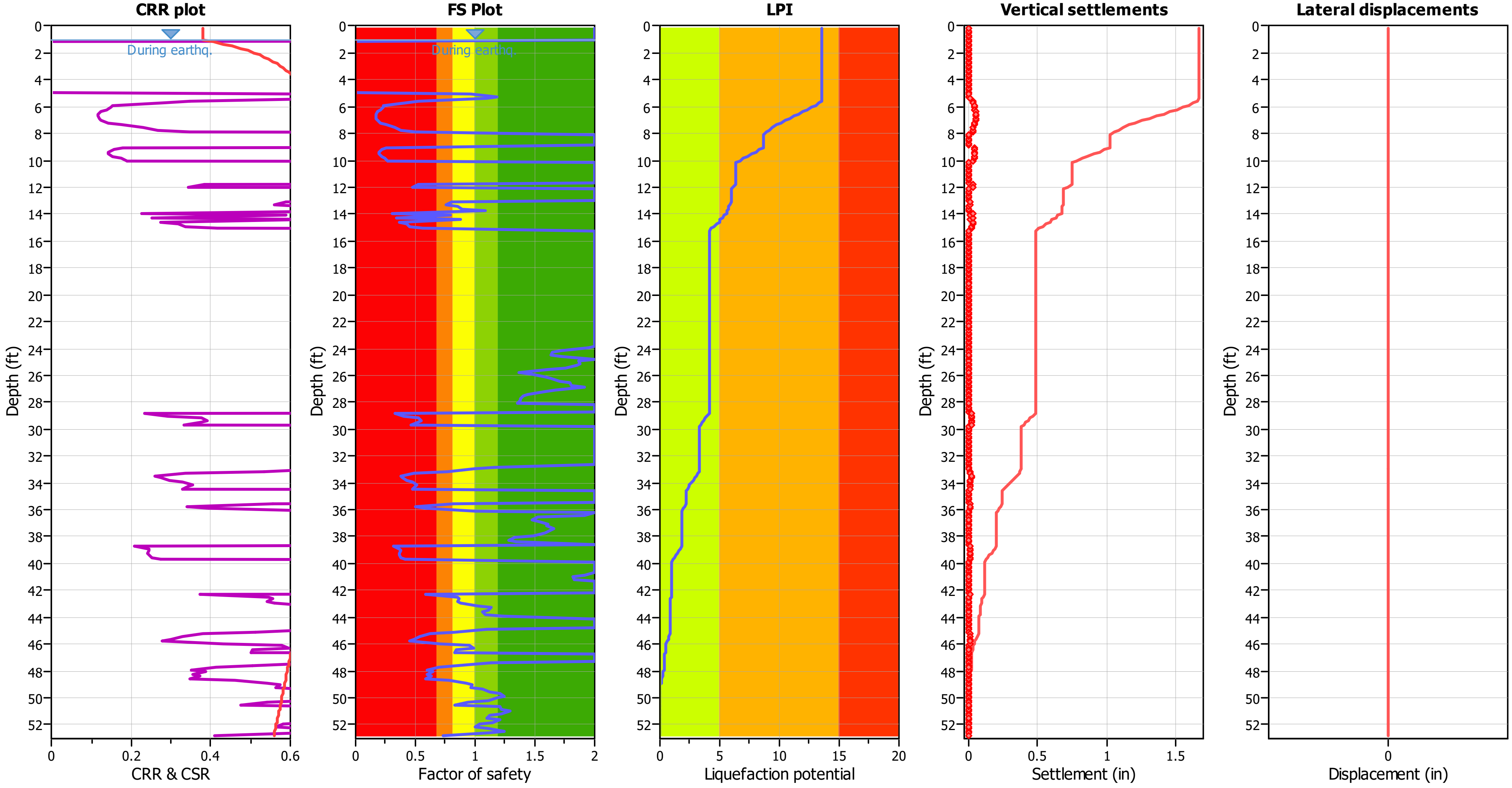
Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	1.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.78	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

- 🟥 1. Sensitive fine grained
- 🟫 2. Organic material
- 🟦 3. Clay to silty clay
- 🟩 4. Clayey silt to silty
- 🟩 5. Silty sand to sandy silt
- 🟨 6. Clean sand to silty sand
- 🟧 7. Gravely sand to sand
- ⬛ 8. Very stiff sand to
- ⬜ 9. Very stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	1.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.78	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 ft	Fill height:	N/A	Limit depth:	N/A

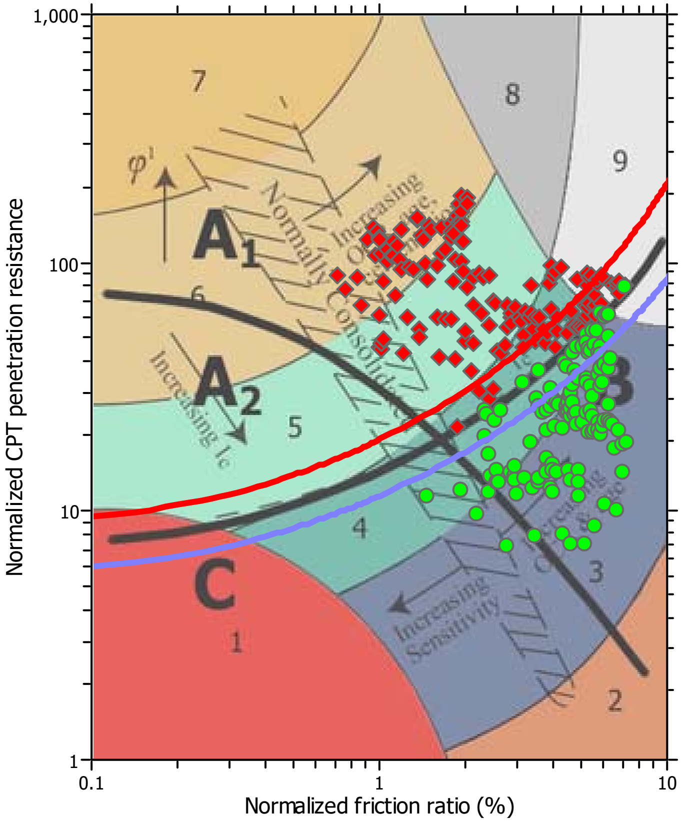
F.S. color scheme

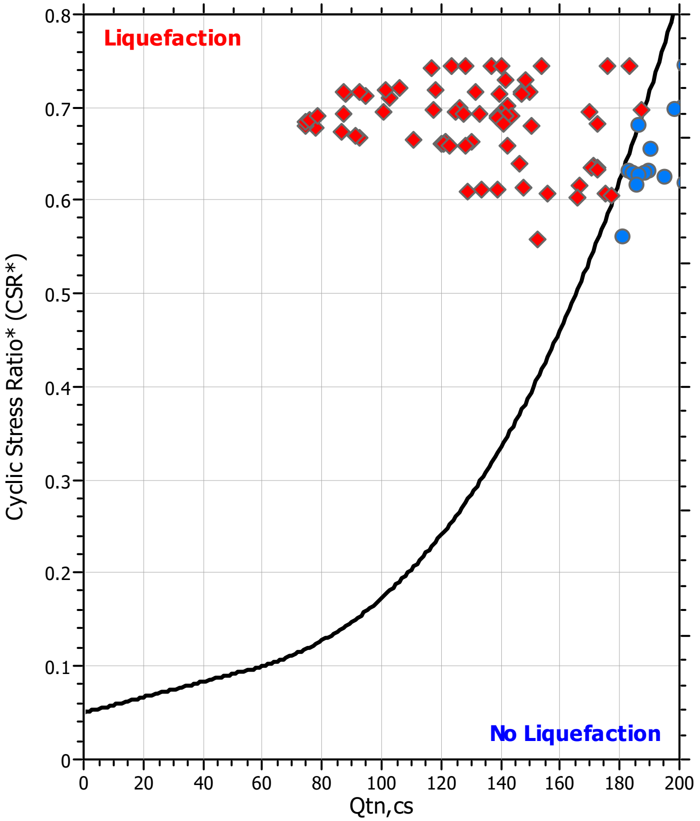
- 🟥 Almost certain it will liquefy
- 🟧 Very likely to liquefy
- 🟨 Liquefaction and no liq. are equally likely
- 🟩 Unlike to liquefy
- 🟩 Almost certain it will not liquefy

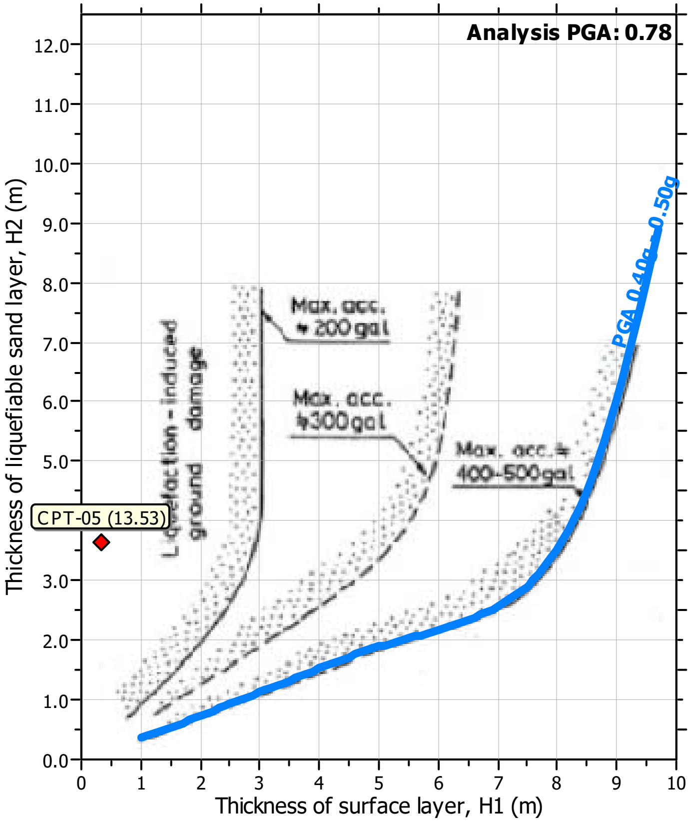
LPI color scheme

- 🟥 Very high risk
- 🟧 High risk
- 🟨 Low risk

Liquefaction analysis summary plots



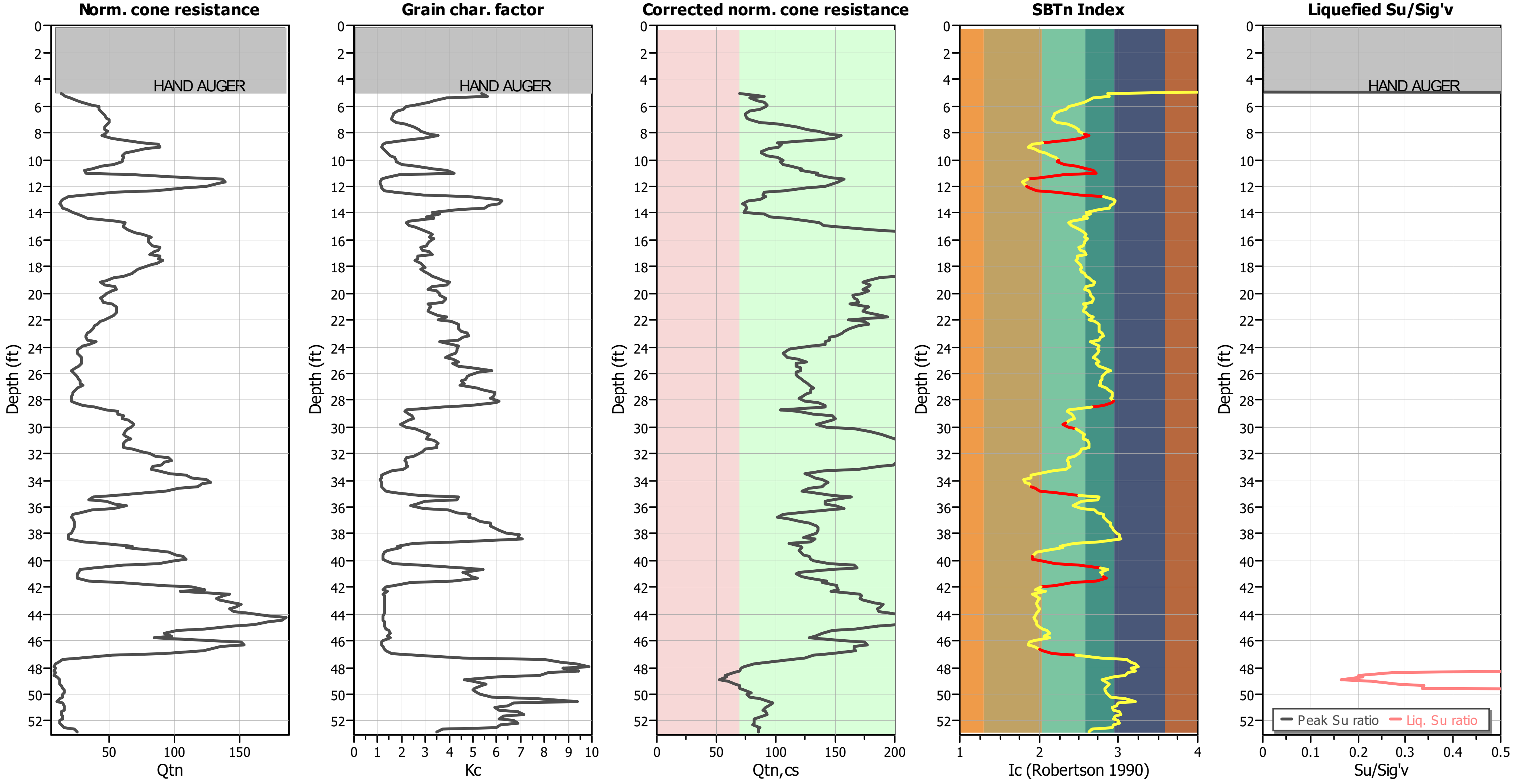




Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	1.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.78	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 ft	Fill height:	N/A	Limit depth:	N/A

Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	1.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.78	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 ft	Fill height:	N/A	Limit depth:	N/A

APPENDIX C-1

SPT Liquefaction Analysis

NTS
GEOTECHNICAL

NTS GEOTECHNICAL, INC.
15333 CULVER DR., SUITE 340
IRVINE, CA 92604
WWW.NTSGEO.COM

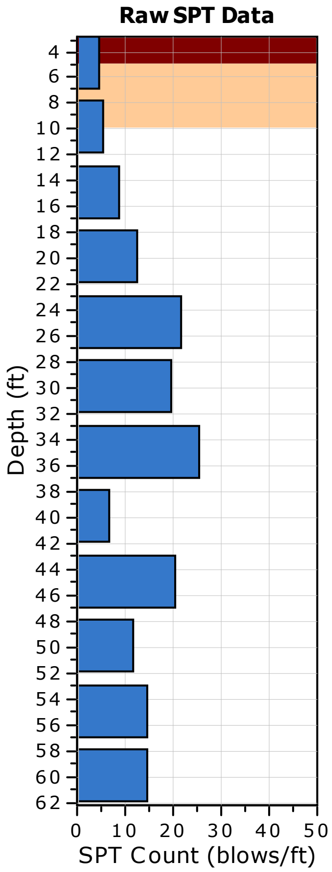
SPT BASED LIQUEFACTION ANALYSIS REPORT

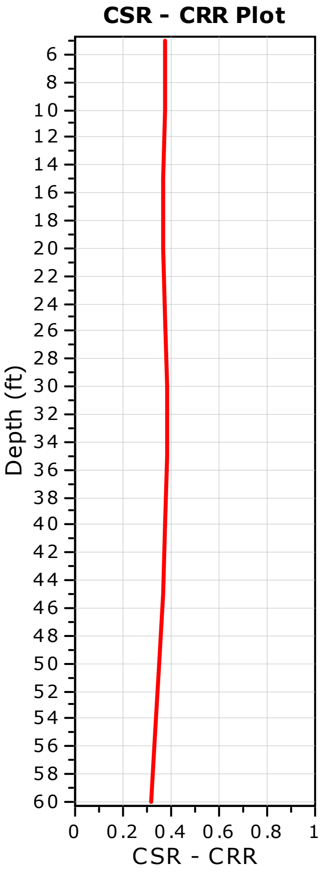
Project title : The Hub at Fullerton **SPT Name: B-1**

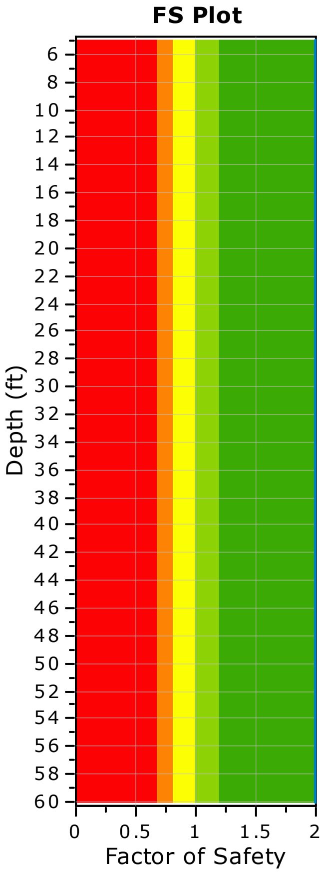
Location : 2601 - 2651 Chapman Ave

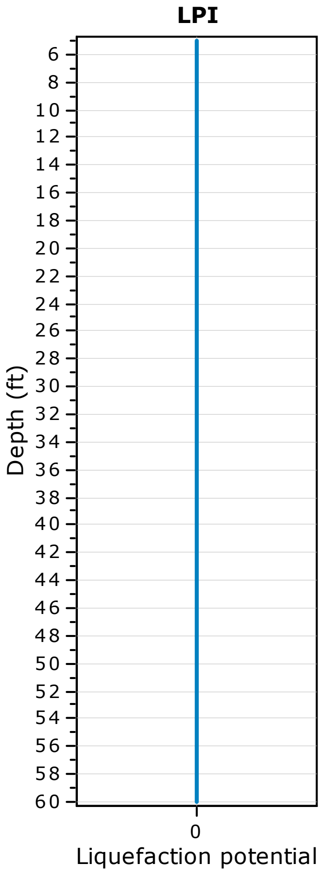
:: Input parameters and analysis properties ::

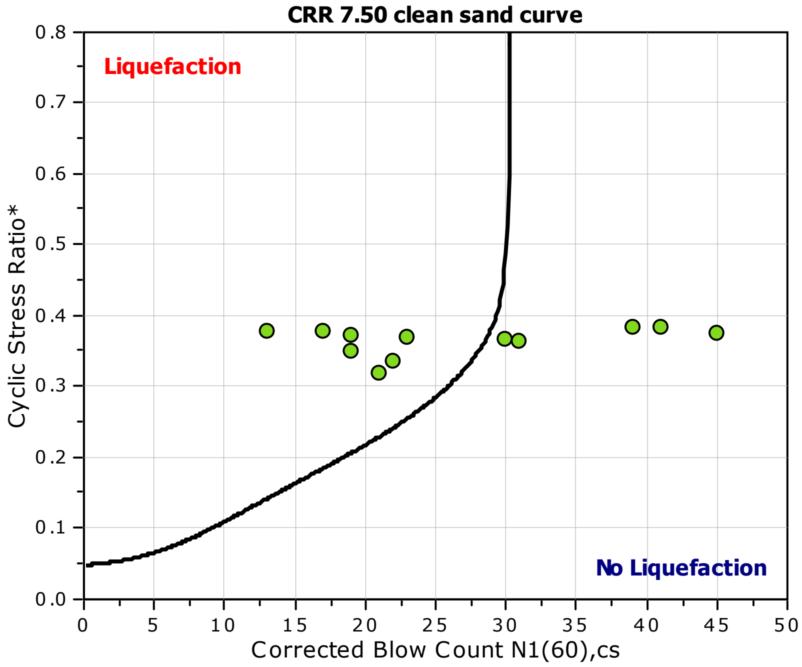
Analysis method:	NCEER 1998	G.W.T. (in-situ):	70.00 ft
Fines correction method:	NCEER 1998	G.W.T. (earthq.):	70.00 ft
Sampling method:	Sampler wo liners	Earthquake magnitude M_w:	6.70
Borehole diameter:	200mm	Peak ground acceleration:	0.78 g
Rod length:	3.30 ft	Eq. external load:	0.00 tsf
Hammer energy ratio:	1.28		







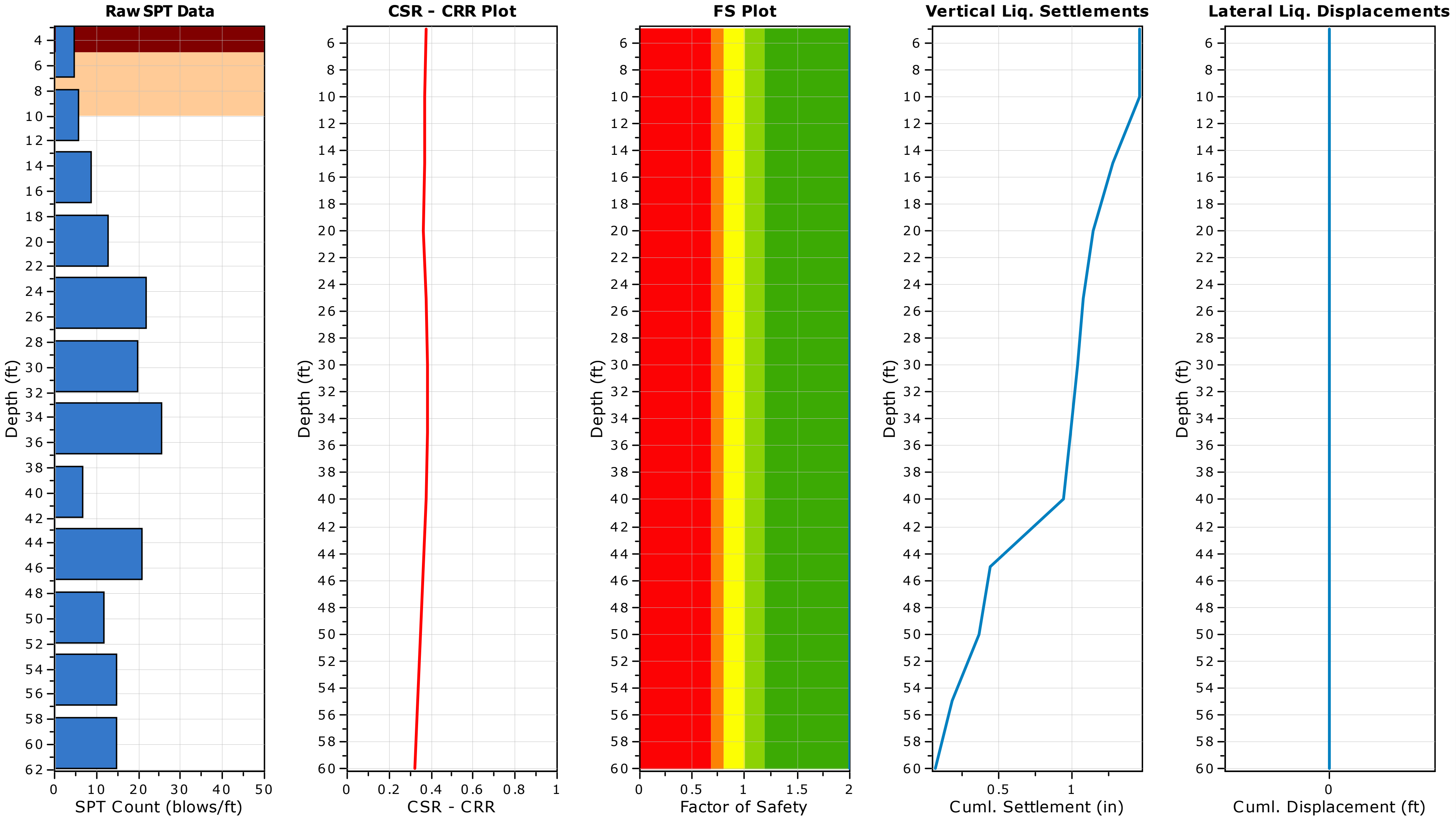




F.S. color scheme
- 🟥 Almost certain it will liquefy
- 🟧 Very likely to liquefy
- 🟨 Liquefaction and no liq. are equally likely
- 🟩 Unlike to liquefy
- 🟩 Almost certain it will not liquefy

LPI color scheme
- 🟥 Very high risk
- 🟧 High risk
- 🟨 Low risk

:: Overall Liquefaction Assessment Analysis Plots ::



:: Field input data ::

Test Depth (ft)	SPT Field Value (blows)	Fines Content (%)	Unit Weight (pcf)	Infl. Thickness (ft)	Can Liquefy
5.00	5	53.00	125.00	8.25	No
10.00	6	55.00	95.00	5.00	Yes
15.00	9	55.00	95.00	5.00	Yes
20.00	13	53.00	95.00	5.00	Yes
25.00	22	49.00	130.00	5.00	Yes
30.00	20	49.00	125.00	5.00	Yes
35.00	26	25.00	125.00	5.00	Yes
40.00	7	25.00	125.00	5.00	Yes
45.00	21	30.00	125.00	5.00	Yes
50.00	12	82.00	125.00	5.00	Yes
55.00	15	82.00	125.00	5.00	Yes
60.00	15	82.00	125.00	3.25	Yes

Abbreviations

Depth:	Depth at which test was performed (ft)
SPT Field Value:	Number of blows per foot
Fines Content:	Fines content at test depth (%)
Unit Weight:	Unit weight at test depth (pcf)
Infl. Thickness:	Thickness of the soil layer to be considered in settlements analysis (ft)
Can Liquefy:	User defined switch for excluding/including test depth from the analysis procedure

:: Cyclic Resistance Ratio (CRR) calculation data ::

Depth (ft)	SPT Field Value	Unit Weight (pcf)	σ_v (tsf)	u_o (tsf)	σ'_{vo} (tsf)	C_N	C_E	C_B	C_R	C_S	$(N_1)_{60}$	Fines Content (%)	α	β	$(N_1)_{60cs}$	$CRR_{7.5}$
5.00	5	125.00	0.31	0.00	0.31	1.47	1.28	1.15	0.75	1.20	10	53.00	5.00	1.20	17	4.000
10.00	6	95.00	0.55	0.00	0.55	1.28	1.28	1.15	0.85	1.20	12	55.00	5.00	1.20	19	4.000
15.00	9	95.00	0.79	0.00	0.79	1.13	1.28	1.15	0.85	1.20	15	55.00	5.00	1.20	23	4.000
20.00	13	95.00	1.02	0.00	1.02	1.01	1.28	1.15	0.95	1.20	22	53.00	5.00	1.20	31	4.000
25.00	22	130.00	1.35	0.00	1.35	0.89	1.28	1.15	0.95	1.20	33	49.00	5.00	1.20	45	4.000
30.00	20	125.00	1.66	0.00	1.66	0.79	1.28	1.15	1.00	1.20	28	49.00	5.00	1.20	39	4.000
35.00	26	125.00	1.98	0.00	1.98	0.72	1.28	1.15	1.00	1.20	33	25.00	4.29	1.12	41	4.000
40.00	7	125.00	2.29	0.00	2.29	0.65	1.28	1.15	1.00	1.20	8	25.00	4.29	1.12	13	4.000
45.00	21	125.00	2.60	0.00	2.60	0.60	1.28	1.15	1.00	1.20	22	30.00	4.71	1.15	30	4.000
50.00	12	125.00	2.91	0.00	2.91	0.56	1.28	1.15	1.00	1.20	12	82.00	5.00	1.20	19	4.000
55.00	15	125.00	3.23	0.00	3.23	0.52	1.28	1.15	1.00	1.20	14	82.00	5.00	1.20	22	4.000
60.00	15	125.00	3.54	0.00	3.54	0.48	1.28	1.15	1.00	1.20	13	82.00	5.00	1.20	21	4.000

Abbreviations

σ_v:	Total stress during SPT test (tsf)
u_o:	Water pore pressure during SPT test (tsf)
σ'_{vo}:	Effective overburden pressure during SPT test (tsf)
C_N:	Overburden corretion factor
C_E:	Energy correction factor
C_B:	Borehole diameter correction factor
C_R:	Rod length correction factor
C_S:	Liner correction factor
$N_{1(60)}$:	Corrected N_{SPT} to a 60% energy ratio
α, β:	Clean sand equivalent clean sand formula coefficients
$N_{1(60)cs}$:	Corected $N_{1(60)}$ value for fines content
$CRR_{7.5}$:	Cyclic resistance ratio for M=7.5

:: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::

Depth (ft)	Unit Weight (pcf)	$\sigma_{v,eq}$ (tsf)	$u_{o,eq}$ (tsf)	$\sigma'_{vo,eq}$ (tsf)	r_d	α	CSR	MSF	$CSR_{eq,M=7.5}$	K_{sigma}	CSR^*	FS	
5.00	125.00	0.31	0.00	0.31	0.99	1.00	0.502	1.33	0.376	1.00	0.376	2.000	●
10.00	95.00	0.55	0.00	0.55	0.98	1.00	0.496	1.33	0.372	1.00	0.372	2.000	●
15.00	95.00	0.79	0.00	0.79	0.97	1.00	0.491	1.33	0.368	1.00	0.368	2.000	●
20.00	95.00	1.02	0.00	1.02	0.96	1.00	0.485	1.33	0.364	1.00	0.364	2.000	●
25.00	130.00	1.35	0.00	1.35	0.94	1.00	0.478	1.33	0.358	0.95	0.376	2.000	●
30.00	125.00	1.66	0.00	1.66	0.92	1.00	0.467	1.33	0.350	0.91	0.383	2.000	●
35.00	125.00	1.98	0.00	1.98	0.89	1.00	0.452	1.33	0.338	0.88	0.383	2.000	●
40.00	125.00	2.29	0.00	2.29	0.85	1.00	0.431	1.33	0.323	0.86	0.377	2.000	●
45.00	125.00	2.60	0.00	2.60	0.80	1.00	0.407	1.33	0.305	0.84	0.366	2.000	●
50.00	125.00	2.91	0.00	2.91	0.75	1.00	0.382	1.33	0.286	0.82	0.350	2.000	●
55.00	125.00	3.23	0.00	3.23	0.70	1.00	0.357	1.33	0.267	0.80	0.334	2.000	●
60.00	125.00	3.54	0.00	3.54	0.66	1.00	0.334	1.33	0.250	0.79	0.319	2.000	●

Abbreviations

$\sigma_{v,eq}$: Total overburden pressure at test point, during earthquake (tsf)
$u_{o,eq}$: Water pressure at test point, during earthquake (tsf)
$\sigma'_{vo,eq}$: Effective overburden pressure, during earthquake (tsf)
r_d : Nonlinear shear mass factor
α: Improvement factor due to stone columns
CSR : Cyclic Stress Ratio (adjusted for improvement)
MSF : Magnitude Scaling Factor
$CSR_{eq,M=7.5}$: CSR adjusted for M=7.5
K_{sigma}: Effective overburden stress factor
CSR^*: CSR fully adjusted (user FS applied)***
FS: Calculated factor of safety against soil liquefaction

*** User FS: 1.00

:: Liquefaction potential according to Iwasaki ::

Depth (ft)	FS	F	wz	Thickness (ft)	I_L
5.00	2.000	0.00	9.24	5.00	0.00
10.00	2.000	0.00	8.48	5.00	0.00
15.00	2.000	0.00	7.71	5.00	0.00
20.00	2.000	0.00	6.95	5.00	0.00
25.00	2.000	0.00	6.19	5.00	0.00
30.00	2.000	0.00	5.43	5.00	0.00
35.00	2.000	0.00	4.67	5.00	0.00
40.00	2.000	0.00	3.90	5.00	0.00
45.00	2.000	0.00	3.14	5.00	0.00
50.00	2.000	0.00	2.38	5.00	0.00
55.00	2.000	0.00	1.62	5.00	0.00
60.00	2.000	0.00	0.86	5.00	0.00

Overall potential I_L : 0.00

I_L = 0.00 - No liquefaction
I_L between 0.00 and 5 - Liquefaction not probable
I_L between 5 and 15 - Liquefaction probable
I_L > 15 - Liquefaction certain

:: Vertical settlements estimation for dry sands ::

Depth (ft)	$(N_1)_{60}$	τ_{av}	p	G_{max} (tsf)	α	b	γ	ε_{15}	N_c	ε_{Nc} (%)	Δh (ft)	ΔS (in)
5.00	10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.25	0.000
10.00	12	0.27	0.37	724.06	0.15	9161.41	0.00	0.00	8.63	0.15	5.00	0.184
15.00	15	0.39	0.53	923.38	0.15	7386.35	0.00	0.00	8.63	0.11	5.00	0.127
20.00	22	0.50	0.69	1163.66	0.16	6305.88	0.00	0.00	8.63	0.06	5.00	0.070
25.00	33	0.64	0.90	1512.11	0.18	5345.39	0.00	0.00	8.63	0.03	5.00	0.035
30.00	28	0.78	1.11	1599.85	0.19	4717.62	0.00	0.00	8.63	0.04	5.00	0.049
35.00	33	0.89	1.32	1773.06	0.20	4254.41	0.00	0.00	8.63	0.04	5.00	0.045
40.00	8	0.99	1.53	1301.19	0.21	3895.50	0.00	0.01	8.63	0.42	5.00	0.499
45.00	22	1.06	1.74	1833.18	0.23	3607.41	0.00	0.00	8.63	0.06	5.00	0.076
50.00	12	1.11	1.95	1666.21	0.24	3369.93	0.00	0.00	8.63	0.15	5.00	0.174
55.00	14	1.15	2.16	1841.13	0.25	3170.02	0.00	0.00	8.63	0.10	5.00	0.117
60.00	13	1.18	2.37	1898.60	0.26	2998.90	0.00	0.00	8.63	0.10	3.25	0.076

Cumulative settlemetns: 1.452

Abbreviations

τ_{av}: Average cyclic shear stress
p: Average stress
G_{max}: Maximum shear modulus (tsf)
α, b: Shear strain formula variables
γ: Average shear strain
ε_{15}: Volumetric strain after 15 cycles
N_c: Number of cycles
ε_{Nc}: Volumetric strain for number of cycles N_c (%)
Δh: Thickness of soil layer (in)
ΔS: Settlement of soil layer (in)

:: Lateral displacements estimation for saturated sands ::

Depth (ft)	$(N_1)_{60}$	D_r (%)	γ_{max} (%)	d_z (ft)	LDI	LD (ft)
5.00	10	44.27	0.00	8.25	0.000	0.00
10.00	12	48.50	0.00	5.00	0.000	0.00
15.00	15	54.22	0.00	5.00	0.000	0.00
20.00	22	65.67	0.00	5.00	0.000	0.00
25.00	33	80.42	0.00	5.00	0.000	0.00
30.00	28	74.08	0.00	5.00	0.000	0.00
35.00	33	80.42	0.00	5.00	0.000	0.00
40.00	8	39.60	0.00	5.00	0.000	0.00
45.00	22	65.67	0.00	5.00	0.000	0.00
50.00	12	48.50	0.00	5.00	0.000	0.00
55.00	14	52.38	0.00	5.00	0.000	0.00
60.00	13	50.48	0.00	3.25	0.000	0.00

Cumulative lateral displacements: 0.00

Abbreviations

D_r: Relative density (%)
γ_{max}: Maximum amplitude of cyclic shear strain (%)
d_z: Soil layer thickness (ft)
LDI: Lateral displacement index (ft)
LD: Actual estimated displacement (ft)

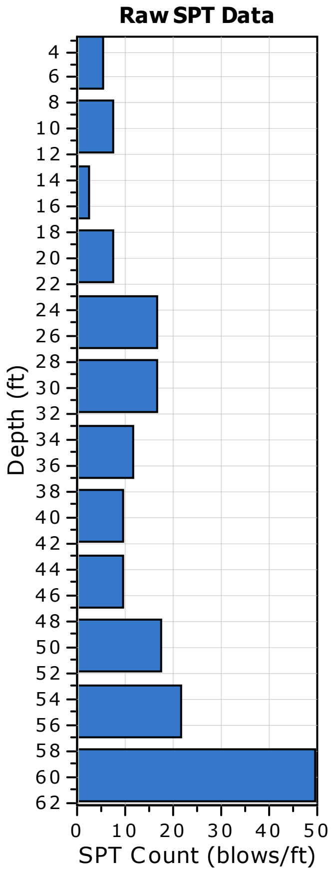
SPT BASED LIQUEFACTION ANALYSIS REPORT

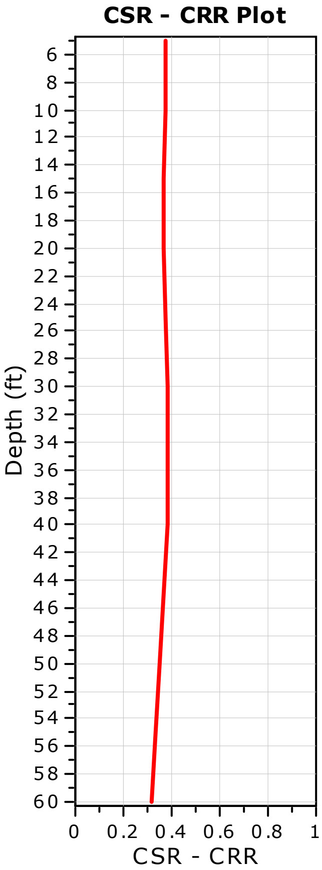
Project title : The Hub at Fullerton **SPT Name: B-5**

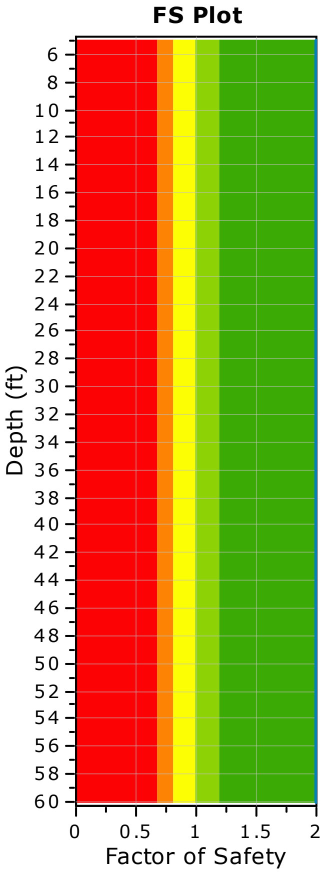
Location : 2601 - 2651 Chapman Ave

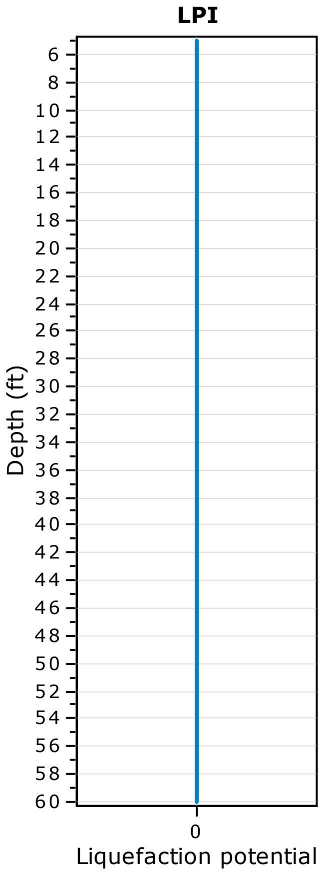
:: Input parameters and analysis properties ::

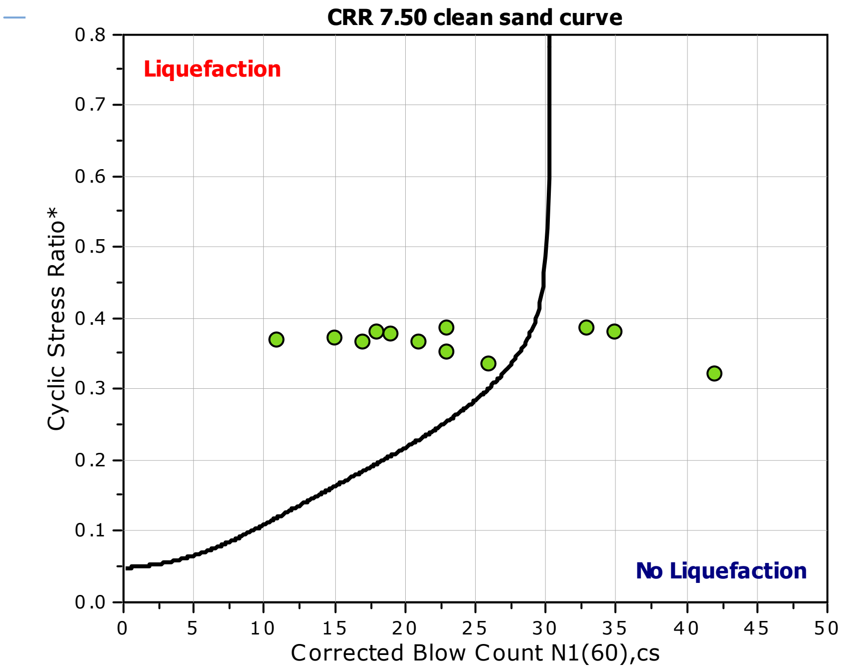
Analysis method:	NCEER 1998	G.W.T. (in-situ):	70.00 ft
Fines correction method:	NCEER 1998	G.W.T. (earthq.):	70.00 ft
Sampling method:	Sampler wo liners	Earthquake magnitude M_w:	6.70
Borehole diameter:	200mm	Peak ground acceleration:	0.78 g
Rod length:	3.30 ft	Eq. external load:	0.00 tsf
Hammer energy ratio:	1.28		


Raw SPT Data


CSR - CRR Plot


FS Plot


LPI


CRR 7.50 clean sand curve

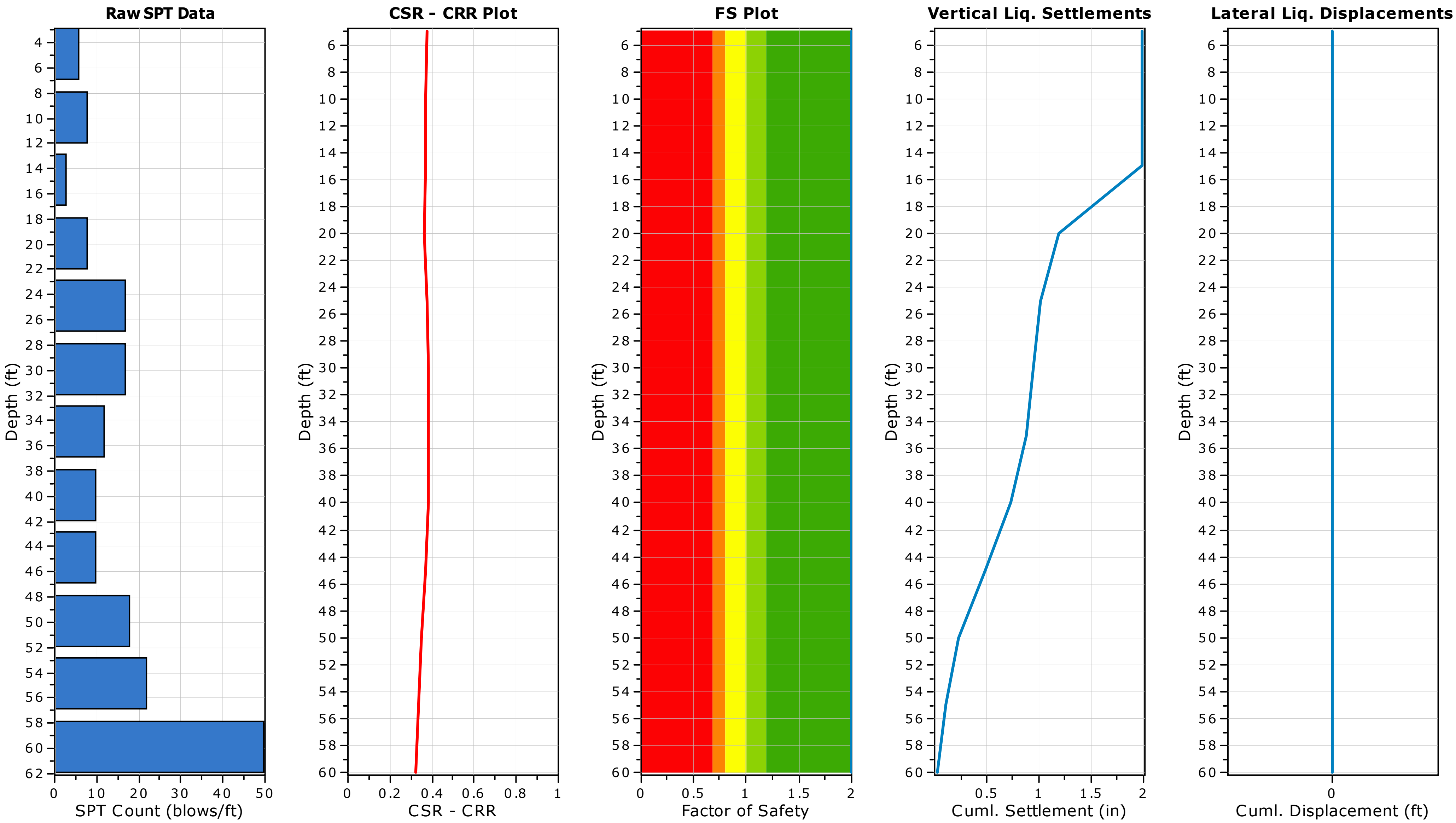
F.S. color scheme

- 🟥 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

:: Overall Liquefaction Assessment Analysis Plots ::



:: Field input data ::

Test Depth (ft)	SPT Field Value (blows)	Fines Content (%)	Unit Weight (pcf)	Infl. Thickness (ft)	Can Liquefy
5.00	6	55.00	125.00	8.25	No
10.00	8	5.00	90.00	5.00	No
15.00	3	55.00	90.00	5.00	Yes
20.00	8	59.00	130.00	5.00	Yes
25.00	17	75.00	130.00	5.00	Yes
30.00	17	49.00	125.00	5.00	Yes
35.00	12	56.00	125.00	5.00	Yes
40.00	10	56.00	125.00	5.00	Yes
45.00	10	88.00	125.00	5.00	Yes
50.00	18	24.00	125.00	5.00	Yes
55.00	22	24.00	125.00	5.00	Yes
60.00	50	5.00	125.00	5.00	Yes

Abbreviations

Depth: Depth at which test was performed (ft)
SPT Field Value: Number of blows per foot
Fines Content: Fines content at test depth (%)
Unit Weight: Unit weight at test depth (pcf)
Infl. Thickness: Thickness of the soil layer to be considered in settlements analysis (ft)
Can Liquefy: User defined switch for excluding/including test depth from the analysis procedure

:: Cyclic Resistance Ratio (CRR) calculation data ::

Depth (ft)	SPT Field Value	Unit Weight (pcf)	σ_v (tsf)	u_o (tsf)	σ'_{vo} (tsf)	C_N	C_E	C_B	C_R	C_S	$(N_1)_{60}$	Fines Content (%)	α	β	$(N_1)_{60cs}$	$CRR_{7.5}$
5.00	6	125.00	0.31	0.00	0.31	1.47	1.28	1.15	0.75	1.20	12	55.00	5.00	1.20	19	4.000
10.00	8	90.00	0.54	0.00	0.54	1.29	1.28	1.15	0.85	1.20	15	5.00	0.00	1.00	15	4.000
15.00	3	90.00	0.76	0.00	0.76	1.15	1.28	1.15	0.85	1.20	5	55.00	5.00	1.20	11	4.000
20.00	8	130.00	1.09	0.00	1.09	0.99	1.28	1.15	0.95	1.20	13	59.00	5.00	1.20	21	4.000
25.00	17	130.00	1.41	0.00	1.41	0.87	1.28	1.15	0.95	1.20	25	75.00	5.00	1.20	35	4.000
30.00	17	125.00	1.73	0.00	1.73	0.78	1.28	1.15	1.00	1.20	23	49.00	5.00	1.20	33	4.000
35.00	12	125.00	2.04	0.00	2.04	0.70	1.28	1.15	1.00	1.20	15	56.00	5.00	1.20	23	4.000
40.00	10	125.00	2.35	0.00	2.35	0.64	1.28	1.15	1.00	1.20	11	56.00	5.00	1.20	18	4.000
45.00	10	125.00	2.66	0.00	2.66	0.59	1.28	1.15	1.00	1.20	10	88.00	5.00	1.20	17	4.000
50.00	18	125.00	2.98	0.00	2.98	0.55	1.28	1.15	1.00	1.20	17	24.00	4.18	1.11	23	4.000
55.00	22	125.00	3.29	0.00	3.29	0.51	1.28	1.15	1.00	1.20	20	24.00	4.18	1.11	26	4.000
60.00	50	125.00	3.60	0.00	3.60	0.48	1.28	1.15	1.00	1.20	42	5.00	0.00	1.00	42	4.000

Abbreviations

σ_v: Total stress during SPT test (tsf)
u_o: Water pore pressure during SPT test (tsf)
σ'_{vo}: Effective overburden pressure during SPT test (tsf)
C_N: Overburden corretion factor
C_E: Energy correction factor
C_B: Borehole diameter correction factor
C_R: Rod length correction factor
C_S: Liner correction factor
$N_{1(60)}$: Corrected N_{SPT} to a 60% energy ratio
α, β: Clean sand equivalent clean sand formula coefficients
$N_{1(60)cs}$: Corected $N_{1(60)}$ value for fines content
$CRR_{7.5}$: Cyclic resistance ratio for M=7.5

:: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::

Depth (ft)	Unit Weight (pcf)	$\sigma_{v,eq}$ (tsf)	$u_{o,eq}$ (tsf)	$\sigma'_{vo,eq}$ (tsf)	r_d	α	CSR	MSF	$CSR_{eq,M=7.5}$	K_{sigma}	CSR^*	FS	
5.00	125.00	0.31	0.00	0.31	0.99	1.00	0.502	1.33	0.376	1.00	0.376	2.000	●
10.00	90.00	0.54	0.00	0.54	0.98	1.00	0.496	1.33	0.372	1.00	0.372	2.000	●
15.00	90.00	0.76	0.00	0.76	0.97	1.00	0.491	1.33	0.368	1.00	0.368	2.000	●
20.00	130.00	1.09	0.00	1.09	0.96	1.00	0.485	1.33	0.364	0.99	0.366	2.000	●
25.00	130.00	1.41	0.00	1.41	0.94	1.00	0.478	1.33	0.358	0.94	0.379	2.000	●
30.00	125.00	1.73	0.00	1.73	0.92	1.00	0.467	1.33	0.350	0.91	0.386	2.000	●
35.00	125.00	2.04	0.00	2.04	0.89	1.00	0.452	1.33	0.338	0.88	0.386	2.000	●
40.00	125.00	2.35	0.00	2.35	0.85	1.00	0.431	1.33	0.323	0.85	0.379	2.000	●
45.00	125.00	2.66	0.00	2.66	0.80	1.00	0.407	1.33	0.305	0.83	0.367	2.000	●
50.00	125.00	2.98	0.00	2.98	0.75	1.00	0.382	1.33	0.286	0.81	0.352	2.000	●
55.00	125.00	3.29	0.00	3.29	0.70	1.00	0.357	1.33	0.267	0.80	0.335	2.000	●
60.00	125.00	3.60	0.00	3.60	0.66	1.00	0.334	1.33	0.250	0.78	0.320	2.000	●

Abbreviations

$\sigma_{v,eq}$: Total overburden pressure at test point, during earthquake (tsf)
$u_{o,eq}$: Water pressure at test point, during earthquake (tsf)
$\sigma'_{vo,eq}$: Effective overburden pressure, during earthquake (tsf)
r_d : Nonlinear shear mass factor
α: Improvement factor due to stone columns
CSR : Cyclic Stress Ratio (adjusted for improvement)
MSF : Magnitude Scaling Factor
$CSR_{eq,M=7.5}$: CSR adjusted for M=7.5
K_{sigma}: Effective overburden stress factor
CSR^*: CSR fully adjusted (user FS applied)***
FS: Calculated factor of safety against soil liquefaction

*** User FS: 1.00

:: Liquefaction potential according to Iwasaki ::

Depth (ft)	FS	F	wz	Thickness (ft)	I_L
5.00	2.000	0.00	9.24	5.00	0.00
10.00	2.000	0.00	8.48	5.00	0.00
15.00	2.000	0.00	7.71	5.00	0.00
20.00	2.000	0.00	6.95	5.00	0.00
25.00	2.000	0.00	6.19	5.00	0.00
30.00	2.000	0.00	5.43	5.00	0.00
35.00	2.000	0.00	4.67	5.00	0.00
40.00	2.000	0.00	3.90	5.00	0.00
45.00	2.000	0.00	3.14	5.00	0.00
50.00	2.000	0.00	2.38	5.00	0.00
55.00	2.000	0.00	1.62	5.00	0.00
60.00	2.000	0.00	0.86	5.00	0.00

Overall potential I_L : 0.00

I_L = 0.00 - No liquefaction
I_L between 0.00 and 5 - Liquefaction not probable
I_L between 5 and 15 - Liquefaction probable
I_L > 15 - Liquefaction certain

:: Vertical settlements estimation for dry sands ::

Depth (ft)	$(N_1)_{60}$	τ_{av}	p	G_{max} (tsf)	α	b	γ	ε_{15}	N_c	ε_{Nc} (%)	Δh (ft)	ΔS (in)
5.00	12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.25	0.000
10.00	15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.000
15.00	5	0.37	0.51	710.55	0.15	7530.71	0.00	0.01	8.63	0.67	5.00	0.800
20.00	13	0.53	0.73	1052.69	0.17	6085.87	0.00	0.00	8.63	0.14	5.00	0.171
25.00	25	0.67	0.95	1422.42	0.18	5202.20	0.00	0.00	8.63	0.05	5.00	0.060
30.00	23	0.81	1.16	1541.38	0.19	4614.31	0.00	0.00	8.63	0.06	5.00	0.070
35.00	15	0.92	1.37	1485.26	0.20	4175.62	0.00	0.00	8.63	0.13	5.00	0.151
40.00	11	1.01	1.57	1469.95	0.22	3833.00	0.00	0.00	8.63	0.20	5.00	0.243
45.00	10	1.08	1.78	1535.11	0.23	3556.36	0.00	0.00	8.63	0.21	5.00	0.249
50.00	17	1.14	1.99	1794.72	0.24	3327.27	0.00	0.00	8.63	0.10	5.00	0.120
55.00	20	1.17	2.20	1965.33	0.25	3133.72	0.00	0.00	8.63	0.07	5.00	0.086
60.00	42	1.20	2.41	2413.12	0.26	2967.55	0.00	0.00	8.63	0.03	5.00	0.033

Cumulative settlemetns: 1.982

Abbreviations

τ_{av}:	Average cyclic shear stress
p:	Average stress
G_{max}:	Maximum shear modulus (tsf)
α, b:	Shear strain formula variables
γ:	Average shear strain
ε_{15}:	Volumetric strain after 15 cycles
N_c:	Number of cycles
ε_{Nc}:	Volumetric strain for number of cycles N_c (%)
Δh:	Thickness of soil layer (in)
ΔS:	Settlement of soil layer (in)

:: Lateral displacements estimation for saturated sands ::

Depth (ft)	$(N_1)_{60}$	D_r (%)	γ_{max} (%)	d_z (ft)	LDI	LD (ft)
5.00	12	48.50	0.00	8.25	0.000	0.00
10.00	15	54.22	0.00	5.00	0.000	0.00
15.00	5	31.30	0.00	5.00	0.000	0.00
20.00	13	50.48	0.00	5.00	0.000	0.00
25.00	25	70.00	0.00	5.00	0.000	0.00
30.00	23	67.14	0.00	5.00	0.000	0.00
35.00	15	54.22	0.00	5.00	0.000	0.00
40.00	11	46.43	0.00	5.00	0.000	0.00
45.00	10	44.27	0.00	5.00	0.000	0.00
50.00	17	57.72	0.00	5.00	0.000	0.00
55.00	20	62.61	0.00	5.00	0.000	0.00
60.00	42	90.73	0.00	5.00	0.000	0.00

Cumulative lateral displacements: 0.00

Abbreviations

D_r:	Relative density (%)
γ_{max}:	Maximum amplitude of cyclic shear strain (%)
d_z:	Soil layer thickness (ft)
LDI:	Lateral displacement index (ft)
LD:	Actual estimated displacement (ft)

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APPENDIX D

Infiltration Test Result

NTS GEOTECHNICAL

Falling Head Borehole Infiltration Test

Project Name:	2601 Chapman Ave			**Date:**	4/3/2020	
Project Number:	20073			**Tested By:**	LB	
Test Hole Number:	P-1			**USCS Soil Classification:**	CL/SM	
Total Depth :	10.00	feet		**Water Temperature:**	76	°F
Test Hole Diameter:	8.00	inches	radius=	4	inches	

Trial	Start Time	End Time	ΔT	Total Time	Initial Depth of Water	Final Depth of Water	H_0	H_f	ΔH	Havg	Infiltration Rate
			(min)	*(min)*	*(ft)*	*(ft)*	*(in)*	*(in)*	*(in)*	*(in.)*	*(in/hour)*
1	7:55	8:25	30.0	30.0	5.58	6.16	66.96	73.92	6.96	70.44	0.38
2	8:25	8:55	30.0	60.0	6.16	6.74	73.92	80.88	6.96	77.40	0.35
3	8:55	9:25	30.0	90.0	6.74	7.32	80.88	87.84	6.96	84.36	0.32
4	9:25	9:55	30.0	120.0	7.32	8.07	87.84	96.84	9.00	92.34	0.38
5	9:55	10:25	30.0	150.0	8.07	8.65	96.84	103.80	6.96	100.32	0.27
6	10:25	10:55	30.0	180.0	8.65	9.03	103.80	108.36	4.56	106.08	0.17
7	10:55	11:25	30.0	210.0	9.03	9.40	108.36	112.80	4.44	110.58	0.16
8	11:25	11:55	30.0	240.0	9.40	9.75	112.80	117.00	4.20	114.90	0.14

WATER TEMPERATURE CORRECTION FACTOR:	0.84
SAFETY FACTOR*:	2
UNFACTORED INFILTRATION RATE (IN/HR):	0.12

Factor Category	Factor Description	Assigned Weight (w)	Factor Value (v)	Product (p) = w x v
Suitability Assessment	Soil assessment methods	0.25	3	0.75
	Predominant soil texture	0.25	2	0.5
	Site soil variablity	0.25	2	0.5
	Depth to groundwater	0.25	1	0.25
			Geotechnical Factor of Safety (SA)*:	2

***Factor of safety should not be less than 2. Additional factor of safety in accordance with Table D-7 of the South Orange County Technical Guidance Document should be applied by the project civil engineer.**

NTS GEOTECHNICAL

Falling Head Borehole Infiltration Test

Project Name:	2601 Chapman Ave				**Date:**	4/3/2020	
Project Number:	20073				**Tested By:**	LB	
Test Hole Number:	P-2				**USCS Soil Classification:**	CL/SM/ML	
Total Depth :	10.00	feet			**Water Temperature:**	76	°F
Test Hole Diameter:	8.00	inches	radius=	4	inches		

Trial	**Start Time**	**End Time**	**ΔT**	**Total Time**	**Initial Depth of Water**	**Final Depth of Water**	**H_0**	**H_f**	**ΔH**	**Havg**	**Infiltration Rate**
			(min)	*(min)*	*(ft)*	*(ft)*	*(in)*	*(in)*	*(in)*	*(in.)*	*(in/hour)*
1	7:55	8:25	30.0	30.0	3.58	3.83	42.96	45.96	3.00	44.46	0.26
2	8:25	8:55	30.0	60.0	3.83	4.00	45.96	48.00	2.04	46.98	0.17
3	8:55	9:25	30.0	90.0	4.00	4.25	48.00	51.00	3.00	49.50	0.23
4	9:25	9:55	30.0	120.0	4.25	4.67	51.00	56.04	5.04	53.52	0.36
5	9:55	10:25	30.0	150.0	4.67	5.03	56.04	60.36	4.32	58.20	0.29
6	10:25	10:55	30.0	180.0	5.03	5.36	60.36	64.32	3.96	62.34	0.25
7	10:55	11:25	30.0	210.0	5.36	5.69	64.32	68.28	3.96	66.30	0.23
8	11:25	11:55	30.0	240.0	5.69	6.03	68.28	72.36	4.08	70.32	0.23

WATER TEMPERATURE CORRECTION FACTOR:	0.84
SAFETY FACTOR*:	2
UNFACTORED INFILTRATION RATE (IN/HR):	0.19

Factor Category	**Factor Description**	**Assigned Weight (w)**	**Factor Value (v)**	**Product (p) = w x v**
Suitability Assessment	Soil assessment methods	0.25	3	0.75
	Predominant soil texture	0.25	2	0.5
	Site soil variablity	0.25	2	0.5
	Depth to groundwater	0.25	1	0.25
			Geotechnical Factor of Safety (S_A):	2

***Factor of safety should not be less than 2. Additional factor of safety in accordance with Table D-7 of the South Orange County Technical Guidance Document should be applied by the project civil engineer.**

ATTACHMENT D

SOIL INFILTRATION TECHNICAL MEMORANDUM

Preliminary Infiltration Testing

Two (2) preliminary infiltration tests were performed in general conformance with the County of Orange Technical Guidance Document (TGD). The borings are shown on the attached Plate 2 – Geotechnical Map, were excavated to depths of from approximately 10 feet below the existing grade using a hollow-stem-auger drill rig. The calculated unfactored raw observed infiltration rates are presented in the following table:

Unfactored Raw Infiltration Rates Summary

Boring No.	Depth Below Finish Grade (feet)	Unfactored Raw Observed Infiltration Rates (inches/hour) *
P-1	10.0	0.12
P-2	10.0	0.19

**Rates do not incorporate a factor of safety.*

The results of the infiltration testing indicate that the unfactored raw observed infiltration rates within the southern side of the development range from 0.12 to 0.19 inches per hour, with an average unfactored infiltration of 0.16 inches per hour. Thus, we conclude for the entire site that infiltration rates do not meet the minimum requirement of 0.3 inch/hour when a minimum factor of safety of 2 is applied per the County of Orange TGD manual. The results of the infiltration testing are contained in Appendix D of this report.

Excavation Characteristics

The majority of the soil materials underlying the site can be excavated with excavators and other conventional grading equipment.

GEOTECHNICAL ENGINEERING CONLUSIONS AND RECOMMENDATIONS

Conclusions

Based on the results of our field exploration and engineering analyses, it is our opinion that the proposed development is feasible from a geotechnical standpoint, provided that the recommendations in this report are incorporated into the design plans and are implemented during construction.

ATTACHMENT E

CALCULATIONS

The Hub at Fullerton
WQMP Flow Rate Calculations

Area	% Impervious	C	I (in/hr)	A (acres)	Q (cfs)	Reduction	Adjusted Q (cfs)	Selected Modular Wetland	Modular Wetland Allowable Q
DMA-1	97%	0.881	0.23	0.87	0.176	20.0%	0.141	MWS-L-4-15	0.175
DMA-2	96%	0.872	0.23	0.47	0.094	20.0%	0.075	MWS-L-4-8	0.115
DMA-3	96%	0.873	0.23	0.33	0.066	20.0%	0.053	MWS-L-4-6	0.073
DMA-4	94%	0.857	0.23	0.33	0.065	20.0%	0.052	MWS-L-4-6	0.073
DMA-5	98%	0.887	0.23	0.89	0.181	20.0%	0.145	MWS-L-4-15	0.175
DMA-6	94%	0.857	0.23	0.31	0.061	20.0%	0.049	MWS-L-4-6	0.073
DMA-7	95%	0.86	0.23	0.35	0.069	20.0%	0.055	MWS-L-4-6	0.073

Note: Reduction is based on 20%

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             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
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                           Analysis prepared by:





 ************************** DESCRIPTION OF STUDY **************************
* EXISTING CONDITIONS                                                      *
* 100 YEAR 24 HR STORM                                                     *
* THE HUB AT FULLERTON                                                     *
 **************************************************************************

  FILE NAME: HUBEX100.DAT
  TIME/DATE OF STUDY: 17:14 02/15/2021
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) III 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

****************************************************************************
  FLOW PROCESS FROM NODE    100.00 TO NODE    101.00 IS CODE =  21
```

```
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    82.80
  ELEVATION DATA: UPSTREAM(FEET) =    226.00  DOWNSTREAM(FEET) =    225.28

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.000
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  6.187
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 B        0.12      0.30     0.100    76    5.00
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      0.66
  TOTAL AREA(ACRES) =      0.12   PEAK FLOW RATE(CFS) =      0.66

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    225.28  DOWNSTREAM(FEET) =    224.84
  CHANNEL LENGTH THRU SUBAREA(FEET) =   214.84   CHANNEL SLOPE =  0.0020
  CHANNEL BASE(FEET) =    0.00   "Z" FACTOR =  99.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   0.50
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.412
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        1.09      0.30     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.86
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   0.89
  AVERAGE FLOW DEPTH(FEET) =   0.18   TRAVEL TIME(MIN.) =   4.02
  Tc(MIN.) =    9.02
  SUBAREA AREA(ACRES) =     1.09       SUBAREA RUNOFF(CFS) =    4.30
  EFFECTIVE AREA(ACRES) =      1.21     AREA-AVERAGED Fm(INCH/HR) =   0.03
  AREA-AVERAGED Fp(INCH/HR) =   0.30  AREA-AVERAGED Ap =   0.10
  TOTAL AREA(ACRES) =        1.2         PEAK FLOW RATE(CFS) =       4.77

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.22   FLOW VELOCITY(FEET/SEC.) =   1.03
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =     297.64 FEET.

****************************************************************************
```

```
  FLOW PROCESS FROM NODE    200.00 TO NODE    201.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    40.35
  ELEVATION DATA: UPSTREAM(FEET) =    228.01  DOWNSTREAM(FEET) =    226.90

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.000
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  6.187
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 B        0.03      0.30     0.100    76    5.00
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      0.17
  TOTAL AREA(ACRES) =      0.03   PEAK FLOW RATE(CFS) =      0.17

****************************************************************************
  FLOW PROCESS FROM NODE    201.00 TO NODE    202.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    226.90  DOWNSTREAM(FEET) =    224.79
  CHANNEL LENGTH THRU SUBAREA(FEET) =   536.24   CHANNEL SLOPE =  0.0039
  CHANNEL BASE(FEET) =    0.00   "Z" FACTOR =  99.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   0.50
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.764
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        2.31      0.30     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       4.16
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.29
  AVERAGE FLOW DEPTH(FEET) =   0.18   TRAVEL TIME(MIN.) =   6.90
  Tc(MIN.) =   11.90
  SUBAREA AREA(ACRES) =     2.31       SUBAREA RUNOFF(CFS) =    7.76
  EFFECTIVE AREA(ACRES) =      2.34     AREA-AVERAGED Fm(INCH/HR) =   0.03
  AREA-AVERAGED Fp(INCH/HR) =   0.30  AREA-AVERAGED Ap =   0.10
  TOTAL AREA(ACRES) =        2.3         PEAK FLOW RATE(CFS) =       7.86

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.23   FLOW VELOCITY(FEET/SEC.) =   1.48
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    202.00 =     576.59 FEET.
============================================================================
```

```
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        2.3  TC(MIN.) =     11.90
  EFFECTIVE AREA(ACRES) =      2.34  AREA-AVERAGED Fm(INCH/HR)=  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap = 0.100
  PEAK FLOW RATE(CFS)   =       7.86
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS

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****************************************************************************
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                           Analysis prepared by:







 ************************** DESCRIPTION OF STUDY **************************
* THE HUB AT FLLERTON                                                      *
* PROPOSED CONDITION                                                       *
* FINAL HYDROLOGY ANALYSIS 100 YEAR 24 HOUR                                *
 **************************************************************************

  FILE NAME: HUBPR100.DAT
  TIME/DATE OF STUDY: 12:52 02/15/2021
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) III 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   26.0     21.0    0.018/0.018/0.020   0.50    2.00 0.0312 0.125 0.0150
  2   41.0     36.0    0.018/0.017/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.67 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  1.3 (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    100.00 TO NODE    101.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    59.00
  ELEVATION DATA: UPSTREAM(FEET) =    225.65  DOWNSTREAM(FEET) =    225.35

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.000
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  6.187
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  APARTMENTS                 B        0.10      0.30     0.200    76    5.00
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      0.55
  TOTAL AREA(ACRES) =      0.10   PEAK FLOW RATE(CFS) =      0.55

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   220.88  DOWNSTREAM(FEET) =   218.22
  FLOW LENGTH(FEET) =   516.00   MANNING'S N =  0.015
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   4.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   2.29
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       0.55
  PIPE TRAVEL TIME(MIN.) =   3.75    Tc(MIN.) =    8.75
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =     575.00 FEET.

+--------------------------------------------------------------------------+
| ADDITION OF SUB AREA = DMA 1 + DMA 4                                     |
|                                                                          |
|                                                                          |
+--------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    102.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    8.75
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.490
  SUBAREA LOSS RATE DATA(AMC III):
```

```
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 APARTMENTS                 B       1.14      0.30     0.200    76
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
 SUBAREA AREA(ACRES) =    1.14      SUBAREA RUNOFF(CFS) =    4.55
 EFFECTIVE AREA(ACRES) =      1.24   AREA-AVERAGED Fm(INCH/HR) =  0.06
 AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.20
 TOTAL AREA(ACRES) =        1.2       PEAK FLOW RATE(CFS) =       4.94

****************************************************************************
 FLOW PROCESS FROM NODE    102.00 TO NODE    102.00 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.) =    8.75
 RAINFALL INTENSITY(INCH/HR) =   4.49
 AREA-AVERAGED Fm(INCH/HR) =  0.06
 AREA-AVERAGED Fp(INCH/HR) =  0.30
 AREA-AVERAGED Ap =  0.20
 EFFECTIVE STREAM AREA(ACRES) =       1.24
 TOTAL STREAM AREA(ACRES) =       1.24
 PEAK FLOW RATE(CFS) AT CONFLUENCE =       4.94

****************************************************************************
 FLOW PROCESS FROM NODE    200.00 TO NODE    201.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    22.00
 ELEVATION DATA: UPSTREAM(FEET) =    228.01  DOWNSTREAM(FEET) =    227.58

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.000
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  6.187
 SUBAREA Tc AND LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 APARTMENTS                 B       0.11      0.30     0.200    76    5.00
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
 SUBAREA RUNOFF(CFS) =      0.61
 TOTAL AREA(ACRES) =      0.11   PEAK FLOW RATE(CFS) =      0.61

****************************************************************************
 FLOW PROCESS FROM NODE    201.00 TO NODE    202.00 IS CODE =  31
----------------------------------------------------------------------------
```

```
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   222.07  DOWNSTREAM(FEET) =   220.05
  FLOW LENGTH(FEET) =   470.00   MANNING'S N =  0.015
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   4.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   2.22
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       0.61
  PIPE TRAVEL TIME(MIN.) =   3.53    Tc(MIN.) =    8.53
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    202.00 =     492.00 FEET.

+--------------------------------------------------------------------------+
| ADDITION OF SUB-AREA= DMA 2 + DAM 3 + DMA 5 + DMA 6 + DMA 7              |
|                                                                          |
|                                                                          |
+--------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    202.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    8.53
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.557
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  APARTMENTS                 B        2.16      0.30     0.200    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA AREA(ACRES) =    2.16      SUBAREA RUNOFF(CFS) =    8.74
  EFFECTIVE AREA(ACRES) =      2.27   AREA-AVERAGED Fm(INCH/HR) =  0.06
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =        2.3       PEAK FLOW RATE(CFS) =       9.19

****************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    102.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   220.05  DOWNSTREAM(FEET) =   218.22
  FLOW LENGTH(FEET) =   402.00   MANNING'S N =  0.015
  DEPTH OF FLOW IN  24.0 INCH PIPE IS  15.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.46
  ESTIMATED PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       9.19
  PIPE TRAVEL TIME(MIN.) =   1.50    Tc(MIN.) =   10.03
```

```
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    102.00 =     894.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    102.00 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.) =   10.03
  RAINFALL INTENSITY(INCH/HR) =   4.15
  AREA-AVERAGED Fm(INCH/HR) =  0.06
  AREA-AVERAGED Fp(INCH/HR) =  0.30
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =       2.27
  TOTAL STREAM AREA(ACRES) =       2.27
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       9.19

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        4.94    8.75    4.490  0.30( 0.06) 0.20       1.2     100.00
      2        9.19   10.03    4.152  0.30( 0.06) 0.20       2.3     200.00

  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       13.62    8.75    4.490  0.30( 0.06) 0.20       3.2     100.00
      2       13.75   10.03    4.152  0.30( 0.06) 0.20       3.5     200.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      13.75    Tc(MIN.) =    10.03
  EFFECTIVE AREA(ACRES) =       3.51   AREA-AVERAGED Fm(INCH/HR) =  0.06
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =       3.5
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    102.00 =     894.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        3.5  TC(MIN.) =     10.03
  EFFECTIVE AREA(ACRES) =      3.51  AREA-AVERAGED Fm(INCH/HR)=  0.06
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap = 0.200
  PEAK FLOW RATE(CFS)   =      13.75

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
```

```
      1       13.62    8.75    4.490  0.30( 0.06) 0.20       3.2     100.00
      2       13.75   10.03    4.152  0.30( 0.06) 0.20       3.5     200.00
================================================================================
================================================================================
  END OF RATIONAL METHOD ANALYSIS

↑
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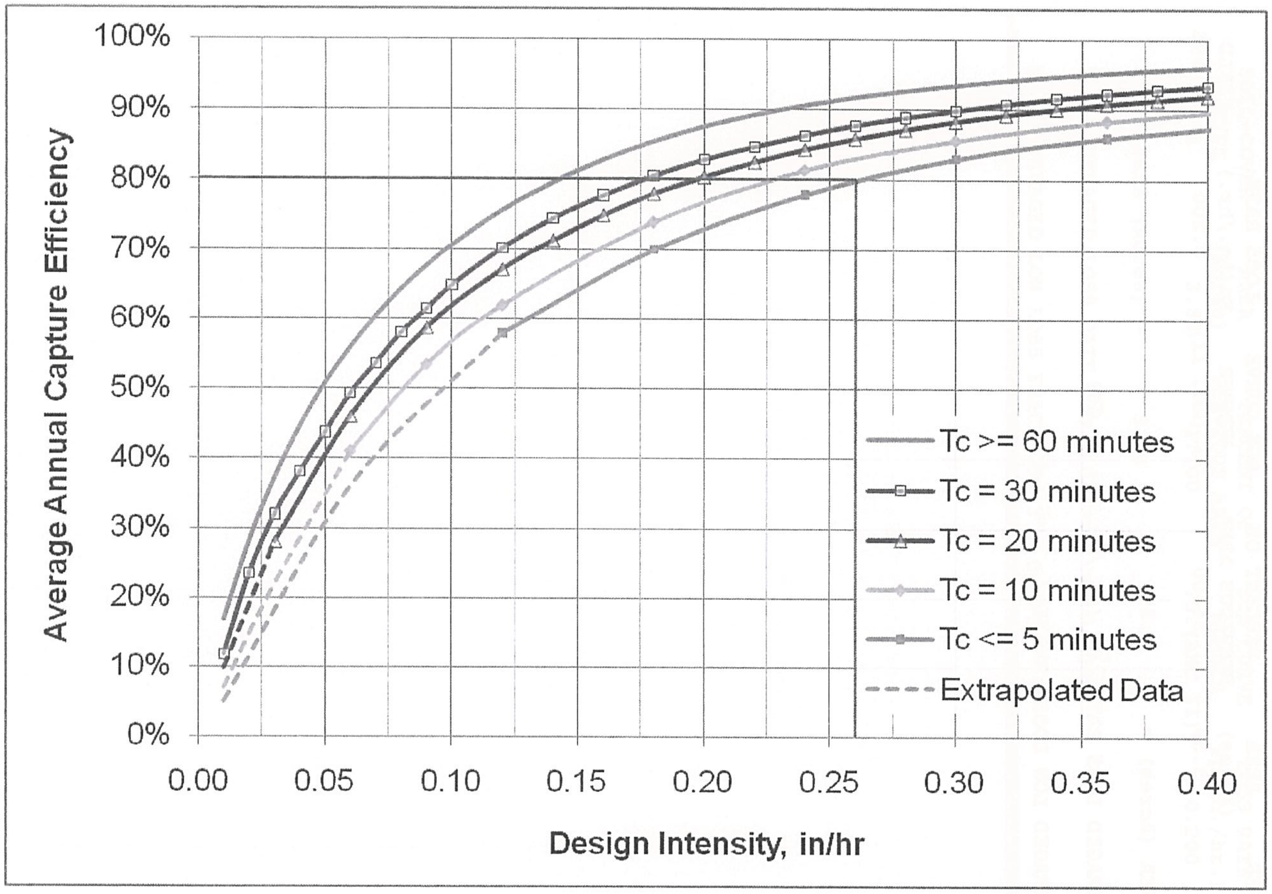
Figure III.4. Capture Efficiency Nomograph for Off-line Flow-based Systems in Orange County



Worksheet D: Capture Efficiency Method for Flow-Based BMPs

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=	10.03	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=	0.23	in/hr
3	Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (**Worksheet A**)	d_{HSC}=	0	inches
4	Enter capture efficiency corresponding to d_{HSC}, Y_2 (**Worksheet A**)	Y_2=	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=	0.23	
6	Determine the design intensity that must be provided by BMP, $I_{design}= I_1 - I_2$	I_{design}=	0.23	
Step 2: Calculate the design flowrate				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=		acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=		
3	Calculate runoff coefficient, $C= (0.75 \times imp) + 0.15$	C=		
4	Calculate design flowrate, $Q_{design}= (C \times i_{design} \times A)$	Q_{design}=		cfs
Supporting Calculations				
Describe system: Step 2 Calculations are included in the first page of this appendix as well as in IV.2.				
Provide time of concentration assumptions: Time of Concentration is based off of the AES model. Calculations are provided prior.				

Table X.8: Minimum Irrigated Area for Potential Partial Capture Feasibility

General Landscape Type	**Conservation Design: K_L = 0.35**			**Active Turf Areas: K_L = 0.7**		
Closest ET Station	*Irvine*	*Santa Ana*	*Laguna*	*Irvine*	*Santa Ana*	*Laguna*
Design Capture Storm Depth, inches	**Minimum Required Irrigated Area per Tributary Impervious Acre for Potential Partial Capture, ac/ac**					
0.60	0.66	0.68	0.72	0.33	0.34	0.36
0.65	0.72	0.73	0.78	0.36	0.37	0.39
0.70	0.77	0.79	0.84	0.39	0.39	0.42
0.75	0.83	0.84	0.90	0.41	0.42	0.45
0.80	0.88	0.90	0.96	0.44	0.45	0.48
0.85	0.93	0.95	1.02	0.47	0.48	0.51
0.90	0.99	1.01	1.08	0.49	0.51	0.54
0.95	1.04	1.07	1.14	0.52	0.53	0.57
1.00	1.10	1.12	1.20	0.55	0.56	0.60

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	☐		
3	Landscape irrigation	☐		
4	Other:______________________________________	☐		
5	What is the design capture storm depth? (**Figure III.1**)	d		inches
6	What is the project size?	A		ac
7	What is the acreage of impervious area?	IA		ac
	For projects with multiple types of demand (toilet flushing, indoor demand, and/or other demand)			
8	What is the minimum use required for partial capture? (**Table X.6**)			gpd
9	What is the project estimated wet season total daily use?			gpd
10	Is partial capture potentially feasible? (Line 9 > Line 8?)			
	For projects with only toilet flushing demand			
11	What is the minimum TUTIA for partial capture? (**Table X.7**)			
12	What is the project estimated TUTIA?			

Worksheet J: Summary of Harvested Water Demand and Feasibility

13	Is partial capture potentially feasible? (Line 12 > Line 11?)		
	For projects with only irrigation demand		
14	What is the minimum irrigation area required based on conservation landscape design? (Table X.8)		ac
15	What is the proposed project irrigated area? (multiply conservation landscaping by 1; multiply active turf by 2)		ac
16	Is partial capture potentially feasible? (Line 15 > Line 14?)		
Provide supporting assumptions and citations for controlling demand calculation:			

Worksheet G: Alternative Compliance Volume Worksheet

Step 1: Determine the alternative compliance volume without water quality credits				
1	Determine the capture efficiency achieved in upstream BMPs using **Appendix III**, X_1 (%)	X_1=	0	%
2	Enter design capture storm depth from **Figure III.1**, *d* (inches)	d=	0.23	inches
3	Using **Figure VI.1**, pivot from where X_1 intersects the curve to determine the fraction of design capture storm depth remaining to be met, Y_1	Y_1=	1.0	
4	Calculate the design depth that must be managed in alternative compliance BMPs, $d_{alternative} = Y_1 \times d$	$d_{alternative}$=	0.23	inches
5	Compute the alternative compliance volume corresponding to $d_{alternative}$ using the hydrologic methods described in Section **III.1.1**, *ACV* (cu-ft)	ACV=	1967	cu-ft
Step 2: Determine Credit Volume				
Method 1: Determine Credit Volume based on Reducing Impervious Footprint				
1	Enter design capture storm depth from **Figure III.1**, *d* (inches)	d=		inches
2	Using d, calculate the DCV using the pre-project imperviousness and the methods described in **Appendix III**, DCV_{pre} (cu-ft).	DCV_{pre}=		cu-ft
3	Using d, calculate the DCV using the proposed imperviousness and the methods described in **Appendix III**, DCV_{post} (cu-ft).	DCV_{post}=		cu-ft
4	Calculate the $Credit\ Volume = DCV_{pre} - DCV_{post}$ (cu-ft).	Credit Volume=		cu-ft
Method 2: Determine Credit Volume based on Project Type and Density				
1	Determine the sum of the Credit Percentages applicable to the Project, *∑Credit Percentages* (%). (See Section 3.1 of the **Model WQMP**)	*∑Credit Percentages* =	20	%
2	Enter design capture storm depth from **Figure III.1**, *d* (inches)	d=	0.87	inches
3	Using d, calculate the DCV using the proposed imperviousness without BMPs and the methods described in **Appendix III**, $DCV_{post\ no\ BMP}$ (cu-ft).	$DCV_{post\ no\ BMP}$=	1967	cu-ft
4	Calculate the $Credit\ Volume = DCV_{post\ no\ BMP} \times \sum Credit\ Percentages$	Credit Volume=	393	cu-ft

Worksheet G: Alternative Compliance Volume Worksheet

Step 3: Determine the Alternative Compliance Volume after WQ Credits				
1	Enter design capture storm depth from **Figure III.1**, *d* (inches)	d=	0.87	inches
2	Using d, calculate the DCV using the proposed imperviousness and the methods described in **Appendix III**, DCV_{post} (cu-ft).	DCV_{post}=	1967	cu-ft
3	Calculate the alternative compliance volume, $ACV = DCV_{post} - Credit\ Volume$	ACV=	393	cu-ft

ATTACHMENT F

EDUCATION MATERIALS

LIST OF EDUCATIONAL MATERIALS PROVIDED

1. THE OCEAN BEGINS AT YOUR FRONT DOOR
2. PROPOER MAINTENANCE PRACTICES FOR YOUR BUSINESS
3. HOMEOWNERS GUIDE TO SUSTAINABLE WATER USE
4. HOUSEHOLD TIPS
5. PROPER DISPOSAL OF HOUSEHOLD HAZARDOUS WASTE
6. RESPONSIBLE PEST CONTROL
7. TIPS FOR HOME IMPROVEMENT PROJECTS
8. TIPS FOR LANDSCAPING AND GARDENING
9. TIPS FOR PET CARE
10. TIPS FOR POOL MAINTENANCE
11. TIPS FOR RESIDENTIAL POOL, LANDSCAPE, AND HARDSCAPE DRAINS
12. TIPS FOR PROJECTS USING PAINTt
13. SC-10: NON-STORMWATER DISCHARGE
14. SC-30: OUTDOOR LOADING/UNLOADING
15. SC-34: WASTE HANDLING & DISPOSAL
16. SC-41: BUILDING & GROUNDS MAINTENANCE
17. SC-43: PARKING/STORAGE AREA MAINTENANCE
18. SC-44: DRAINAGE SYSTEM MAINTENANCE
19. SC-70: ROAD AND STREET MAINTENANCE
20. SD-10: SITE DESIGN & LANDSCAPE PLANNING
21. SD-12: EFFICIENT IRRIGATION
22. SD-13: STORM DRAIN SIGNAGE
23. SD-32: TRASH STORAGE AREAS
24. SD-34: OUTDOOR MATERIAL STORARE AREAS
25. MODULAR WETLAND PRODUCT INFORMATION

The Ocean Begins at Your Front Door

PROJECT Pollution PREVENTION

K-215

Follow these simple steps to help reduce water pollution:

Household Activities

- Do not rinse spills with water. Use dry cleanup methods such as applying cat litter or another absorbent material, sweep and dispose of in the trash. Take items such as used or excess batteries, oven cleaners, automotive fluids, painting products and cathode ray tubes, like TVs and computer monitors, to a Household Hazardous Waste Collection Center (HHWCC).
- For a HHWCC near you call (714) 834-6752 or visit www.oclandfills.com.
- Do not hose down your driveway, sidewalk or patio to the street, gutter or storm drain. Sweep up debris and dispose of it in the trash.

Automotive

- Take your vehicle to a commercial car wash whenever possible. If you wash your vehicle at home, choose soaps, cleaners, or detergents labeled non-toxic, phosphate- free or biodegradable. Vegetable and citrus-based products are typically safest for the environment.
- Do not allow washwater from vehicle washing to drain into the street, gutter or storm drain. Excess washwater should be disposed of in the sanitary sewer (through a sink or toilet) or onto an absorbent surface like your lawn.
- Monitor your vehicles for leaks and place a pan under leaks. Keep your vehicles well maintained to stop and prevent leaks.
- Never pour oil or antifreeze in the street, gutter or storm drain. Recycle these substances at a service station, a waste oil collection center or used oil recycling center. For the nearest Used Oil Collection Center call 1-800-CLEANUP or visit www.1800cleanup.org.

Pool Maintenance

- Pool and spa water must be dechlorinated and free of excess acid, alkali or color to be allowed in the street, gutter or storm drain.
- When it is not raining, drain dechlorinated pool and spa water directly into the sanitary sewer.
- Some cities may have ordinances that do not allow pool water to be disposed of in the storm drain. Check with your city.

Landscape and Gardening

- Do not over-water. Water your lawn and garden by hand to control the amount of water you use or set irrigation systems to reflect seasonal water needs. If water flows off your yard onto your driveway or sidewalk, your system is over-watering. Periodically inspect and fix leaks and misdirected sprinklers.
- Do not rake or blow leaves, clippings or pruning waste into the street, gutter or storm drain. Instead, dispose of waste by composting, hauling it to a permitted landfill, or as green waste through your city's recycling program.
- Follow directions on pesticides and fertilizer, (measure, do not estimate amounts) and do not use if rain is predicted within 48 hours.
- Take unwanted pesticides to a HHWCC to be recycled. For locations and hours of HHWCC, call (714) 834-6752 or visit www.oclandfills.com.

Trash

- Place trash and litter that cannot be recycled in securely covered trash cans.
- Whenever possible, buy recycled products.
- Remember: Reduce, Reuse, Recycle.

Pet Care

- Always pick up after your pet. Flush waste down the toilet or dispose of it in the trash. Pet waste, if left outdoors, can wash into the street, gutter or storm drain.
- If possible, bathe your pets indoors. If you must bathe your pet outside, wash it on your lawn or another absorbent/permeable surface to keep the washwater from entering the street, gutter or storm drain.
- Follow directions for use of pet care products and dispose of any unused products at a HHWCC.

Common Pollutants

Home Maintenance

- Detergents, cleaners and solvents
- Oil and latex paint
- Swimming pool chemicals
- Outdoor trash and litter

Lawn and Garden

- Pet and animal waste
- Pesticides
- Clippings, leaves and soil
- Fertilizer

Automobile

- Oil and grease
- Radiator fluids and antifreeze
- Cleaning chemicals
- Brake pad dust

The Ocean Begins at Your Front Door

Never allow pollutants to enter the street, gutter or storm drain!

Did You Know?

- Most people believe that the largest source of water pollution in urban areas comes from specific sources such as factories and sewage treatment plants. In fact, the largest source of water pollution comes from city streets, neighborhoods, construction sites and parking lots. This type of pollution is sometimes called “non-point source” pollution.
- There are two types of non-point source pollution: stormwater and urban runoff pollution.
- Stormwater runoff results from rainfall. When rainstorms cause large volumes of water to rinse the urban landscape, picking up pollutants along the way.
- Urban runoff can happen any time of the year when excessive water use from irrigation, vehicle washing and other sources carries trash, lawn clippings and other urban pollutants into storm drains.

Where Does It Go?

- Anything we use outside homes, vehicles and businesses – like motor oil, paint, pesticides, fertilizers and cleaners – can be blown or washed into storm drains.
- A little water from a garden hose or rain can also send materials into storm drains.
- Storm drains are separate from our sanitary sewer systems; unlike water in sanitary sewers (from sinks or toilets), water in storm drains is not treated before entering our waterways.

Sources of Non-Point Source Pollution

- Automotive leaks and spills.
- Improper disposal of used oil and other engine fluids.
- Metals found in vehicle exhaust, weathered paint, rust, metal plating and tires.
- Pesticides and fertilizers from lawns, gardens and farms.
- Improper disposal of cleaners, paint and paint removers.
- Soil erosion and dust debris from landscape and construction activities.
- Litter, lawn clippings, animal waste, and other organic matter.
- Oil stains on parking lots and paved surfaces.

The Effect on the Ocean

Non-point source pollution can have a serious impact on water quality in Orange County. Pollutants from the storm drain system can harm marine life as well as coastal and wetland habitats. They can also degrade recreation areas such as beaches, harbors and bays.

Stormwater quality management programs have been developed throughout Orange County to educate and encourage the public to protect water quality, monitor runoff in the storm drain system, investigate illegal dumping and maintain storm drains.

Support from Orange County residents and businesses is needed to improve water quality and reduce urban runoff pollution. Proper use and disposal of materials will help stop pollution before it reaches the storm drain and the ocean.

For More Information

Orange County Stormwater Program

California Environmental Protection Agency
www.calepa.ca.gov

- **Air Resources Board**
  www.arb.ca.gov
- **Department of Pesticide Regulation**
  www.cdpr.ca.gov
- **Department of Toxic Substances Control**
  www.dtsc.ca.gov
- **Integrated Waste Management Board**
  www.ciwmb.ca.gov
- **Office of Environmental Health Hazard Assessment**
  www.oehha.ca.gov
- **State Water Resources Control Board**
  www.waterboards.ca.gov

Earth 911 - Community-Specific Environmental Information 1-800-cleanup or visit www.1800cleanup.org

Health Care Agency's Ocean and Bay Water Closure and Posting Hotline
(714) 433-6400 or visit www.ocbeachinfo.com

Integrated Waste Management Dept. of Orange County (714) 834-6752 or visit www.oclandfills.com for information on household hazardous waste collection centers, recycling centers and solid waste collection

O.C. Agriculture Commissioner
(714) 447-7100 or visit www.ocagcomm.com

Stormwater Best Management Practice Handbook
Visit www.cabmphandbooks.com

UC Master Gardener Hotline
(714) 708-1646 or visit www.uccemg.com

The Orange County Stormwater Program has created and moderates an electronic mailing list to facilitate communications, take questions and exchange ideas among its users about issues and topics related to stormwater and urban runoff and the implementation of program elements. To join the list, please send an email to ocstormwaterinfo-join@list.ocwatersheds.com

Aliso Viejo	(949)	425-2535
Anaheim Public Works Operations	(714)	765-6860
Brea Engineering	(714)	990-7666
Buena Park Public Works	(714)	562-3655
Costa Mesa Public Services	(714)	754-5323
Cypress Public Works	(714)	229-6740
Dana Point Public Works	(949)	248-3584
Fountain Valley Public Works	(714)	593-4441
Fullerton Engineering Dept.	(714)	738-6853
Garden Grove Public Works	(714)	741-5956
Huntington Beach Public Works	(714)	536-5431
Irvine Public Works	(949)	724-6315
La Habra Public Services	(562)	905-9792
La Palma Public Works	(714)	690-3310
Laguna Beach Water Quality	(949)	497-0378
Laguna Hills Public Services	(949)	707-2650
Laguna Niguel Public Works	(949)	362-4337
Laguna Woods Public Works	(949)	639-0500
Lake Forest Public Works	(949)	461-3480
Los Alamitos Community Dev.	(562)	431-3538
Mission Viejo Public Works	(949)	470-3056
Newport Beach, Code & Water Quality Enforcement	(949)	644-3215
Orange Public Works	(714)	532-6480
Placentia Public Works	(714)	993-8245
Rancho Santa Margarita	(949)	635-1800
San Clemente Environmental Programs	(949)	361-6143
San Juan Capistrano Engineering	(949)	234-4413
Santa Ana Public Works	(714)	647-3380
Seal Beach Engineering	(562)	431-2527 x317
Stanton Public Works.	(714)	379-9222 x204
Tustin Public Works/Engineering	(714)	573-3150
Villa Park Engineering	(714)	998-1500
Westminster Public Works/Engineering	(714)	898-3311 x446
Yorba Linda Engineering	(714)	961-7138
Orange County Stormwater Program	(877)	897-7455

Orange County 24-Hour
Water Pollution Problem Reporting Hotline
1-877-89-SPILL (1-877-897-7455)

On-line Water Pollution Problem Reporting Form
www.ocwatersheds.com

Printed on Recycled Paper

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

K-220
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

The Pollution Solution

Several residential activities can result in water pollution. Among these activities are car washing and hosing off driveways and sidewalks. Both activities can waste water and result in excess runoff. Water conservation methods described in this pamphlet can prevent considerable amounts of runoff and conserve water. By taking your car to a commercial car wash and by sweeping driveways and sidewalks, you can further prevent the transport of pollutants to Orange County waterways. Here are some of the common pollutants for which you can be part of the solution:

1 Pesticides and Fertilizer

- **Pollution:** The same pesticides that are designed to be toxic to pests can have an equally lethal impact on our marine life. The same fertilizer that promotes plant growth in lawns and gardens can also create nuisance algae blooms, which remove oxygen from the water and clog waterways when it decomposes.
- **Solution:** Never use pesticides or fertilizer within 48 hours of an anticipated rainstorm. Use only as much as is directed on the label and keep it off driveways and sidewalks.

2 Dirt and Sediment

- **Pollution:** Dirt or sediment can impede the flow of the stormwater and negatively impact stream habitat as it travels through waterways and deposits downstream. Pollutants can attach to sediment, which can then be transported through our waterways.
- **Solution:** Protect dirt stockpiles by covering them with tarps or secure plastic sheets to prevent wind or rain from allowing dirt or sediment to enter the storm drain system.

3 Metals

- **Pollution:** Metals and other toxins present in car wash water can harm important plankton, which forms the base of the aquatic food chain.
- **Solution:** Take your car to a commercial car wash where the wash water is captured and treated at a local wastewater treatment plant.

DID YOU KNOW?

Did you know that most of the pollution found in our waterways is not from a single source, but from a "non-point" source meaning the accumulation of pollution from residents and businesses throughout the community.

4 Pet Waste

- **Pollution:** Pet waste carries bacteria through our watersheds and eventually will be washed out to the ocean. This can pose a health risk to swimmers and surfers.
- **Solution:** Pick up after your pets!

5 Trash and Debris

- **Pollution:** Trash and debris can enter waterways by wind, littering and careless maintenance of trash receptacles. Street sweeping collects some of this trash; however, much of what isn't captured ends up in our storm drain system where it flows untreated out to the ocean.
- **Solution:** Don't litter and make sure trash containers are properly covered. It is far more expensive to clean up the litter and trash that ends up in our waterways than it is to prevent it in the first place. Come out to one of Orange County's many locations for Coastal and Inner-Coastal Cleanup Day, which is held in September.

6 Motor Oil / Vehicle Fluids

- **Pollution:** Oil and petroleum products from our vehicles are toxic to people, wildlife and plants.

- **Solution:** Fix any leaks from your vehicle and keep the maintenance up on your car. Use absorbent material such as cat litter on oil spills, then sweep it up and dispose of it in the trash. Recycle used motor oil at a local Household Hazardous Waste Collection Center.

A TEAM EFFORT

The Orange County Stormwater Program has teamed with the Municipal Water District of Orange County (MWDOC) and the University of California Cooperative Extension Program (UCCE) to develop this pamphlet.

Low Impact Development (LID) and sustainable water use prevents water pollution and conserves water for drinking and reuse. Reducing your water use and the amount of water flowing from your home protects the environment and saves you money.

Thank you for making water protection a priority!

For more information,
please visit

Orange County Stormwater Program
www.ocwatersheds.com/publiced/

Municipal Water District of Orange County
www.mwdoc.com

University of California Master Gardeners of Orange County
www.uccemg.com

UC Cooperative Extension OC Water Quality and Water Resources
www.ucanr.org/sites/urbanwatermgmt/

Hi OC!

Follow OC's spokesgnome on his adventure to help keep water in the yard, not the sidewalk.

OverwateringIsOut.org

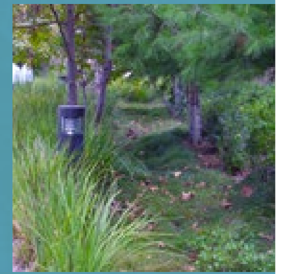
To report a spill, call the Orange County 24-Hour Water Pollution Prevention Reporting Hotline at 1-877-89-SPILL \ (1-877-897-7455)

Special Thanks to
The City of Los Angeles Stormwater Program for the use of its artwork

The Metropolitan Water District of Southern California for the use of the California-Friendly Plant and Native Habitat photos

Homeowners Guide for Sustainable Water Use

Low Impact Development, Water Conservation & Pollution Prevention



The Ocean Begins at Your Front Door

RUNOFF, RAINWATER AND REUSE

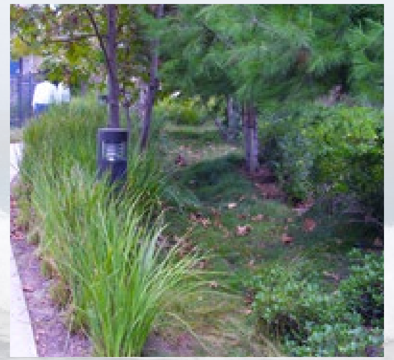
Where Does Water Runoff Go?

Stormwater, or water from rainfall events, and runoff from outdoor water use such as sprinklers and hoses flows from homes directly into catch basins and the storm drain system. After entering the storm drain, the water flows untreated into streams, rivers, bays and ultimately the Pacific Ocean. Runoff can come from lawns, gardens, driveways, sidewalks and roofs. As it flows over hard, impervious surfaces, it picks up pollutants. Some pollutants carried by the water runoff include trash, pet waste, pesticides, fertilizer, motor oil and more.

Water Conservation

Pollution not only impairs the water quality for habitat and recreation, it can also reduce the water available for reuse. Runoff allowed to soak into the ground is called percolation. Water that percolates through the soil, replenishing depleted groundwater supplies. Groundwater provides at least 50% of the total water for drinking and other indoor household activities in north and central Orange County. When land is covered with roads, parking lots, homes, etc., there is less land to take in the water and more hard surfaces over which the water can flow.

In Orange County, 60-70% of water used by residents and businesses goes to irrigation and other outdoor uses. Reusing rainwater to irrigate our lawn not only reduces the impact of water pollution from runoff, but it also is a great way to conserve our precious water resources and replenish our groundwater basin.



What is Low Impact Development (LID)?

Low Impact Development (LID) is a method of development that seeks to maintain the natural hydrologic character of an area. LID provides a more sustainable and pollution-preventative approach to water management.

New water quality regulations require implementation of LID in larger new developments and encourage implementation of LID and other sustainable practices in existing residential areas. Implementing modifications to your lawn or garden can reduce pollution in our environment, conserve water and reduce your water bill.

Permeable pavement allows water runoff to infiltrate through the soil and prevents most pollutants from reaching the storm drain system.

OPTIONS FOR RAINWATER HARVESTING AND REUSE

Rainwater harvesting is a great way to save money, prevent pollution and reduce potable water use. To harvest your rainwater, simply redirect the runoff from roofs and downspouts to rain barrels. Rain gardens are another option; these reduce runoff as well as encourage infiltration.

Downspout Disconnection/Redirection

Disconnecting downspouts from pipes running to the gutter prevents runoff from transporting pollutants to the storm drain. Once disconnected, downspouts can be redirected to rain gardens or other vegetated areas, or be connected to a rain barrel.

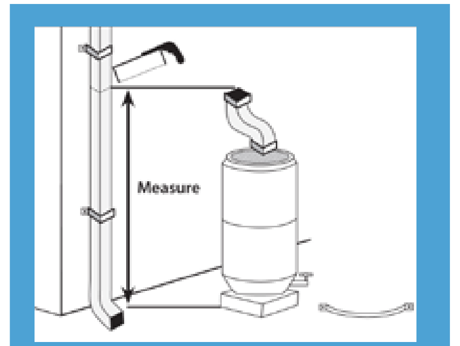
Rain Barrels

Rain barrels capture rainwater flow from roofs for reuse in landscape irrigation. Capacity of rain barrels needed for your home will depend on the amount of roof area and rainfall received. When purchasing your rain barrel, make sure it includes a screen, a spigot to siphon water for use, an overflow tube to allow for excess water to run out and a connector if you wish to connect multiple barrels to add capacity of water storage.

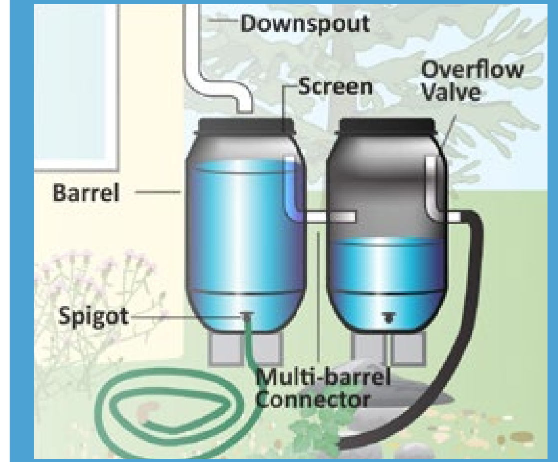
Mosquito growth prevention is very important when installing a rain barrel. The best way to prevent mosquito breeding is to eliminate entry points by ensuring all openings are sealed tightly. If these methods are unsuccessful, products are available to kill mosquito larvae, but that are harmless to animals and humans. Regular application of these products is essential. Please visit the Orange County Vector Control website for more information at www.ocvcd.org/mosquitoes3.php.

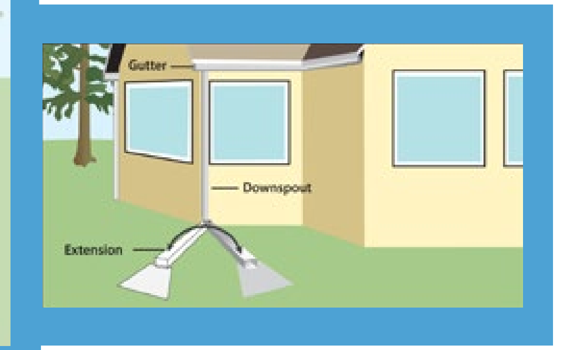
Rain Gardens

Rain gardens allow runoff to be directed from your roof downspout into a landscaped area. Vegetation and rocks in the garden will slow the flow of water to allow for infiltration into the soil. Plants and soil particles will absorb pollutants from the roof runoff. By utilizing a native plant palate, rain gardens can be maintained all year with minimal additional irrigation. These plants are adapted to the semi-arid climate of Southern California, require less water and can reduce your water bill.

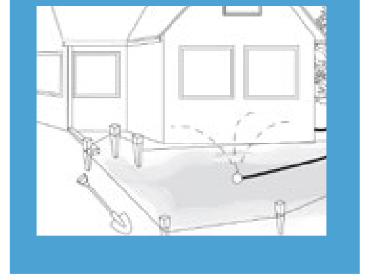


Before modifying your yard to install a rain garden, please consult your local building and/or planning departments to ensure your garden plan follows pertinent building codes and ordinances. Besides codes and ordinances, some home owner associations also have guidelines for yard modifications. If your property is in hill areas or includes engineered slopes, please seek professional advice before proceeding with changes.





For information on how to disconnect a downspout or to install and maintain a rain barrel or rain garden at your home, please see the Los Angeles Rainwater Harvesting Program, A Homeowner's "How-To" Guide, November 2009 at www.larainwaterharvesting.org/



OTHER WATER CONSERVATION AND POLLUTION PREVENTION TECHNIQUES

Native Vegetation and Maintenance

"California Friendly" plants or native vegetation can significantly reduce water use. These plants often require far less fertilizers and pesticides, which are two significant pollutants found in Orange County waterways. Replacing water "thirsty" plants and grass types with water efficient natives is a great way to save water and reduce the need for potentially harmful pesticides and fertilizer.

Please see the California Friendly Garden Guide produced by the Metropolitan Water District of Southern California and associated Southern California Water Agencies for a catalog of California friendly plants and other garden resources at www.bewaterwise.com/Gardensoft.

Weed Free Yards

Weeds are water thieves. They often reproduce quickly and rob your yard of both water and nutrients. Weed your yard by hand if possible. If you use herbicides to control the weeds, use only the amount recommended on the label and never use it if rain is forecast within the next 48 hours.

Soil Amendments

Soil amendments such as green waste (e.g. grass clippings, compost, etc.) can be a significant source of nutrients and can help keep the soil near the roots of plants moist. However, they can cause algal booms if they get into our waterways, which reduces the amount of oxygen in the water and impacts most aquatic organisms. It is important to apply soil amendments more than 48 hours prior to predicted rainfall.

IRRIGATE EFFICIENTLY

Smart Irrigation Controllers

Water runoff from sprinklers left on too long will carry pollutants into our waterways.

Smart Irrigation Controllers have internal clocks as well as sensors that will turn off the sprinklers in response to environmental changes. If it is raining, too windy or too cold, the smart irrigation control sprinklers will automatically shut off.

Check with your local water agency for available rebates on irrigation controllers and smart timers.

- Aim your sprinklers at your lawn, not the sidewalk – By simply adjusting the direction of your sprinklers you can save water, prevent water pollution from runoff, keep your lawn healthy and save money.
- **Set a timer for your sprinklers** – lawns absorb the water they need to stay healthy within a few minutes of turning on the sprinklers. Time your sprinklers; when water begins running off your lawn, you can turn them off. Your timer can be set to water your lawn for this duration every time.
- **Water at Sunrise** – Watering early in the morning will reduce water loss due to evaporation. Additionally, winds tend to die down in the early morning so the water will get to the lawn as intended.
- **Water by hand** – Instead of using sprinklers, consider watering your yard by hand. Hand-watering ensures that all plants get the proper amount of water and you will prevent any water runoff, which wastes water and carries pollutants into our waterways.
- **Fix leaks** - Nationwide, households waste one trillion gallons of water a year to leaks – that is enough water to serve the entire state of Texas for a year. If your garden hose is leaking, replace the nylon or rubber hose washer and ensure a tight connection. Fix broken sprinklers immediately.

Do your part to prevent water pollution in our creeks, rivers, bays and ocean.

Clean beaches and healthy creeks, rivers, bays, and ocean are important to Orange County. However, many common household activities can lead to water pollution if you're not careful.

Litter, oil, chemicals and other substances that are left on your yard or driveway can be blown or washed into storm drains that flow to the ocean. Over-watering your lawn and washing your car can also flush materials into the storm drains. Unlike water in sanitary sewers (from sinks and toilets), water in storm drains is not treated.

Remember the Water in Your Storm Drain is Not Treated BEFORE It Enters Our Waterways

You would never pour soap, fertilizers or oil into the ocean, so don't let them enter streets, gutters or storm drains. Follow the easy tips in this brochure to help prevent water pollution.

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
1-877-89-SPILL (1-877-897-7455).

For emergencies, dial 911.

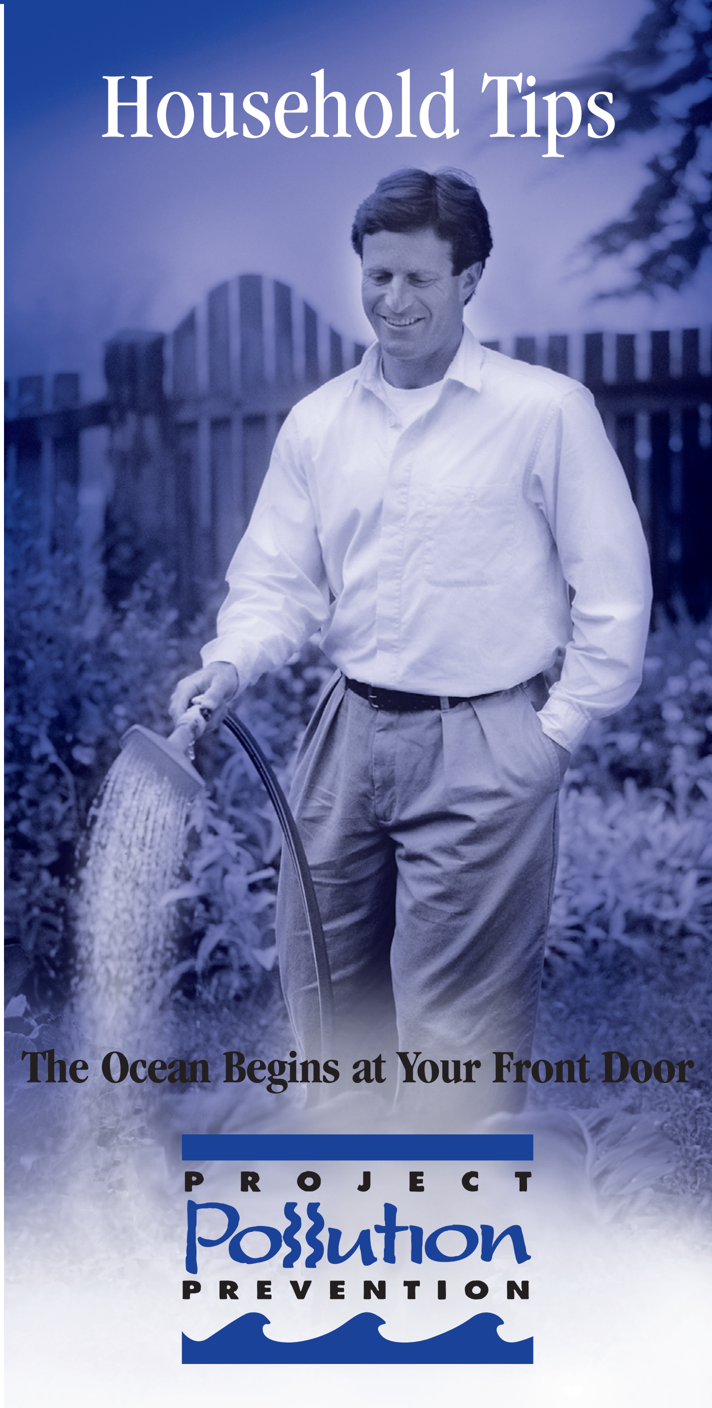
The tips contained in this brochure provide useful information to help prevent water pollution while performing everyday household activities. If you have other suggestions, please contact your city's stormwater representatives or call the Orange County Stormwater Program.

GENUINE RECYCLED PAPER

50% PRE-CONSUMER AND 15% POST-CONSUMER

RECYCLE USED OIL

K-224



Help Prevent Ocean Pollution:

Household Tips

The Ocean Begins at Your Front Door

PROJECT
Pollution
PREVENTION

Pollution Prevention

Household Activities

- **Do not rinse spills with water!** Sweep outdoor spills and dispose of in the trash. For wet spills like oil, apply cat litter or another absorbent material, then sweep and bring to a household hazardous waste collection center (HHWCC).
- Securely cover trash cans.
- Take household hazardous waste to a household hazardous waste collection center.
- Store household hazardous waste in closed, labeled containers inside or under a cover.
- Do not hose down your driveway, sidewalk or patio. Sweep up debris and dispose of in trash.
- Always pick up after your pet. Flush waste down the toilet or dispose of in the trash.
- Bathe pets indoors or have them professionally groomed.

Household Hazardous Wastes include:

- **Batteries**
- **Paint thinners, paint strippers and removers**
- **Adhesives**
- **Drain openers**
- **Oven cleaners**
- **Wood and metal cleaners and polishes**
- **Herbicides and pesticides**
- **Fungicides/wood preservatives**
- **Automotive fluids and products**
- **Grease and rust solvents**
- **Thermometers and other products containing mercury**
- **Fluorescent lamps**
- **Cathode ray tubes, e.g. TVs, computer monitors**
- **Pool and spa chemicals**

Gardening Activities

- Follow directions on pesticides and fertilizers, (measure, do not estimate amounts) and do not use if rain is predicted within 48 hours.
- Water your lawn and garden by hand to control the amount of water you use. Set irrigation systems to reflect seasonal water needs. If water flows off your yard and onto your driveway or sidewalk, your system is over-watering.
- Mulch clippings or leave them on the lawn. If necessary, dispose in a green waste container.
- Cultivate your garden often to control weeds.

Washing and Maintaining Your Car

- Take your car to a commercial car wash whenever possible.
- Choose soaps, cleaners, or detergents labeled “non-toxic,” “phosphate free” or “biodegradable.” Vegetable and citrus-based products are typically safest for the environment, **but even these should not be allowed into the storm drain.**
- Shake floor mats into a trash can or vacuum to clean.
- Do not use acid-based wheel cleaners and “hose off” engine degreasers at home. They can be used at a commercial facility, which can properly process the washwater.
- **Do not dump washwater onto your driveway, sidewalk, street, gutter or storm drain.** Excess washwater should be disposed of in the sanitary sewers (through a sink, or toilet) or onto an absorbent surface like your lawn.
- Use a nozzle to turn off water when not actively washing down automobile.
- Monitor vehicles for leaks and place pans under leaks. Keep your car well maintained to stop and prevent leaks.
- Use cat litter or other absorbents and sweep to remove any materials deposited by vehicles. Contain sweepings and dispose of at a HHWCC.
- Perform automobile repair and maintenance under a covered area and use drip pans or plastic sheeting to keep spills and waste material from reaching storm drains.
- **Never pour oil or antifreeze in the street, gutter or storm drains.** Recycle these substances at a service station, HHWCC, or used oil recycling center. For the nearest Used Oil Collection Center call 1-800-CLEANUP or visit www.ciwmb.ca.gov/UsedOil.

For locations and hours of Household Hazardous Waste Collection Centers in Anaheim, Huntington Beach, Irvine and San Juan Capistrano, call (714)834-6752 or visit www.oclandfills.com.

Do your part to prevent water pollution in our creeks, rivers, bays and ocean.

Clean beaches and healthy creeks, rivers, bays and ocean are important to Orange County. However, not properly disposing of household hazardous waste can lead to water pollution. Batteries, electronics, paint, oil, gardening chemicals, cleaners and other hazardous materials cannot be thrown in the trash. They also must never be poured or thrown into yards, sidewalks, driveways, gutters or streets. Rain or other water could wash the materials into the storm drain and eventually into our waterways and the ocean. In addition, hazardous waste must not be poured in the sanitary sewers (sinks and toilets).

NEVER DISPOSE OF HOUSEHOLD HAZARDOUS WASTE IN THE TRASH, STREET, GUTTER, STORM DRAIN OR SEWER.

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 Illegal Dumping of Household Hazardous Waste call 1-800-69-TOXIC

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

For emergencies, dial 911.

RECYCLE USED OIL

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K-226

Help Prevent Ocean Pollution:

Proper Disposal of Household Hazardous Waste

The Ocean Begins at Your Front Door

PROJECT POLLUTION PREVENTION

ORANGE COUNTY

Pollution Prevention

WHEN POSSIBLE, USE NON-HAZARDOUS OR LESS-HAZARDOUS PRODUCTS.

Leftover household products that contain corrosive, toxic, ignitable, or reactive ingredients are considered to be "household hazardous waste" or "HHW." HHW can be found throughout your home, including the bathroom, kitchen, laundry room and garage.

Disposal of HHW down the drain, on the ground, into storm drains, or in the trash is illegal and unsafe.

Proper disposal of HHW is actually easy. Simply drop them off at a Household Hazardous Waste Collection Center (HHWCC) for free disposal and recycling. Many materials including anti-freeze, latex-based paint, motor oil and batteries can be recycled. Some centers have a "Stop & Swap" program that lets you take partially used home, garden, and automobile products free of charge. There are four HHWCCs in Orange County:

Anaheim:..................1071 N. Blue Gum St
Huntington Beach:.........17121 Nichols St
Irvine:............................ 6411 Oak Canyon
San Juan Capistrano:... 32250 La Pata Ave

Centers are open Tuesday-Saturday, 9 a.m.-3 p.m. Centers are closed on rainy days and major holidays. For more information, call **(714) 834-6752** or visit **www.oclandfills.com.**

Common household hazardous wastes

- Batteries
- Paint and paint products
- Adhesives
- Drain openers
- Household cleaning products
- Wood and metal cleaners and polishes
- Pesticides
- Fungicides/wood preservatives
- Automotive products (antifreeze, motor oil, fluids)
- Grease and rust solvents
- Fluorescent lamps
- Mercury (thermometers & thermostats)
- All forms of electronic waste including computers and microwaves
- Pool & spa chemicals
- Cleaners
- Medications
- Propane (camping & BBQ)
- Mercury-containing lamps
- Television & monitors (CRTs, flatscreens)

Tips for household hazardous waste

- Never dispose of HHW in the trash, street, gutter, storm drain or sewer.
- Keep these materials in closed, labeled containers and store materials indoors or under a cover.
- When possible, use non-hazardous products.
- Reuse products whenever possible or share with family and friends.
- Purchase only as much of a product as you'll need. Empty containers may be disposed of in the trash.
- HHW can be harmful to humans, pets and the environment. Report emergencies to 911.

Clean beaches and healthy creeks, rivers, bays and ocean are important to Orange County. However, many common activities such as pest control can lead to water pollution if you're not careful. Pesticide treatments must be planned and applied properly to ensure that pesticides do not enter the street, gutter or storm drain. Unlike water in sanitary sewers (from sinks and toilets), water in storm drains is not treated before entering our waterways.

You would never dump pesticides into the ocean, so don't let it enter the storm drains. Pesticides can cause significant damage to our environment if used improperly. If you are thinking of using a pesticide to control a pest, there are some important things to consider.

For more information,
please call
University of California Cooperative
Extension Master Gardeners at
(714) 708-1646
or visit these Web sites:
www.uccemg.org
www.ipm.ucdavis.edu

For instructions on collecting a specimen sample visit the Orange County Agriculture Commissioner's website at:
http://www.ocagcomm.com/ser_lab.asp

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.

Information From:
Cheryl Wilen, Area IPM Advisor; Darren Haver, Watershed Management Advisor; Mary Louise Flint, IPM Education and Publication Director; Pamela M. Geisel, Environmental Horticulture Advisor; Carolyn L. Unruh, University of California Cooperative Extension staff writer. Photos courtesy of the UC Statewide IPM Program and Darren Haver.

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K-228
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Help Prevent Ocean Pollution:

Responsible Pest Control

The Ocean Begins at Your Front Door

PROJECT
Pollution
PREVENTION

Tips for Pest Control

Key Steps to Follow:

Step 1: **Correctly identify the pest (insect, weed, rodent, or disease) and verify that it is actually causing the problem.**

Three life stages of the common lady beetle, a beneficial insect.

This is important because beneficial insects are often mistaken for pests and sprayed with pesticides needlessly.

Consult with a Certified Nursery Professional at a local nursery or garden center or send a sample of the pest to the Orange County Agricultural Commissioner's Office.

Determine if the pest is still present – even though you see damage, the pest may have left.

Step 2: **Determine how many pests are present and causing damage.**

Small pest populations may be controlled more safely using non-pesticide techniques. These include removing food sources, washing off leaves with a strong stream of water, blocking entry into the home using caulking and replacing problem plants with ones less susceptible to pests.

Integrated Pest Management (IPM) usually combines several least toxic pest control methods for long-term prevention and management of pest problems without harming you, your family, or the environment.

UC CE
University of California
Cooperative Extension

Step 3: **If a pesticide must be used, choose the least toxic chemical.**

Obtain information on the least toxic pesticides that are effective at controlling the target pest from the UC Statewide Integrated Pest Management (IPM) Program's Web site at www.ipm.ucdavis.edu.

Seek out the assistance of a Certified Nursery Professional at a local nursery or garden center when selecting a pesticide. Purchase the smallest amount of pesticide available.

Apply the pesticide to the pest during its most vulnerable life stage. This information can be found on the pesticide label.

Step 4: **Wear appropriate protective clothing.**

Follow pesticide labels regarding specific types of protective equipment you should wear. Protective clothing should always be washed separately from other clothing.

Step 5: **Continuously monitor external conditions when applying pesticides such as weather, irrigation, and the presence of children and animals.**

Never apply pesticides when rain is predicted within the next 48 hours. Also, do not water after applying pesticides unless the directions say it is necessary.

Apply pesticides when the air is still; breezy conditions may cause the spray or dust to drift away from your targeted area.

In case of an emergency call 911 and/or the regional poison control number at (714) 634-5988 or (800) 544-4404 (CA only).

For general questions you may also visit www.calpoison.org.

Step 6: **In the event of accidental spills, sweep up or use an absorbent agent to remove any excess pesticides. Avoid the use of water.**

Be prepared. Have a broom, dust pan, or dry absorbent material, such as cat litter, newspapers or paper towels, ready to assist in cleaning up spills.

Contain and clean up the spill right away. Place contaminated materials in a doubled plastic bag. All materials used to clean up the spill should be properly disposed of according to your local Household Hazardous Waste Disposal site.

Step 7: **Properly store and dispose of unused pesticides.**

Purchase Ready-To-Use (RTU) products to avoid storing large concentrated quantities of pesticides.

Store unused chemicals in a locked cabinet.

Unused pesticide chemicals may be disposed of at a Household Hazardous Waste Collection Center.

Empty pesticide containers should be triple rinsed prior to disposing of them in the trash.

Household Hazardous Waste
Collection Center
(714) 834-6752
www.oclandfills.com

PROJECT Pollution PREVENTION

Clean beaches and healthy creeks, rivers, bays and ocean are important to Orange County. However, many common activities can lead to water pollution if you're not careful. Home improvement projects and work sites must be maintained to ensure that building materials do not enter the street, gutter or storm drain. Unlike water in sanitary sewers (from sinks and toilets), water in storm drains is not treated before entering our waterways.

You would never dump building materials into the ocean, so don't let them enter the storm drains. Follow these tips to help prevent water pollution.

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.

The tips contained in this brochure provide useful information to help prevent water pollution while performing home improvement projects. If you have other suggestions, please contact your city's stormwater representatives or call the Orange County Stormwater Program.

K-230
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Help Prevent Ocean Pollution:

Tips for Home Improvement Projects

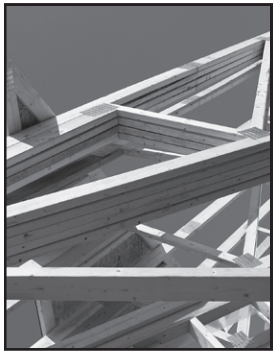
The Ocean Begins
at Your Front Door

PROJECT
Pollution
PREVENTION

Tips for Home Improvement Projects

Home improvement projects can cause significant damage to the environment. Whether you hire a contractor or work on the house yourself, it is important to follow these simple tips while renovating, remodeling or improving your home:

General Construction



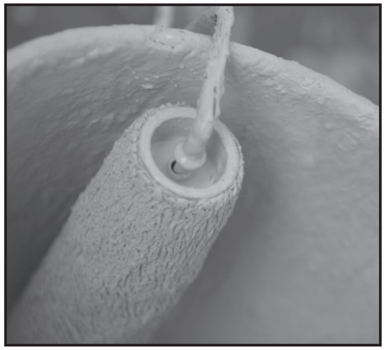
- Schedule projects for dry weather.
- Keep all construction debris away from the street, gutter and storm drain.
- Store materials under cover with temporary roofs or plastic sheets to eliminate or reduce the possibility that rainfall, runoff or wind will carry materials from the project site to the street, storm drain or adjacent properties.

Building Materials

- Never hose materials into a street, gutter or storm drain.
- Exposed piles of construction material should not be stored on the street or sidewalk.
- Minimize waste by ordering only the amount of materials needed to complete the job.
- Do not mix more fresh concrete than is needed for each project.
- Wash concrete mixers and equipment in a designated washout area where the water can flow into a containment area or onto dirt.
- Dispose of small amounts of dry excess materials in the trash. Powdery waste, such as dry concrete, must be properly contained within a box or bag prior to disposal. Call your local trash hauler for weight and size limits.

Paint

- Measure the room or object to be painted, then buy only the amount needed.
- Place the lid on firmly and store the paint can upside-down in a dry location away from the elements.
- Tools such as brushes, buckets and rags should never be washed where excess water can drain into the street, gutter or storm drain. All tools should be rinsed in a sink connected to the sanitary sewer.
- When disposing of paint, never put wet paint in the trash.
- Dispose of water-based paint by removing the lid and letting it dry in the can. Large amounts must be taken to a Household Hazardous Waste Collection Center (HHWCC).
- Oil-based paint is a household hazardous waste. All leftover paint should be taken to a HHWCC.



- For HHWCC locations and hours, call **(714) 834-6752** or visit **www.oclandfills.com**.

Erosion Control

- Schedule grading and excavation projects for dry weather.
- When temporarily removing soil, pile it in a contained, covered area where it cannot spill into the street, or obtain the required temporary encroachment or street closure permit and follow the conditions instructed by the permit.
- When permanently removing large quantities of soil, a disposal location must be found prior to excavation. Numerous businesses are available to handle disposal needs. For disposal options, visit **www.ciwmb.ca.gov/SWIS**.
- Prevent erosion by planting fast-growing annual and perennial grasses. They will shield and bind the soil.

Recycle

- Use a construction and demolition recycling company to recycle lumber, paper, cardboard, metals, masonry (bricks, concrete, etc.), carpet, plastic, pipes (plastic, metal and clay), drywall, rocks, dirt and green waste.

- For a listing of construction and demolition recycling locations in your area, visit **www.ciwmb.ca.gov/recycle.**

Spills

- Clean up spills immediately by using an absorbent material such as cat litter, then sweep it up and dispose of it in the trash.
- Immediately report spills that have entered the street, gutter or storm drain to the County's 24-Hour Water Pollution Problem Reporting Hotline at **(714) 567-6363** or visit **www.ocwatersheds.com** to fill out an incident reporting form.

K-231

PROJECT Pollution PREVENTION

Clean beaches and healthy creeks, rivers, bays and ocean are important to Orange County. However, many common activities can lead to water pollution if you're not careful. Fertilizers, pesticides and other chemicals that are left on yards or driveways can be blown or washed into storm drains that flow to the ocean. Overwatering lawns can also send materials into storm drains. Unlike water in sanitary sewers (from sinks and toilets), water in storm drains is not treated before entering our waterways.

You would never pour gardening products into the ocean, so don't let them enter the storm drains. Follow these easy tips to help prevent water pollution.

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

UCCE Master Gardener Hotline:
(714) 708-1646

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

For emergencies, dial 911.

The tips contained in this brochure provide useful information to help prevent water pollution while landscaping or gardening. If you have other suggestions, please contact your city's stormwater representatives or call the Orange County Stormwater Program.

K-232
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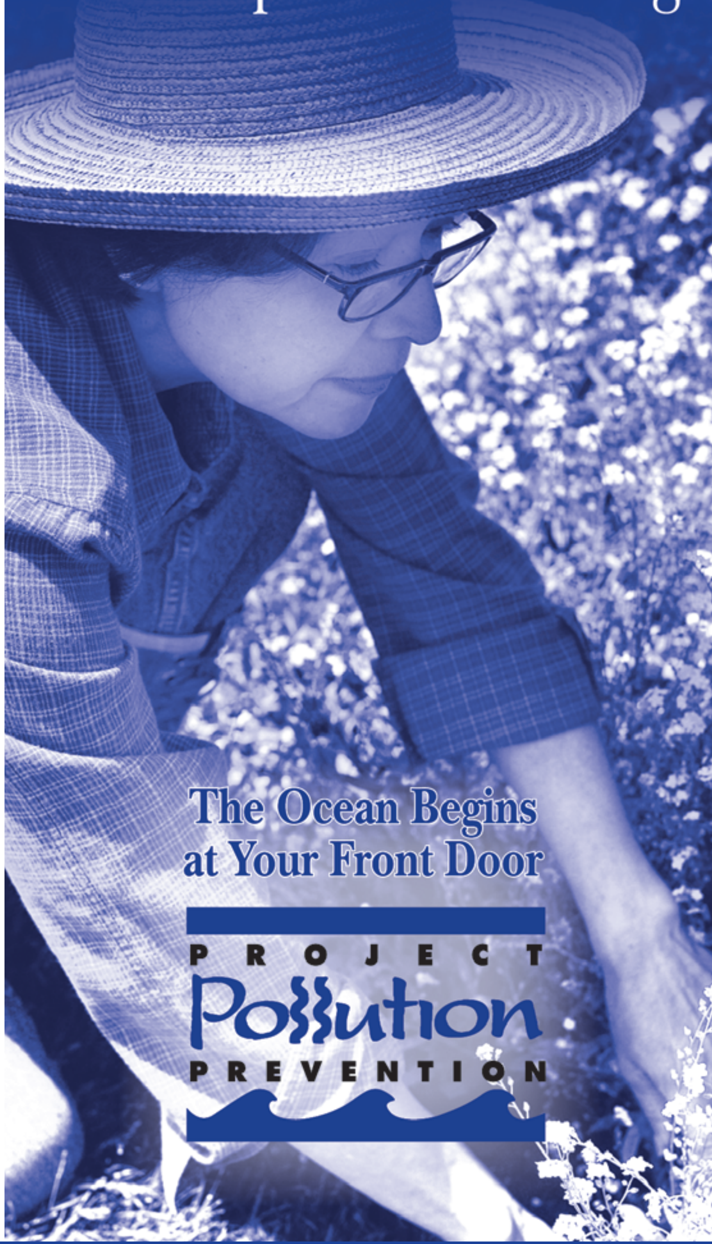
Help Prevent Ocean Pollution:

Tips for Landscape & Gardening



The Ocean Begins at Your Front Door

PROJECT
Pollution
PREVENTION

Tips for Landscape & Gardening

Never allow gardening products or polluted water to enter the street, gutter or storm drain.

General Landscaping Tips

- Protect stockpiles and materials from wind and rain by storing them under tarps or secured plastic sheeting.
- Prevent erosion of slopes by planting fast-growing, dense ground covering plants. These will shield and bind the soil.

- Plant native vegetation to reduce the amount of water, fertilizers, and pesticide applied to the landscape.
- Never apply pesticides or fertilizers when rain is predicted within the next 48 hours.

Garden & Lawn Maintenance

- Do not overwater. Use irrigation practices such as drip irrigation, soaker hoses or micro spray systems. Periodically inspect and fix leaks and misdirected sprinklers.

- Do not rake or blow leaves, clippings or pruning waste into the street, gutter or storm drain. Instead, dispose of green waste by composting, hauling it to a permitted landfill, or recycling it through your city's program.
- Use slow-release fertilizers to minimize leaching, and use organic fertilizers.
- Read labels and use only as directed. Do not over-apply pesticides or fertilizers. Apply to spots as needed, rather than blanketing an entire area.
- Store pesticides, fertilizers and other chemicals in a dry covered area to prevent exposure that may result in the deterioration of containers and packaging.

- Rinse empty pesticide containers and re-use rinse water as you would use the product. Do not dump rinse water down storm drains. Dispose of empty containers in the trash.
- When available, use non-toxic alternatives to traditional pesticides, and use pesticides specifically designed to control the pest you are targeting. For more information, visit **www.ipm.ucdavis.edu**.
- If fertilizer is spilled, sweep up the spill before irrigating. If the spill is liquid, apply an absorbent material such as cat litter, and then sweep it up and dispose of it in the trash.
- Take unwanted pesticides to a Household Hazardous Waste Collection Center to be recycled. Locations are provided below.

Household Hazardous Waste Collection Centers

Anaheim: 1071 N. Blue Gum St.
Huntington Beach: 17121 Nichols St.
Irvine: 6411 Oak Canyon
San Juan Capistrano: 32250 La Pata Ave.

For more information, call (714) 834-6752 or visit www.oclandfills.com

Clean beaches and healthy creeks, rivers, bays and ocean are important to Orange County. However, many common activities can lead to water pollution if you're not careful. Pet waste and pet care products can be washed into the 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 put pet waste or pet care products into the ocean, so don't let them enter the storm drains. Follow these easy tips to help prevent water pollution.

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
1-877-89-SPILL (1-877-897-7455).

For emergencies, dial 911.

The tips contained in this brochure provide useful information to help prevent water pollution while caring for your pet. If you have other suggestions, please contact your city's stormwater representatives or call the Orange County Stormwater Program.

K-234
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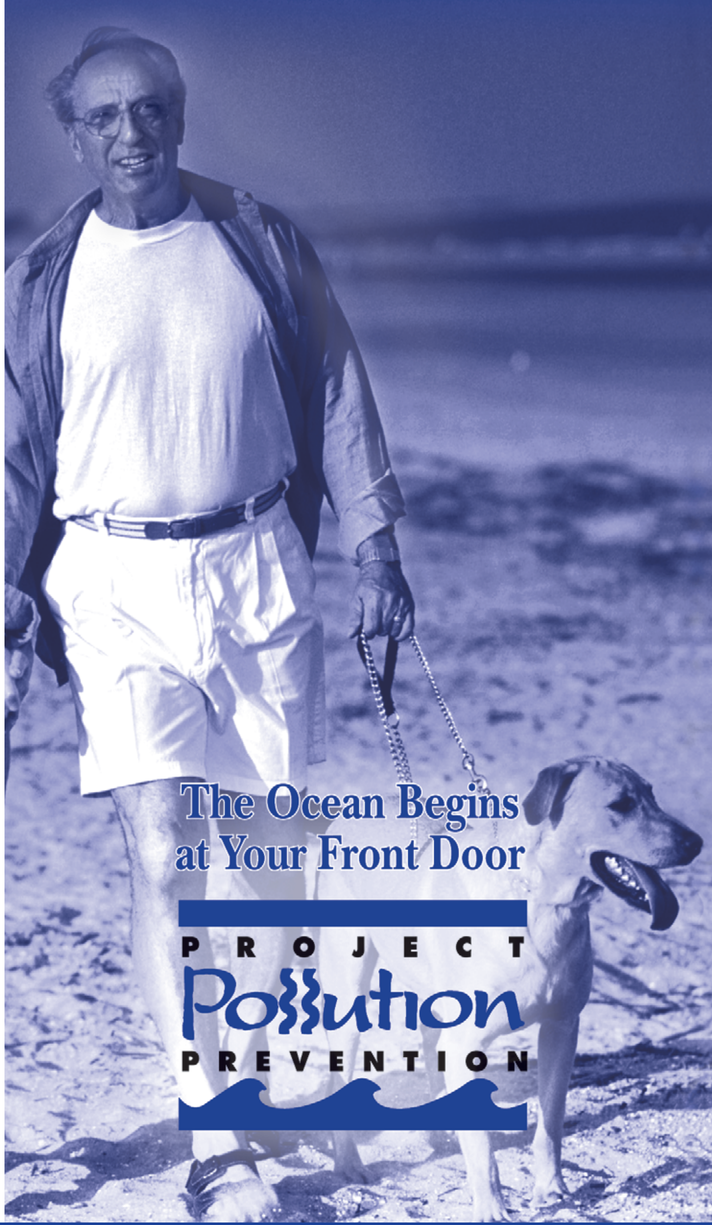
Help Prevent Ocean Pollution:

Tips for Pet Care



The Ocean Begins at Your Front Door

PROJECT
Pollution
PREVENTION

Tips for Pet Care

Never let any pet care products or washwater run off your yard and into the street, gutter or storm drain.

Washing Your Pets

Even biodegradable soaps and shampoos can be harmful to marine life and the environment.

- If possible, bathe your pets indoors using less-toxic shampoos or have your pet professionally groomed. Follow instructions on the products and clean up spills.
- If you bathe your pet outside, wash it on your lawn or another absorbent/ permeable surface to keep the washwater from running into the street, gutter or storm drain.

Flea Control

- Consider using oral or topical flea control products.
- If you use flea control products such as shampoos, sprays or collars, make sure to dispose of any unused products at a Household Hazardous Waste Collection Center. For location information, call **(714) 834-6752**.

Why You Should Pick Up After Your Pet

It's the law! Every city has an ordinance requiring you to pick up after your pet. Besides being a nuisance, pet waste can lead to water pollution, even if you live inland. During rainfall, pet waste left outdoors can wash into storm drains. This waste flows directly into our waterways and the ocean where it can harm human health, marine life and the environment.

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As it decomposes, pet waste demands a high level of oxygen from water. This decomposition can contribute to killing marine life by reducing the amount of dissolved oxygen available to them.

Have fun with your pets, but please be a responsible pet owner by taking care of them and the environment.

- Take a bag with you on walks to pick up after your pet.
- Dispose of the waste in the trash or in a toilet.

PROJECT POLLUTION PREVENTION

Clean beaches and healthy creeks, rivers, bays, and ocean are important to Orange County. However, many common activities can lead to water pollution if you're not careful. Swimming pools and spas are common in Orange County, but they must be maintained properly to guarantee that chemicals aren't allowed to enter the street, where they can flow into the storm drains and then into the waterways. Unlike water in sanitary sewers (from sinks and toilets), water in storm drains is not treated before entering our waterways.

You would never dump pool chemicals into the ocean, so don't let it enter the storm drains. Follow these easy tips to help prevent water pollution.

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

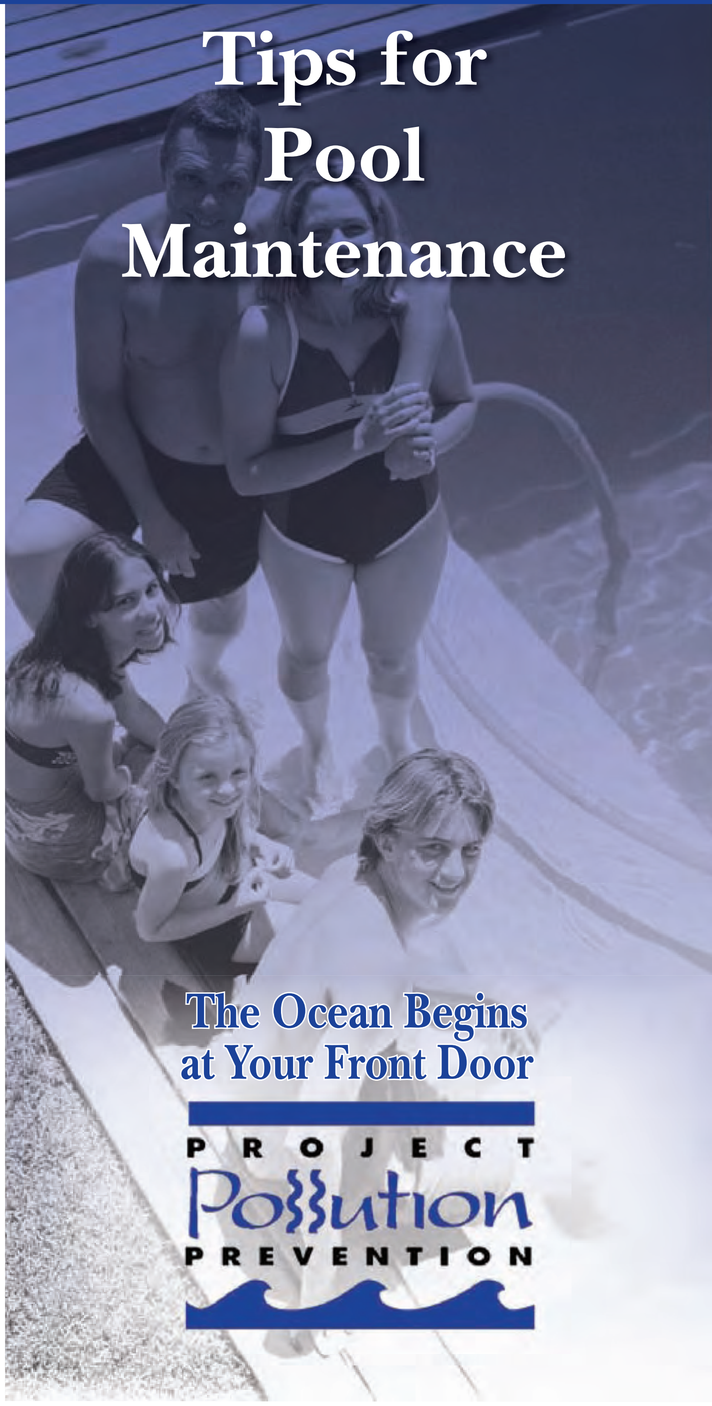
To report a spill,
call the
Orange County 24-Hour
Water Pollution Reporting Hotline
1-877-89-SPILL (1-877-897-7455).

For emergencies, dial 911.

The tips contained in this brochure provide useful information to help prevent water pollution while maintaining your pool. If you have other suggestions, please contact your city's stormwater representatives or call the Orange County Stormwater Program.

K-236

Help Prevent Ocean Pollution:



Tips for Pool Maintenance

The Ocean Begins
at Your Front Door

PROJECT
Pollution
PREVENTION

Tips for Pool Maintenance

Many pools are plumbed to allow the pool to drain directly to the sanitary sewer. If yours is not, follow these instructions for disposing of pool and spa water.

Acceptable and Preferred Method of Disposal

When you cannot dispose of pool water in the sanitary sewer, the release of dechlorinated swimming pool water is allowed if all of these tips are followed:

- The residual chlorine does not exceed 0.1 mg/l (parts per million).
- The pH is between 6.5 and 8.5.
- The water is free of any unusual coloration, dirt or algae.
- There is no discharge of filter media.
- There is no discharge of acid cleaning wastes.
- Some cities may have ordinances that do not allow pool water to be disposed into a storm drain. Check with your city.

How to Know if You're Following the Standards

You can find out how much chlorine is in your water by using a pool testing kit. Excess chlorine can be removed by discontinuing the use of chlorine for a few days prior to discharge or by purchasing dechlorinating chemicals from a local pool supply company. Always make sure to follow the instructions that come with any products you use.

Doing Your Part

By complying with these guidelines, you will make a significant contribution toward keeping pollutants out of Orange County's creeks, streams, rivers, bays and the ocean. This helps to protect organisms that are sensitive to pool chemicals, and helps to maintain the health of our environment.

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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.

The tips contained in this brochure provide useful information to help prevent water pollution. If you have other suggestions, please contact your city's stormwater representatives or call the Orange County Stormwater Program.

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Help Prevent Ocean Pollution:

Tips for Residential Pool, Landscape and Hardscape Drains

The Ocean Begins at Your Front Door

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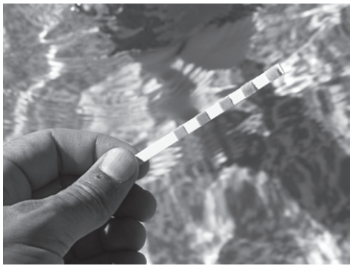
Tips for Residential Pool, Landscape and Hardscape Drains

Pool Maintenance

All pool water discharged to the curb, gutter or permitted pool drain from your property must meet the following water quality criteria:



- The residual chlorine does not exceed 0.1 mg/L (parts per million).
- The pH is between 6.5 and 8.5.
- The water is free of any unusual coloration.
- There is no discharge of filter media or acid cleaning wastes.

Some cities have ordinances that do not allow pool water to be discharged to the storm drain. Check with your city.

Landscape and Hardscape Drains

The following recommendations will help reduce or prevent pollutants from your landscape and hardscape drains from entering the street, gutter or storm drain. Unlike water that enters the sewer (from sinks and toilets), water that enters a landscape or hardscape drain is not treated before entering our creeks, rivers, bays and ocean.

Household Activities

- Do not rinse spills of materials or chemicals to any drain.
- Use dry cleanup methods such as applying cat litter or another absorbent material, then sweep it up and dispose of it in the trash. If the material is hazardous, dispose of it at a Household Hazardous Waste Collection Center (HHWCC). For locations, call **(714) 834-6752** or visit **www.oclandfills.com**.
- Do not hose down your driveways, sidewalks or patios to your landscape or hardscape drain. Sweep up debris and dispose of it in the trash.
- Always pick up after your pet. Flush waste down the toilet or dispose of it in the trash.
- Do not store items such as cleaners, batteries, automotive fluids, paint products, TVs, or computer monitors uncovered outdoors. Take them to a HHWCC for disposal.

Yard Maintenance

- Do not overwater. Water by hand or set automated irrigation systems to reflect seasonal water needs.
- Follow directions on pesticides and fertilizers (measure, do not estimate amounts) and do not use if rain is predicted within 48 hours.
- Cultivate your garden often to control weeds and reduce the need to use chemicals.

Vehicle Maintenance

- Never pour oil or antifreeze down your landscape or hardscape drain. Recycle these substances at a service station, a waste collection center or used oil recycling center. For locations, contact the Used Oil Program at **1-800-CLEANUP** or visit **www.CLEANUP.org**.
- Whenever possible, take your vehicle to a commercial car wash.
- If you do wash your vehicle at home, do not allow the washwater to go down your landscape or hardscape drain. Instead, dispose of it in the sanitary sewer (a sink or toilet) or onto an absorbent surface such as your lawn.
- Use a spray nozzle that will shut off the water when not in use.

Clean beaches and healthy creeks, rivers, bays and ocean are important to Orange County. However, many common activities such as painting can lead to water pollution if you're not careful. Paint must be used, stored and disposed of properly to ensure that it does not enter the street, gutter or storm drain. Unlike water in sanitary sewers (from sinks and toilets), water in storm drains is not treated before entering our waterways.

You would never dump paint into the ocean, so don't let it enter the storm drains. Follow these easy tips to help prevent water pollution.

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.

The tips contained in this brochure provide useful information to help prevent water pollution while using, storing and disposing of paint. If you have other suggestions, please contact your city's stormwater representatives or call the Orange County Stormwater Program.

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Help Prevent Ocean Pollution:

Tips for Projects Using Paint

The Ocean Begins at Your Front Door

PROJECT POLLUTION PREVENTION

Tips for Projects Using Paint

Paint can cause significant damage to our environment. Whether you hire a contractor or do it yourself, it is important to follow these simple tips when purchasing, using, cleaning, storing and disposing of paint.

Purchasing Paint

- Measure the room or object to be painted, then buy only the amount needed.
- Whenever possible, use water-based paint since it usually does not require hazardous solvents such as paint thinner for cleanup.

Painting

- Use only one brush or roller per color of paint to reduce the amount of water needed for cleaning.
- Place open paint containers or trays on a stable surface and in a position that is unlikely to spill.
- Always use a tarp under the area or object being painted to collect paint drips and contain spills.

Cleaning

- Never clean brushes or rinse paint containers in the street, gutter or storm drain.
- For oil-based products, use as much of the paint on the brushes as possible. Clean brushes with thinner. To reuse thinner, pour it through a fine filter (e.g. nylon, metal gauze or filter paper) to remove solids such as leftover traces of paint.
- For water-based products, use as much of the paint on the brushes as possible, then rinse in the sink.
- Collect all paint chips and dust. Chips and dust from marine paints or paints containing lead, mercury or tributyl tin are hazardous waste. Sweep up and dispose of at a Household Hazardous Waste Collection Center (HHWCC).

Storing Paint

- Store paint in a dry location away from the elements.
- Store leftover water-based paint, oil-based paint and solvents separately in original or clearly marked containers.
- Avoid storing paint cans directly on cement floors. The bottom of the can will rust much faster on cement.
- Place the lid on firmly and store the paint can upside-down to prevent air from entering. This will keep the paint usable longer. Oil-based paint is usable for up to 15 years. Water-based paint remains usable for up to 10 years.

Alternatives to Disposal

- Use excess paint to apply another coat, for touch-ups, or to paint a closet, garage, basement or attic.
- Give extra paint to friends or family. Extra paint can also be donated to a local theatre group, low-income housing program or school.
- Take extra paint to an exchange program such as the **"Stop & Swap"** that allows you to drop off or pick up partially used home care products free of charge. **"Stop & Swap"** programs are available at most HHWCCs.
- For HHWCC locations and hours, call **(714) 834-6752** or visit **www.oclandfills.com**.

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Disposing of Paint

- Never put wet paint in the trash.

For water-based paint:

- If possible, brush the leftover paint on cardboard or newspaper. Otherwise, allow the paint to dry in the can with the lid off in a well-ventilated area protected from the elements, children and pets. Stirring the paint every few days will speed up the drying.
- Large quantities of extra paint should be taken to a HHWCC.
- Once dried, paint and painted surfaces may be disposed of in the trash. When setting a dried paint can out for trash collection, leave the lid off so the collector will see that the paint has dried.

For oil-based paint:

- Oil-based paint is a household hazardous waste. All leftover paint should be taken to a HHWCC.

Aerosol paint:

- Dispose of aerosol paint cans at a HHWCC.

Spills

- Never hose down pavement or other impermeable surfaces where paint has spilled.
- Clean up spills immediately by using an absorbent material such as cat litter. Cat litter used to clean water-based paint spills can be disposed of in the trash. When cleaning oil-based paint spills with cat litter, it must be taken to a HHWCC.
- Immediately report spills that have entered the street, gutter or storm drain to the County's 24-Hour Water Pollution Problem Reporting Hotline at **(714) 567-6363** or visit **www.ocwatersheds.com** to fill out an incident reporting form.

PROJECT
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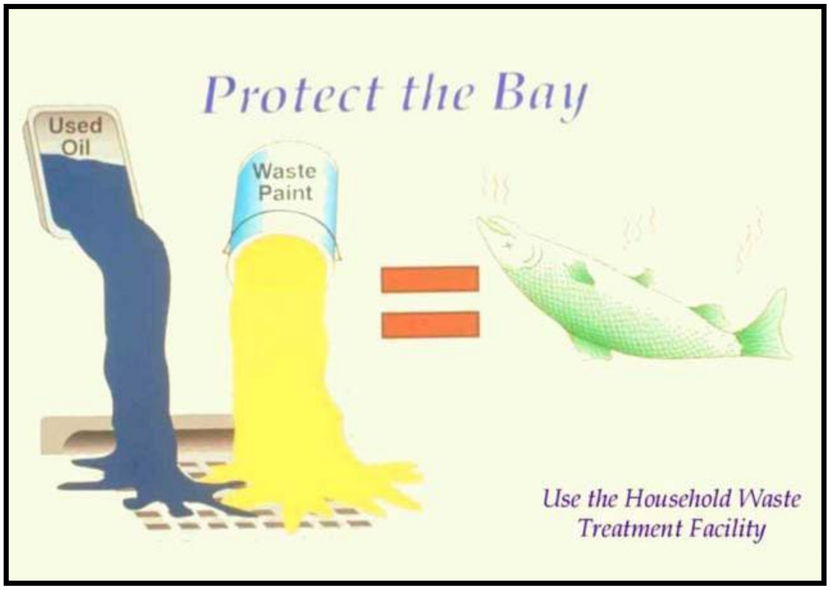
Non-Stormwater Discharges SC-10



Description

Non-stormwater discharges are those flows that do not consist entirely of stormwater. Some non-stormwater discharges do not include pollutants and may be discharged to the storm drain. These include uncontaminated groundwater and natural springs. There are also some non-stormwater discharges that typically do not contain pollutants and may be discharged to the storm drain with conditions. These include car washing, air conditioner condensate, etc. However there are certain non-stormwater discharges that pose environmental concern. These discharges may originate from illegal dumping or from internal floor drains, appliances, industrial processes, sinks, and toilets that are connected to the nearby storm drainage system. These discharges (which may include: process waste waters, cooling waters, wash waters, and sanitary wastewater) can carry substances such as paint, oil, fuel and other automotive fluids, chemicals and other pollutants into storm drains. They can generally be detected through a combination of detection and elimination. The ultimate goal is to effectively eliminate non-stormwater discharges to the stormwater drainage system through implementation of measures to detect, correct, and enforce against illicit connections and illegal discharges of pollutants on streets and into the storm drain system and creeks.

Approach

Initially the industry must make an assessment of non-stormwater discharges to determine which types must be eliminated or addressed through BMPs. The focus of the following approach is in the elimination of non-stormwater discharges.

Objectives

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

Targeted Constituents

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

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Pollution Prevention

- Ensure that used oil, used antifreeze, and hazardous chemical recycling programs are being implemented. Encourage litter control.

Suggested Protocols

Recommended Complaint Investigation Equipment

- Field Screening Analysis
    - pH paper or meter
    - Commercial stormwater pollutant screening kit that can detect for reactive phosphorus, nitrate nitrogen, ammonium nitrogen, specific conductance, and turbidity
    - Sample jars
    - Sample collection pole
    - A tool to remove access hole covers
- Laboratory Analysis
    - Sample cooler
    - Ice
    - Sample jars and labels
    - Chain of custody forms
- Documentation
    - Camera
    - Notebook
    - Pens
    - Notice of Violation forms
    - Educational materials

General

- Develop clear protocols and lines of communication for effectively prohibiting non-stormwater discharges, especially those that are not classified as hazardous. These are often not responded to as effectively as they need to be.

- Stencil or demarcate storm drains, where applicable, to prevent illegal disposal of pollutants. Storm drain inlets should have messages such as "Dump No Waste Drains to Stream" stenciled or demarcated next to them to warn against ignorant or intentional dumping of pollutants into the storm drainage system.

- See SC44 Stormwater Drainage System Maintenance for additional information.

Illicit Connections

- Locate discharges from the industrial storm drainage system to the municipal storm drain system through review of “as-built” piping schematics.
- Isolate problem areas and plug illicit discharge points.
- Locate and evaluate all discharges to the industrial storm drain system.

Visual Inspection and Inventory

- Inventory and inspect each discharge point during dry weather.
- Keep in mind that drainage from a storm event can continue for a day or two following the end of a storm and groundwater may infiltrate the underground stormwater collection system. Also, non-stormwater discharges are often intermittent and may require periodic inspections.

Review Infield Piping

- A review of the “as-built” piping schematic is a way to determine if there are any connections to the stormwater collection system.
- Inspect the path of floor drains in older buildings.

Smoke Testing

- Smoke testing of wastewater and stormwater collection systems is used to detect connections between the two systems.
- During dry weather the stormwater collection system is filled with smoke and then traced to sources. The appearance of smoke at the base of a toilet indicates that there may be a connection between the sanitary and the stormwater system.

Dye Testing

- A dye test can be performed by simply releasing a dye into either your sanitary or process wastewater system and examining the discharge points from the stormwater collection system for discoloration.

TV Inspection of Drainage System

- TV Cameras can be employed to visually identify illicit connections to the industrial storm drainage system.

Illegal Dumping

- Regularly inspect and clean up hot spots and other storm drainage areas where illegal dumping and disposal occurs.
- 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.

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

Once a site has been cleaned:

- Post "No Dumping" signs with a phone number for reporting dumping and disposal.
- Landscaping and beautification efforts of hot spots may also discourage future dumping, as well as provide open space and increase property values.
- Lighting or barriers may also be needed to discourage future dumping.
- See fact sheet SC11 Spill Prevention, Control, and Cleanup.

Inspection

- Regularly inspect and clean up hot spots and other storm drainage areas where illegal dumping and disposal occurs.
- Conduct field investigations of the industrial storm drain system for potential sources of non-stormwater discharges.
- Pro-actively conduct investigations of high priority areas. Based on historical data, prioritize specific geographic areas and/or incident type for pro-active investigations.

Reporting

- A database is useful for defining and tracking the magnitude and location of the problem.
- Report prohibited non-stormwater discharges observed during the course of normal daily activities so they can be investigated, contained, and cleaned up or eliminated.
- Document that non-stormwater discharges have been eliminated by recording tests performed, methods used, dates of testing, and any on-site drainage points observed.
- Document and report annually the results of the program.
- Maintain documentation of illicit connection and illegal dumping incidents, including significant conditionally exempt discharges that are not properly managed.

Training

- Training of technical staff in identifying and documenting illegal dumping incidents is required.
- Consider posting the quick reference table near storm drains to reinforce training.
- Train employees to identify non-stormwater discharges and report discharges to the appropriate departments.

- 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.

- Determine and implement appropriate outreach efforts to reduce non-permissible non-stormwater discharges.

- Conduct spill response drills annually (if no events occurred to evaluate your plan) in cooperation with other industries.

- When a responsible party is identified, educate the party on the impacts of his or her actions.

Spill Response and Prevention

- See SC11 Spill Prevention Control and Cleanup.

Other Considerations

- Many facilities do not have accurate, up-to-date schematic drawings.

Requirements

Costs (including capital and operation & maintenance)

- The primary cost is for staff time and depends on how aggressively a program is implemented.

- Cost for containment and disposal is borne by the discharger.

- Illicit connections can be difficult to locate especially if there is groundwater infiltration.

- Indoor floor drains may require re-plumbing if cross-connections to storm drains are detected.

Maintenance (including administrative and staffing)

- Illegal dumping and illicit connection violations requires technical staff to detect and investigate them.

Supplemental Information

Further Detail of the BMP

Illegal Dumping

- Substances illegally dumped on streets and into the storm drain systems and creeks include paints, used oil and other automotive fluids, construction debris, chemicals, fresh concrete, leaves, grass clippings, and pet wastes. All of these wastes cause stormwater and receiving water quality problems as well as clog the storm drain system itself.

- 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

One of the keys to success of reducing or eliminating illegal dumping is increasing the number of people at the facility who are aware of the problem and who have the tools to at least identify the incident, if not correct it. Therefore, train field staff to recognize and report the incidents.

What constitutes a “non-stormwater” discharge?

- Non-stormwater discharges to the stormwater collection system may include any water used directly in the manufacturing process (process wastewater), air conditioning condensate and coolant, non-contact cooling water, cooling equipment condensate, outdoor secondary containment water, vehicle and equipment wash water, sink and drinking fountain wastewater, sanitary wastes, or other wastewaters.

Permit Requirements

- Facilities subject to stormwater permit requirements must include a certification that the stormwater collection system has been tested or evaluated for the presence of non-stormwater discharges. The State’s General Industrial Stormwater Permit requires that non-stormwater discharges be eliminated prior to implementation of the facility’s SWPPP.

Performance Evaluation

- Review annually internal investigation results; assess whether goals were met and what changes or improvements are necessary.
- Obtain feedback from personnel assigned to respond to, or inspect for, illicit connections and illegal dumping incidents.

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 Storm Water Managers Resource Center http://www.stormwatercenter.net/

Outdoor Loading/Unloading SC-30

Objectives

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

Targeted Constituents

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

Description

The loading/unloading of materials usually takes place outside on docks or terminals; therefore, materials spilled, leaked, or lost during loading/unloading may collect in the soil or on other surfaces and have the potential to be carried away by stormwater runoff or when the area is cleaned. Additionally, rainfall may wash pollutants from machinery used to unload or move materials. Implementation of the following protocols will prevent or reduce the discharge of pollutants to stormwater from outdoor loading/unloading of materials.

Approach

Reduce potential for pollutant discharge through source control pollution prevention and BMP implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

Pollution Prevention

- Keep accurate maintenance logs to evaluate materials removed and improvements made.
- Park tank trucks or delivery vehicles in designated areas so that spills or leaks can be contained.
- Limit exposure of material to rainfall whenever possible.
- Prevent stormwater run-on.
- Check equipment regularly for leaks.

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Suggested Protocols

Loading and Unloading – General Guidelines

- Develop an operations plan that describes procedures for loading and/or unloading.
- Conduct loading and unloading in dry weather if possible.
- Cover designated loading/unloading areas to reduce exposure of materials to rain.
- Consider placing a seal or door skirt between delivery vehicles and building to prevent exposure to rain.
- Design loading/unloading area to prevent stormwater run-on, which would include grading or berming the area, and position roof downspouts so they direct stormwater away from the loading/unloading areas.
- Have employees load and unload all materials and equipment in covered areas such as building overhangs at loading docks if feasible.
- Load/unload only at designated loading areas.
- Use drip pans underneath hose and pipe connections and other leak-prone spots during liquid transfer operations, and when making and breaking connections. Several drip pans should be stored in a covered location near the liquid transfer area so that they are always available, yet protected from precipitation when not in use. Drip pans can be made specifically for railroad tracks. Drip pans must be cleaned periodically, and drip collected materials must be disposed of properly.
- Pave loading areas with concrete instead of asphalt.
- Avoid placing storm drains in the area.
- Grade and/or berm the loading/unloading area to a drain that is connected to a deadend.

Inspection

- Check loading and unloading equipment regularly for leaks, including valves, pumps, flanges and connections.
- Look for dust or fumes during loading or unloading operations.

Training

- Train employees (e.g., fork lift operators) and contractors on proper spill containment and cleanup.
- Have employees trained in spill containment and cleanup present during loading/unloading.
- Train employees in proper handling techniques during liquid transfers to avoid spills.
- Make sure forklift operators are properly trained on loading and unloading procedures.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Contain leaks during transfer.
- Store and maintain appropriate spill cleanup materials in a location that is readily accessible and known to all and ensure that employees are familiar with the site's spill control plan and proper spill cleanup procedures.
- Have an emergency spill cleanup plan readily available.
- Use drip pans or comparable devices when transferring oils, solvents, and paints.

Other Considerations (Limitations and Regulations)

- Space and time limitations may preclude all transfers from being performed indoors or under cover.
- It may not be possible to conduct transfers only during dry weather.

Requirements

Costs

Costs should be low except when covering a large loading/unloading area.

Maintenance

- Conduct regular inspections and make repairs as necessary. The frequency of repairs will depend on the age of the facility.
- Check loading and unloading equipment regularly for leaks.
- Conduct regular broom dry-sweeping of area.

Supplemental Information

Further Detail of the BMP

Special Circumstances for Indoor Loading/Unloading of Materials

Loading or unloading of liquids should occur in the manufacturing building so that any spills that are not completely retained can be discharged to the sanitary sewer, treatment plant, or treated in a manner consistent with local sewer authorities and permit requirements.

- For loading and unloading tank trucks to above and below ground storage tanks, the following procedures should be used:
  - The area where the transfer takes place should be paved. If the liquid is reactive with the asphalt, Portland cement should be used to pave the area.
  - The transfer area should be designed to prevent run-on of stormwater from adjacent areas. Sloping the pad and using a curb, like a speed bump, around the uphill side of the transfer area should reduce run-on.

  - The transfer area should be designed to prevent runoff of spilled liquids from the area. Sloping the area to a drain should prevent runoff. The drain should be connected to a dead-end sump or to the sanitary sewer. A positive control valve should be installed on the drain.

- For transfer from rail cars to storage tanks that must occur outside, use the following procedures:
  - Drip pans should be placed at locations where spillage may occur, such as hose connections, hose reels, and filler nozzles. Use drip pans when making and breaking connections.
  - Drip pan systems should be installed between the rails to collect spillage from tank cars.

References and Resources

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 Storm Water Managers Resource Center http://www.stormwatercenter.net/

Waste Handling & Disposal SC-34

Objectives

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

Description

Improper storage and handling of solid wastes can allow toxic compounds, oils and greases, heavy metals, nutrients, suspended solids, and other pollutants to enter stormwater runoff. The discharge of pollutants to stormwater from waste handling and disposal can be prevented and reduced by tracking waste generation, storage, and disposal; reducing waste generation and disposal through source reduction, reuse, and recycling; and preventing run-on and runoff.

Targeted Constituents

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

Approach

Pollution Prevention

- Accomplish reduction in the amount of waste generated using the following source controls:
  - Production planning and sequencing
  - Process or equipment modification
  - Raw material substitution or elimination
  - Loss prevention and housekeeping
  - Waste segregation and separation
  - Close loop recycling
- Establish a material tracking system to increase awareness about material usage. This may reduce spills and minimize contamination, thus reducing the amount of waste produced.
- Recycle materials whenever possible.

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Suggested Protocols

General

- Cover storage containers with leak proof lids or some other means. If waste is not in containers, cover all waste piles (plastic tarps are acceptable coverage) and prevent stormwater run-on and runoff with a berm. The waste containers or piles must be covered except when in use.

- Use drip pans or absorbent materials whenever grease containers are emptied by vacuum trucks or other means. Grease cannot be left on the ground. Collected grease must be properly disposed of as garbage.

- Check storage containers weekly for leaks and to ensure that lids are on tightly. Replace any that are leaking, corroded, or otherwise deteriorating.

- Sweep and clean the storage area regularly. If it is paved, do not hose down the area to a storm drain.

- Dispose of rinse and wash water from cleaning waste containers into a sanitary sewer if allowed by the local sewer authority. Do not discharge wash water to the street or storm drain.

- Transfer waste from damaged containers into safe containers.

- Take special care when loading or unloading wastes to minimize losses. Loading systems can be used to minimize spills and fugitive emission losses such as dust or mist. Vacuum transfer systems can minimize waste loss.

Controlling Litter

- Post "No Littering" signs and enforce anti-litter laws.

- Provide a sufficient number of litter receptacles for the facility.

- Clean out and cover litter receptacles frequently to prevent spillage.

Waste Collection

- Keep waste collection areas clean.

- Inspect solid waste containers for structural damage regularly. Repair or replace damaged containers as necessary.

- Secure solid waste containers; containers must be closed tightly when not in use.

- Do not fill waste containers with washout water or any other liquid.

- Ensure that only appropriate solid wastes are added to the solid waste container. Certain wastes such as hazardous wastes, appliances, fluorescent lamps, pesticides, etc., may not be disposed of in solid waste containers (see chemical/ hazardous waste collection section below).

- Do not mix wastes; this can cause chemical reactions, make recycling impossible, and complicate disposal.

Good Housekeeping

- Use all of the product before disposing of the container.
- Keep the waste management area clean at all times by sweeping and cleaning up spills immediately.
- Use dry methods when possible (e.g., sweeping, use of absorbents) when cleaning around restaurant/food handling dumpster areas. If water must be used after sweeping/using absorbents, collect water and discharge through grease interceptor to the sewer.

Chemical/Hazardous Wastes

- Select designated hazardous waste collection areas on-site.
- Store hazardous materials and wastes in covered containers and protect them from vandalism.
- Place hazardous waste containers in secondary containment.
- Make sure that hazardous waste is collected, removed, and disposed of only at authorized disposal areas.
- Stencil or demarcate storm drains on the facility's property with prohibitive message regarding waste disposal.

Run-on/Runoff Prevention

- Prevent stormwater run-on from entering the waste management area by enclosing the area or building a berm around the area.
- Prevent waste materials from directly contacting rain.
- Cover waste piles with temporary covering material such as reinforced tarpaulin, polyethylene, polyurethane, polypropyleneor hypalon.
- Cover the area with a permanent roof if feasible.
- Cover dumpsters to prevent rain from washing waste out of holes or cracks in the bottom of the dumpster.
- Move the activity indoor after ensuring all safety concerns such as fire hazard and ventilation are addressed.

Inspection

- Inspect and replace faulty pumps or hoses regularly to minimize the potential of releases and spills.
- Check waste management areas for leaking containers or spills.

- Repair leaking equipment including valves, lines, seals, or pumps promptly.

Training

- Train staff in pollution prevention measures and proper disposal methods.
- Train employees and contractors in proper spill containment and cleanup. The employee should have the tools and knowledge to immediately begin cleaning up a spill should one occur.
- Train employees and subcontractors in proper hazardous waste management.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Have an emergency plan, equipment and trained personnel ready at all times to deal immediately with major spills
- Collect all spilled liquids and properly dispose of them.
- Store and maintain appropriate spill cleanup materials in a location known to all near the designated wash area.
- Ensure that vehicles transporting waste have spill prevention equipment that can prevent spills during transport. Spill prevention equipment includes:
  - Vehicles equipped with baffles for liquid waste
  - Trucks with sealed gates and spill guards for solid waste

Other Considerations (Limitations and Regulations)

Hazardous waste cannot be reused or recycled; it must be disposed of by a licensed hazardous waste hauler.

Requirements

Costs

Capital and O&M costs for these programs will vary substantially depending on the size of the facility and the types of waste handled. Costs should be low if there is an inventory program in place.

Maintenance

- None except for maintaining equipment for material tracking program.

Supplemental Information

Further Detail of the BMP

Land Treatment System

Minimize runoff of polluted stormwater from land application by:

- Choosing a site where slopes are under 6%, the soil is permeable, there is a low water table, it is located away from wetlands or marshes, and there is a closed drainage system

- Avoiding application of waste to the site when it is raining or when the ground is saturated with water
- Growing vegetation on land disposal areas to stabilize soils and reduce the volume of surface water runoff from the site
- Maintaining adequate barriers between the land application site and the receiving waters (planted strips are particularly good)
- Using erosion control techniques such as mulching and matting, filter fences, straw bales, diversion terracing, and sediment basins
- Performing routine maintenance to ensure the erosion control or site stabilization measures are working

Examples

The port of Long Beach has a state-of-the-art database for identifying potential pollutant sources, documenting facility management practices, and tracking pollutants.

References and Resources

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

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

Solid Waste Container Best Management Practices – Fact Sheet On-Line Resources – Environmental Health and Safety. Harvard University. 2002.

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

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

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

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

Building & Grounds Maintenance SC-41

Objectives

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

Targeted Constituents

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

Description

Stormwater runoff from building and grounds maintenance activities can be contaminated with toxic hydrocarbons in solvents, fertilizers and pesticides, suspended solids, heavy metals, abnormal pH, and oils and greases. Utilizing the protocols in this fact sheet will prevent or reduce the discharge of pollutants to stormwater from building and grounds maintenance activities by washing and cleaning up with as little water as possible, following good landscape management practices, preventing and cleaning up spills immediately, keeping debris from entering the storm drains, and maintaining the stormwater collection system.

Approach

Reduce potential for pollutant discharge through source control pollution prevention and BMP implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

Pollution Prevention

- Switch to non-toxic chemicals for maintenance when possible.
- Choose cleaning agents that can be recycled.
- Encourage proper lawn management and landscaping, including use of native vegetation.

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- Encourage use of Integrated Pest Management techniques for pest control.

- Encourage proper onsite recycling of yard trimmings.

- Recycle residual paints, solvents, lumber, and other material as much as possible.

Suggested Protocols

Pressure Washing of Buildings, Rooftops, and Other Large Objects

- In situations where soaps or detergents are used and the surrounding area is paved, pressure washers must use a water collection device that enables collection of wash water and associated solids. A sump pump, wet vacuum or similarly effective device must be used to collect the runoff and loose materials. The collected runoff and solids must be disposed of properly.

- If soaps or detergents are not used, and the surrounding area is paved, wash runoff does not have to be collected but must be screened. Pressure washers must use filter fabric or some other type of screen on the ground and/or in the catch basin to trap the particles in wash water runoff.

- If you are pressure washing on a grassed area (with or without soap), runoff must be dispersed as sheet flow as much as possible, rather than as a concentrated stream. The wash runoff must remain on the grass and not drain to pavement.

Landscaping Activities

- Dispose of grass clippings, leaves, sticks, or other collected vegetation as garbage, or by composting. Do not dispose of collected vegetation into waterways or storm drainage systems.

- Use mulch or other erosion control measures on exposed soils.

Building Repair, Remodeling, and Construction

- Do not dump any toxic substance or liquid waste on the pavement, the ground, or toward a storm drain.

- Use ground or drop cloths underneath outdoor painting, scraping, and sandblasting work, and properly dispose of collected material daily.

- Use a ground cloth or oversized tub for activities such as paint mixing and tool cleaning.

- Clean paintbrushes and tools covered with water-based paints in sinks connected to sanitary sewers or in portable containers that can be dumped into a sanitary sewer drain. Brushes and tools covered with non-water-based paints, finishes, or other materials must be cleaned in a manner that enables collection of used solvents (e.g., paint thinner, turpentine, etc.) for recycling or proper disposal.

- Use a storm drain cover, filter fabric, or similarly effective runoff control mechanism if dust, grit, wash water, or other pollutants may escape the work area and enter a catch basin. This is particularly necessary on rainy days. The containment device(s) must be in place at the beginning of the work day, and accumulated dirty runoff and solids must be collected and disposed of before removing the containment device(s) at the end of the work day.

- If you need to de-water an excavation site, you may need to filter the water before discharging to a catch basin or off-site. If directed off-site, you should direct the water through hay bales and filter fabric or use other sediment filters or traps.

- Store toxic material under cover during precipitation events and when not in use. A cover would include tarps or other temporary cover material.

Mowing, Trimming, and Planting

- Dispose of leaves, sticks, or other collected vegetation as garbage, by composting or at a permitted landfill. Do not dispose of collected vegetation into waterways or storm drainage systems.

- Use mulch or other erosion control measures when soils are exposed.

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

- Consider an alternative approach when bailing out muddy water: do not put it in the storm drain; pour over landscaped areas.

- Use hand weeding where practical.

Fertilizer and Pesticide Management

- Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of fertilizers and pesticides and training of applicators and pest control advisors.

- Use less toxic pesticides that will do the job when applicable. Avoid use of copper-based pesticides if possible.

- Do not use pesticides if rain is expected.

- Do not mix or prepare pesticides for application near storm drains.

- Use the minimum amount needed for the job.

- Calibrate fertilizer distributors to avoid excessive application.

- Employ techniques to minimize off-target application (e.g., spray drift) of pesticides, including consideration of alternative application techniques.

- Apply pesticides only when wind speeds are low.

- Fertilizers should be worked into the soil rather than dumped or broadcast onto the surface.

- Irrigate slowly to prevent runoff and then only as much as is needed.

- Clean pavement and sidewalk if fertilizer is spilled on these surfaces before applying irrigation water.

- Dispose of empty pesticide containers according to the instructions on the container label.

- Use up the pesticides. Rinse containers, and use rinse water as product. Dispose of unused pesticide as hazardous waste.

- Implement storage requirements for pesticide products with guidance from the local fire department and County Agricultural Commissioner. Provide secondary containment for pesticides.

Inspection

- Inspect irrigation system periodically to ensure that the right amount of water is being applied and that excessive runoff is not occurring. Minimize excess watering and repair leaks in the irrigation system as soon as they are observed.

Training

- Educate and train employees on pesticide use and in pesticide application techniques to prevent pollution.

- Train employees and contractors in proper techniques for spill containment and cleanup.

- Be sure the frequency of training takes into account the complexity of the operations and the nature of the staff.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.

- Place a stockpile of spill cleanup materials, such as brooms, dustpans, and vacuum sweepers (if desired) near the storage area where it will be readily accessible.

- Have employees trained in spill containment and cleanup present during the loading/unloading of dangerous wastes, liquid chemicals, or other materials.

- Familiarize employees with the Spill Prevention Control and Countermeasure Plan.

- Clean up spills immediately.

Other Considerations

Alternative pest/weed controls may not be available, suitable, or effective in many cases.

Requirements

Costs

- Cost will vary depending on the type and size of facility.

- Overall costs should be low in comparison to other BMPs.

Maintenance

Sweep paved areas regularly to collect loose particles. Wipe up spills with rags and other absorbent material immediately, do not hose down the area to a storm drain.

Supplemental Information

Further Detail of the BMP

Fire Sprinkler Line Flushing

Building fire sprinkler line flushing may be a source of non-stormwater runoff pollution. The water entering the system is usually potable water, though in some areas it may be non-potable reclaimed wastewater. There are subsequent factors that may drastically reduce the quality of the water in such systems. Black iron pipe is usually used since it is cheaper than potable piping, but it is subject to rusting and results in lower quality water. Initially, the black iron pipe has an oil coating to protect it from rusting between manufacture and installation; this will contaminate the water from the first flush but not from subsequent flushes. Nitrates, polyphosphates and other corrosion inhibitors, as well as fire suppressants and antifreeze may be added to the sprinkler water system. Water generally remains in the sprinkler system a long time (typically a year) and between flushes may accumulate iron, manganese, lead, copper, nickel, and zinc. The water generally becomes anoxic and contains living and dead bacteria and breakdown products from chlorination. This may result in a significant BOD problem and the water often smells. Consequently dispose fire sprinkler line flush water into the sanitary sewer. Do not allow discharge to storm drain or infiltration due to potential high levels of pollutants in fire sprinkler line water.

References and Resources

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

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

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

Mobile Cleaners Pilot Program: Final Report. 1997. Bay Area Stormwater Management Agencies Association (BASMAA). http://www.basmaa.org/

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

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

Parking/Storage Area Maintenance SC-43

Objectives

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

Targeted Constituents

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

Description

Parking lots and storage areas can contribute a number of substances, such as trash, suspended solids, hydrocarbons, oil and grease, and heavy metals that can enter receiving waters through stormwater runoff or non-stormwater discharges. The protocols in this fact sheet are intended to prevent or reduce the discharge of pollutants from parking/storage areas and include using good housekeeping practices, following appropriate cleaning BMPs, and training employees.

Approach

The goal of this program is to ensure stormwater pollution prevention practices are considered when conducting activities on or around parking areas and storage areas to reduce potential for pollutant discharge to receiving waters. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

Pollution Prevention

- Encourage alternative designs and maintenance strategies for impervious parking lots. (See New Development and Redevelopment BMP Handbook)

- Keep accurate maintenance logs to evaluate BMP implementation.

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Suggested Protocols

General

- Keep the parking and storage areas clean and orderly. Remove debris in a timely fashion.
- Allow sheet runoff to flow into biofilters (vegetated strip and swale) and/or infiltration devices.
- Utilize sand filters or oleophilic collectors for oily waste in low quantities.
- Arrange rooftop drains to prevent drainage directly onto paved surfaces.
- Design lot to include semi-permeable hardscape.
- Discharge soapy water remaining in mop or wash buckets to the sanitary sewer through a sink, toilet, clean-out, or wash area with drain.

Controlling Litter

- Post “No Littering” signs and enforce anti-litter laws.
- Provide an adequate number of litter receptacles.
- Clean out and cover litter receptacles frequently to prevent spillage.
- Provide trash receptacles in parking lots to discourage litter.
- Routinely sweep, shovel, and dispose of litter in the trash.

Surface Cleaning

- Use dry cleaning methods (e.g., sweeping, vacuuming) to prevent the discharge of pollutants into the stormwater conveyance system if possible.
- Establish frequency of public parking lot sweeping based on usage and field observations of waste accumulation.
- Sweep all parking lots at least once before the onset of the wet season.
- Follow the procedures below if water is used to clean surfaces:
    - Block the storm drain or contain runoff.
    - Collect and pump wash water to the sanitary sewer or discharge to a pervious surface. Do not allow wash water to enter storm drains.
    - Dispose of parking lot sweeping debris and dirt at a landfill.
- Follow the procedures below when cleaning heavy oily deposits:
    - Clean oily spots with absorbent materials.
    - Use a screen or filter fabric over inlet, then wash surfaces.

  - Do not allow discharges to the storm drain.
  - Vacuum/pump discharges to a tank or discharge to sanitary sewer.
  - Appropriately dispose of spilled materials and absorbents.

Surface Repair

- Preheat, transfer or load hot bituminous material away from storm drain inlets.
- Apply concrete, asphalt, and seal coat during dry weather to prevent contamination from contacting stormwater runoff.
- Cover and seal nearby storm drain inlets where applicable (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc. Leave covers in place until job is complete and all water from emulsified oil sealants has drained or evaporated. Clean any debris from these covered manholes and drains for proper disposal.
- Use only as much water as necessary for dust control, to avoid runoff.
- Catch drips from paving equipment that is not in use with pans or absorbent material placed under the machines. Dispose of collected material and absorbents properly.

Inspection

- Have designated personnel conduct inspections of parking facilities and stormwater conveyance systems associated with parking facilities on a regular basis.
- Inspect cleaning equipment/sweepers for leaks on a regular basis.

Training

- Provide regular training to field employees and/or contractors regarding cleaning of paved areas and proper operation of equipment.
- Train employees and contractors in proper techniques for spill containment and cleanup.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Place a stockpile of spill cleanup materials where it will be readily accessible or at a central location.
- Clean up fluid spills immediately with absorbent rags or material.
- Dispose of spilled material and absorbents properly.

Other Considerations

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

Requirements

Costs

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

Maintenance

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

Supplemental Information

Further Detail of the BMP

Surface Repair

Apply concrete, asphalt, and seal coat during dry weather to prevent contamination from contacting stormwater runoff. Where applicable, cover and seal nearby storm drain inlets (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc. Leave covers in place until job is complete and all water from emulsified oil sealants has drained or evaporated. Clean any debris from these covered manholes and drains for proper disposal. Only use only as much water as is necessary for dust control to avoid runoff.

References and Resources

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

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

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

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

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

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

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

Drainage System Maintenance SC-44

Description

As a consequence of its function, the stormwater conveyance system collects and transports urban runoff and stormwater that may contain certain pollutants. The protocols in this fact sheet are intended to reduce pollutants reaching receiving waters through proper conveyance system operation and maintenance.

Approach

Pollution Prevention

Maintain catch basins, stormwater inlets, and other stormwater conveyance structures on a regular basis to remove pollutants, reduce high pollutant concentrations during the first flush of storms, prevent clogging of the downstream conveyance system, restore catch basins' sediment trapping capacity, and ensure the system functions properly hydraulically to avoid flooding.

Suggested Protocols

Catch Basins/Inlet Structures

- Staff should regularly inspect facilities to ensure compliance with the following:
  - Immediate repair of any deterioration threatening structural integrity.
  - Cleaning before the sump is 40% full. Catch basins should be cleaned as frequently as needed to meet this standard.
  - Stenciling of catch basins and inlets (see SC34 Waste Handling and Disposal).

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize

Targeted Constituents

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

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- Clean catch basins, storm drain inlets, and other conveyance structures before the wet season to remove sediments and debris accumulated during the summer.

- Conduct inspections more frequently during the wet season for problem areas where sediment or trash accumulates more often. Clean and repair as needed.

- Keep accurate logs of the number of catch basins cleaned.

- Store wastes collected from cleaning activities of the drainage system in appropriate containers or temporary storage sites in a manner that prevents discharge to the storm drain.

- Dewater the wastes if necessary with outflow into the sanitary sewer if permitted. Water should be treated with an appropriate filtering device prior to discharge to the sanitary sewer. If discharge to the sanitary sewer is not allowed, water should be pumped or vacuumed to a tank and properly disposed. Do not dewater near a storm drain or stream.

Storm Drain Conveyance System

- Locate reaches of storm drain with deposit problems and develop a flushing schedule that keeps the pipe clear of excessive buildup.

- Collect and pump flushed effluent to the sanitary sewer for treatment whenever possible.

Pump Stations

- Clean all storm drain pump stations prior to the wet season to remove silt and trash.

- Do not allow discharge to reach the storm drain system when cleaning a storm drain pump station or other facility.

- Conduct routine maintenance at each pump station.

- Inspect, clean, and repair as necessary all outlet structures prior to the wet season.

Open Channel

- Modify storm channel characteristics to improve channel hydraulics, increase pollutant removals, and enhance channel/creek aesthetic and habitat value.

- Conduct channel modification/improvement in accordance with existing laws. Any person, government agency, or public utility proposing an activity that will change the natural (emphasis added) state of any river, stream, or lake in California, must enter into a Steam or Lake Alteration Agreement with the Department of Fish and Game. The developer-applicant should also contact local governments (city, county, special districts), other state agencies (SWRCB, RWQCB, Department of Forestry, Department of Water Resources), and Federal Corps of Engineers and USFWS.

Illicit Connections and Discharges

- Look for evidence of illegal discharges or illicit connections during routine maintenance of conveyance system and drainage structures:

  - Is there evidence of spills such as paints, discoloring, etc?

  - Are there any odors associated with the drainage system?

  - Record locations of apparent illegal discharges/illicit connections?

  - Track flows back to potential dischargers and conduct aboveground inspections. This can be done through visual inspection of upgradient manholes or alternate techniques including zinc chloride smoke testing, fluorometric dye testing, physical inspection testing, or television camera inspection.

  - Eliminate the discharge once the origin of flow is established.

- Stencil or demarcate storm drains, where applicable, to prevent illegal disposal of pollutants. Storm drain inlets should have messages such as "Dump No Waste Drains to Stream" stenciled next to them to warn against ignorant or intentional dumping of pollutants into the storm drainage system.

- Refer to fact sheet SC-10 Non-Stormwater Discharges.

Illegal Dumping

- Inspect and clean up hot spots and other storm drainage areas regularly where illegal dumping and disposal occurs.

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

  - Illegal dumping hot spots

  - Types and quantities (in some cases) of wastes

  - Patterns in time of occurrence (time of day/night, month, or year)

  - Mode of dumping (abandoned containers, "midnight dumping" from moving vehicles, direct dumping of materials, accidents/spills)

  - Responsible parties

- Post "No Dumping" signs in problem areas with a phone number for reporting dumping and disposal. Signs should also indicate fines and penalties for illegal dumping.

- Refer to fact sheet SC-10 Non-Stormwater Discharges.

Training

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

- Allow only properly trained individuals to handle hazardous materials/wastes.

- Have staff involved in detection and removal of illicit connections trained in the following:

  - OSHA-required Health and Safety Training (29 CFR 1910.120) plus annual refresher training (as needed).

  - OSHA Confined Space Entry training (Cal-OSHA Confined Space, Title 8 and Federal OSHA 29 CFR 1910.146).

  - Procedural training (field screening, sampling, smoke/dye testing, TV inspection).

Spill Response and Prevention

- Investigate all reports of spills, leaks, and/or illegal dumping promptly.

- Clean up all spills and leaks using "dry" methods (with absorbent materials and/or rags) or dig up, remove, and properly dispose of contaminated soil.

- Refer to fact sheet SC-11 Spill Prevention, Control, and Cleanup.

Other Considerations (Limitations and Regulations)

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

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

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

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

Requirements

Costs

- An aggressive catch basin cleaning program could require a significant capital and O&M budget.

- The elimination of illegal dumping is dependent on the availability, convenience, and cost of alternative means of disposal. The primary cost is for staff time. Cost depends on how aggressively a program is implemented. Other cost considerations for an illegal dumping program include:

  - Purchase and installation of signs.

  - Rental of vehicle(s) to haul illegally-disposed items and material to landfills.

  - Rental of heavy equipment to remove larger items (e.g., car bodies) from channels.

  - Purchase of landfill space to dispose of illegally-dumped items and material.

- Methods used for illicit connection detection (smoke testing, dye testing, visual inspection, and flow monitoring) can be costly and time-consuming. Site-specific factors, such as the level of impervious area, the density and ages of buildings, and type of land use will determine the level of investigation necessary.

Maintenance

- Two-person teams may be required to clean catch basins with vactor trucks.
- Teams of at least two people plus administrative personnel are required to identify illicit discharges, depending on the complexity of the storm sewer system.
- Arrangements must be made for proper disposal of collected wastes.
- Technical staff are required to detect and investigate illegal dumping violations.

Supplemental Information

Further Detail of the BMP

Storm Drain Flushing

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

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

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

It has been found that cleansing efficiency of periodic flush waves is dependent upon flush volume, flush discharge rate, sewer slope, sewer length, sewer flow rate, sewer diameter, and population density. As a rule of thumb, the length of line to be flushed should not exceed 700 feet. At this maximum recommended length, the percent removal efficiency ranges between 65-75% for organics and 55-65% for dry weather grit/inorganic material. The percent removal efficiency drops rapidly beyond that. Water is commonly supplied by a water truck, but fire hydrants can also supply water. To make the best use of water, it is recommended that reclaimed water be used or that fire hydrant line flushing coincide with storm sewer flushing.

References and Resources

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

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

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

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http://www.epa.gov/npdes/menuofbmps/poll_16.htm

Road and Street Maintenance SC-70

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.

- 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

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

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

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

Site Design & Landscape Planning SD-10

Design Objectives

☑ Maximize Infiltration

☑ Provide Retention

☑ Slow Runoff

☑ Minimize Impervious Land Coverage

Prohibit Dumping of Improper Materials

Contain Pollutants

Collect and Convey

Description

Each project site possesses unique topographic, hydrologic, and vegetative features, some of which are more suitable for development than others. Integrating and incorporating appropriate landscape planning methodologies into the project design is the most effective action that can be done to minimize surface and groundwater contamination from stormwater.

Approach

Landscape planning should couple consideration of land suitability for urban uses with consideration of community goals and projected growth. Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

Suitable Applications

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

Design Considerations

Design requirements for site design and landscapes planning should conform to applicable standards and specifications of agencies with jurisdiction and be consistent with applicable General Plan and Local Area Plan policies.

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Designing New Installations

Begin the development of a plan for the landscape unit with attention to the following general principles:

- Formulate the plan on the basis of clearly articulated community goals. Carefully identify conflicts and choices between retaining and protecting desired resources and community growth.

- Map and assess land suitability for urban uses. Include the following landscape features in the assessment: wooded land, open unwooded land, steep slopes, erosion-prone soils, foundation suitability, soil suitability for waste disposal, aquifers, aquifer recharge areas, wetlands, floodplains, surface waters, agricultural lands, and various categories of urban land use. When appropriate, the assessment can highlight outstanding local or regional resources that the community determines should be protected (e.g., a scenic area, recreational area, threatened species habitat, farmland, fish run). Mapping and assessment should recognize not only these resources but also additional areas needed for their sustenance.

Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

Conserve Natural Areas during Landscape Planning

If applicable, the following items are required and must be implemented in the site layout during the subdivision design and approval process, consistent with applicable General Plan and Local Area Plan policies:

- Cluster development on least-sensitive portions of a site while leaving the remaining land in a natural undisturbed condition.

- Limit clearing and grading of native vegetation at a site to the minimum amount needed to build lots, allow access, and provide fire protection.

- Maximize trees and other vegetation at each site by planting additional vegetation, clustering tree areas, and promoting the use of native and/or drought tolerant plants.

- Promote natural vegetation by using parking lot islands and other landscaped areas.

- Preserve riparian areas and wetlands.

Maximize Natural Water Storage and Infiltration Opportunities Within the Landscape Unit

- Promote the conservation of forest cover. Building on land that is already deforested affects basin hydrology to a lesser extent than converting forested land. Loss of forest cover reduces interception storage, detention in the organic forest floor layer, and water losses by evapotranspiration, resulting in large peak runoff increases and either their negative effects or the expense of countering them with structural solutions.

- Maintain natural storage reservoirs and drainage corridors, including depressions, areas of permeable soils, swales, and intermittent streams. Develop and implement policies and regulations to discourage the clearing, filling, and channelization of these features. Utilize them in drainage networks in preference to pipes, culverts, and engineered ditches.

- Evaluating infiltration opportunities by referring to the stormwater management manual for the jurisdiction and pay particular attention to the selection criteria for avoiding groundwater contamination, poor soils, and hydrogeological conditions that cause these facilities to fail. If necessary, locate developments with large amounts of impervious surfaces or a potential to produce relatively contaminated runoff away from groundwater recharge areas.

Protection of Slopes and Channels during Landscape Design

- Convey runoff safely from the tops of slopes.
- Avoid disturbing steep or unstable slopes.
- Avoid disturbing natural channels.
- Stabilize disturbed slopes as quickly as possible.
- Vegetate slopes with native or drought tolerant vegetation.
- Control and treat flows in landscaping and/or other controls prior to reaching existing natural drainage systems.
- Stabilize temporary and permanent channel crossings as quickly as possible, and ensure that increases in run-off velocity and frequency caused by the project do not erode the channel.
- Install energy dissipaters, such as riprap, at the outlets of new storm drains, culverts, conduits, or channels that enter unlined channels in accordance with applicable specifications to minimize erosion. Energy dissipaters shall be installed in such a way as to minimize impacts to receiving waters.
- Line on-site conveyance channels where appropriate, to reduce erosion caused by increased flow velocity due to increases in tributary impervious area. The first choice for linings should be grass or some other vegetative surface, since these materials not only reduce runoff velocities, but also provide water quality benefits from filtration and infiltration. If velocities in the channel are high enough to erode grass or other vegetative linings, riprap, concrete, soil cement, or geo-grid stabilization are other alternatives.
- Consider other design principles that are comparable and equally effective.

Redeveloping Existing Installations

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

Redevelopment may present significant opportunity to add features which had not previously been implemented. Examples include incorporation of depressions, areas of permeable soils, and swales in newly redeveloped areas. While some site constraints may exist due to the status of already existing infrastructure, opportunities should not be missed to maximize infiltration, slow runoff, reduce impervious areas, disconnect directly connected impervious areas.

Other Resources

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

Stormwater Management Manual for Western Washington, Washington State Department of Ecology, August 2001.

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

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

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

Efficient Irrigation SD-12

Design Objectives

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

Description

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

Approach

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

Suitable Applications

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

Design Considerations

Designing New Installations

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

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

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

Redeveloping Existing Installations

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

Other Resources

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

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

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

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

Storm Drain Signage SD-13

Design Objectives

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

Description

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

Approach

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

Suitable Applications

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

Design Considerations

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

Designing New Installations

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

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

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

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

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

Redeveloping Existing Installations

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

Additional Information

Maintenance Considerations

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

Placement

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

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

Supplemental Information

Examples

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

Other Resources

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

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

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

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

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.

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- 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.

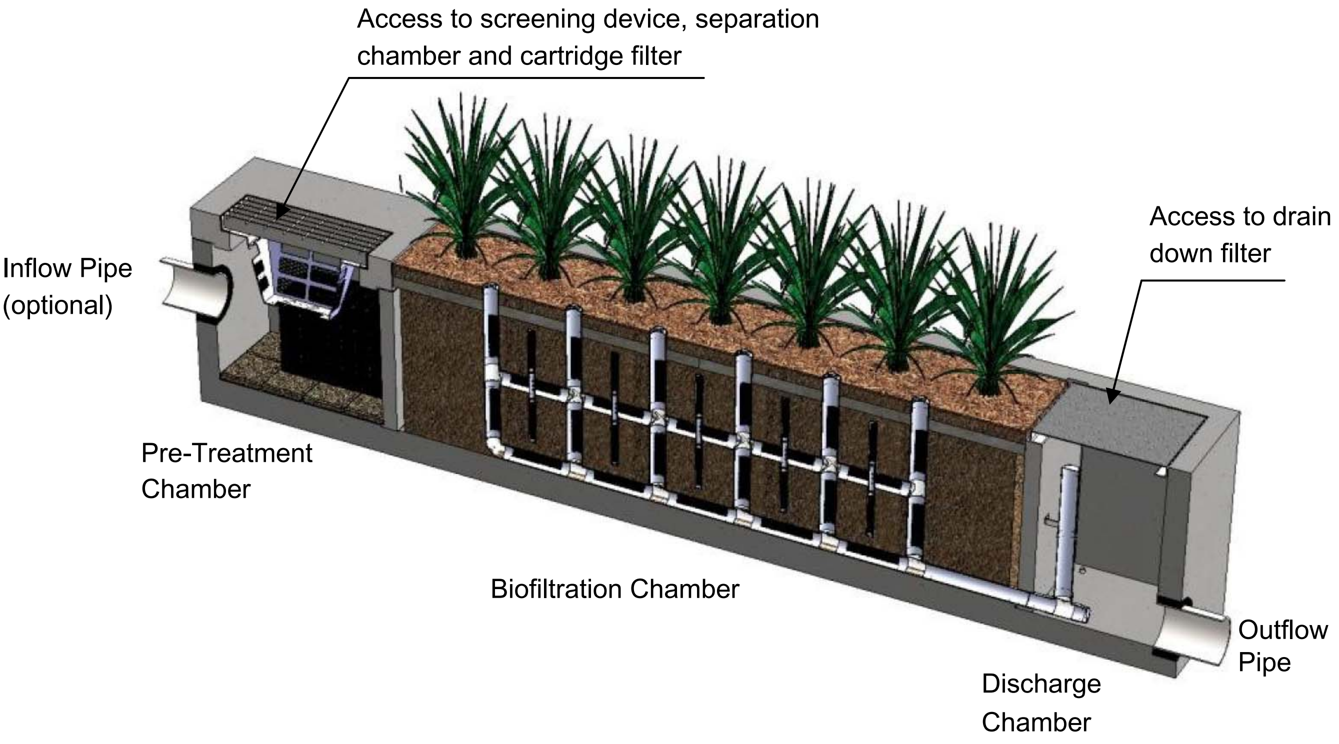
Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Maintenance Guidelines for
Modular Wetland System - Linear

Maintenance Summary

- Remove Trash from Screening Device – average maintenance interval is 6 to 12 months.
    - (*5 minute average service time*).
- Remove Sediment from Separation Chamber – average maintenance interval is 12 to 24 months.
    - (*10 minute average service time*).
- Replace Cartridge Filter Media – average maintenance interval 12 to 24 months.
    - (*10-15 minute per cartridge average service time*).
- Replace Drain Down Filter Media – average maintenance interval is 12 to 24 months.
    - (*5 minute average service time*).
- Trim Vegetation – average maintenance interval is 6 to 12 months.
    - (*Service time varies*).

System Diagram



Maintenance Procedures

Screening Device

1. Remove grate or manhole cover to gain access to the screening device in the Pre-Treatment Chamber. Vault type units do not have screening device. Maintenance can be performed without entry.
2. Remove all pollutants collected by the screening device. Removal can be done manually or with the use of a vacuum truck. The hose of the vacuum truck will not damage the screening device.
3. Screening device can easily be removed from the Pre-Treatment Chamber to gain access to separation chamber and media filters below. Replace grate or manhole cover when completed.

Separation Chamber

1. Perform maintenance procedures of screening device listed above before maintaining the separation chamber.
2. With a pressure washer spray down pollutants accumulated on walls and cartridge filters.
3. Vacuum out Separation Chamber and remove all accumulated pollutants. Replace screening device, grate or manhole cover when completed.

Cartridge Filters

1. Perform maintenance procedures on screening device and separation chamber before maintaining cartridge filters.
2. Enter separation chamber.
3. Unscrew the two bolts holding the lid on each cartridge filter and remove lid.
4. Remove each of 4 to 8 media cages holding the media in place.
5. Spray down the cartridge filter to remove any accumulated pollutants.
6. Vacuum out old media and accumulated pollutants.
7. Reinstall media cages and fill with new media from manufacturer or outside supplier. Manufacturer will provide specification of media and sources to purchase.
8. Replace the lid and tighten down bolts. Replace screening device, grate or manhole cover when completed.

Drain Down Filter

1. Remove hatch or manhole cover over discharge chamber and enter chamber.
2. Unlock and lift drain down filter housing and remove old media block. Replace with new media block. Lower drain down filter housing and lock into place.
3. Exit chamber and replace hatch or manhole cover.

Maintenance Notes

1. Following maintenance and/or inspection, it is recommended the maintenance operator prepare a maintenance/inspection record. The record should include any maintenance activities performed, amount and description of debris collected, and condition of the system and its various filter mechanisms.

2. The owner should keep maintenance/inspection record(s) for a minimum of five years from the date of maintenance. These records should be made available to the governing municipality for inspection upon request at any time.

3. Transport all debris, trash, organics and sediments to approved facility for disposal in accordance with local and state requirements.

4. Entry into chambers may require confined space training based on state and local regulations.

5. No fertilizer shall be used in the Biofiltration Chamber.

6. Irrigation should be provided as recommended by manufacturer and/or landscape architect. Amount of irrigation required is dependent on plant species. Some plants may require irrigation.

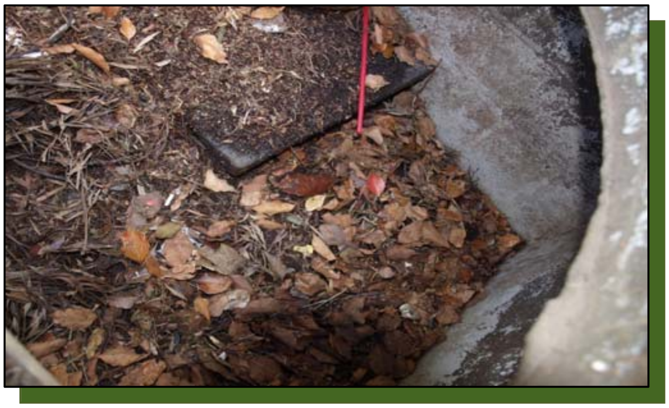
Maintenance Procedure Illustration

Screening Device

The screening device is located directly under the manhole or grate over the Pre-Treatment Chamber. It's mounted directly underneath for easy access and cleaning. Device can be cleaned by hand or with a vacuum truck.

Separation Chamber

The separation chamber is located directly beneath the screening device. It can be quickly cleaned using a vacuum truck or by hand. A pressure washer is useful to assist in the cleaning process.



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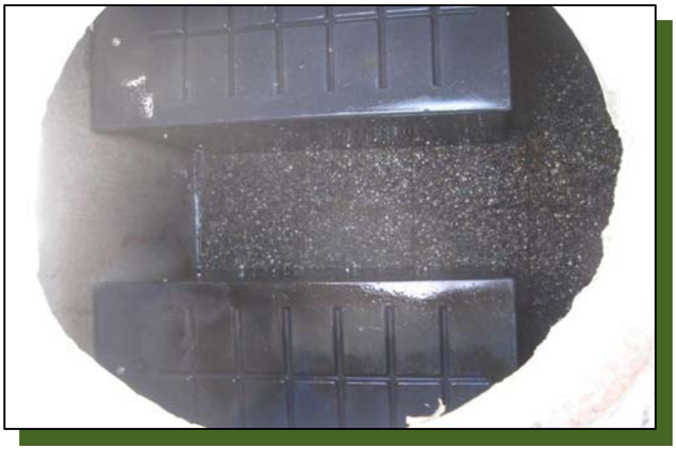
Cartridge Filters

The cartridge filters are located in the Pre-Treatment chamber connected to the wall adjacent to the biofiltration chamber. The cartridges have removable tops to access the individual media filters. Once the cartridge is open media can be easily removed and replaced by hand or a vacuum truck.



Drain Down Filter

The drain down filter is located in the Discharge Chamber. The drain filter unlocks from the wall mount and hinges up. Remove filter block and replace with new block.

Trim Vegetation

Vegetation should be maintained in the same manner as surrounding vegetation and trimmed as needed. No fertilizer shall be used on the plants. Irrigation per the recommendation of the manufacturer and or landscape architect. Different types of vegetation requires different amounts of irrigation.

Inspection Form

Modular Wetland System, Inc.
P. 760.433-7640
F. 760-433-3176
E. Info@modularwetlands.com

www.modularwetlands.com

Inspection Report
Modular Wetlands System

Project Name ______________________________

Project Address ______________________________ (city) (Zip Code)

Owner / Management Company ______________________________

Contact ______________________ Phone (   )   –

Inspector Name ______________________ Date ___/___/_____ Time __________ AM / PM

Type of Inspection ☐ Routine ☐ Follow Up ☐ Complaint ☐ Storm Storm Event in Last 72-hours? ☐ No ☐ Yes

Weather Condition ______________________ Additional Notes ______________________

For Office Use Only
(Reviewed By)
(Date) Office personnel to complete section to the left.

Inspection Checklist

Modular Wetland System Type (Curb, Grate or UG Vault): __________ Size (22', 14' or etc.): __________

Structural Integrity:	**Yes**	**No**	**Comments**	
Damage to pre-treatment access cover (manhole cover/grate) or cannot be opened using normal lifting pressure?				
Damage to discharge chamber access cover (manhole cover/grate) or cannot be opened using normal lifting pressure?				
Does the MWS unit show signs of structural deterioration (cracks in the wall, damage to frame)?				
Is the inlet/outlet pipe or drain down pipe damaged or otherwise not functioning properly?				
Working Condition:				
Is there evidence of illicit discharge or excessive oil, grease, or other automobile fluids entering and clogging the unit?				
Is there standing water in inappropriate areas after a dry period?				
Is the filter insert (if applicable) at capacity and/or is there an accumulation of debris/trash on the shelf system?				
Does the depth of sediment/trash/debris suggest a blockage of the inflow pipe, bypass or cartridge filter? If yes, specify which one in the comments section. Note depth of accumulation in in pre-treatment chamber.				Depth:
Does the cartridge filter media need replacement in pre-treatment chamber and/or discharge chamber?			Chamber:	
Any signs of improper functioning in the discharge chamber? Note issues in comments section.				
Other Inspection Items:				
Is there an accumulation of sediment/trash/debris in the wetland media (if applicable)?				
Is it evident that the plants are alive and healthy (if applicable)? Please note Plant Information below.				
Is there a septic or foul odor coming from inside the system?				

Waste:	**Yes**	**No**
Sediment / Silt / Clay		
Trash / Bags / Bottles		
Green Waste / Leaves / Foliage		

Recommended Maintenance	
No Cleaning Needed	
Schedule Maintenance as Planned	
Needs Immediate Maintenance	

Plant Information	
Damage to Plants	
Plant Replacement	
Plant Trimming	

Additional Notes: ______________________________

Maintenance Report

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www.modularwetlands.com

K-300

BIO CLEAN
ENVIRONMENTAL SERVICES, INC.

Cleaning and Maintenance Report
Modular Wetlands System

MODULAR WETLANDS

Project Name ______________________________

Project Address ______________________________
(city) (Zip Code)

Owner / Management Company ______________________________

Contact ______________________________ Phone ( ) –

Inspector Name ______________________________ Date ____/____/______ Time __________ AM / PM

Type of Inspection ☐ Routine ☐ Follow Up ☐ Complaint ☐ Storm Storm Event in Last 72-hours? ☐ No ☐ Yes

Weather Condition ______________________________ Additional Notes ______________________________

For Office Use Only
(Reviewed By)
(Date) Office personnel to complete section to the left.

Site Map #	GPS Coordinates of Insert	Manufacturer / Description / Sizing	Trash Accumulation	Foliage Accumulation	Sediment Accumulation	Total Debris Accumulation	Condition of Media 25/50/75/100 (will be changed @ 75%)	Operational Per Manufactures' Specifications (If not, why?)
	Lat: Long:	MWS Catch Basins						
		MWS Sedimentation Basin						
		Media Filter Condition						
		Plant Condition						
		Drain Down Media Condition						
		Discharge Chamber Condition						
		Drain Down Pipe Condition						
		Inlet and Outlet Pipe Condition						

Comments:

2972 San Luis Rey Road, Oceanside, CA 92058 P. 760.433.7640 F. 760.433.3176

WASHINGTON STATE
DEPARTMENT OF
ECOLOGY

April 2014

GENERAL USE LEVEL DESIGNATION FOR BASIC, ENHANCED, AND PHOSPHORUS TREATMENT

For the

MWS-Linear Modular Wetland

Ecology's Decision:

Based on Modular Wetland Systems, Inc. application submissions, including the Technical Evaluation Report, dated April 1, 2014, Ecology hereby issues the following use level designation:

1. General use level designation (GULD) for the MWS-Linear Modular Wetland Stormwater Treatment System for Basic treatment
    - Sized at a hydraulic loading rate of 1 gallon per minute (gpm) per square foot (sq ft) of wetland cell surface area. For moderate pollutant loading rates (low to medium density residential basins), size the Prefilters at 3.0 gpm/sq ft of cartridge surface area. For high loading rates (commercial and industrial basins), size the Prefilters at 2.1 gpm/sq ft of cartridge surface area.
2. General use level designation (GULD) for the MWS-Linear Modular Wetland Stormwater Treatment System for Phosphorus treatment
    - Sized at a hydraulic loading rate of 1 gallon per minute (gpm) per square foot (sq ft) of wetland cell surface area. For moderate pollutant loading rates (low to medium density residential basins), size the Prefilters at 3.0 gpm/sq ft of cartridge surface area. For high loading rates (commercial and industrial basins), size the Prefilters at 2.1 gpm/sq ft of cartridge surface area.
3. General use level designation (GULD) for the MWS-Linear Modular Wetland Stormwater Treatment System for Enhanced treatment
    - Sized at a hydraulic loading rate of 1 gallon per minute (gpm) per square foot (sq ft) of wetland cell surface area. For moderate pollutant loading rates (low to medium density residential basins), size the Prefilters at 3.0 gpm/sq ft of cartridge surface area. For high loading rates (commercial and industrial basins), size the Prefilters at 2.1 gpm/sq ft of cartridge surface area.

4. Ecology approves the MWS - Linear Modular Wetland Stormwater Treatment System units for Basic, Phosphorus, and Enhanced treatment at the hydraulic loading rate listed above. Designers shall calculate the water quality design flow rates using the following procedures:
   - Western Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using the latest version of the Western Washington Hydrology Model or other Ecology-approved continuous runoff model.
   - Eastern Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using one of the three methods described in Chapter 2.2.5 of the Stormwater Management Manual for Eastern Washington (SWMMEW) or local manual.
   - Entire State: For treatment installed downstream of detention, the water quality design flow rate is the full 2-year release rate of the detention facility.
5. These use level designations have no expiration date but may be revoked or amended by Ecology, and are subject to the conditions specified below.

Ecology's Conditions of Use:

Applicants shall comply with the following conditions:

1. Design, assemble, install, operate, and maintain the MWS – Linear Modular Wetland Stormwater Treatment System units, in accordance with Modular Wetland Systems, Inc. applicable manuals and documents and the Ecology Decision.
2. Each site plan must undergo Modular Wetland Systems, Inc. review and approval before site installation. This ensures that site grading and slope are appropriate for use of a MWS – Linear Modular Wetland Stormwater Treatment System unit.
3. MWS – Linear Modular Wetland Stormwater Treatment System media shall conform to the specifications submitted to, and approved by, Ecology.
4. Maintenance: The required maintenance interval for stormwater treatment devices is often dependent upon the degree of pollutant loading from a particular drainage basin. Therefore, Ecology does not endorse or recommend a "one size fits all" maintenance cycle for a particular model/size of manufactured filter treatment device.
   - Typically, Modular Wetland Systems, Inc. designs MWS - Linear Modular Wetland systems for a target prefilter media life of 6 to 12 months.
   - Indications of the need for maintenance include effluent flow decreasing to below the design flow rate or decrease in treatment below required levels.
   - Owners/operators must inspect MWS - Linear Modular Wetland systems for a minimum of twelve months from the start of post-construction operation to determine site-specific maintenance schedules and requirements. You must conduct inspections monthly during the wet season, and every other month during the dry season. (According to the SWMMWW, the wet season in western Washington is October 1 to April 30. According to SWMMEW, the wet season in eastern Washington is October 1 to June 30). After the

first year of operation, owners/operators must conduct inspections based on the findings during the first year of inspections.

- Conduct inspections by qualified personnel, follow manufacturer's guidelines, and use methods capable of determining either a decrease in treated effluent flowrate and/or a decrease in pollutant removal ability.
- When inspections are performed, the following findings typically serve as maintenance triggers:
    - Standing water remains in the vault between rain events, or
    - Bypass occurs during storms smaller than the design storm.
    - If excessive floatables (trash and debris) are present (but no standing water or excessive sedimentation), perform a minor maintenance consisting of gross solids removal, not prefilter media replacement.
    - Additional data collection will be used to create a correlation between pretreatment chamber sediment depth and pre-filter clogging (see *Issues to be Addressed by the Company* section below)

6. Discharges from the MWS - Linear Modular Wetland Stormwater Treatment System units shall not cause or contribute to water quality standards violations in receiving waters.

Applicant:	Modular Wetland Systems, Inc.
Applicant's Address:	*PO. Box 869* *Oceanside, CA 92054*

Application Documents:

- *Original Application for Conditional Use Level Designation*, Modular Wetland System, Linear Stormwater Filtration System Modular Wetland Systems, Inc., January 2011
- *Quality Assurance Project Plan*: Modular Wetland system – Linear Treatment System performance Monitoring Project, draft, January 2011.
- *Revised Application for Conditional Use Level Designation*, Modular Wetland System, Linear Stormwater Filtration System Modular Wetland Systems, Inc., May 2011
- *Memorandum: Modular Wetland System-Linear GULD Application Supplementary Data, April 2014*
- *Technical Evaluation Report: Modular Wetland System Stormwater Treatment System Performance Monitoring, April 2014.*

Applicant's Use Level Request:

General use level designation as a Basic, Enhanced, and Phosphorus treatment device in accordance with Ecology's Guidance for Evaluating Emerging Stormwater Treatment Technologies Technology Assessment Protocol – Ecology (TAPE) January 2011 Revision.

Applicant's Performance Claims:

- The MWS – Linear Modular wetland is capable of removing a minimum of 80-percent of TSS from stormwater with influent concentrations between 100 and 200 mg/l.
- The MWS – Linear Modular wetland is capable of removing a minimum of 50-percent of Total Phosphorus from stormwater with influent concentrations between 0.1 and 0.5 mg/l.
- The MWS – Linear Modular wetland is capable of removing a minimum of 30-percent of dissolved Copper from stormwater with influent concentrations between 0.005 and 0.020 mg/l.
- The MWS – Linear Modular wetland is capable of removing a minimum of 60-percent of dissolved Zinc from stormwater with influent concentrations between 0.02 and 0.30 mg/l.

Ecology Recommendations:

- Modular Wetland Systems, Inc. has shown Ecology, through laboratory and field-testing, that the MWS - Linear Modular Wetland Stormwater Treatment System filter system is capable of attaining Ecology's Basic, Total phosphorus, and Enhanced treatment goals.

Findings of Fact:

Laboratory Testing

The MWS-Linear Modular wetland has the:

- Capability to remove 99 percent of total suspended solids (using Sil-Co-Sil 106) in a quarter-scale model with influent concentrations of 270 mg/L.
- Capability to remove 91 percent of total suspended solids (using Sil-Co-Sil 106) in laboratory conditions with influent concentrations of 84.6 mg/L at a flow rate of 3.0 gpm per square foot of media.
- Capability to remove 93 percent of dissolved Copper in a quarter-scale model with influent concentrations of 0.757 mg/L.
- Capability to remove 79 percent of dissolved Copper in laboratory conditions with influent concentrations of 0.567 mg/L at a flow rate of 3.0 gpm per square foot of media.
- Capability to remove 80.5-percent of dissolved Zinc in a quarter-scale model with influent concentrations of 0.95 mg/L at a flow rate of 3.0 gpm per square foot of media.
- Capability to remove 78-percent of dissolved Zinc in laboratory conditions with influent concentrations of 0.75 mg/L at a flow rate of 3.0 gpm per square foot of media.

Field Testing

- Modular Wetland Systems, Inc. conducted monitoring of an MWS-Linear (Model # MWS-L-4-13) from April 2012 through May 2013, at a transportation maintenance facility in Portland, Oregon. The manufacturer collected flow-weighted composite samples of the system's influent and effluent during 28 separate storm events. The system treated approximately 75 percent of the runoff from 53.5 inches of rainfall during the monitoring period. The applicant sized the system at 1 gpm/sq ft. (wetland media) and 3gpm/sq ft. (prefilter).

- Influent TSS concentrations for qualifying sampled storm events ranged from 20 to 339 mg/L. Average TSS removal for influent concentrations greater than 100 mg/L (n=7) averaged 85 percent. For influent concentrations in the range of 20-100 mg/L (n=18), the upper 95 percent confidence interval about the mean effluent concentration was 12.8 mg/L.
- Total phosphorus removal for 17 events with influent TP concentrations in the range of 0.1 to 0.5 mg/L averaged 65 percent. A bootstrap estimate of the lower 95 percent confidence limit (LCL95) of the mean total phosphorus reduction was 58 percent.
- The lower 95 percent confidence limit of the mean percent removal was 60.5 percent for dissolved zinc for influent concentrations in the range of 0.02 to 0.3 mg/L (n=11). The lower 95 percent confidence limit of the mean percent removal was 32.5 percent for dissolved copper for influent concentrations in the range of 0.005 to 0.02 mg/L (n=14) at flow rates up to 28 gpm (design flow rate 41 gpm). Laboratory test data augmented the data set, showing dissolved copper removal at the design flow rate of 41 gpm (93 percent reduction in influent dissolved copper of 0.757 mg/L).

Issues to be addressed by the Company:

1. Modular Wetland Systems, Inc. should collect maintenance and inspection data for the first year on all installations in the Northwest in order to assess standard maintenance requirements for various land uses in the region. Modular Wetland Systems, Inc. should use these data to establish required maintenance cycles.
2. Modular Wetland Systems, Inc. should collect pre-treatment chamber sediment depth data for the first year of operation for all installations in the Northwest. Modular Wetland Systems, Inc. will use these data to create a correlation between sediment depth and pre-filter clogging.

Technology Description:
Download at http://www.modularwetlands.com/

Contact Information:

Applicant:	Greg Kent Modular Wetland Systems, Inc. P.O. Box 869 Oceanside, CA 92054 *gkent@biocleanenvironmental.net*

Applicant website: http://www.modularwetlands.com/

Ecology web link: http://www.ecy.wa.gov/programs/wg/stormwater/newtech/index.html

Ecology: Douglas C. Howie, P.E.
Department of Ecology
Water Quality Program
(360) 407-6444
douglas.howie@ecy.wa.gov

Revision History

Date	**Revision**
June 2011	Original use-level-designation document
September 2012	Revised dates for TER and expiration
January 2013	Modified Design Storm Description, added Revision Table, added maintenance discussion, modified format in accordance with Ecology standard
December 2013	Updated name of Applicant
April 2014	Approved GULD designation for Basic, Phosphorus, and Enhanced treatment

ATTACHMENT G

OPERATIONS AND MAINTENANCE (O&M) PLAN

EXHIBIT B – INSPECTION AND MAINTENANCE FORM

Exhibit B

Inspection and Maintenance Form

BMP DEVICE			**INSPECTION ITEMS**			**MAINTENANCE ITEMS**		**NOTES:**
Modular Wetlands	Inspection Date	Inspector's Name	Debris, Trash, & Mulch at surface (list if any)	Inspect Filterra Unit and internal components for damage and obstructions (list below)	Filter Media Evaluation	Replace Mulch	Evaluate Healthiness of Plant	Manufacturer's Rec. Inspection Rate (2 times/year)

Note:

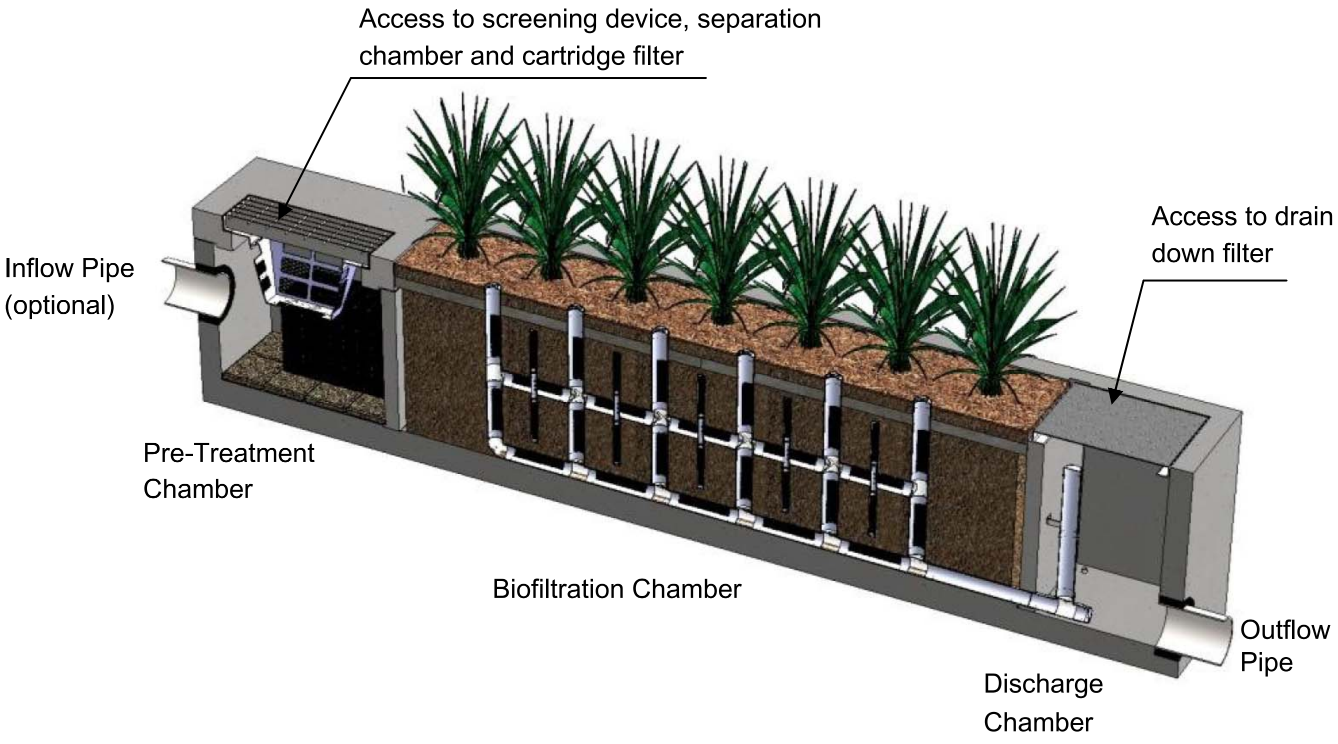
Refer to manufacturer's recommended maintenance schedule.
Contact Kristar or Drainage Protection Service (888)950-8826

Maintenance Guidelines for Modular Wetland System - Linear

Maintenance Summary

- Remove Trash from Screening Device – average maintenance interval is 6 to 12 months.
  - (*5 minute average service time*).
- Remove Sediment from Separation Chamber – average maintenance interval is 12 to 24 months.
  - (*10 minute average service time*).
- Replace Cartridge Filter Media – average maintenance interval 12 to 24 months.
  - (*10-15 minute per cartridge average service time*).
- Replace Drain Down Filter Media – average maintenance interval is 12 to 24 months.
  - (*5 minute average service time*).
- Trim Vegetation – average maintenance interval is 6 to 12 months.
  - (*Service time varies*).

System Diagram



www.modularwetlands.com

Maintenance Procedures

Screening Device

1. Remove grate or manhole cover to gain access to the screening device in the Pre-Treatment Chamber. Vault type units do not have screening device. Maintenance can be performed without entry.
2. Remove all pollutants collected by the screening device. Removal can be done manually or with the use of a vacuum truck. The hose of the vacuum truck will not damage the screening device.
3. Screening device can easily be removed from the Pre-Treatment Chamber to gain access to separation chamber and media filters below. Replace grate or manhole cover when completed.

Separation Chamber

1. Perform maintenance procedures of screening device listed above before maintaining the separation chamber.
2. With a pressure washer spray down pollutants accumulated on walls and cartridge filters.
3. Vacuum out Separation Chamber and remove all accumulated pollutants. Replace screening device, grate or manhole cover when completed.

Cartridge Filters

1. Perform maintenance procedures on screening device and separation chamber before maintaining cartridge filters.
2. Enter separation chamber.
3. Unscrew the two bolts holding the lid on each cartridge filter and remove lid.
4. Remove each of 4 to 8 media cages holding the media in place.
5. Spray down the cartridge filter to remove any accumulated pollutants.
6. Vacuum out old media and accumulated pollutants.
7. Reinstall media cages and fill with new media from manufacturer or outside supplier. Manufacturer will provide specification of media and sources to purchase.
8. Replace the lid and tighten down bolts. Replace screening device, grate or manhole cover when completed.

Drain Down Filter

1. Remove hatch or manhole cover over discharge chamber and enter chamber.
2. Unlock and lift drain down filter housing and remove old media block. Replace with new media block. Lower drain down filter housing and lock into place.
3. Exit chamber and replace hatch or manhole cover.

Maintenance Notes

1. Following maintenance and/or inspection, it is recommended the maintenance operator prepare a maintenance/inspection record. The record should include any maintenance activities performed, amount and description of debris collected, and condition of the system and its various filter mechanisms.

2. The owner should keep maintenance/inspection record(s) for a minimum of five years from the date of maintenance. These records should be made available to the governing municipality for inspection upon request at any time.

3. Transport all debris, trash, organics and sediments to approved facility for disposal in accordance with local and state requirements.

4. Entry into chambers may require confined space training based on state and local regulations.

5. No fertilizer shall be used in the Biofiltration Chamber.

6. Irrigation should be provided as recommended by manufacturer and/or landscape architect. Amount of irrigation required is dependent on plant species. Some plants may require irrigation.

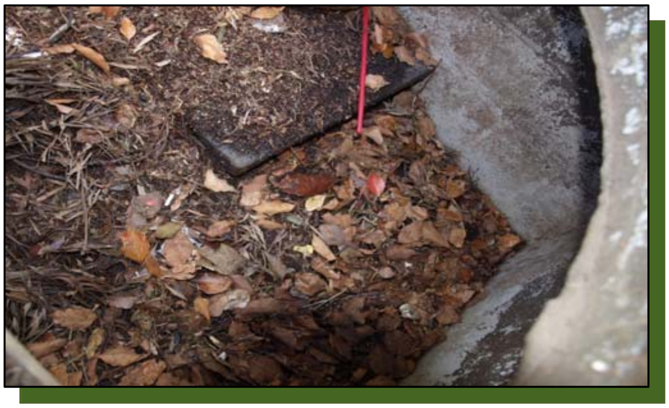
Maintenance Procedure Illustration

Screening Device

The screening device is located directly under the manhole or grate over the Pre-Treatment Chamber. It's mounted directly underneath for easy access and cleaning. Device can be cleaned by hand or with a vacuum truck.

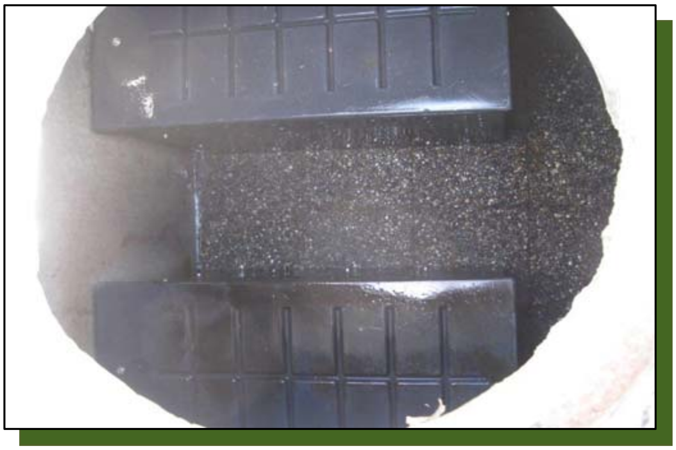
Separation Chamber

The separation chamber is located directly beneath the screening device. It can be quickly cleaned using a vacuum truck or by hand. A pressure washer is useful to assist in the cleaning process.



Cartridge Filters

The cartridge filters are located in the Pre-Treatment chamber connected to the wall adjacent to the biofiltration chamber. The cartridges have removable tops to access the individual media filters. Once the cartridge is open media can be easily removed and replaced by hand or a vacuum truck.



Drain Down Filter

The drain down filter is located in the Discharge Chamber. The drain filter unlocks from the wall mount and hinges up. Remove filter block and replace with new block.

Trim Vegetation

Vegetation should be maintained in the same manner as surrounding vegetation and trimmed as needed. No fertilizer shall be used on the plants. Irrigation per the recommendation of the manufacturer and or landscape architect. Different types of vegetation requires different amounts of irrigation.

Inspection Form

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BIO CLEAN
ENVIRONMENTAL SERVICES, INC.

Inspection Report
Modular Wetlands System

MODULAR WETLANDS

For Office Use Only
(Reviewed By)
(Date) Office personnel to complete section to the left.

Project Name

Project Address
(city) (Zip Code)

Owner / Management Company

Contact

Phone ( ) –

Inspector Name

Date / /

Time AM / PM

Type of Inspection ☐ Routine ☐ Follow Up ☐ Complaint ☐ Storm

Storm Event in Last 72-hours? ☐ No ☐ Yes

Weather Condition

Additional Notes

Inspection Checklist

Modular Wetland System Type (Curb, Grate or UG Vault):

Size (22', 14' or etc.):

Structural Integrity:	**Yes**	**No**	**Comments**
Damage to pre-treatment access cover (manhole cover/grate) or cannot be opened using normal lifting pressure?			
Damage to discharge chamber access cover (manhole cover/grate) or cannot be opened using normal lifting pressure?			
Does the MWS unit show signs of structural deterioration (cracks in the wall, damage to frame)?			
Is the inlet/outlet pipe or drain down pipe damaged or otherwise not functioning properly?			
Working Condition:			
Is there evidence of illicit discharge or excessive oil, grease, or other automobile fluids entering and clogging th unit?			
Is there standing water in inappropriate areas after a dry period?			
Is the filter insert (if applicable) at capacity and/or is there an accumulation of debris/trash on the shelf system?			
Does the depth of sediment/trash/debris suggest a blockage of the inflow pipe, bypass or cartridge filter? If yes specify which one in the comments section. Note depth of accumulation in in pre-treatment chamber.			Depth:
Does the cartridge filter media need replacement in pre-treatment chamber and/or discharge chamber?			Chamber:
Any signs of improper functioning in the discharge chamber? Note issues in comments section.			
Other Inspection Items:			
Is there an accumulation of sediment/trash/debris in the wetland media (if applicable)?			
Is it evident that the plants are alive and healthy (if applicable)? Please note Plant Information below.			
Is there a septic or foul odor coming from inside the system?			

Waste:	**Yes**	**No**
Sediment / Silt / Clay		
Trash / Bags / Bottles		
Green Waste / Leaves / Foliage		

Recommended Maintenance	
No Cleaning Needed	
Schedule Maintenance as Planned	
Needs Immediate Maintenance	

Plant Information	
Damage to Plants	
Plant Replacement	
Plant Trimming	

Additional Notes:

Maintenance Report

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BIO CLEAN
ENVIRONMENTAL SERVICES, INC.

Cleaning and Maintenance Report
Modular Wetlands System

MODULAR WETLANDS

For Office Use Only

(Reviewed By)

(Date)

Office personnel to complete section to the left.

Project Name ______________________________

Project Address ______________________________ (city) (Zip Code)

Owner / Management Company ______________________________

Contact ______________________________ Phone (   )   –

Inspector Name ______________________________ Date ____ / ____ / ______ Time __________ AM / PM

Type of Inspection ☐ Routine ☐ Follow Up ☐ Complaint ☐ Storm Storm Event in Last 72-hours? ☐ No ☐ Yes

Weather Condition ______________________________ Additional Notes ______________________________

Site Map #	GPS Coordinates of Insert	Manufacturer / Description / Sizing	Trash Accumulation	Foliage Accumulation	Sediment Accumulation	Total Debris Accumulation	Condition of Media 25/50/75/100 (will be changed @ 75%)	Operational Per Manufactures' Specifications (If not, why?)
	Lat: Long:	MWS Catch Basins						
		MWS Sedimentation Basin						
		Media Filter Condition						
		Plant Condition						
		Drain Down Media Condition						
		Discharge Chamber Condition						
		Drain Down Pipe Condition						
		Inlet and Outlet Pipe Condition						

Comments:

Exhibit A, Operations and Maintenance Plan

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

Trained Contractor and Personnel Log

Stormwater Management Training Log and Documentation

Project Name: _

WDID #: ______

Stormwater Management Topic: (check as appropriate)

☐ Erosion Control
☐ Wind Erosion Control
☐ Non-Stormwater Management
☐ Stormwater Sampling
☐ Sediment Control
☐ Tracking Control
☐ Waste Management and Materials Pollution Control
☐ Other (explain)

Specific Training Objective: ____

Location: _____

Date: ___

Instructor:_____

Telephone: ____

Course Length (hours):

Attendee Roster (Attach additional forms if necessary)

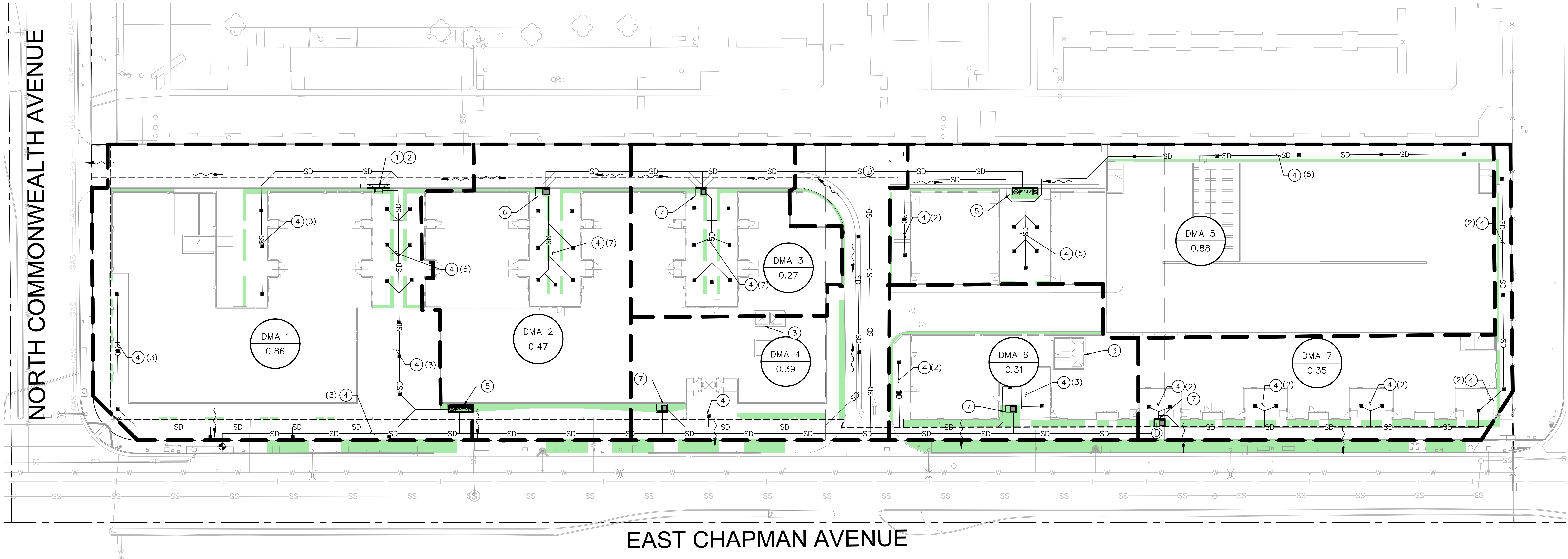
Name	Company	Phone

As needed, add proof of external training (e.g., course completion certificates, credentials for QSP, QSD).

ATTACHMENT H

WQMP SITE PLAN

Plotted By: Huo, Kevin Sheet Set: Kha Layout: PROPOSED HYDROLOGY MAP January 22, 2021 04:05:14pm K:\ORA_LDEV\194224001-Hub at Fullerton\CAD\Exhibits\Proposed WQMP Exhibit.dwg
This document, together with the concepts and designs presented herein, as an instrument of service, is intended only for the specific purpose and client for which it was prepared. Reuse of and improper reliance on this document without written authorization and adaptation by Kimley-Horn and Associates, Inc. shall be without liability to Kimley-Horn and Associates, Inc.



LEGEND

RIGHT OF WAY/ PROPERTY LINE
CENTERLINE
DRAINAGE BOUNDARY
EXISTING STORM DRAIN
PROPOSED STORM DRAIN
EXISTING CATCH BASIN
PROPOSED CATCH BASIN

LEGEND

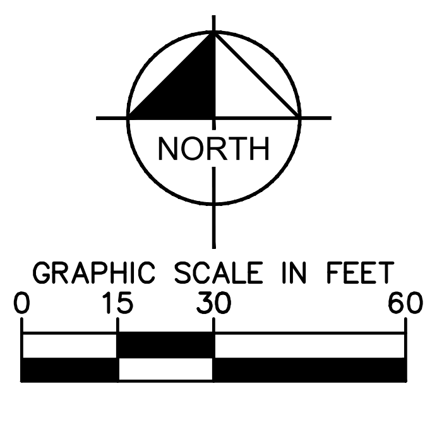
EXISTING STORM DRAIN MANHOLE
PROPOSED STORM DRAIN MANHOLE
DIRECTION OF WATER FLOW
PROPOSED MODULAR WETLAND
DA ID / ACRES — DRAINGAGE AREA LABEL
🟩 LANDSCAPE AREA

STRUCTURAL BMP NOTES

① CONSTRUCT CURB INLET CATCH BASIN PER COUNTY OF RIVERSIDE STANDARD PLAN 111-5 FOR PUBLIC WORKS CONSTRUCTION, 2012 EDITION. INSTALL DVERT WATER QUALITY DIVERSION SYSTEM PER DETAIL DV, SHEET 21
② STORM DRAIN STENCILING AND SIGNAGE
③ TRASH ENCLOSURE AREA PER ARCHITECTURAL PLAN
④ INSTALL 2424 BROOKS PRODUCTS PRECAST CATCH BASIN WITH TRAFFIC RATED GRATE OR APPROVED EQUIVALENT.
⑤ INSTALL MODULAR WETLAND SYSTEM MWS-L-4-15
⑥ INSTALL MODULAR WETLAND SYSTEM MWS-L-4-8
⑦ INSTALL MODULAR WETLAND SYSTEM MWS-L-4-6

FLOOD ZONE

FLOOD ZONE X : AREA OF MINIMAL FLOOD HAZARD



Know what's below.
Call 811 before you dig.

No.	REVISIONS	DATE	BY

Kimley»Horn

765 THE CITY DRIVE, SUITE 200, ORANGE, CA 92868
PHONE: 714-939-1030 FAX: 714-938-9488
WWW.KIMLEY-HORN.COM

LICENSED PROFESSIONAL
BRIAN GILLIS
CA LICENSE NUMBER
63021
DATE: 6/30/22

KHA PROJECT
194224001
DATE
10/22/20
SCALE AS SHOWN
DESIGNED BY BG
DRAWN BY KH
CHECKED BY BG

FINAL WQMP EXHIBIT

THE HUB
PREPARED FOR
CORE CAMPUS MANAGER

FULLERTON CA

SHEET NUMBER
1

ATTACHMENT I

TRANSFER OF RESPONSIBILITY

Water Quality Management Plan

Notice of Transfer of Responsibility

Tracking No. Assigned by the City of Santa Ana: __________

Submission of this Notice of Transfer of Responsibility constitutes notice to the City of Santa Ana that responsibility for the Water Quality Management Plan ("WQMP") for the subject property identified bellow, 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 numbers 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 Pro
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 the opposed to the entire project/parcel addressed by the WQMP, the

General Description of the Site transferred, and the remainder of the project/parcel not 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 shall be labeled "previous Owner," and those portions previously transferred 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 form the previous owner to the new owner, and 2) to facilitate notification to a transferee of property subject to a WQMP that such new owner 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 Owners 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 of New Owner Representative	Date