APPENDIX H

WATER QUALITY MANAGEMENT PLAN

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Preliminary Water Quality Management Plan (pWQMP)

Project Name:

DLX 7
6400 Katella Avenue
Cypress, CA 90630

Prepared for:
Greenlaw Partners
18301 Von Karman, Suite 250
Irvine, CA 92612
949-331-1338

Prepared on:
December 3, 2019
Revised March 19, 2020
Revised June 23, 2020
Revised July 2, 2020
Revised August 4, 2020

Prepared by:
raSmith
Engineer: Samuel Jacoby, P.E. Registration No. C74309
8881 Research Drive
Irvine, CA 92618
949-242-8041
Sam.Jacoby@raSmith.com

City Planner (Checked for site plan consistency only)	**Date**
Water Quality Manager	**Date**
Reviewing Engineer	**Date**
City Engineer	**Date**

Project Owner's Certification			
Permit/Application No.		Grading Permit No.	
Tract/Parcel Map No.		Building Permit No.	
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract)			

This Water Quality Management Plan (WQMP) has been prepared for Greenlaw Partners by raSmith, Samuel Jacoby, P.E. The WQMP is intended to comply with the requirements of the local 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 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			
Company	Greenlaw Partners		
Address	18301 Von Karman, Suite 250, Irvine, CA 92612		
Email			
Telephone #	949-331-1338		
Signature		Date	

Project Owner's Certification			
Permit/Application No.		Grading Permit No.	
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Owner:			
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Company	Greenlaw Partners		
Address	18301 Von Karman, Suite 250, Irvine, CA 92612		
Email			
Telephone #	949-331-1338		
Signature		Date	

Project Engineer's Certification			
Permit/Application No.		Grading Permit No.	
Tract/Parcel Map No.		Building Permit No.	
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract)			

I, Samuel Jacoby certify that this Water Quality Management Plan (WQMP) has been prepared under my responsible charge and as the engineer of record, I have read and understood the requirements of the Regional Board Order R8-2009-0030, Section XII-B, the 2003 and 2007 Drainage Area Management Plan (DAMP), the City of Cypress Local Implementation Plan (LIP), Section 13-23 of the City of Cypress Municipal Code, and prepared this WQMP in compliance with all requirements thereto.

Furthermore, I attest that the WQMP for the development includes, but is not limited to the following:

1) Prioritization of the use of Low Impact Development principles as follows:
    a. Preserves natural features;
    b. Minimizes runoff and reduces impervious surfaces;
    c. Utilizes infiltration of runoff as the method of pollutant treatment.
2) Incorporation of the applicable Routine Source and Structural Control BMPs as defined in the Drainage Area Management Plan (DAMP).
3) Matching time of concentration, runoff, velocity, volume and hydrograph for a 2-year storm event, providing no increase in downstream erosion and avoids downstream impacts to physical structures, aquatic and riparian habitat.
4) Using alternative treatment controls (in lieu of standard) that meet the requirements of section 7.6.5 of the DAMP, and are equally or more effective in pollutant reduction than comparable BMPs.

Additionally, this WQMP contains information that:

1) Describes the long-term operation and maintenance requirements for structural and Treatment Control BMPs.
2) Identifies the entity or employees that will be responsible for long-term operation, maintenance, repair and or replacement of the structural and Treatment Control BMPs, and the training that qualifies such entity or employees to operate and maintain the BMPs.
3) Describes the recordkeeping requirements and contains a copy of the forms to be used in conducting maintenance and inspection activities.
4) Describes the mechanism for funding the long-term operation and maintenance of all structural and Treatment Control BMPs.

Engineer:			
Name	Samuel Jacoby, P.E.		
Company	raSmith		
Email	Sam.Jacoby@raSmith.com		
Telephone #	949-242-8041		
Signature		Date	

Registered Engineer's Seal

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Attachments

Attachment A . .....Educational Materials
Attachment B . .....Operation and Maintenance Plan/ Maintenance Covenant
Attachment C . .....BMP Exhibit and Site Plan
Attachment D . .....Summary of Harvested Water Demand and Feasibility
Attachment E . .....Geotechnical Investigation
Attachment F . ..... 2YR Hydrology and BMP Calculations

Section I Discretionary Permit(s) and Water Quality Conditions

Provide discretionary permit and water quality information. *Refer to Section 2.1 in the Technical Guidance Document (TGD) available from the Orange County Stormwater Program (ocwatersheds.com).*

Project Infomation			
Permit/Application No.		Tract/Parcel Map No.	224-261-04
Additional Information/ Comments:	6400 Katella Ave.		
Water Quality Conditions			
Water Quality Conditions (list verbatim)	N/A not yet determined.		
Watershed-Based Plan Conditions			
Provide applicable conditions from watershed - based plans including WIHMPs and TMDLS.	The project is located in the Bolsa Chica and Anaheim Bay watersheds. Currently there are no approved WIHMP for the Bolsa Chica and Anaheim Bay watersheds. There are no USEPA approved TMDL's for Bolsa Chica or Anaheim Bay receiving waters.		

Section II Project Description

II.1 Project Description

Provide a detailed project description including:

- Project areas;
- Land uses;
- Land cover;
- Design elements;
- A general description not broken down by drainage management areas (DMAs).

Include attributes relevant to determining applicable source controls. *Refer to Section 2.2 in the TGD for information that must be included in the project description.*

<table>
<tr><th colspan="3">Description of Proposed Project</th></tr>
<tr><td>Development Category (Verbatim from WQMP):</td><td colspan="2">8. All significant redevelopment projects, where significant redevelopment is defined as the addition or replacement of 5,000 or more square feet of impervious surface on an already developed site. Redevelopment does not include routine maintenance activities that are conducted to maintain original line and grade, hydraulic capacity, original purpose of the facility, or emergency redevelopment activity required to protect public health and safety.

If the redevelopment results in the addition or replacement of less than 50 percent of the impervious area on-site and the existing development was not subject to WQMP requirement, the numeric sizing criteria discussed in Section 7.II-2.0 only applies to the addition or replacement area.

If the addition or replacement accounts for 50 percent or more of the impervious area, the Project WQMP requirements apply to the entire development.</td></tr>
<tr><td>Project Area (ft^2):
412,078</td><td>Number of Dwelling Units: 0</td><td>SIC Code: 4212</td></tr>
<tr><td>Narrative Project Description:</td><td colspan="2">The project proposes to redevelop an existing 22.31 acre lot, located at the Southwest corner of Katella and Holder in the City of Cypress. Only 14.96 Ac will be under construction and of that, 5.50 Ac will be pavement rehab, resulting in a 9.46 Ac of project Area. The existing Mitsubishi Motors Headquarters along Katella Ave. will remain and only the parking lot will be reconfigured. The existing storage facility at the south end of the site will be repurposed as a delivery facility for Amazon. These facilities are warehouses for same day or next day deliveries. Incoming deliveries are typically dropped off via loading docks on the north side of the building. Outgoing deliveries are typically by vans that load inside the building. Outdoor operations are not expected. All vehicular maintenance is done offsite. The site is bounded on the north by Katella Ave., on</td></tr>
</table>

Description of Proposed Project

	the west by private development, on the south by Orange County drainage channel C02S01 (Stanton Storm Channel), and on the east by Holder St. The site is underlain by "A" soils. Unfortunately, since groundwater is less than 10-ft from the surface, biofiltration will be utilized. The project site generally drains currently from northeast to southwest, into existing storm drain infrastructure which in turn discharges to Orange County drainage channel C02S01. The proposed project area is about 42.5% of the existing impervious area for infrastructure, water quality implementation, and increased landscaping. Pavement areas from the existing site will reused and maintained as part of this project. These maintenance areas are shown on the plans (approximately 5.5 Ac) and will not include soil disturbance.			
Project Area	Pervious		Impervious	
	Area (acres or sq ft)	Percentage	Area (acres or sq ft)	Percentage
Pre-Project Conditions	126,334	31%	285,744	69%
Post-Project Conditions	92,784	23%	319,294	77%
Drainage Patterns/Connections	There is a large 45" diameter existing storm drain located on the west side of the site that flows from south of Katella Ave to the Stanton Channel. As the site is relatively flat, multiple inlet drains are connected to main via storm drain. Runoff sheet flows into the inlets and via underground drains to the Stanton Channel (C02S01). The channel continues to the Bolsa Chica Channel and discharges into the Anaheim Bay.			

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 TGD for guidance.*

Pollutants of Concern			
Pollutant	Circle One: E=Expected to be of concern N=Not Expected to be of concern		Additional Information and Comments
Suspended-Solid/ Sediment	E ☒	N ☐	Landscaping exists on site, therefore expected
Nutrients	E ☒	N ☐	Landscaping exists on site, therefore expected
Heavy Metals	E ☒	N ☐	Outdoor storage, metal roofs and potentially vehicles could contribute, therefore expected
Pathogens (Bacteria/Virus)	E ☒	N ☐	Land Use potentially involved food or waste products, therefore expected
Pesticides	E ☒	N ☐	Landscaping exists on site, therefore expected
Oil and Grease	E ☒	N ☐	Site use is related to automotive uses, therefore expected
Toxic Organic Compounds	E ☒	N ☐	Pesticides used on landscaping as well as PCBs leaked from cars
Trash and Debris	E ☒	N ☐	These sources include common litter and biodegradable matter such as grass and leaves from landscaped areas

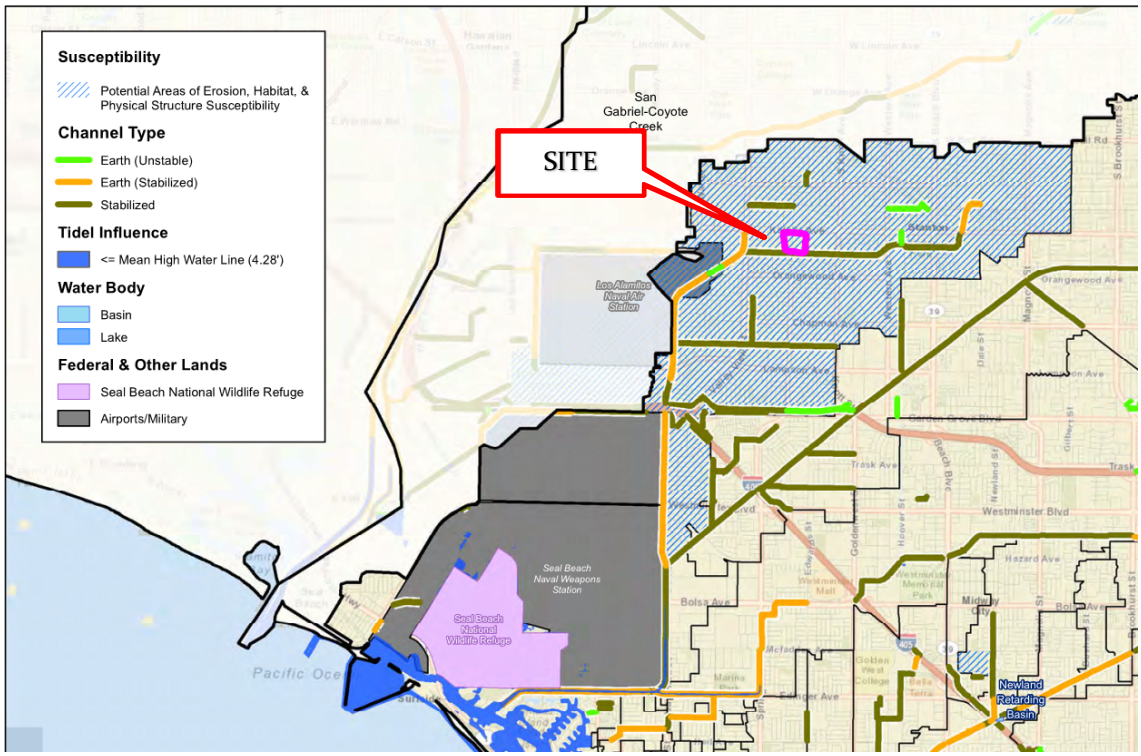
II.3 Hydrologic Conditions of Concern

Determine if streams located downstream from the project area are determined to be potentially susceptible to hydromodification impacts. *Refer to Section 2.2.3.1 in the TGD for* NOC *or Section 2.2.3.2 for* SOC.

☐ No – Show map

☒ Yes – Describe applicable hydrologic conditions of concern below. *Refer to Section 2.2.3 in the TGD.*

The site discharges to Orange County drainage channel C02S01, which in turn discharges to C02 which contains a portion of unstable earth channel.



II.4 Post Development Drainage Characteristics

Describe post development drainage characteristics. *Refer to Section 2.2.4 in the TGD.*

The proposed site contains pavement for parking lots and drive aisles. The drainage will generally conform to existing drainage paths. The inclusion of BMPs will reduce all increases and mitigate hydromodification concerns. We are proposing multiple BMPs including Filterra Bioscape Vaults and Bioretention with underdrain to treat runoff prior to entering the existing storm drain onsite that drains to the OC drainage channel C02S01. All overland flow routes (excess of 85th percentile) will be directed to C02S01 as well.

II.5 Property Ownership/Management

Describe property ownership/management. *Refer to Section 2.2.5 in the TGD.*

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Section III Site Description

III.1 Physical Setting

Fill out table with relevant information. *Refer to Section 2.3.1 in the TGD.*

Planning Area/ Community Name	Cypress Corporate Center planned community zone
Location/Address	6400 Katella Ave. Cypress, CA
Land Use	Current: office/light industrial Proposed: light industrial
Zoning	Cypress Corporate Center planned community zone
Acreage	22.31 ac.
Predominant Soil Type	Hueneme fine sandy loam, drained

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 TGD.

Precipitation Zone	*P=0.85*
Topography	*Site is generally flat*
Drainage Patterns/Connections	*Site generally drains from northeast to southwest into existing drainage inlets and* Orange County drainage channel C02S01
Soil Type, Geology, and Infiltration Properties	*HSG "A" group soils, Heuneme fine sandy loam, drained.*
Hydrogeologic (Groundwater) Conditions	*Groundwater exists at depths of 5-ft to 10 ft.*
Geotechnical Conditions (relevant to infiltration)	*Shallow Groundwater*
Off-Site Drainage	*Site discharge south west to* Orange County drainage channel C02S01
Utility and Infrastructure Information	*Existing storm drain infrastructure will be maintained to maximum extent practicable.*

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 TGD.*

Receiving Waters	Bolsa Chica Channel and Anaheim Bay
303(d) Listed Impairments	Nickel, PCBs, and Toxicity for Anaheim Bay Ammonia (Unionized), Indicator Bacteria, and pH for Bolsa Chica Channel
Applicable TMDLs	There are no USEPA approved TMDL's for Bolsa Chica or Anaheim Bay receiving waters.
Pollutants of Concern for the Project	Suspended-Solid/ Sediment, Nutrients, Heavy Metals, Pathogens (Bacteria/Virus), Pesticides, Oil and Grease, Toxic Organic Compounds, Trash and Debris
Environmentally Sensitive and Special Biological Significant Areas	N/A

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. The local Permittee planning or NPDES staff should be consulted regarding the existence 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 ☒

Project Performance Criteria (continued)	
If HCOC exists, list applicable hydromodification control performance criteria (Section 7.II-2.4.2.2 in MWQMP)	Post-development runoff volume for the 2-year frequency storm does not exceed that of the predevelopment condition by more than 5 percent, and the time of concentration of post-development runoff for the 2-year storm event is not less than that of the predevelopment condition by more than 5 percent.
List applicable LID performance criteria (Section 7.II-2.4.3 from MWQMP)	A properly designed biotreatment system may only be considered if infiltration, harvest and use, and evapotranspiration (ET) cannot be feasibly implemented for the full design capture volume. In this case, infiltration, harvest and use, and ET practices must be implemented to the greatest extent feasible and biotreatment may be provided for the remaining design capture volume.
List applicable treatment control BMP performance criteria (Section 7.II-3.2.2 from MWQMP)	Capture and treat 80 percent of average annual runoff volume,
Calculate LID design storm capture volume for Project.	21,308 cf required per worksheet B

IV.2. SITE DESIGN AND DRAINAGE PLAN

Describe site design and drainage plan 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 plot plan.
- Calculation of Design Capture Volume (DCV) for each drainage area.
- A listing of GIS coordinates for LID and Treatment Control BMPs (unless not required by local jurisdiction).

Refer to Section 2.4.2 in the TGD.

Please see attached WQ Maps

The project proposes to discharge proposed pavement to existing inlets, generally draining to southwest.

BMPs shall be dispersed to take first-flush, before overflow to existing infrastructure.

The site has been calculated as with multiple DMA's each with a specific BMP. There are multiple areas where maintenance areas drain without being treated.

IV.3 LID BMP SELECTION AND PROJECT CONFORMANCE ANALYSIS

Each sub-section below documents that the proposed design features conform to the applicable project performance criteria via check boxes, tables, calculations, narratives, and/or references to worksheets. *Refer to Section 2.4.2.3 in the TGD for selecting LID BMPs and Section 2.4.3 in the TGD for conducting conformance analysis with project performance criteria.*

IV.3.1 Hydrologic Source Controls

If required HSCs are included, fill out applicable check box forms. If the retention criteria are otherwise met with other LID BMPs, include a statement indicating HSCs not required.

Name	Included?
Localized on-lot infiltration	☐
Impervious area dispersion (e.g. roof top disconnection)	☐
Street trees (canopy interception)	☐
Residential rain barrels (not actively managed)	☐
Green roofs/Brown roofs	☐
Blue roofs	☐
Impervious area reduction (e.g. permeable pavers, site design)	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐

IV.3.2 Infiltration BMPs

Identify infiltration BMPs to be used in project. If design volume cannot be met state why BMPs cannot be met

Name	Included?
Bioretention without underdrains	☐
Rain gardens	☐
Porous landscaping	☐
Infiltration planters	☐
Retention swales	☐
Infiltration trenches	☐
Infiltration basins	☐
Drywells	☐
Subsurface infiltration galleries	☐
French drains	☐
Permeable asphalt	☐
Permeable concrete	☐
Permeable concrete pavers	☐
Other:	☐
Other:	☐

Show calculations below to demonstrate if the LID Design Strom Capture Volume can be met with infiltration BMPs. If not document how much can be met with infiltration and document why it is not feasible to meet the full volume with infiltration BMPs.

Infiltration is not feasible (groundwater depth). See Workseet I in Attachment D.

IV.3.3 Evapotranspiration, Rainwater Harvesting BMPs

If the full Design Storm Capture Volume cannot be met with infiltration BMPs, describe any evapotranspiration, rainwater harvesting BMPs.

Name	Included?
All HSCs; *See Section IV.3.1*	☐
Surface-based infiltration BMPs	☐
Biotreatment BMPs	☐
Above-ground cisterns and basins	☐
Underground detention	☐
Other:	☐
Other:	☐
Other:	☐

Show calculations below to demonstrate if the LID Design Strom Capture Volume can be met with evapotranspiration, rainwater harvesting BMPs in combination with infiltration BMPs. If not document how much can be met with either infiltration BMPs, evapotranspiration, rainwater harvesting BMPs, or a combination, and document why it is not feasible to meet the full volume with either of these BMPs categories.

Full DCV is needed for stormwater, but irrigation demand would require a standing water condition. See Workseet J in Attachment D.

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. 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:	☐

Show calculations below to demonstrate if the LID Design Strom Capture Volume can be met with infiltration, evapotranspiration, rainwater harvesting and/or biotreatment BMPs. If not document how much can be met with either infiltration BMPs, evapotranspiration, rainwater harvesting BMPs, or a combination, and document why it is not feasible to meet the full volume with either of these BMPs categories.

Proprietary vegetated biotreatment systems (Filterra Bioscape Vaults) and bioretention with underdrain will be installed at dispersed points across the site to handle the DCV with underground detention prior to discharge to mitigate HCOC. See BMP calculations in Attachment F.

IV.3.5 Hydromodification Control BMPs

Describe hydromodification control BMPs. See Section 5 TGD. Include sections for selection, suitability, sizing, and infeasibility, as applicable. Detail compliance with Prior Conditions of Approval.

Hydromodification Control BMPs	
BMP Name	**BMP Description**
BMP1 (BIO-7)	Proprietary vegetated biotreatment systems (Filterra Bioscape Vaults) will be installed at dispersed points across the site to handle the DCV with underground detention prior to discharge to mitigate HCOC.
BMP2 (BIO-1)	Bioretention basins with underdrain units will be installed at dispersed points across the site to handle the DCV with underground detention prior to discharge to mitigate HCOC.

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	☐	☒	No activity restrictions expected.
N3	Common Area Landscape Management	☒	☐	
N4	BMP Maintenance	☒	☐	
N5	Title 22 CCR Compliance (How development will comply)	☐	☒	No hazardous waste expected on site.
N6	Local Industrial Permit Compliance	☒	☐	
N7	Spill Contingency Plan	☐	☒	No hazardous material transfers anticipated
N8	Underground Storage Tank Compliance	☐	☒	No underground storage tanks
N9	Hazardous Materials Disclosure Compliance	☐	☒	No hazardous material storage
N10	Uniform Fire Code Implementation	☒	☐	
N11	Common Area Litter Control	☒	☐	
N12	Employee Training	☒	☐	
N13	Housekeeping of Loading Docks	☒	☐	
N14	Common Area Catch Basin Inspection	☒	☐	
N15	Street Sweeping Private Streets and Parking Lots	☒	☐	
N16	Retail Gasoline Outlets	☐	☒	No retail gasoline.

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	☐	☒	No outdoor material storage on-site.
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	☐	☒	No existing slopes and channels on-site.
	Incorporate requirements applicable to individual priority project categories (from SDRWQCB NPDES Permit)	☐	☒	
S6	Dock areas	☒	☐	
S7	Maintenance bays	☐	☒	No maintenance bays on-site.
S8	Vehicle wash areas	☐	☒	No vehicle wash areas on-site.
S9	Outdoor processing areas	☐	☒	No outdoor processing areas on-site.
S10	Equipment wash areas	☐	☒	No equipment wash areas on-site.
S11	Fueling areas	☐	☒	No fueling areas on-site.
S12	Hillside landscaping	☐	☒	No hillside landscaping on-site.
S13	Wash water control for food preparation areas	☐	☒	No Food Prep on site.
S14	Community car wash racks	☐	☒	No community car wash racks on-site.

IV.4 ALTERNATIVE COMPLIANCE PLAN (IF APPLICABLE)

IV.4.1 Water Quality Credits

Determine if water quality credits are applicable for the project. *Refer to Section 3.1 of the Model WQMP for description of credits and Appendix VI of the TGD for calculation methods for applying water quality credits.*

<table>
<tr><th colspan="5">Description of Proposed Project</th></tr>
<tr><td colspan="5">Project Types that Qualify for Water Quality Credits (Select all that apply):</td></tr>
<tr><td colspan="2">☐Redevelopment projects that reduce the overall impervious footprint of the project site.</td><td colspan="2">☐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>☐ 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="2">☐ 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>☐ 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="4"></td></tr>
</table>

Section V Inspection/Maintenance Responsibility for BMPs

Fill out information in table below. Prepare and attach an Operation and Maintenance Plan. Identify the mechanism through which BMPs will be maintained. Inspection and maintenance records must be kept for a minimum of five years for inspection by the regulatory agencies. *Refer to Section 7.II 4.0 in the Model WQMP.* Note – Rainy season begins October 1st. All BMPs have been designed to drawdown within 72 hours for vector control.

BMP Inspection/Maintenance				
BMP	**Reponsible Party(s)**	**Inspection/ Maintenance Activities Required**	**Estimated Annual Budget**	**Minimum Frequency of Activities**
BIO-7 Filterra Bioscape Vaults (7)	Owner	See O&M Manual Attachment B	$500	See O&M Manual Attachment B
BIO-1 BioRetention w/ Underdrain	Owner	See O&M Manual Attachment B	$500	See O&M Manual Attachment B
Inlet Stenciling	Owner	See O&M Manual Attachment B	$200	See O&M Manual Attachment B
Education of Owners, Tenants, and Occupants	Owner	Provide Education Materials per Attachment A	$0	Yearly

BMP Inspection/Maintenance				
BMP	**Reponsible Party(s)**	**Inspection/ Maintenance Activities Required**	**Estimated Annual Budget**	**Minimum Frequency of Activities**
Parking Lot Sweeping	Owner	See O&M Manual Attachment B	$300	Semi-Annual
Common Area Litter Control	Owner	See O&M Manual Attachment B	$250	Weekly

Section VI Site Plan and Drainage Plan

VI.1 SITE PLAN AND DRAINAGE PLAN

Include a site plan and drainage plan sheet set containing the following minimum information:

- Project location
- Site boundary
- Land uses and land covers, as applicable
- Suitability/feasibility constraints
- Structural BMP locations
- Drainage delineations and flow information
- Drainage connections
- BMP details

VI.2 ELECTRONIC DATA SUBMITTAL

The minimum requirement is to provide submittal of PDF exhibits in addition to hard copies. Format must not require specialized software to open.

If the local jurisdiction requires specialized electronic document formats (CAD, GIS) to be submitted, this section will be used to describe the contents (e.g., layering, nomenclature, georeferencing, etc.) of these documents so that they may be interpreted efficiently and accurately.

Section VII Educational Materials

Refer to the Orange County Stormwater Program (ocwatersheds.com) for a library of materials available. For the copy submitted to the Permittee, only attach the educational materials specifically applicable to the project. Other materials specific to the project may be included as well and must be attached.

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)	☐	BMP factsheets	☒
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

Educational Materials



Preventing water pollution at your commercial/industrial site

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

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

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

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

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

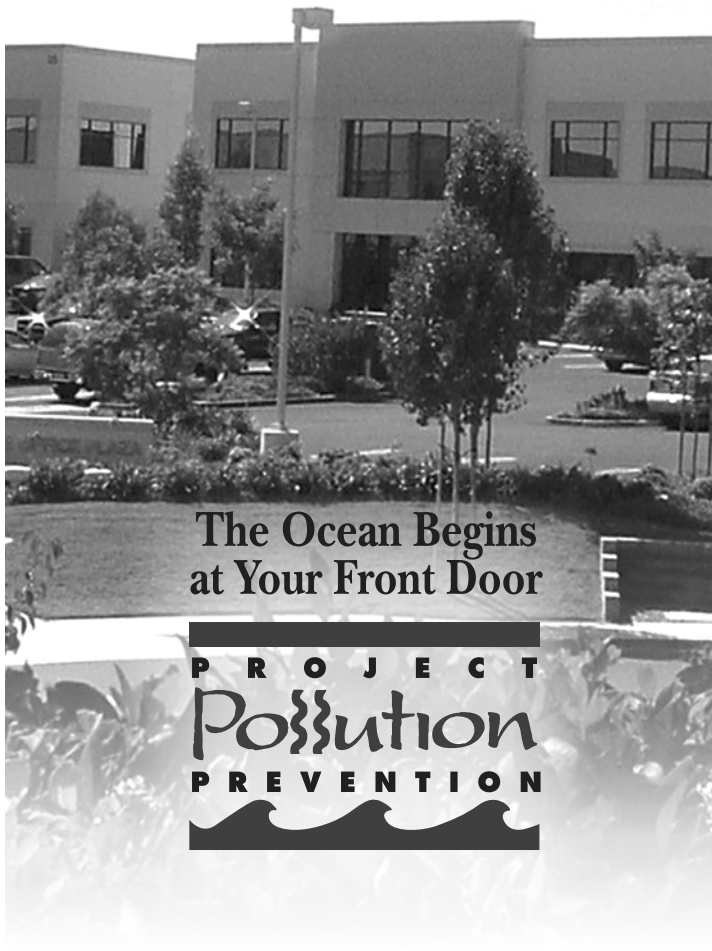
For emergencies, dial 911.

RECYCLE USED OIL

Printed on Recycled Paper

Help Prevent Ocean Pollution:

Proper Maintenance Practices for Your Business



The Ocean Begins at Your Front Door

PROJECT Pollution PREVENTION

Proper Maintenance Practices for your Business

Landscape Maintenance

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

Building Maintenance

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

NEVER DISPOSE OF ANYTHING IN THE STORM DRAIN.

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

PROJECT Pollution PREVENTION

Attachment B

O & M Plan

Operation & Maintenance (O&M) Plan for WQMP

Project Name:

DLX 7
6400 Katella Avenue
Cypress, CA 90630

Prepared for:
Greenlaw Partners
18301 Von Karman, Suite 250
Irvine, CA 92612
949-331-1338

Prepared on:
March 19, 2020
June 23, 2020
July 2, 2020

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Section 1 Project Description and BMP Overview

General Project Attributes and Stormwater Control Measures		
Site Location	6400 Katella Avenue Cypress, CA 90630	
Project Area (ft^2): 412,078	Number of Dwelling Units:	SIC Code: 4212
Narrative Project Description:	The project proposes to redevelop an existing 22.31 acre lot, located at the Southwest corner of Katella and Holder in the City of Cypress. The existing Mitsubishi Motors Headquarters along Katella Ave. will remain and only the parking lot will be reconfigured. The existing storage facility at the south end of the site will be repurposed as a delivery facility for Amazon. These facilities are warehouses for same day or next day deliveries. Incoming deliveries are typically dropped off via loading docks on the north side of the building. Outgoing deliveries are typically by vans that load inside the building. Outdoor operations are not expected. All vehicular maintenance is done offsite. The site is bounded on the north by Katella Ave., on the west by private development, on the south by Orange County drainage channel C02S01 (Stanton Channel), and on the east by Holder St.	
Project-specific Source Control BMPs	Filterra Bioscape Vaults, Bioretention with underdrain , Dock Maintenance, BMP Maintenance, Local Industrial Permit Compliance, Uniform Fire Code Compliance, Employee Training, Catch Basin Inspection	

General Project Attributes and Stormwater Control Measures	
Summary of Drainage Patterns	There is a large 45" diameter existing storm drain located on the west side of the site that flows from south of Katella Ave to the Stanton Channel. As the site is relatively flat, multiple inlet drains are connected to main via storm drain. Runoff sheet flows into the inlets and via underground drains to the Stanton Channel (C02S01). The channel continues to the Bolsa Chica Channel and discharges into the Anaheim Bay.
Summary of Hydrologic Source Controls	None, only Source Controls BMPs will be used on this project.
Structural Treatment and Hydromodification BMPs	The proposed site contains pavement for parking lots and drive aisles. The drainage will generally conform to existing drainage paths. The inclusion of BMPs will reduce all increases and mitigate hydromodification concerns.

BMP ID	BMP Type	Narrative Description	Location	Other Considerations
BMP 1	*Biorention with Underdrain*	*Landscaped depressions that capture and filter stormwater runoff.*	*DMA-2 (Parking Island)* *DMA-7 (SW Bldg Corner)* *DMA-8 (Parking Island)* *DMA-9 (Parking Island)* *DMA-10 (NE Bldg Corner)*	*Underdrain directly connected to storm drain.*
BMP 2	*Proprietary Biofiltration Basin*	*Separate Proprietary Filterra Bioscape Vaults receives Flow from DMA 1, 3-6.*	*Three 8'x6' devices located in the central parking lot. Four additional devices in the west parking lot.* *(2)-8'x6'* *(1)-10'x6'* *(1)-6'x6''*	*Additional overflow storage provided by 4' Diameter pipes 200' long for each filterra unit located in the central parking lot.*

Section 2 Personnel, Documentation, and Reporting

2.1 Maintenance Roles and Responsibilities

The roles related to O&M of the BMPs are defined as follows:

- ***Facility Owner*** *– The Facility Owner is the party who is ultimately responsible for the functionality of all BMPs. The maintenance agreement (Attachment 2) identifies the facility owner for each BMP, including the timing of any ownership transitions.*
- ***Responsible Party*** *– The Responsible Party is the party that shall have direct responsibility for the O&M of the BMPs. This party shall be the designated contact with inspectors and lead maintenance personnel. The Responsible Party shall sign self-inspection reports and any correspondence regarding the verification of inspections and required maintenance. The Responsible Party will establish a system to delegate general inquiries to the appropriate maintenance personnel concerning the operation and maintenance of the BMPs. The Responsible Party reports directly to the Facility Owner and operates and manages the BMPs on the Facility Owner's behalf.*
- ***Designated Emergency Respondent*** *– The Designated Emergency Respondent is the party responsible for directing activities and communications during emergencies such as broken irrigation pipes, landslides, hazardous spill responses etc., that would require immediate response should they occur during off-hours. It is the responsibility of the Designated Emergency Respondent to communicate the emergent situation with the Responsible Party as soon as possible.*
- ***Key Maintenance Personnel*** *– Key Maintenance Personnel are the designated lead field manager(s) or supervisor(s) who directly oversee and delegate the maintenance activities, maintain the scheduling, and coordinate activities between all personnel. These tend to change more often than other personnel over time, so their names do not necessarily need to be included in the O&M Plan. However, they must be properly trained as recorded in the training logs (Section 2.2).*

The table below lists the roles for this project. This table must be updated whenever changes occur.

Role	Name (Title and Affiliation)	Phone Number	Address	Email Address
Facility Owner	Greenlaw Partners	949-331-1338	18301 Von Karman, Suite 250 Irvine, CA 92612	
Responsible Party	Adam Schmid Duke Realty	865-776-1344	200 Spectrum Center Drive, Suite 1600 Irvine, CA 92618	

Designated Emergency Respondent	TBD			

2.2 Qualification and Training Requirements for Personnel

Many of the activities presented in this O&M plan can be completed by personnel with basic landscaping and yard maintenance skills and project-specific orientation. However, there are activities that require a more experienced skillset to identify and remediate potential issues that could compromise the functionality of each BMP. The Responsible Party shall exercise discretion in determining the skillset required to complete each task.

Activities that can typically be completed by maintenance personnel with basic training and/or qualifications include:

- General landscaping activities (pruning, weeding, and raking)
- Routine sediment, trash and debris removal;
- Filling in minor scour or erosion areas, or replacing rip rap that has become displaced; and
- Watering or irrigation, as necessary.

Activities that typically require maintenance personnel with specialized qualifications, training, and/or engineering oversight include:

- Inspection and/or repair of inflow and outflow structures;
- Inspection and/or repair of underground elements;
- Large-volume sediment or media removal requiring specialized equipment;
- Inspection, diagnosis, and remediation of significant erosion issues potentially compromising function and/or structural stability; and
- Spill response and remediation.

Maintenance personnel who have identified a potential major issue with any facility should contact the designated key maintenance personnel for the facility immediately.

Training must be provided for all personnel performing maintenance tasks on or providing maintenance oversight of structural BMPs. The table below provides the personnel and relevant training topics.

Training Logs contained in Attachment 3 should be used to document training of maintenance personnel.

Training Topic	Responsible Party	Designated Emergency Respondent	Key Maintenance Personnel
Proper Maintenance of all BMP components	X		X
Identification and clean-up procedures for spills and overflows	X	X	X
Safety concerns when maintaining devices and responding to emergency situations	X	X	X

2.3 Maintenance Agreements and Funding Mechanisms

Maintenance will be by owner and budgeted annually based on this document. A draft Maintenance Agreement has been provided in Attachment 2.

Documentation of site conditions, maintenance activities performed, and any other remaining maintenance required is necessary during each inspection/maintenance visit. Inspection and maintenance records shall be retained in an accessible, secure location for the life of the facility, and not less than 10 years.

The following documentation mechanisms and procedures have been established for this O&M Plan:

- **Training Logs:** Personnel must document training activities as part of implementing this O&M Plan. Attachment 3 contains a sample training log.
- **Inspection and Routine Maintenance Logs:** Maintenance personnel are required to maintain logs of inspection and maintenance activities. Attachment 4 contain inspection and maintenance logs.
- **Rehabilitative and Corrective Maintenance Log and Reporting:** Rehabilitation and corrective maintenance activities should be documented at a degree of detail that is commensurate to the complexity/significance of the activity. Any significant changes to the BMP designs that arise from rehabilitation/corrective maintenance will be documented via an update to the Project WQMP and as-built drawings. Corrective maintenance that does not result in design changes will be documented as a special entry in the maintenance logs to provide pertinent details of that rehabilitative or corrective maintenance activity.

2.5 Required Permits Associated with Maintenance Activities

None

2.6 Self-Reporting Requirements

The WQMP Verification Form in Attachment 2 shall be completed accurately and submitted with associated documentation to the City of Cypress by September 30 of each year, or as requested by the City. Failure to complete and submit the verification form will result in a noncompliance and enforcement actions may be taken.

2.7 City Inspections

The City of Cypress may conduct a site inspection to evaluate compliance with the Project WQMP, at any time, in accordance with the *municipal ordinance.*

2.8 Electronic Data Submittal

This document, along with the attachments, shall be provided to the City or County in PDF format. Autocad files and/or GIS coordinates of BMPs shall also be submitted to the City/County.

Section 3 Inspection and Maintenance Activities

This section identifies the inspection and O&M activities for each BMP incorporated into the project. Section 3.1 and 3.2 contain common maintenance activities and frequencies associated with Source Control BMPs and HSCs, respectively. Section 3.3 contains individual tables for each structural LID or hydromodification BMP with an explanation of the various types of maintenance activities associated with these BMPs. Rainy season begins October 1. Post Construction BMPs (BIO-1 & BIO-7) are to be inspected at a minimum once before the rainy season and once after.

3.1 Inspection and Maintenance of Source Control BMPs

Source Control BMP	Activity	Frequency
Dry Weather Flow Source Control	Check for dry weather flows such as street washing, irrigation overspray, air conditioner condensate in areas of the project that do not drain to LID BMPs, the sanitary sewer, or landscaped pervious areas. Notify residents of any dry weather flows and follow up to correct.	Twice per year during dry season
	Inspect project outfall or most-downstream project manhole for presence of dry weather flow. If present, conduct reconnaissance to determine source and implement actions to eliminate source.	Twice per year during dry season
N1. Education for Property Owner's Tenants and Occupants	Distribute appropriate materials to owners, tenants, and/or occupants via contract language, mailings, website, or meetings.	Information provided to owners and tenants upon sale or lease. Reminders sent or posted as needed.
	Check www.ocwatersheds.com and/or City website for updated educational materials.	Annually

Source Control BMP	Activity	Frequency
N3/S4. Common Area Landscape Management, Efficient Landscape Design, and Efficient Irrigation	Check that fertilizer and pesticide usage is in accordance wiN1th the Integrated Pest Management Program. Adjust, if needed.	Annually
N3/S4. Common Area Landscape Management, Efficient Landscape Design, and Efficient Irrigation	Check the irrigation system water budget to ensure efficiency targets are being met and the system is in good condition. Adjust/repair irrigation system and controllers, if needed.	Annually prior to irrigation system activation
	Check landscaping for presence of invasive species and remove, if needed.	Annually
N11. Common Area Litter Control	Remove trash from around trash enclosure, inspect to ensure lids closed, structurally sound, and not overflowing. Repair or replace, as needed.	Monthly
N11. Common Area Litter Control	Inspect common area for litter and trash disposal violations by homeowners and reporting to the HOA or responsible party for investigation. Remove litter, as needed.	Weekly
N13/S6. Housekeeping of Loading Docks	Inspect loading dock for litter, spills, broken containers, and broken containers. Remove litter and debris and sweep docking area.	Monthly
N13/S6. Housekeeping of Loading Docks	Check that loading dock is covered and isolated with no run-on or run-off to other areas or the storm drain system. Repair, redesign, regrade, etc. to correct deficiencies.	Annually
N14. Common Area Catch Basin Inspection	If spills of hazardous materials occur, clean up spill, but prevent wash water from entering storm drain system.	As needed

Source Control BMP	Activity	Frequency
	Remove trash and debris from catch basins and grates. Check for damage, clogging, and standing water. Repair or mitigate clogging/standing water, as needed.	Four times per year during wet season, including inspection just before the wet season and within 24 hours after at least two storm events >0.5 inches
N15. Street Sweeping Private Streets and Parking Lots	Sweep curb and gutter areas using a vacuum street sweeper. Report any significant or illicit debris in curb/gutter to HOA or responsible party, as needed.	Weekly to Monthly
S1. Provide Storm Drain System Stenciling and Signage	Check that all catch basins in paved areas marked or stenciled with "No dumping-Drains to Ocean; No Descargue Basura" language. Replace/repaint markings if faded, damaged, removed, or otherwise illegible.	Annually

3.2 Inspection and Maintenance of Hydrologic Source Controls

HSCs	Activity	Frequency

3.3 Inspection and Maintenance of Structural LID and Hydromodification BMPs

The section is organized by type of structural LID or hydromodification BMP with separate tables for each BMP type included in the project. The section identifies four categories of activities related to O&M of the BMPs:

General Inspections - Evaluations conducted at regularly scheduled intervals to indicate the need for maintenance of structural BMPs.

Routine Maintenance Activities – Activities conducted at regularly scheduled intervals to sustain long-term performance of each BMP, including inspections and normal upkeep.

Corrective (Major) Maintenance Activities – Includes activities conducted to replace or rehabilitate system components at the end of their usable life as well as activities conducted to resolve major issues that are not anticipated.

Emergency Response Activities – Activities related to emergencies, primarily concerning spills, which may require immediate action and notifications (Section 3.4).

BMP ID	BMP Type	Reference Maintenance Table
BMP 1	*Bioretention with Underdrain*	*BIO-1*
BMP 2	*Proprietary Biofiltration* Basin (Filterra Bioscape Vaults)	*BIO-7*

BIO-1 Bioretention with Underdrain	
Activity	**Frequency**
GENERAL INSPECTIONS	
Remove trash and debris	Four times per year during wet season, including inspection just before the wet season and within 24 hours after at least two storm events ≥ 0.5 inches.
Identify excess erosion or scour	
Inspect during storm event, when possible, to estimate treatment capacity and determine if premature bypass is occurring	
Evaluate plant health and need for corrective action	
Identify any needed corrective maintenance that will require site-specific planning or design	
OPERATION AND MAINTENANCE	
• O&M of accompanying retention BMPs should follow the guidelines established in the associated fact sheet for that BMP.	

BIO-5/7 Proprietary Biotreatment	
Activity	**Frequency**
GENERAL INSPECTIONS	
Remove trash and debris	Four times per year during wet season, including inspection just before the wet season and within 24 hours after at least two storm events ≥ 0.5 inches.
Identify excess erosion or scour	
Identify sediment accumulation that requires maintenance	
Inspect during storm event, when possible, to estimate treatment capacity and determine if premature bypass is occurring	
Evaluate plant health and need for corrective action	
Identify any needed corrective maintenance that will require site-specific planning or design	
OPERATION AND MAINTENANCE	
• O&M of proprietary BMPs must follow established manufacturer guidelines • O&M of accompanying retention BMPs should follow the guidelines established in the associated fact sheet for that BMP.	

3.4 Emergency Response Plan

In some cases, adverse conditions may occur which could be an imminent threat to human or environmental health or severe damage to infrastructure or property. For example, a spill of hazardous substances in the contributing area to a BMP could cause harmful substances to enter the BMP and be released downstream, affecting environmental and public health. Other emergencies could arise related to the stormwater features or water quality protection, such as landsliding, major erosion, or burst pipes in the tributary area.

In the event of an actual or suspected hazardous material release, the following plan shall take effect.

The primary importance of initial response to an actual or suspected spill will be public safety, control of the source of pollution, and containment of spills that have occurred, as applicable. The table below provides the emergency contact information for hazardous materials spills affecting BMPs.

Name	Phone	When to Report
Local Emergency Response (Fire Department)	911	Immediately
Orange County 24-Hour Water Pollution Problem Reporting Hotline	1-877-897-7455	Immediately
CalOES State Warning Center	1-800-852-7550	Immediately

The first number to call is emergency response (9-1-1), followed by the California Governor's Office of Emergency Services (CalOES), formerly the California Emergency Management Agency (CalEMA). (CalOES) maintains guidance and instructions of what to do in the event of a spill of hazardous substances (http://www.caloes.ca.gov/cal-oes-divisions/fire-rescue/hazardous-materials/spill-release-reporting). This plan is based on the guidance provided by CalOES (CalOES, 2014).

1. If an actual or suspected hazardous material incident exists, maintenance personnel will immediately call 911 and the CalOES State Warning Center (**Error! Reference source not found.**).
2. The Designated Emergency Respondent and Responsible Party assigned to the facility (from Section 2.1) must also be notified of any actual or potential spill.
3. Remediation of contamination in the water quality facility should be handled as a corrective maintenance issue per Section 3.2 of this O&M plan.

In the event that a potential spill is identified prior to it reaching the BMPs, the Designated Emergency Respondent will implement an isolation protocol to prevent the spill from entering the BMP. An inflatable plug, Hazmat Plug, or equivalent device as approved by the Designated Emergency Respondent will be installed within the storm drains or catch basins to block upstream flow from reaching and contaminating the BMP. The temporary plug will be an interim measure until the spill is properly maintained and remediated and the Designated Emergency Respondent has determined the risk to the BMP of contamination no longer exists.

Similar measures should be taken in the event of a landslide, mudslide, or major erosion within the tributary area of the BMP to prevent sediment from damaging the BMP to the extent possible.

3.5 Vector Control

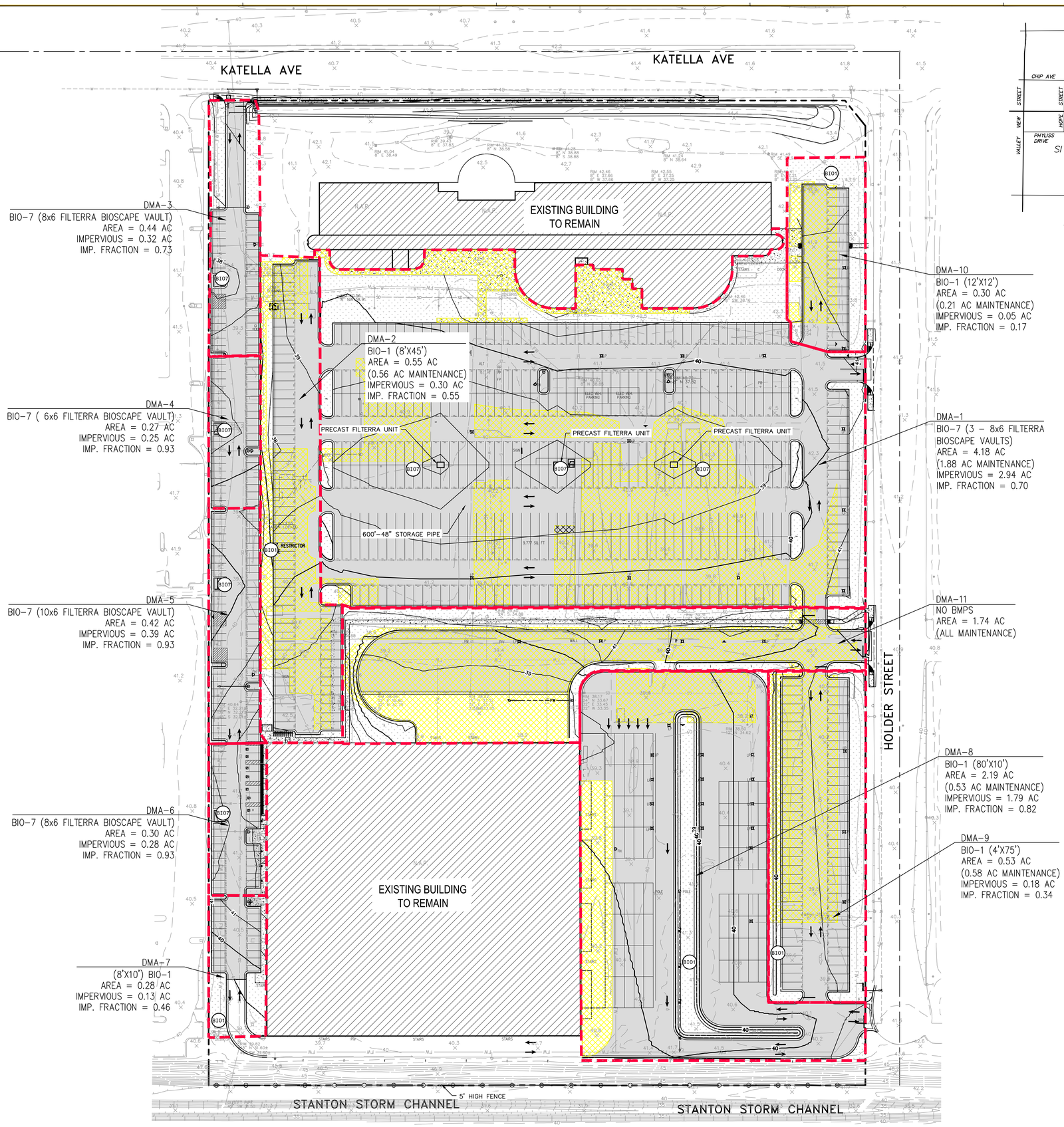
In addition to the inspection and maintenance activities listed in Section 3, all BMPs shall be inspected for standing water on a regular basis. Standing water which exists for longer than 72 hours may contribute to mosquito breeding areas. Standing water may indicate that the BMP is not functioning properly and proper action to remedy the situation shall be taken in a timely manner.

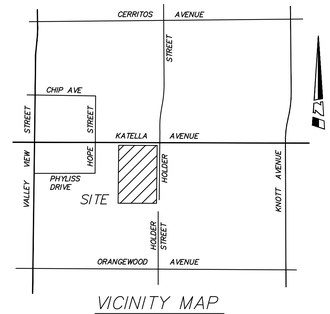
Elimination of standing water and managing garbage, lawn clippings, and pet droppings can help decrease the present of mosquitoes and flies in the area.

The Orange County Vector Control District may be contacted for more information and support at 714-971-2421 or 949-654-2421 or www.ocvcd.org.

Attachment 1:Photos and Exhibits

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VICINITY MAP
NOT TO SCALE

File No.: NCS-979526-SA1

The Land referred to herein below is situated in the City of Cypress, County of Orange, State of California, and is described as follows:

PARCEL 1 OF PARCEL MAP NO. 81-1141, IN THE CITY OF CYPRESS, COUNTY OF RANGE, STATE OF CALIFORNIA, AS PER MAP FILED IN BOOK 167, PAGES 34-36 OF PARCEL MAPS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID

ALSO EXCEPT FROM THAT PORTION OF SAID LAND NOT INCLUDED WITHIN THE LINES OF PARCEL 1 SHOWN ON PARCEL MAP FILED IN BOOK 108, PAGES 10 AND 11 OF PARCEL MAPS, ALL COAL, CHEMICAL, PETROLEUM, OIL, GAS, ASPHALTUM AND OTHER HYDROCARBONS, AND ALL MINERALS, METALS AND MINERAL ORES, WHETHER SIMILAR TO THOSE HEREIN SPECIFIED OR NOT, OF EVERY KIND AND CHARACTER NOW KNOWN TO EXIST OR HEREAFTER DISCOVERED UPON, WITHIN OR UNDERLYING SAID LAND, TOGETHER WITH THE EXCLUSIVE AND PERPETUAL RIGHT OF THE GRANTEE, ITS SUCCESSORS AND ASSIGNS, OF INGRESS AND EGRESS BENEATH THE SURFACE OF SAID LAND TO EXPLORE FOR, EXTRACT, MINE, AND REMOVE THE SAME AND TO MAKE SUCH USE OF SAID LAND BENEATH THE SURFACE AS IS NECESSARY OR USEFUL IN CONNECTION THEREWITH, WHICH USE MAY INCLUDE LATERAL OR SLANT DRILLING, DIGGING, BORING OR SINKING OF WELLS, SHAFTS, TUNNELS OR OTHER METHODS, TOGETHER WITH THE FURTHER EXCLUSIVE AND PERPETUAL RIGHT OF THE GRANTEE, ITS SUCCESSORS AND ASSIGNS, TO MAKE SUCH USE OF SAID LAND AS MAY BE NECESSARY TO STORE, KEEP, DEPOSIT, AND/OR REMOVE ALL COAL, CHEMICALS, PETROLEUM, OIL, GAS, ASPHALTUM AND OTHER HYDROCARBONS AND ALL MINERALS, METALS AND MINERAL ORES, WHETHER SIMILAR TO THOSE HEREIN SPECIFIED OR NOT, OF EVERY KIND AND CHARACTER NOW KNOWN TO EXIST OR HEREAFTER DISCOVERED, PROVIDED, HOWEVER, THAT THE GRANTEE, ITS SUCCESSORS OR ASSIGNS, SHALL NOT USE THE SURFACE OF SAID LAND ABOVE A FIVE HUNDRED FOOT DEPTH IN THE EXERCISE OF ANY OF SAID RIGHTS, AS GRANTED TO CONSOLIDATED PACIFIC INVESTMENT COMPANY BY DEED RECORDED JANUARY 29, 1959 IN BOOK 4567, PAGE 496 OF OFFICIAL RECORDS.

For conveyancing purposes only: APN 224-261-04

LEGEND:

- PROPERTY LINE
- DRAINAGE AREA BOUNDARY
- PROPOSED 6" PVC PIPE
- PR. DRAINAGE PATH
- EXISTING CONTOURS
- PROPOSED CONTOURS
- EXISTING BUILDING
- PROPOSED LANDSCAPING
- PROPOSED PAVEMENT
- PROPOSED SIDEWALK
- PAVEMENT MAINTENANCE AREA - NO SOIL DISTURBANCE
- (B101) BIORETENTION W UNDERDRAIN
- (B107) FILTERRA BIOSCAPE VAULT

SITE CONDITIONS SUMMARY:

PARCEL AREA =	22.31 ACRES
PROJECT LIMITS =	14.96 ACRES
PAVEMENT MAINTENANCE =	5.50 ACRES
PROJECT AREA=	9.46 ACRES

INFILTRATION IS INFEASIBLE (GROUNDWATER DEPTH IS LESS THAN 10-FT)

PROPOSED CONDITIONS AREA SUMMARY

END-PROJECT CONDITION	
PERVIOUS AREA =	23%
IMPERVIOUS AREA =	77%
DMA (WATER QUALITY CALC)	
AREA=	9.46 ACRES
IMPERVIOUS AREA =	7.28 ACRES
85% RAINFALL DEPTH=	0.85 INCH
DCV	21,308 CF
SWQDV (DMA-1)=	9,340 CF
SWQDV (DMA-2)=	1,390 CF
SWQDV (DMA-3)=	950 CF
SWQDV (DMA-4)=	708 CF
SWQDV (DMA-5)=	1,101 CF
SWQDV (DMA-6)=	786 CF
SWQDV (DMA-7)=	432 CF
SWQDV (DMA-8)=	6,275 CF
SWQDV (DMA-9)=	890 CF
SWQDV (DMA-10)=	450 CF
SWQDV (TOTAL)=	22,322 CF

N

GRAPHIC SCALE
25 0 12.5 25 50 100
(IN FEET)
1 inch = 50 ft.

Know what's below. Call before you dig.

RA SMITH ASSUMES NO RESPONSIBILITY FOR DAMAGES, LIABILITY OR COSTS RESULTING FROM CHANGES OR ALTERATIONS MADE TO THIS PLAN WITHOUT THE EXPRESSED WRITTEN CONSENT OF RA SMITH.

THE LOCATIONS OF EXISTING UTILITY INSTALLATIONS AS SHOWN ON THIS PLAN ARE APPROXIMATE. THERE MAY BE OTHER UNDERGROUND UTILITY INSTALLATIONS WITHIN THE PROJECT AREA THAT ARE NOT SHOWN.

ARCHITECTS ORANGE
144 North Orange Street • Orange, California 92866 • 714 639-9960
Sean
04/23/20
Consultant
raSmith
CREATIVITY BEYOND ENGINEERING
8881 Research Drive
Irvine, CA 92618-4236
(949) 872-2378
rasmith.com

PROPOSED WATER QUALITY EXHIBIT

DLX7 T.I.
6400 KATELLA AVE
CYPRESS, CALIFORNIA
90630

PROJECT: DLX7 CYPRESS CALIFORNIA
ADDRESS: 6400 KATELLA AVE, CA
FOR: GREENLAW PARTNERS 18301 VON KARMAN, STE 250 IRVINE CA 92612

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Project Number: 2019-447
Plan Check Number: PC # XXXX-XXX

DATE: 04/23/20
SCALE: AS SHOWN
JOB NO. 3190323
PROJECT MANAGER: SAMUEL J. JACOBY
DESIGNED BY: EAR
CHECKED BY: SJJ

REV 06/23/2020
REV 07/02/2020
REV 08/04/2020

WQ2

DRAW ING NAME: P:\2019\3190323\Dwg\Sheets\3190323-WQ1.dwg, WQ2 PROPOSED WATER QUALITY EXHIBIT, 8/5/2020 2:42:54 PM, rjy
O:\3190323\Dwg\Sheets\3190323-WQ1.dwg

Attachment 2:Maintenance Agreement and Funding Mechanism Documentation

Recording Requested by:
City of Cypress
Engineering Division

When Recorded Mail to:
CITY OF CYPRESS
ATTN: ENGINEERING DIVISION
PO BOX 609
CYPRESS, CA 90630

THIS SPACE IS FOR RECORDER'S USE

The undersigned grantor declares that this transaction is exempt for the payment of a documentary transfer tax pursuant to Revenue and Taxation Code section 11922.

This document is being recorded for the benefit of the City of Cypress and is exempt from payment of a recordation fee pursuant to Government Code Section 27383.

COVENANT AND AGREEMENT REGARDING OPERATIONS AND MAINTENANCE PLAN TO FUND AND MAINTAIN WATER QUALITY BMPS, CONSENT TO INSPECT, AND INDEMNIFICATION

This Agreement Regarding Operations and Maintenance Plan to Fund and Maintain Water Quality BMPs, Consent to Inspect and Indemnification and Covenant Running With the Land ("Agreement") is made on this ___ day of _____, 2020, by and between The City of Cypress, a California municipal corporation ("Covenantee" or "City") and the undersigned property owner(s) ("Covenanter").

RECITALS

A. Covenanter is the owner of the following real property ("Property") at _____ _____. [Provide address, legal description and APN number].

B. The City is the owner of interests in that certain real property within the city of Cypress, County of Orange, State of California, containing storm drains, pipelines, and related appurtenances constituting the City's municipal separate storm sewer system (the City's "Storm Drain System").

C. Covenanter intends to develop, improve, and/or use the Property in such a way that approval of the City for such development, improvement, and/or use is required pursuant to applicable laws.

D. As a condition for said approval by the City, City required Covenanter, and Covenanter desires to, restrict the use of property according to the conditions, covenants, equitable servitudes, and restrictions contained herein for the express benefit of the City's Storm Drain System.

NOW, THEREFORE, incorporating the foregoing Recitals and in consideration thereof, in consideration of the covenants and conditions contained herein, and for other good and valuable consideration, the receipt and sufficiency of which is hereby acknowledged, and expressly for the benefit of, and to bind, their successors in interest, the parties hereto agree as follows:

AGREEMENT

1. Operations and Maintenance ("O&M") Plan for Best Management Practices ("BMPs")

Covenanter, and each successive owner of an interest in all or any part of the Property ("Owner(s)") shall, throughout the period of their respective ownership, implement, and fund implementation of, the O&M Plan for the Property, which was approved by the City as part of the Water Quality Management Plan ("WQMP") required for development of the Property, and shall operate and maintain the BMPs described in the O&M Plan for the Property, which includes:

a. Description of all post-construction BMPs (non-structural and structural),
b. Description of the Property owner's(s') responsibilities and required training of persons performing BMP implementation, operation and maintenance,
c. Implementation frequency and operating schedule,
d. Inspection/Maintenance frequency and schedule,
e. Specific maintenance activities,
f. Required permits from resource agencies, if any,
g. Forms to be used in documenting implementation, operation and maintenance activities,
h. Recordkeeping requirements.

A copy of the approved O&M Plan is described in the current WQMP for the project, as it may be amended from time to time according to its terms, which is on file with the City of Cypress Engineering department, and is incorporated herein by reference.

2. Compliance with Cypress City Code and Consent to Inspect

Owners shall use and maintain the property in full compliance with the provisions of the O&M Plan and the Cypress City Code section 13.21 et seq., as it may be amended from time to time. Owners hereby consent to inspection of the Property by an inspector authorized by the City Manager, or his or her designee, for the purpose for verifying compliance with the provisions of this Agreement.

3. Indemnification

Owners agree to indemnify, defend, and hold harmless the City, its elected officers, employees, agents, and contractors from and against any and all liability, expense, including costs and legal fees, and claims of damage of any nature whatsoever including, but not limited to, death, bodily injury, personal injury, or property damage arising from or connected with the City inspection of the Property expect where such liability, expense, or claim for damage results from the sole negligence or willful misconduct of the City.

4. Rights and Obligations Run with the Land

Unless terminated in accordance with paragraph 5 below, or by law, the rights and obligations of the parties hereunder shall constitute covenants, benefits, burdens, conditions, equitable servitudes, and restrictions which run with the land in perpetuity and which shall be binding upon, and inure to the benefit of, each Owner during its respective period of ownership of all or any part of the Property. No Owner shall be bound by, or entitled to the benefit of, said rights and obligations, upon transfer by the Owner of its entire interest in the Property, in fee, to a successor in interest to the Property.

5. Termination of Agreement Upon Termination of WQMP

This Agreement and the conditions, covenants, equitable servitudes, and restrictions set forth herein shall terminate upon termination of the WQMP applicable to the Property in accordance with its terms. Upon termination of the WQMP applicable to the Property, the Owner may request that the City execute a

recordable document approved by the City approving and acknowledging termination of this agreement. A recorded document duly executed and acknowledged by the Director of Public Works of City, or his or her Designee, approving termination of this Agreement shall be conclusive evidence of such termination.

6. Enforcement

The City may, but shall not be obligated to, enforce this Agreement by a proceeding at law or in equity against any person or persons violating or attempting to violate any condition, covenant, equitable servitude, or restriction provided for herein, either to restrain such violation or to recover damages.

7. Entire Agreement

This Agreement constitutes the entire agreement and understanding between the parties with respect of the subject matter of this Agreement and supersedes all prior or contemporaneous agreements and understandings with respect to the subject matter hereof, whether oral or written.

8. Severability

If any part of this Agreement is declared by a final decision of a court of competent jurisdiction to be invalid for any reason, such shall not affect the validity of the rest of the Agreement. The other parts of this Agreement shall remain in effect as if this agreement had been executed without the invalid party. The partied declare that they intend and desire that the remaining parts of tis Agreement continue to be effective without any part or parts that have been declared invalid.

9. Counterparts

This Agreement may be executed in counterparts, each of which so executed shall, irrespective of the date of tits execution and delivery, be deemed an original, and all such counterparts together shall constitute one and the same instrument.

10. Attorneys' Fees

If any party files an action or brings any proceeding against the other arising from this Agreement, the prevailing party shall be entitled to recover as an element of its costs of suit, and not as damages, reasonable attorneys' fees and costs to be fixed by the court. A party not entitled to recover its costs shall not recover attorneys' fees. No sum for attorneys' fees shall be included in calculating the amount of a judgment for purposes of deciding whether a part is entitled to its costs or attorneys' fees.

11. Amendment

No modification, amendment, addition to, alteration of the terms of this Agreement whether written or verbal, shall be valid unless made in writing, formally approved and executed by the City and the current Owner(s) of the Property, and duly recorded.

12. Authority of Signatories to Agreement

Each person executing this Agreement represents and warrants that he or she is duly authorized and has legal capacity to execute and deliver this Agreement on behalf of the parties for which execution is made. Each party represents and warrants to the other that the execution of this Agreement and the performance of such party's obligations hereunder have been duly authorized and that the agreement is valid and legal agreement binding on such party and enforceable in accordance with its terms.

[SIGNATURES OF FOLLOWING PAGE]

IN WITNESS WHEREOF, the parties hereto have executed this agreement as of the date set forth above.

"CITY"/"COVENANTEE"
CITY OF CYPRESS

_____
Douglas C. Dancs, P.E.
Director of Community Development

ATTEST:

_____
Alisha Farnell
City Clerk

APPROVED AS TO FORM:

_____
Anthony Taylor
City Attorney

"COVENANTER"

_____
Name of Covenanter

_____
Signature

_____
Title

_____
Signature

_____
Title

[Signatures must be Notarized]

Attachment 3:Training Log Form

TRAINING / EDUCATIONAL LOG

Date of Training/Educational Activity: _____

Name of Person Performing Activity (Printed): _____

Signature: _____

Topic of Training/Educational Activity:

_____

_____

Name of Participant	Signature of Participant

For newsletter or mailer educational activities, please include the following information:

- Date of mailing:
- Number distributed:
- Method of distribution:
- Topics addressed:

If a newsletter article was distributed, please include a copy of it.

Attachment 4: Inspection and Maintenance Log Form

BMP OPERATION & MAINTENANCE LOG

6400 KATELLA AVE.

Today's Date: _____

Name of Person Performing Activity (Printed): _____

Signature: _____

BMP Name or Type (As Shown in O&M Plan)	Brief Description of Operation, Maintenance, or Inspection Activity Performed	Summary of Notable Observations or Outcomes from Activity

[add additional pages, photographs, drawings, notes as needed]

Attachment 5: Inspection and O&M Checklist (Optional)

Weekly Activities	**Check Box**
Selected source control/housekeeping activities (See Section 3.1)	
Monthly Activities	
Selected source control/housekeeping activities (See Section 3.1)	
Quarterly Activities (before wet season, after wet season, plus twice after rain > 0.5 inches)	
Inspections of selected source control BMPs (See Section 3.1)	
Inspections and as-needed minor maintenance of all structural treatment and hydromodification BMPs (See Section 3.3)	
Twice Yearly Activities (during dry weather)	
Dry weather flow inspections (non-structural source control) (See Section 3.1)	
Inspection and as-needed maintenance of other selected source control BMPs(See Section 3.1)	
Annual Activities	
Self-certification (See Section 2.6)	
Various source control BMP and housekeeping activities (See Section 3.1)	
Inspection and maintenance of HSCs (See Section 3.2)	
Various planned maintenance activities of treatment and hydromodification BMPs, such as vegetation maintenance, minor sediment maintenance, etc. (See Section 3.3)	

Attachment 6: Vendor O&M Information

Filterra Owner's Manual



filterra®

Bioretention Systems

CONTECH®
ENGINEERED SOLUTIONS

filterra®
Bioretention Systems

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Enclosed

Local Area Filterra Plant List

CONTECH®
ENGINEERED SOLUTIONS

Introduction

Thank you for your purchase of the Filterra® Bioretention System. Filterra is a specially engineered stormwater treatment system incorporating high performance biofiltration media to remove pollutants from stormwater runoff. The system's biota (vegetation and soil microorganisms) then further breakdown and absorb captured pollutants. All components of the system work together to provide a sustainable long-term solution for treating stormwater runoff.

The Filterra system has been delivered to you with protection in place to resist intrusion of construction related sediment which can contaminate the biofiltration media and result in inadequate system performance. These protection devices are intended as a best practice and cannot fully prevent contamination. It is the purchaser's responsibility to provide adequate measures to prevent construction related runoff from entering the Filterra system.

Included with your purchase is Activation of the Filterra system by the manufacturer as well as a 1-year warranty from delivery of the system and 1-year of routine maintenance (mulch replacement, debris removal, and pruning of vegetation) up to twice during the first year after activation.

Design and Installation

Each project presents different scopes for the use of Filterra systems. Information and help may be provided to the design engineer during the planning process. Correct Filterra box sizing (by rainfall region) is essential to predict pollutant removal rates for a given area. The engineer shall submit calculations for approval by the local jurisdiction. The contractor is responsible for the correct installation of Filterra units as shown in approved plans. A comprehensive installation manual is available at www.ContechES.com.

Activation Overview

Activation of the Filterra system is a procedure completed by the manufacturer to place the system into working condition. This involves the following items:

- Removal of construction runoff protection devices
- Planting of the system's vegetation
- Placement of pretreatment mulch layer using mulch certified for use in Filterra systems.

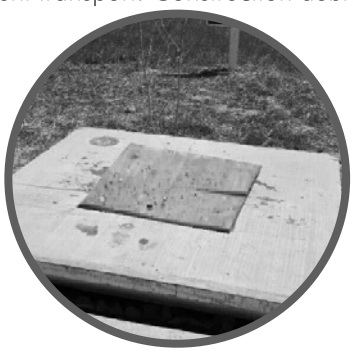
Activation MUST be provided by the manufacturer to ensure proper site conditions are met for Activation, proper installation of the vegetation, and use of pretreatment mulch certified for use in Filterra systems.



Minimum Requirements

The minimum requirements for Filterra Activation are as follows:

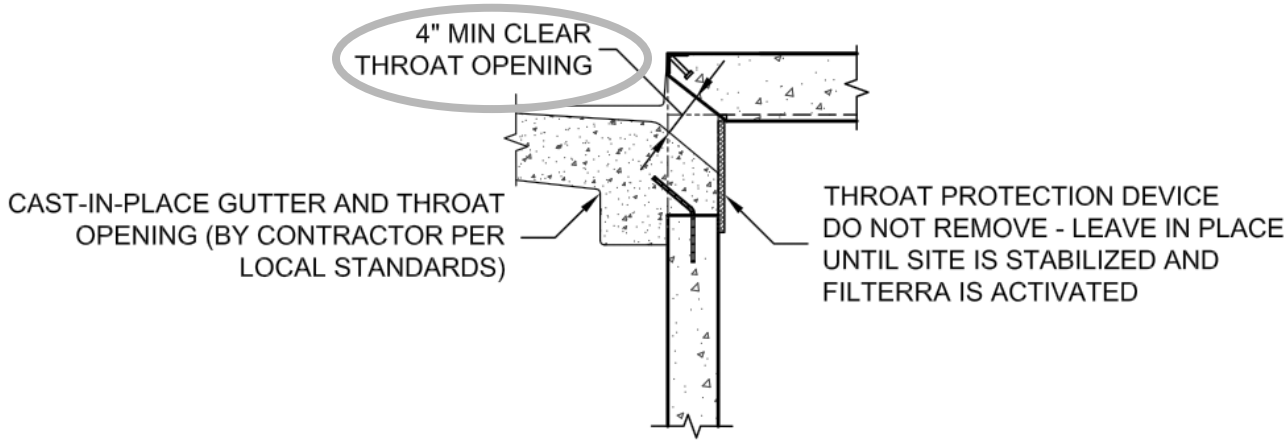
1. The site landscaping must be fully stabilized, i.e. full landscaping installed and some grass cover (not just straw and seed) is required to reduce sediment transport. Construction debris and materials should be removed from surrounding area.




2. Final paving must be completed. Final paving ensures that paving materials will not enter and contaminate the Filterra system during the paving process, and that the plant will receive runoff from the drainage area, assisting with plant survival for the Filterra system.




3. Filterra throat opening should be at least 4" in order to ensure adequate capacity for inflow and debris.



An Activation Checklist is included on page 12 to ensure proper conditions are met for Contech to perform the Activation services. A charge of $500.00 will be invoiced for each Activation visit requested by Customer where Contech determines that the site does not meet the conditions required for Activation.

Filterra Plant Selection Overview

A Plant List has been enclosed with this packet highlighting recommended plants for Filterra systems in your area. Keep in mind that plants are subject to availability due to seasonality and required minimum size for the Filterra system. Plants installed in the Filterra system are container plants (max 15 gallon) from nursery stock and will be immature in height and spread at Activation.

It is the responsibility of the owner to provide adequate irrigation when necessary to the plant of the Filterra system.

The "Planting Requirements for Filterra Systems" document is included as an appendix and discusses proper selection and care of the plants within Filterra systems.

Warranty Overview

Refer to the Contech Engineered Solutions LLC Stormwater Treatment System LIMITED WARRANTY for further information. The following conditions may void the Filterra system's warranty and waive the manufacturer provided Activation and Maintenance services:

- Unauthorized activation or performance of any of the items listed in the activation overview
- Any tampering, modifications or damage to the Filterra system or runoff protection devices
- Removal of any Filterra system components
- Failure to prevent construction related runoff from entering the Filterra system
- Failure to properly store and protect any Filterra components (including media and underdrain stone) that may be shipped separately from the vault

Routine Maintenance Guidelines

With proper routine maintenance, the biofiltration media within the Filterra system should last as long as traditional bioretention media. Routine maintenance is included by the manufacturer on all Filterra systems for the first year after activation. This includes a maximum of 2 visits to remove debris, replace pretreatment mulch, and prune the vegetation. More information is provided in the Operations and Maintenance Guidelines. Some Filterra systems also contain pretreatment or outlet bays. Depending on site pollutant loading, these bays may require periodic removal of debris, however this is not included in the first year of maintenance, and would likely not be required within the first year of operation.

These services, as well as routine maintenance outside of the included first year, can be provided by certified maintenance providers listed on the Contech website. Training can also be provided to other stormwater maintenance or landscape providers.



Why Maintain?

All stormwater treatment systems require maintenance for effective operation. This necessity is often incorporated in your property's permitting process as a legally binding BMP maintenance agreement. Other reasons to maintain are:

- Avoiding legal challenges from your jurisdiction's maintenance enforcement program.
- Prolonging the expected lifespan of your Filterra media.
- Avoiding more costly media replacement.
- Helping reduce pollutant loads leaving your property.

Simple maintenance of the Filterra is required to continue effective pollutant removal from stormwater runoff before discharge into downstream waters. This procedure will also extend the longevity of the living biofilter system. The unit will recycle and accumulate pollutants within the biomass, but is also subjected to other materials entering the inlet. This may include trash, silt and leaves etc. which will be contained above the mulch layer. Too much silt may inhibit the Filterra's flow rate, which is the reason for site stabilization before activation. Regular replacement of the mulch stops accumulation of such sediment.

When to Maintain?

Contech includes a 1-year maintenance plan with each system purchase. Annual included maintenance consists of a maximum of two (2) scheduled visits. Additional maintenance may be necessary depending on sediment and trash loading (by Owner or at additional cost). The start of the maintenance plan begins when the system is activated.

Maintenance visits are scheduled seasonally; the spring visit aims to clean up after winter loads including salts and sands while the fall visit helps the system by removing excessive leaf litter.

It has been found that in regions which receive between 30-50 inches of annual rainfall, (2) two visits are generally required; regions with less rainfall often only require (1) one visit per annum. Varying land uses can affect maintenance frequency; e.g. some fast food restaurants require more frequent trash removal. Contributing drainage areas which are subject to new development wherein the recommended erosion and sediment control measures have not been implemented may require additional maintenance visits.

Some sites may be subjected to extreme sediment or trash loads, requiring more frequent maintenance visits. This is the reason for detailed notes of maintenance actions per unit, helping the Supplier and Owner predict future maintenance frequencies, reflecting individual site conditions.

Owners must promptly notify the (maintenance) Supplier of any damage to the plant(s), which constitute(s) an integral part of the bioretention technology. Owners should also advise other landscape or maintenance contractors to leave all maintenance to the Supplier (i.e. no pruning or fertilizing) during the first year.



Exclusion of Services

Clean up due to major contamination such as oils, chemicals, toxic spills, etc. will result in additional costs and are not covered under the Supplier maintenance contract. Should a major contamination event occur the Owner must block off the outlet pipe of the Filterra (where the cleaned runoff drains to, such as drop inlet) and block off the throat of the Filterra. The Supplier should be informed immediately.

Maintenance Visit Summary

Each maintenance visit consists of the following simple tasks (detailed instructions below).

1. Inspection of Filterra and surrounding area
2. Removal of tree grate and erosion control stones
3. Removal of debris, trash and mulch
4. Mulch replacement
5. Plant health evaluation and pruning or replacement as necessary
6. Clean area around Filterra
7. Complete paperwork

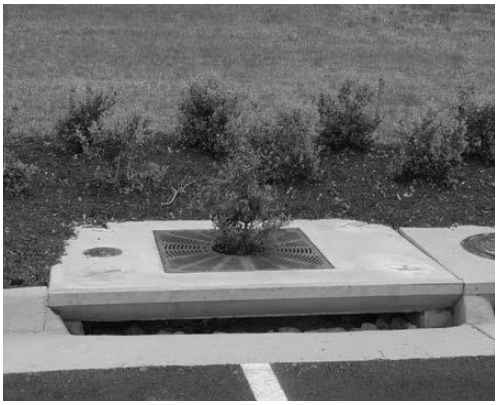
Maintenance Tools, Safety Equipment and Supplies

Ideal tools include: camera, bucket, shovel, broom, pruners, hoe/rake, and tape measure. Appropriate Personal Protective Equipment (PPE) should be used in accordance with local or company procedures. This may include impervious gloves where the type of trash is unknown, high visibility clothing and barricades when working in close proximity to traffic and also safety hats and shoes. A T-Bar or crowbar should be used for moving the tree grates (up to 170 lbs ea.). Most visits require minor trash removal and a full replacement of mulch. See below for actual number of bagged mulch that is required in each media bay size. Mulch should be a double shredded, hardwood variety. Some visits may require additional Filterra engineered soil media available from the Supplier.

Box Length	Box Width	Filter Surface Area (ft^2)	Volume at 3" (ft^3)	# of 2 ft^3 Mulch Bags
4	4	16	4	2
6	4	24	6	3
8	4	32	8	4
6	6	36	9	5
8	6	48	12	6
10	6	60	15	8
12	6	72	18	9
13	7	91	23	12

Maintenance Visit Procedure

Keep sufficient documentation of maintenance actions to predict location specific maintenance frequencies and needs. An example Maintenance Report is included in this manual.



1. Inspection of Filterra and surrounding area

- Record individual unit before maintenance with photograph (numbered). Record on Maintenance Report (see example in this document) the following:

Record on Maintenance Report the following:

Standing Water	yes | no
Damage to Box Structure	yes | no
Damage to Grate	yes | no
Is Bypass Clear	yes | no

If yes answered to any of these observations, record with close-up photograph (numbered).



2. Removal of tree grate and erosion control stones

- Remove cast iron grates for access into Filterra box.
- Dig out silt (if any) and mulch and remove trash & foreign items.

3. Removal of debris, trash and mulch

Record on Maintenance Report the following:

Silt/Clay	yes | no
Cups/ Bags	yes | no
Leaves	yes | no
Buckets Removed	_____



- After removal of mulch and debris, measure distance from the top of the Filterra engineered media soil to the top of the top slab. Compare the measured distance to the distance shown on the approved Contract Drawings for the system. Add Filterra media (not top soil or other) to bring media up as needed to distance indicated on drawings.

Record on Maintenance Report the following:

Distance to Top of Top Slab (inches)	_____
Inches of Media Added	_____



4. Mulch replacement

- Add double shredded mulch evenly across the entire unit to a depth of 3".
- Refer to Filterra Mulch Specifications for information on acceptable sources.
- Ensure correct repositioning of erosion control stones by the Filterra inlet to allow for entry of trash during a storm event.
- Replace Filterra grates correctly using appropriate lifting or moving tools, taking care not to damage the plant.



5. Plant health evaluation and pruning or replacement as necessary

- Examine the plant's health and replace if necessary.
- Prune as necessary to encourage growth in the correct directions

Record on Maintenance Report the following:

Height above Grate	_____ (ft)
Width at Widest Point	_____ (ft)
Health	healthy | unhealthy
Damage to Plant	yes | no
Plant Replaced	yes | no



6. Clean area around Filterra

- Clean area around unit and remove all refuse to be disposed of appropriately.



7. Complete paperwork

- Deliver Maintenance Report and photographs to appropriate location (normally Contech during maintenance contract period).
- Some jurisdictions may require submission of maintenance reports in accordance with approvals. It is the responsibility of the Owner to comply with local regulations.

Maintenance Checklist

Drainage System Failure	Problem	Conditions to Check	Condition that Should Exist	Actions
Inlet	Excessive sediment or trash accumulation.	Accumulated sediments or trash impair free flow of water into Filterra.	Inlet should be free of obstructions allowing free distributed flow of water into Filterra.	Sediments and/or trash should be removed.
Mulch Cover	Trash and floatable debris accumulation.	Excessive trash and/or debris accumulation.	Minimal trash or other debris on mulch cover.	Trash and debris should be removed and mulch cover raked level. Ensure bark nugget mulch is not used.
Mulch Cover	"Ponding" of water on mulch cover.	"Ponding" in unit could be indicative of clogging due to excessive fine sediment accumulation or spill of petroleum oils.	Stormwater should drain freely and evenly through mulch cover.	Recommend contact manufacturer and replace mulch as a minimum.
Vegetation	Plants not growing or in poor condition.	Soil/mulch too wet, evidence of spill. Incorrect plant selection. Pest infestation. Vandalism to plants.	Plants should be healthy and pest free.	Contact manufacturer for advice.
Vegetation	Plant growth excessive.	Plants should be appropriate to the species and location of Filterra.		Trim/prune plants in accordance with typical landscaping and safety needs.
Structure	Structure has visible cracks.	Cracks wider than 1/2 inch or evidence of soil particles entering the structure through the cracks.		Vault should be repaired.
Maintenance is ideally to be performed twice annually.				

Filterra Inspection & Maintenance Log

Filterra System Size/Model:_____**Location:** _____

Date	Mulch & Debris Removed	Depth of Mulch Added	Mulch Brand	Height of Vegetation Above Grate	Vegetation Species	Issues with System	Comments
1/1/17	*5 – 5 gal Buckets*	*3″*	*Lowe's Premium Brown Mulch*	*4′*	*Galaxy Magnolia*	*- Standing water in downstream structure*	*- Removed blockage in downstream structure*

Appendix 1 – Filterra® Activation Checklist

CONTECH® ENGINEERED SOLUTIONS

Project Name: _____ Company: _____

Site Contact Name: _____ Site Contact Phone/Email: _____

Site Owner/End User Name: _____ Site Owner/End User Phone/Email: _____

Preferred Activation Date: _____ (provide 2 weeks minimum from date this form is submitted)

Site Designation	System Size	Final Pavement / Top Coat Complete	Landscaping Complete / Grass Emerging	Construction materials / Piles / Debris Removed	Throat Opening Measures 4" Min. Height	Plant Species Requested
		☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
		☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
		☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
		☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
		☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
		☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
		☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
		☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
		☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
		☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	

Attach additional sheets as necessary.

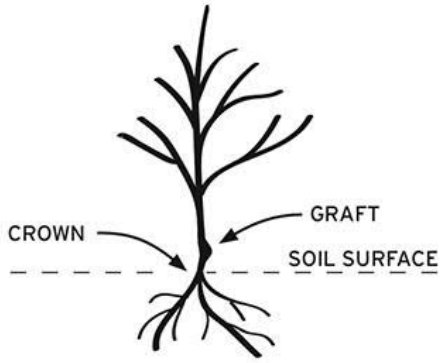
NOTE: A charge of $500.00 will be invoiced for each Activation visit requested by Customer where Contech determines that the site does not meet the conditions required for Activation. ONLY Contech authorized representatives can perform Activation of Filterra systems; unauthorized Activations will void the system warranty and waive manufacturer supplied Activation and 1st Year Maintenance.

_____ _____

Signature Date

Appendix 2 – Planting Requirements for Filterra® Systems

Plant Material Selection



- Select plant(s) as specified in the engineering plans and specifications.
- Select plant(s) with full root development but not to the point where root bound.
- Use local nursery container plants only. Ball and burlapped plants are not permitted.
- For precast Filterra systems with a tree grate, plant(s) must not have scaffold limbs at least 14 inches from the crown due to spacing between the top of the mulch and the tree grate. Lower branches can be pruned away provided there are sufficient scaffold branches for tree or shrub development.
- For precast Filterra systems with a tree grate, at the time of installation, it is required that plant(s) must be at least 6" above the tree grate opening at installation for all Filterra configurations. This DOES NOT apply to Full Grate Cover designs.
- Plant(s) shall not have a mature height greater than 25 feet.
- For standard 21" media depth, a 7 – 15 gallon container size shall be used. Media less than 21" (Filterra boxes only) will require smaller container plants.
- For precast Filterra systems, plant(s) should have a single trunk at installation, and pruning may be necessary at activation and maintenance for some of the faster growing species, or species known to produce basal sprouts.

Plant Installation

- During transport protect the plant leaves from wind and excessive jostling.
- Prior to removing the plant(s) from the container, ensure the soil moisture is sufficient to maintain the integrity of the root ball. If needed, pre-wet the container plant.
- Cut away any roots which are growing out of the container drain holes. Plants with excessive root growth from the drain holes should be rejected.
- Plant(s) should be carefully removed from the pot by gently pounding on the sides of the container with the fist to loosen root ball. Then carefully slide out. Do not lift plant(s) by trunk as this can break roots and cause soil to fall off. Extract the root ball in a horizontal position and support it to prevent it from breaking apart. Alternatively the pot can be cut away to minimize root ball disturbance.
- Remove any excess soil from above the root flare after removing plant(s) from container.
- Excavate a hole with a diameter 4" greater than the root ball, gently place the plant(s).
- If plant(s) have any circling roots from being pot bound, gently tease them loose without breaking them.
- If root ball has a root mat on the bottom, it should be shaved off with a knife just above the mat line.
- Plant the tree/shrub/grass with the top of the root ball 1" above surrounding media to allow for settling.
- All plants should have the main stem centered in the tree grate (where applicable) upon completion of installation.
- With all trees/shrubs, remove dead, diseased, crossed/rubbing, sharply crotched branches or branches growing excessively long or in wrong direction compared to majority of branches.
- To prevent transplant shock (especially if planting takes place in the hot season), it may be necessary to prune some of the foliage to compensate for reduced root uptake capacity. This is accomplished by pruning away some of the smaller secondary branches or a main scaffold branch if there are too many. Too much foliage relative to the root ball can dehydrate and damage the plant.
- Plant staking may be required.

Mulch Installation

- Only mulch that has been meeting Contech Engineered Solutions' mulch specifications can be used in the Filterra system.
- Mulch must be applied to a depth of 3" evenly over the surface of the media.

Irrigation Requirements

- Each Filterra system must receive adequate irrigation to ensure survival of the living system during periods of drier weather.
- Irrigation sources include rainfall runoff from downspouts and/or gutter flow, applied water through the tree grate or in some cases from an irrigation system with emitters installed during construction.
- At Activation: Apply about one (cool climates) to two (warm climates) gallons of water per inch of trunk diameter over the root ball.
- During Establishment: In common with all plants, each Filterra plant will require more frequent watering during the establishment period. One inch of applied water per week for the first three months is recommended for cooler climates (2 to 3 inches for warmer climates). If the system is receiving rainfall runoff from the drainage area, then irrigation may not be needed. Inspection of the soil moisture content can be evaluated by gently brushing aside the mulch layer and feeling the soil. Be sure to replace the mulch when the assessment is complete. Irrigate as needed**.
- Established Plants: Established plants have fully developed root systems and can access the entire water column in the media. Therefore irrigation is less frequent but requires more applied water when performed. For a mature system assume 3.5 inches of available water within the media matrix. Irrigation demand can be estimated as 1" of irrigation demand per week. Therefore if dry periods exceed 3 weeks, irrigation may be required. It is also important to recognize that plants which are exposed to windy areas and reflected heat from paved surfaces may need more frequent irrigation. Long term care should develop a history which is more site specific.

** Five gallons per square yard approximates 1 inch of water Therefore for a 6' by 6' Filterra approximately 20-60 gallons of water is needed. To ensure even distribution of water it needs to be evenly sprinkled over the entire surface of the filter bed, with special attention to make sure the root ball is completely wetted. NOTE: if needed, measure the time it takes to fill a five gallon bucket to estimate the applied water flow rate then calculate the time needed to irrigate the Filterra. For example, if the flow rate of the sprinkler is 5 gallons/minute then it would take 12 minutes to irrigate a 6' by 6' filter.



Notes



CONTECH®
ENGINEERED SOLUTIONS

9025 Centre Pointe Drive, Suite 400
West Chester, OH 45069
info@conteches.com | 800-338-1122
www.ContechES.com

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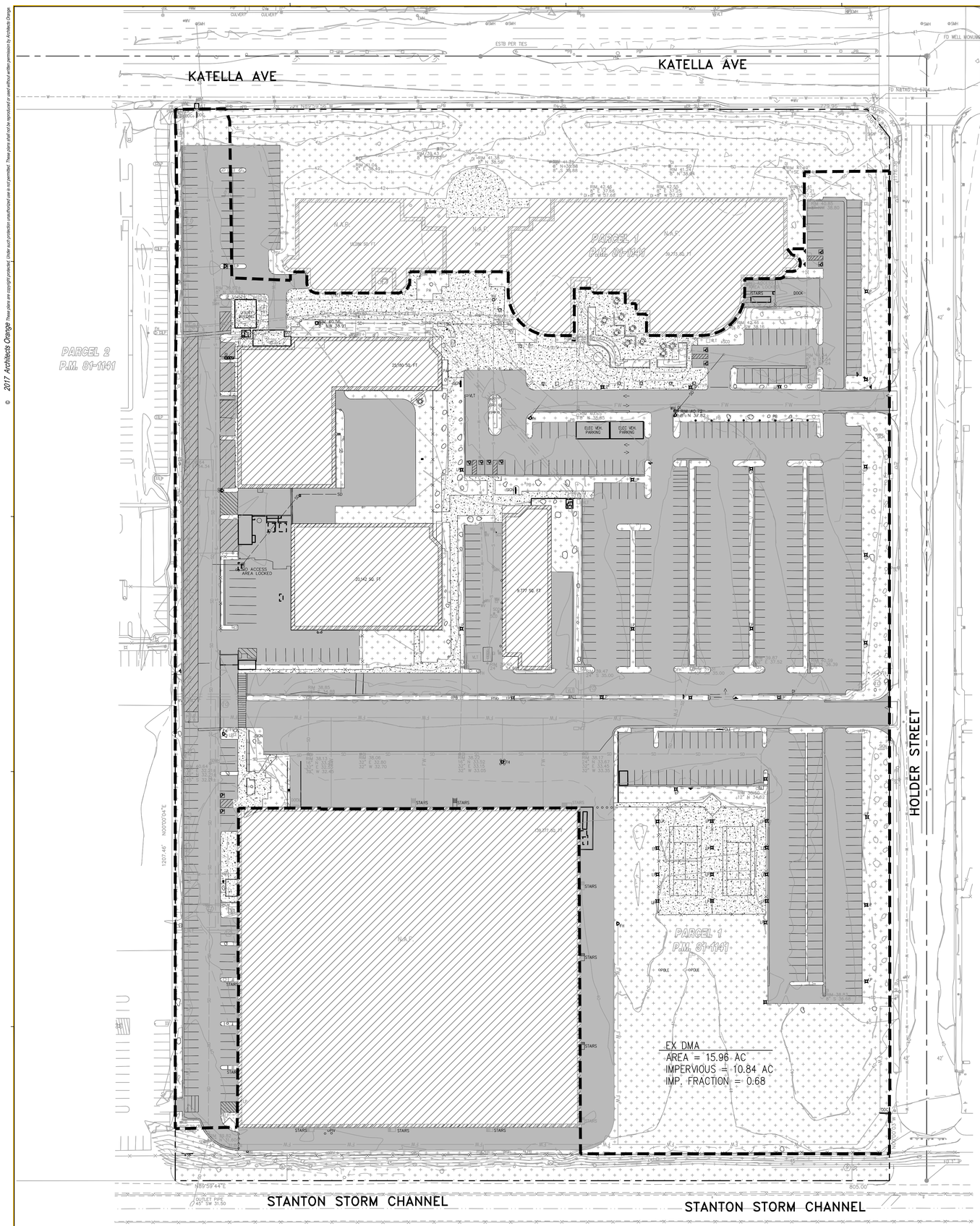
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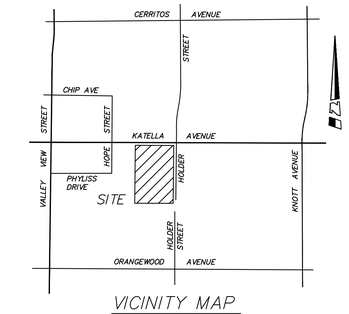
PDF 6/20

Attachment C

BMP Exhibit and Site Plan

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VICINITY MAP
NOT TO SCALE

LEGEND:

- PROPERTY LINE
- EXISTING STORM DRAIN
- EXISTING CONTOURS
- EXISTING LANDSCAPING
- EXISTING PAVEMENT
- EXISTING BUILDING
- EXISTING SIDEWALK

File No.: NCS-979526-SA1

The Land referred to herein below is situated in the City of Cypress, County of Orange, State of California, and is described as follows:

PARCEL 1 OF PARCEL MAP NO. 81-1141, IN THE CITY OF CYPRESS, COUNTY OF RANGE, STATE OF CALIFORNIA, AS PER MAP FILED IN BOOK 167, PAGES 34-36 OF PARCEL MAPS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID

ALSO EXCEPT FROM THAT PORTION OF SAID LAND NOT INCLUDED WITHIN THE LINES OF PARCEL 1 SHOWN ON PARCEL MAP FILED IN BOOK 108, PAGES 10 AND 11 OF PARCEL MAPS, ALL COAL, CHEMICAL, PETROLEUM, OIL, GAS, ASPHALTUM AND OTHER HYDROCARBONS, AND ALL MINERALS, METALS AND MINERAL ORES, WHETHER SIMILAR TO THOSE HEREIN SPECIFIED OR NOT, OF EVERY KIND AND CHARACTER NOW KNOWN TO EXIST OR HEREAFTER DISCOVERED UPON, WITHIN OR UNDERLYING SAID LAND, TOGETHER WITH THE EXCLUSIVE AND PERPETUAL RIGHT OF THE GRANTEE, ITS SUCCESSORS AND ASSIGNS, OF INGRESS AND EGRESS BENEATH THE SURFACE OF SAID LAND TO EXPLORE FOR, EXTRACT, MINE, AND REMOVE THE SAME AND TO MAKE SUCH USE OF SAID LAND BENEATH THE SURFACE AS IS NECESSARY OR USEFUL IN CONNECTION THEREWITH, WHICH USE MAY INCLUDE LATERAL OR SLANT DRILLING, DIGGING, BORING OR SINKING OF WELLS, SHAFTS, TUNNELS OR OTHER METHODS, TOGETHER WITH THE FURTHER EXCLUSIVE AND PERPETUAL RIGHT OF THE GRANTEE, ITS SUCCESSORS AND ASSIGNS, TO MAKE SUCH USE OF SAID LAND AS MAY BE NECESSARY TO STORE, KEEP, DEPOSIT, AND/OR REMOVE ALL COAL, CHEMICALS, PETROLEUM, OIL, GAS, ASPHALTUM AND OTHER HYDROCARBONS AND ALL MINERALS, METALS AND MINERAL ORES, WHETHER SIMILAR TO THOSE HEREIN SPECIFIED OR NOT, OF EVERY KIND AND CHARACTER NOW KNOWN TO EXIST OR HEREAFTER DISCOVERED, PROVIDED, HOWEVER, THAT THE GRANTEE, ITS SUCCESSORS OR ASSIGNS, SHALL NOT USE THE SURFACE OF SAID LAND ABOVE A FIVE HUNDRED FOOT DEPTH IN THE EXERCISE OF ANY OF SAID RIGHTS, AS GRANTED TO CONSOLIDATED PACIFIC INVESTMENT COMPANY BY DEED RECORDED JANUARY 29, 1959 IN BOOK 4567, PAGE 496 OF OFFICIAL RECORDS.

For conveyancing purposes only: APN 224-261-04

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R.A. Smith, Inc.

DATE: 04/23/20
SCALE: AS SHOWN
JOB NO. 3190323
PROJECT MANAGER: SAMUEL J. JACOBY
DESIGNED BY: EAR
CHECKED BY: SJJ

N

GRAPHIC SCALE
25 0 12.5 25 50 100
(IN FEET)
1 inch = 50 ft.

811 Know what's below. Call before you dig.

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ARCHITECTS ORANGE
144 North Orange Street • Orange, California 92866 • 714 639-9960

Sheet

04/23/20

Consultant

raSmith
CREATIVITY BEYOND ENGINEERING
8881 Research Drive
Irvine, CA 92618-4236
(949) 872-2378
rasmith.com

DLX7 T.I.

6400 KATELLA AVE
CYPRESS, CALIFORNIA
90630

EXISTING WATER QUALITY EXHIBIT

PROJECT: DLX7 CYPRESS CALIFORNIA
ADDRESS: 6400 KATELLA AVE, CA
FOR: GREENLAW PARTNERS 18301 VON KARMAN, STE 250 IRVINE CA 92612

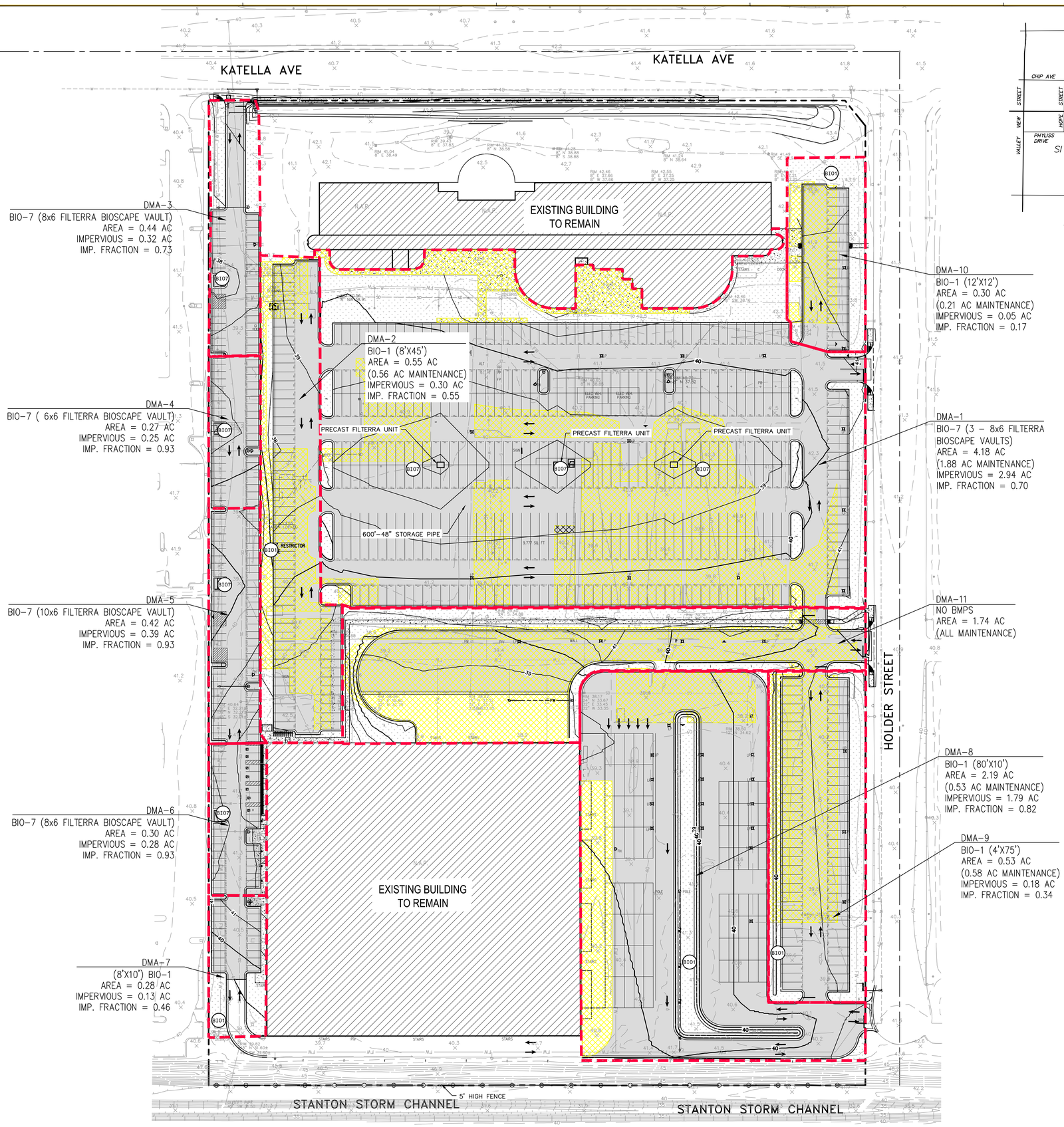
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Plan Check Number: PC # XXXX/XXX

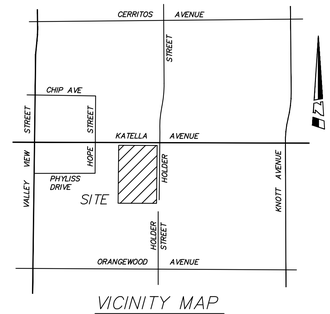
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REV 08/04/2020

WQ1

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VICINITY MAP
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File No.: NCS-979526-SA1

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ALSO EXCEPT FROM THAT PORTION OF SAID LAND NOT INCLUDED WITHIN THE LINES OF PARCEL 1 SHOWN ON PARCEL MAP FILED IN BOOK 108, PAGES 10 AND 11 OF PARCEL MAPS, ALL COAL, CHEMICAL, PETROLEUM, OIL, GAS, ASPHALTUM AND OTHER HYDROCARBONS, AND ALL MINERALS, METALS AND MINERAL ORES, WHETHER SIMILAR TO THOSE HEREIN SPECIFIED OR NOT, OF EVERY KIND AND CHARACTER NOW KNOWN TO EXIST OR HEREAFTER DISCOVERED UPON, WITHIN OR UNDERLYING SAID LAND, TOGETHER WITH THE EXCLUSIVE AND PERPETUAL RIGHT OF THE GRANTEE, ITS SUCCESSORS AND ASSIGNS, OF INGRESS AND EGRESS BENEATH THE SURFACE OF SAID LAND TO EXPLORE FOR, EXTRACT, MINE, AND REMOVE THE SAME AND TO MAKE SUCH USE OF SAID LAND BENEATH THE SURFACE AS IS NECESSARY OR USEFUL IN CONNECTION THEREWITH, WHICH USE MAY INCLUDE LATERAL OR SLANT DRILLING, DIGGING, BORING OR SINKING OF WELLS, SHAFTS, TUNNELS OR OTHER METHODS, TOGETHER WITH THE FURTHER EXCLUSIVE AND PERPETUAL RIGHT OF THE GRANTEE, ITS SUCCESSORS AND ASSIGNS, TO MAKE SUCH USE OF SAID LAND AS MAY BE NECESSARY TO STORE, KEEP, DEPOSIT, AND/OR REMOVE ALL COAL, CHEMICALS, PETROLEUM, OIL, GAS, ASPHALTUM AND OTHER HYDROCARBONS AND ALL MINERALS, METALS AND MINERAL ORES, WHETHER SIMILAR TO THOSE HEREIN SPECIFIED OR NOT, OF EVERY KIND AND CHARACTER NOW KNOWN TO EXIST OR HEREAFTER DISCOVERED, PROVIDED, HOWEVER, THAT THE GRANTEE, ITS SUCCESSORS OR ASSIGNS, SHALL NOT USE THE SURFACE OF SAID LAND ABOVE A FIVE HUNDRED FOOT DEPTH IN THE EXERCISE OF ANY OF SAID RIGHTS, AS GRANTED TO CONSOLIDATED PACIFIC INVESTMENT COMPANY BY DEED RECORDED JANUARY 29, 1959 IN BOOK 4567, PAGE 496 OF OFFICIAL RECORDS.

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LEGEND:

- PROPERTY LINE
- DRAINAGE AREA BOUNDARY
- PROPOSED 6" PVC PIPE
- PR. DRAINAGE PATH
- EXISTING CONTOURS
- PROPOSED CONTOURS
- EXISTING BUILDING
- PROPOSED LANDSCAPING
- PROPOSED PAVEMENT
- PROPOSED SIDEWALK
- PAVEMENT MAINTENANCE AREA - NO SOIL DISTURBANCE
- (B101) BIORETENTION W UNDERDRAIN
- (B107) FILTERRA BIOSCAPE VAULT

SITE CONDITIONS SUMMARY:

PARCEL AREA =	22.31 ACRES
PROJECT LIMITS =	14.96 ACRES
PAVEMENT MAINTENANCE =	5.50 ACRES
PROJECT AREA=	9.46 ACRES

INFILTRATION IS INFEASIBLE (GROUNDWATER DEPTH IS LESS THAN 10-FT)

PROPOSED CONDITIONS AREA SUMMARY

END-PROJECT CONDITION	
PERVIOUS AREA =	23%
IMPERVIOUS AREA =	77%
DMA (WATER QUALITY CALC)	
AREA=	9.46 ACRES
IMPERVIOUS AREA =	7.28 ACRES
85% RAINFALL DEPTH=	0.85 INCH
DCV	21,308 CF
SWQDV (DMA-1)=	9,340 CF
SWQDV (DMA-2)=	1,390 CF
SWQDV (DMA-3)=	950 CF
SWQDV (DMA-4)=	708 CF
SWQDV (DMA-5)=	1,101 CF
SWQDV (DMA-6)=	786 CF
SWQDV (DMA-7)=	432 CF
SWQDV (DMA-8)=	6,275 CF
SWQDV (DMA-9)=	890 CF
SWQDV (DMA-10)=	450 CF
SWQDV (TOTAL)=	22,322 CF

N

GRAPHIC SCALE
25 0 12.5 25 50 100
(IN FEET)
1 inch = 50 ft.

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144 North Orange Street • Orange, California 92866 • 714 639-9960
Sean
04/23/20
Consultant
raSmith
CREATIVITY BEYOND ENGINEERING
8881 Research Drive
Irvine, CA 92618-4236
(949) 872-2378
rasmith.com

PROPOSED WATER QUALITY EXHIBIT

DLX7 T.I.
6400 KATELLA AVE
CYPRESS, CALIFORNIA
90630

PROJECT: DLX7 CYPRESS CALIFORNIA
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Project Number: 2019-447
Plan Check Number: PC # XXXX-XXX

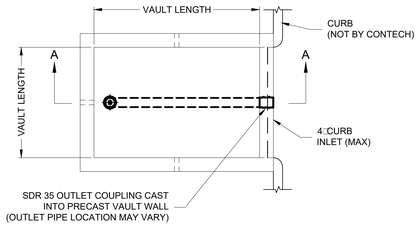
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PROJECT MANAGER: SAMUEL J. JACOBY
DESIGNED BY: EAR
CHECKED BY: SJJ

REV 06/23/2020
REV 07/02/2020
REV 08/04/2020

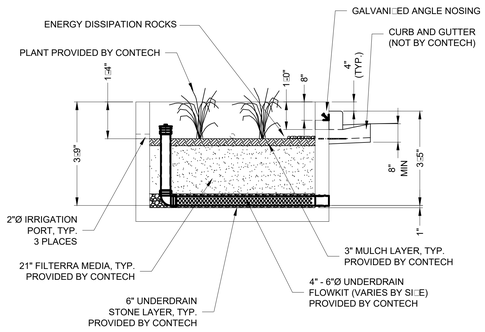
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PLAN VIEW



SECTION A-A

CONTECH ENGINEERED SOLUTIONS

filterra Bioretention Systems

Filterra Sizing Spreadsheet
Uniform Intensity Approach
Storm Intensity = 0.20 in/hr

Filterra Infiltration Rate = 100 (in/hr)
Filterra Flow per Square Foot = 0.0023 (ft3/sec/ft2)

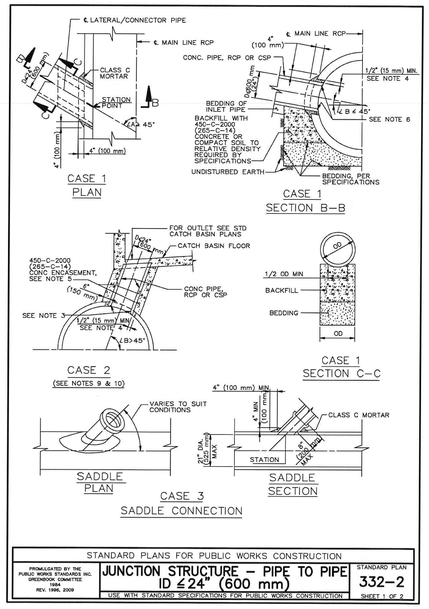
Filterra Flow Rate, Q = 0.0023 ft3/sec x Filterra Surface Area
Rational Method, Q = C x I x A

Site Flowrate, Q = (C x DI x DA x 43560) / (12 x3600)
OR DA = (12 x 3600 x Q) / (C x 43560 x DI)

where Q = Flow (ft3/sec)
DA = Drainage Area (acres)
DI = Design Intensity (in/hr)
C = Runoff coefficient (dimensionless)

			DI	C	C	C
			0.2	1.00	0.85	0.50
Available Filterra Box Sizes			**Filterra**	100%	Commercial	Residential
L (ft)	W (ft)	Filterra Surface Area (ft2)	**Flow Rate, Q (ft3/sec)**	Imperv. DA (acres)	max DA (acres)	max DA (acres)
4	4	16	**0.0370**	0.184	0.216	0.367
6	4	24	**0.0556**	0.275	0.324	0.551
6.5	4	26	**0.0602**	0.298	0.351	0.597
8	4	32	**0.0741**	0.367	0.432	0.735
12	4	48	**0.1111**	0.551	0.648	1.102
6	6	36	**0.0833**	0.413	0.486	0.826
8	6	48	**0.1111**	0.551	0.648	1.102
10	6	60	**0.1389**	0.689	0.810	1.377
12	6	72	**0.1667**	0.826	0.972	1.653
13	7	91	**0.2106**	1.045	1.229	2.089
12	8	96	**0.2222**	1.102	1.296	2.204

9/9/2015



STANDARD PLANS FOR PUBLIC WORKS CONSTRUCTION		
PROMULGATED BY THE PUBLIC WORKS CONSULTANT INC. SPECIFICATION COMMITTEE 1994 REV. 1996, 2009	JUNCTION STRUCTURE – PIPE TO PIPE ID ≤ 24" (600 mm)	STANDARD PLAN 332–2
	USE WITH STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION	SHEET 1 OF 2

NOTES

CASE 1 AND CASE 2

1. IF ANGLE A IS LESS THAN 45° OR IF D IS LARGER THAN 24" (600 mm), THEN ANOTHER STANDARD STRUCTURE SHALL BE SPECIFIED.
2. THE OUTSIDE DIAMETER OF THE INLET PIPE SHALL NOT EXCEED 1/2 THE INSIDE DIAMETER OF THE MAIN LINE.
3. THE INLET PIPE SHALL ENTER THE MAIN LINE RADIALLY. IF THE INLET PIPE CANNOT ENTER RADIALLY, THEN ANOTHER STANDARD STRUCTURE SHALL BE SPECIFIED.
4. THE SIZE OF THE OPENING INTO THE MAIN LINE SHALL BE THE OUTSIDE DIAMETER OF THE INLET PIPE PLUS 1" (30 mm) MINIMUM TO 3" (75 mm) MAXIMUM.
5. ALL CONNECTOR PIPES FOR CASE 2 SHALL BE ENCASED IN CONCRETE IF LAID WITHIN THE MAIN LINE EXCAVATED TRENCH OR IF LAID ON FILL WHICH HAS NOT BEEN DENSIFIED.
6. BURN OR CHIP END OF CONNECTOR PIPE FLUSH WITH INNER SURFACE OF MAIN LINE. ROUND EDGE OF CONCRETE PIPE OR RCP.
7. ALL CSP AND FITTINGS SHALL BE GALVANIZED.
8. STATION SPECIFIED ON THE PLANS APPLIES AT THE INTERSECTION OF THE INSIDE WALL OF MAIN LINE AND THE CENTERLINE OF INLET PIPE.
9. CASE 2 SHALL NOT BE USED TO CONNECT TO THE FLOOR OF A GRATING CATCH BASIN WHERE THE GRATE WILL BE SUBJECT TO VEHICLE TRAFFIC.
10. FOR CASE 2, NOT MORE THAN 12' (3.5 m) OF INLET PIPE SHALL BE LOCATED WITHIN THE MAIN LINE EXCAVATED TRENCH.

CASE 3

11. CONNECTIONS TO PIPES 21" (525 mm) OR LESS IN DIAMETER WITHOUT JUNCTION STRUCTURES OR PRECAST Y BRANCHES SHALL BE MADE WITH SADDLES.
12. THE OUTSIDE DIAMETER OF THE INLET PIPE SHALL NOT EXCEED ONE–HALF THE INSIDE DIAMETER OF THE MAIN LINE.
13. TRIM OR CUT SADDLE TO FIT SNUGLY OVER THE OUTSIDE OF THE MAIN LINE SO ITS AXIS WILL BE ON THE LINE AND GRADE OF THE CONNECTOR PIPE.
14. THE OPENING INTO THE PIPE SHALL BE CUT AND TRIMMED TO FIT THE SADDLE SO THAT NO PART WILL PROJECT WITHIN THE BORE OF THE SADDLE PIPE.
15. THE CONNECTOR PIPE SHALL BE SUPPORTED AS SHOWN IN CASES 1 AND 2.

STANDARD PLANS FOR PUBLIC WORKS CONSTRUCTION	STANDARD PLAN
JUNCTION STRUCTURE – PIPE TO PIPE (ID ≤ 24" (600 mm))	332–2
	SHEET 2 OF 2

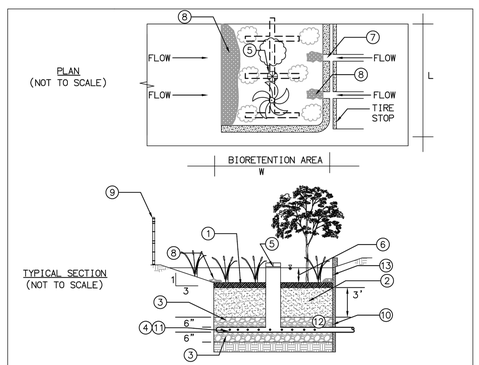
FTBSV SHORT SIDE INLET CONFIGURATION

DESIGNATION	AVAILABILITY	MEDIA BAY SIZE	VAULT SIZE (W □L)	OUTLET PIPE DIA
FTBSV0406	N/A CA	4 □6	4 □6	4" SDR 35
FTBSV04065	CA ONLY	4 □6.5	4 □6.5	4" SDR 35
FTBSV0408	N/A MID-ATL	4 □8	4 □8	4" SDR 35
FTBSV045078	MID-ATL ONLY	4.5 □7.83	4.5 □7.83	4" SDR 35
FTBSV0608	ALL	6 □8	6 □8	4" SDR 35
FTBSV0610	ALL	6 □10	6 □10	6" SDR 35
FTBSV0612	ALL	6 □12	6 □12	6" SDR 35
FTBSV0713	ALL	7 □13	7 □13	6" SDR 35

N/A = NOT AVAILABLE

filterra THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS: 6,569,321; 6,811,696; 7,425,262; 7,470,371 AND/OR FOREIGN PATENTS.

CONTECH ENGINEERED SOLUTIONS LLC
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX



GENERAL NOTES:

1. 3" LAYER OF NON-FLOATABLE WELL-AGED COMPOST OR FINE BARK (1–2" ADDED ANNUALLY OR AS NEEDED).
2. 2"–3" ENGINEERED SOIL (ES) DEPTH (3" DEPTH IS PREFERRED). SEE ES SPECIFICATIONS OR SHEET 2.
3. UNDERDRAIN SHALL BE SURROUNDED BY 6" OF WASHED AGGREGATE.
4. 6" PVC WITH A 0.5% MINIMUM SLOPE. SEE ALSO NOTE 11 AND 12.
5. OVERFLOW RISER SHALL BE SIZED TO CONVEY LARGE STORM EVENTS PER OC HYDROLOGY MANUAL (1' MINIMUM FREEBOARD).
6. PONDING DEPTH SHALL NOT EXCEED 18".
7. 12" WIDE MINIMUM CURB OPENING.
8. ENERGY DISSIPATOR SHALL BE SIZED BY ENGINEER.
9. FENCE PERIMETER IF PONDING EXCEEDS 12" TO PREVENT DROWNING.
10. A 30 MIL LINER SHALL BE INSTALLED IF BMP IS CLOSE TO ROADS OR FOUNDATIONS. IF GROUNDWATER IS CONTAMINATED, A LINER MUST BE INSTALLED ALONG THE BASE OF THE BMP.
11. HOLE DIAMETER SHALL BE 0.5" WITH TWO HORIZONTAL ROWS AND 6" SPACING.
12. THE FOLLOWING AGGREGATE SHALL BE USED TO PROVIDE A GRAVEL BLANKET AND BEDDING FOR THE UNDERDRAIN PIPE.

SIEVE SIZE	PERCENT PASSING
3/4 INCH	100
1/4 INCH	30–60
US NO. 8	20–50
US NO. 50	0–12
US NO. 200	0–1

13. STRUCTURAL WALL AS NEEDED PER CERTIFIED STRUCTURAL ENGINEER OR GEOTECHNICAL ENGINEER.

COUNTY OF ORANGE CALIFORNIA	ORANGE COUNTY PUBLIC WORKS BMP DESIGN	BIORETENTION WITH UNDERDRAIN	Sheet Reference Number 1 of 3 Sheets

GENERAL CONSTRUCTION NOTES:

1. SCARIFY SUBGRADE BEFORE INSTALLING BIORETENTION AREA AGGREGATE AND ES.
2. FACILITY EXCAVATION TO ALLOW FOR SPECIFIED SOIL AND MULCH DEPTHS TO ACHIEVE FINISHED ELEVATIONS ON CIVIL PLANS.
3. COMPACT EACH 6" LIFT OF ES WITH LANDSCAPE ROLLER OR BY LIGHTLY WETTING. IF WETTING, ALLOW TO DRY OVERNIGHT BEFORE PLANTING.
4. DO NOT WORK WITHIN BIORETENTION AREA DURING RAIN OR UNDER WET CONDITIONS.
5. KEEP HEAVY MACHINERY OUTSIDE BIORETENTION AREA LIMITS.
6. UNDERDRAIN DISCHARGE ELEVATION SHALL BE NEAR TOP OF AGGREGATE LAYER. UNDERDRAIN SLOPE MAY BE FLAT.

ENGINEERED SOIL NOTES:
PLANTING/STORAGE MEDIA SHALL CONSIST OF 60–80% FINE SAND AND 20–40% COMPOST.

COMPOST NOTES:
COMPOST SHOULD BE A WELL DECOMPOSED, STABLE WEED FREE ORGANIC MATTER SOURCE DERIVED FROM WASTE MATERIALS INCLUDING YARD DEBRIS, WOOD WASTES, OR OTHER ORGANIC MATERIALS NOT INCLUDING MANURE OR BIOSOLIDS MEETING STANDARDS DEVELOPED BY THE US COMPOSTING COUNCIL (USCC). THE PRODUCT SHALL BE CERTIFIED THROUGH THE USCC SEAL OF TESTING ASSURANCE (STA) PROGRAM (A COMPOST TESTING AND INFORMATION DISCLOSURE PROGRAM). COMPOST QUALITY SHOULD BE VERIFIED VIA A LAB ANALYSIS TO BE:

- FEEDSTOCK MATERIALS SHALL BE SPECIFIED AND INCLUDE ONE OR MORE OF THE FOLLOWING: LANDSCAPE/YARD TRIMMINGS, GRASS CLIPPINGS, FOOD SCRAPS, AND AGRICULTURAL CROP RESIDUES.
- ORGANIC MATTER: 35–75% DRY WEIGHT BASIS.
- CARBON AND NITROGEN RATIO: 15:1 < CN < 25:1
- MATURITY/STABILITY: SHALL HAVE DARK BROWN COLOR AND A SOIL-LIKE ODOR. COMPOST EXHIBITING A SOUR OR PUTRID SMELL, CONTAINING RECOGNIZABLE GRASS OR LEAVES, OR IS HOT (120 F) UPON DELIVERY OR REWETTING IS NOT ACCEPTABLE.
- TOXICITY: ANY ONE OF THE FOLLOWING MEASURES IS SUFFICIENT TO INDICATE NON–TOXICITY:
  - NH4:NH3 < 3
  - AMMONIUM < 500 PPM, DRY WEIGHT BASIS
  - SEED GERMINATION > 80% OF CONTROL
  - PLANT TRIALS > 80% OF CONTROL
- SOLVITAB > 5 INDEX VALUE
- NUTRIENT CONTENT:
  - TOTAL NITROGEN CONTENT 0.9% OR ABOVE PREFERRED
  - TOTAL BORON SHOULD BE < 2.5 PPM
- SALINITY: < 6.0 MMHOS/CM
- PH BETWEEN 6.5 AND 8 (MAY VARY WITH PLANT PALETTE)
- COMPOST FOR BIORETENTION SHOULD BE ANALYZED BY AN ACCREDITED LAB USING #200, ¼ INCH, ½ INCH, AND 1 INCH SIEVES (ASTM D 422 OR AS APPROVED BY THE LOCAL PERMITTING AUTHORITY) AND MEET THE FOLLOWING GRADATION:

SIEVE SIZE (ASTM D422)	% PASSING BY WEIGHT	
	MINIMUM	MAXIMUM
1 INCH	99	100
1/2 INCH	90	100
1/4 INCH	40	90
#200	2	10

- TESTS SHOULD BE SUFFICIENTLY RECENT TO REPRESENT THE ACTUAL MATERIAL THAT IS ANTICIPATED TO BE DELIVERED TO THE SITE. IF PROCESSES OR SOURCES USED BY THE SUPPLIER HAVE CHANGED SIGNIFICANTLY SINCE THE MOST RECENT TESTING, NEW TESTS SHOULD BE REQUESTED.
- THE GRADATION OF COMPOST USED IN ES IS PLAYS AN IMPORTANT ROLE IN THE SATURATED HYDRAULIC CONDUCTIVITY OF THE MEDIA. TO ACHIEVE A HIGHER SATURATED HYDRAULIC CONDUCTIVITY, IT MAY BE NECESSARY TO UTILIZE COMPOST AT THE COARSER END OF THIS RANGE ("MINIMUM" COLUMN). THE PERCENT PASSING THE #200 SIEVE (FINES) IS BELIEVED TO BE THE MOST IMPORTANT FACTOR IN HYDRAULIC CONDUCTIVITY. IN ADDITION, A COARSER COMPOST MIX PROVIDES MORE HETEROGENEITY OF THE BIORETENTION MEDIA, WHICH IS BELIEVED TO BE ADVANTAGEOUS FOR MORE RAPID DEVELOPMENT OF SOIL STRUCTURE NEEDED TO SUPPORT HEALTH BIOLOGICAL PROCESSES. THIS MAY BE AN ADVANTAGE FOR PLANT ESTABLISHMENT WITH LOWER NUTRIENT AND WATER INPUT.

COUNTY OF ORANGE CALIFORNIA	ORANGE COUNTY PUBLIC WORKS BMP DESIGN	BIORETENTION WITH UNDERDRAIN	Sheet Reference Number 2 of 3 Sheets

SAND NOTES:

- SAND SHOULD BE FREE OF WOOD, WASTE, COATING SUCH AS CLAY, STONE DUST, CARBONATE, ETC., OR ANY OTHER DELETERIOUS MATERIAL. ALL AGGREGATE PASSING THE NO. 200 SIEVE SIZE SHOULD BE NON–PLASTIC. SAND FOR BIORETENTION SHOULD BE ANALYZED BY AN ACCREDITED LAB USING #200, #100, #40, #30, #16, #8, #4, AND 3/8 SIEVES (ASTM D 422 OR AS APPROVED BY THE LOCAL PERMITTING AUTHORITY) AND MEET THE FOLLOWING GRADATION:

SIEVE SIZE (ASTM D422)	% PASSING BY WEIGHT	
	MINIMUM	MAXIMUM
3/8 INCH	100	100
#4	90	100
#8	70	100
#16	40	95
#30	15	70
#40	5	55
#100	0	15
#200	0	5

- ALL SANDS COMPLYING WITH ASTM C33 FOR FINE AGGREGATE SHALL COMPLY WITH THESE GRADATION REQUIREMENTS.
- THE GRADATION OF THE SAND COMPONENT OF THE MEDIA IS A MAJOR FACTOR IN THE HYDRAULIC CONDUCTIVITY OF THE MEDIA MIX. IF THE DESIRED HYDRAULIC CONDUCTIVITY OF THE MEDIA CANNOT BE ACHIEVED WITHIN THE SPECIFIED PROPORTIONS OF SAND AND COMPOST (#2), THEN IT MAY BE NECESSARY TO UTILIZE SAND AT THE COARSER END OF THE RANGE SPECIFIED IN THE TABLE ABOVE ("MINIMUM" COLUMN).

ADDITIONAL ENGINEERED SOIL NOTES:

- NUTRIENT CONTENT AND ORGANIC CONTENT OF THE SELECTED COMPOST SOURCE SHOULD BE CONSIDERED WHEN SPECIFYING THE PROPORTIONS OF COMPOST AND SAND. THE COMPOST SPECIFICATION ALLOWS A RANGE OF ORGANIC CONTENT OVER APPROXIMATELY A FACTOR OF 2 AND NUTRIENT CONTENT MAY VARY MORE WIDELY. THEREFORE DETERMINING THE ACTUAL ORGANIC CONTENT AND NUTRIENT CONTENT OF THE COMPOST EXPECTED TO BE SUPPLIED IS IMPORTANT IN DETERMINING THE PROPORTION TO BE USED FOR AMENDMENT.
- A COMMITMENT TO PERIODIC SOIL TESTING FOR NUTRIENT CONTENT AND A COMMITMENT TO ADAPTIVE MANAGEMENT OF NUTRIENT LEVELS CAN HELP REDUCE THE AMOUNT OF ORGANIC AMENDMENT THAT MUST BE PROVIDED INITIALLY. GENERALLY, NUTRIENTS CAN BE ADDED TO PLANTING AREAS THROUGH THE ADDITION OF ORGANIC MULCH, BUT CANNOT BE REMOVED.

COUNTY OF ORANGE CALIFORNIA	ORANGE COUNTY PUBLIC WORKS BMP DESIGN	BIORETENTION WITH UNDERDRAIN	Sheet Reference Number 3 of 3 Sheets



NOTE:

ALL DRAIN INLETS THAT DISCHARGE INTO AN EXISTING OR PROPOSED STORM DRAIN MUST BE LABELED TO DISCOURAGE ILLEGAL DUMPING OF POLLUTANTS WITH THE STENCIL ABOVE IN A VISIBLE AREA. 2 COATS MINIMMUM.

RA SMITH ASSUMES NO RESPONSIBILITY FOR DAMAGES, LIABILITY OR COSTS RESULTING FROM CHANGES OR ALTERATIONS MADE TO THIS PLAN WITHOUT THE EXPRESSED WRITTEN CONSENT OF RA SMITH.

THE LOCATIONS OF EXISTING UTILITY INSTALLATIONS AS SHOWN ON THIS PLAN ARE APPROXIMATE. THERE MAY BE OTHER UNDERGROUND UTILITY INSTALLATIONS WITHIN THE PROJECT AREA THAT ARE NOT SHOWN.

ARCHITECTS ORANGE
144 North Orange Street • Orange, California 92866 • 714 639-9960
Bear

04/23/20

Consultant
raSmith
CREATIVITY BEYOND ENGINEERING
8881 Research Drive
Irvine, CA 92618-4236
(949) 872-2378
rasmith.com

DLX7 T.I.
6400 KATELLA AVE
CYPRESS, CALIFORNIA
90630

WATER QUALITY DETAILS

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R.A. Smith, Inc.

DATE:	04/23/20
SCALE:	AS SHOWN
JOB NO.	3190323
PROJECT MANAGER:	SAMUEL J. JACOBY
DESIGNED BY:	EAR
CHECKED BY:	SJJ

REV 06/23/2020
REV 07/02/2020

811 Know what's below. Call before you dig.

PROJECT: DLX7 CYPRESS CALIFORNIA
ADDRESS: 6400 KATELLA AVE, CA
FOR: GREENLAW PARTNERS
18301 VON KARMAN, STE 250
IRVINE CA 92612

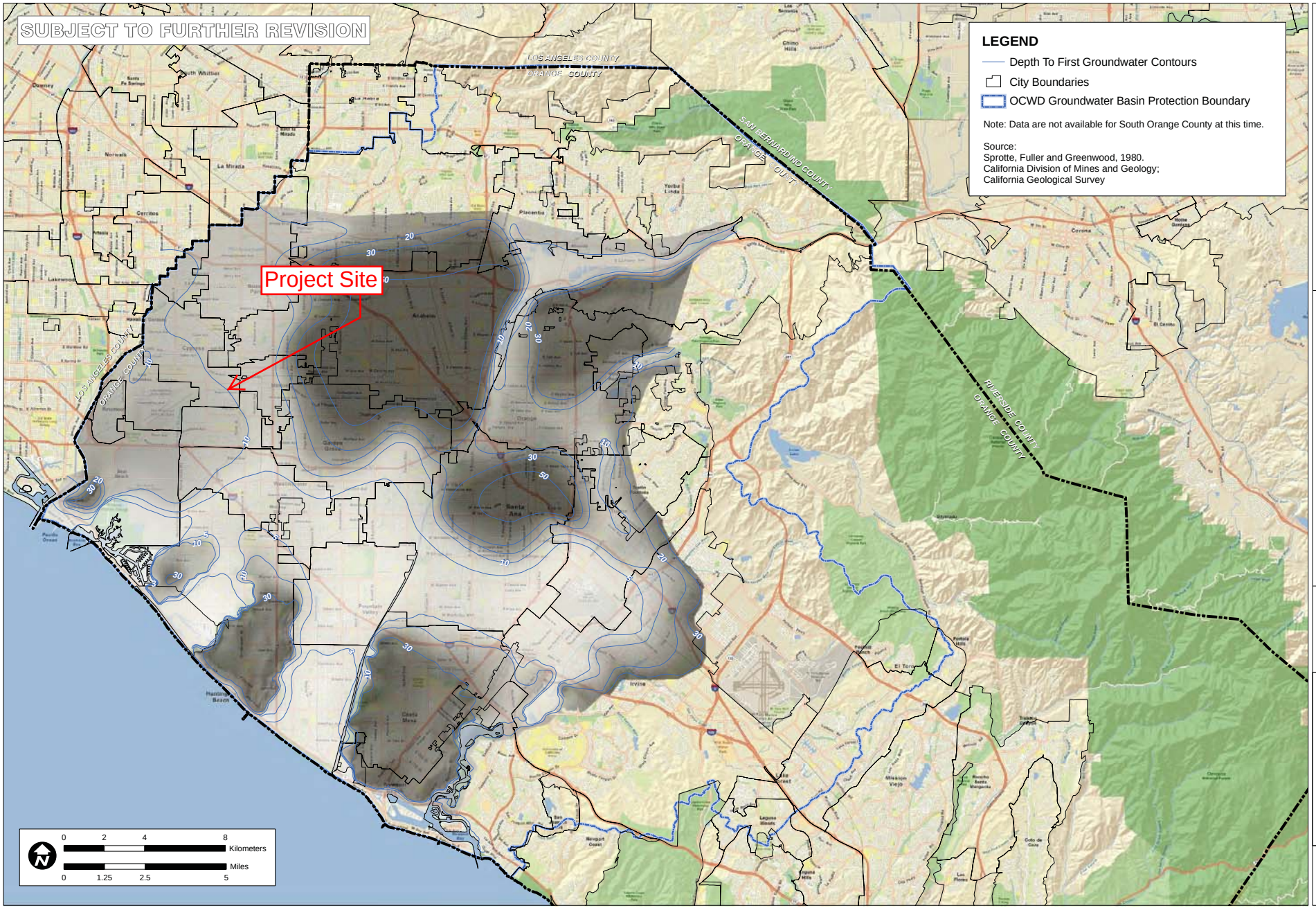
Project Number: 2019-447
Plan Check Number: PC # XXXX-XXX

WQ3

LAST SAVE DATE & TIME: 10/05/2020 2:23 PM by TJT
O:\3190323\Dwg\Sheets\3190323-WQ1.dwg, WQ3 WATER QUALITY DETAILS, 7/8/2020 3:16:39 PM, djr

Attachment D

Summary of Harvested Water Demand and Feasibility



TITLE
NORTH ORANGE COUNTY
MAPPED DEPTH TO FIRST
GROUNDWATER

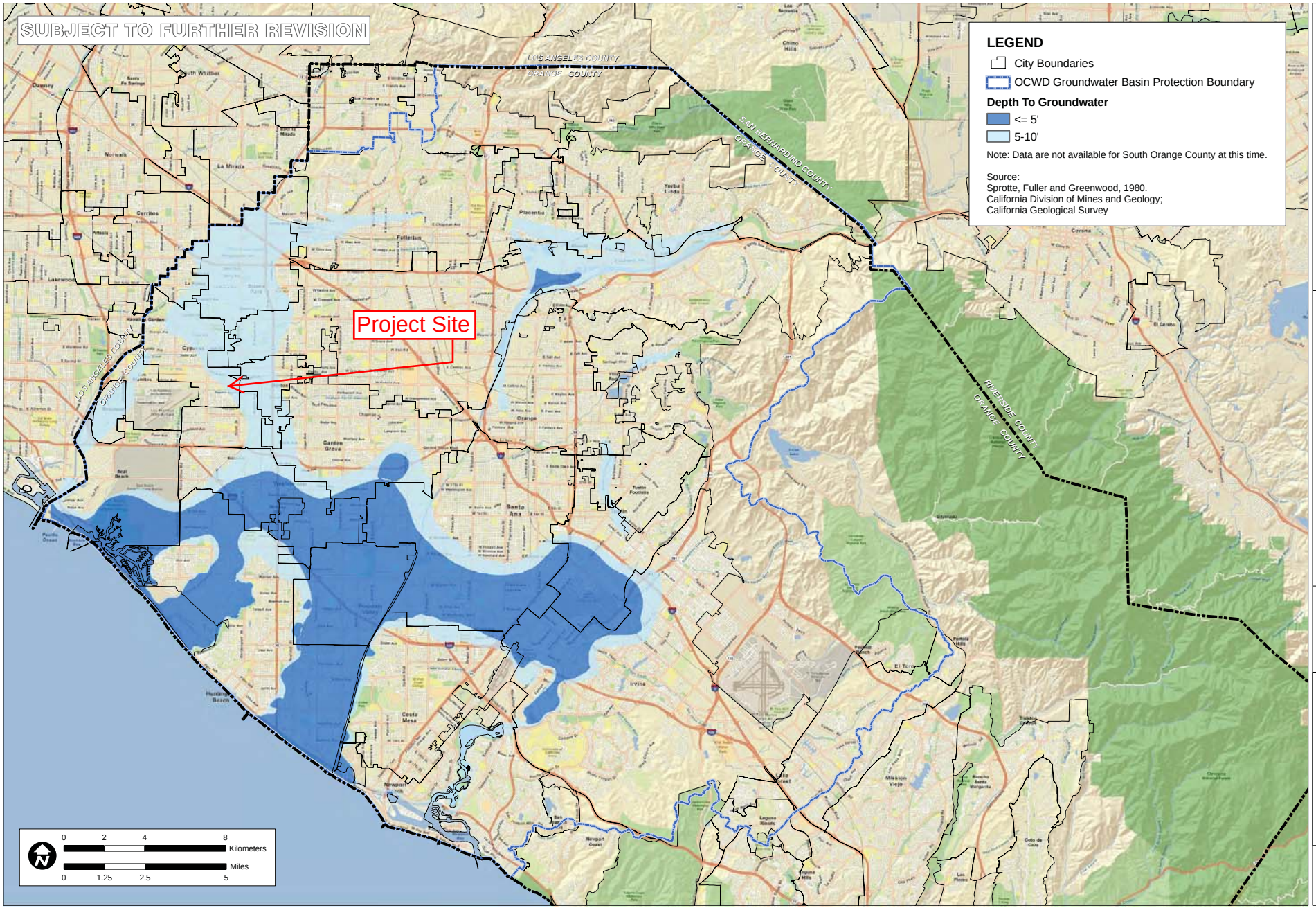
JOB
ORANGE COUNTY
INFILTRATION STUDY
ORANGE CO. CA

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-2d

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P:\9526E\16-GIS\Mxds\Reports\InfiltrationFeasability_20110215\9526E_FigureXVI-2e_DepthToGroundwaterUSH_20110215.mxd

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

raSmith

CREATIVITY BEYOND ENGINEERING

MEMORANDUM

DATE: July 2, 2020

TO: File

FR: Jeff Yersin, P.E., QSD, rasmith

RE: DLX7 Reuse Memorandum

Area (impervious): 7.28 Acres
TUTIA Load: 176 empl/ac

Total employees = 7.28*176 = 1,281 employees.

The project will employ less than 1,281 employees.

Re-use is not feasible

Table X.7: Minimum TUTIA for Minimum Partial Capture

Project Type	Residential	Retail and Office Commercial	Industrial	Schools[1]
Basis of Toilet User Calculation	*Resident*	*Employee (non-visitor)*	*Employee (non-visitor)*	*Employee (non-student)*
Design Capture Storm Depth, inches	**Minimum TUTIA Ratio Required for Minimum Partial Capture (toilet users/impervious acre)**			
0.6	74	98	125	21
0.65	80	106	135	23
0.7	86	114	145	24
0.75	92	122	155	26
0.8	98	130	165	28
0.85	104	138	176	30
0.9	110	146	186	31
0.95	117	154	196	33
1	123	162	206	35

1 – based on employees only; assumes approximately 5 students per employee.

Worksheet 10: Nomograph Method for Determining Capture Efficiency of Harvest and Use BMPs

Part 1: Calculate the EIATA and the effect of upstream HSCs				
1a	Landscape area irrigated with harvested water*	LA=	2.18	acres
1b	Area-weighted landscape coefficient (typically 0.7 for active turf, 0.35 for conservation landscape design)	K_L=	0.35	
1c	Irrigation efficiency (typically 0.90)	IE	0.9	
1d	Enter DMA area tributary to BMP (s), *A* (acres) (not including any self-retaining areas)	A=	9.46	acres
1e	Enter DMA Imperviousness, *imp* (unitless)	imp=	0.77	
1f	Effective Irrigated Area to Tributary Area ratio, EIATA = LA * K_L / (IE * imp * A)	EIATA	.12	ac/ac
2	Enter capture efficiency corresponding to upstream HSCs (Worksheet 4) and locate on Figure E-8 or the figure within the worksheet below	Y_1=	0	%
3	Using Figure E-8 or the figure within the worksheet below, determine the cistern volume as a fraction of the DCV corresponding to the capture efficiency of the HSCs	X_1=	0	
Part 2: Calculate the DCV				
4	85th percentile, 24-hour design storm	d =	0.85	inches
5a	Calculate runoff coefficient, *C= (0.75 x imp) + 0.15*	C=	0.76	
5b	Calculate the DCV= *(C x d x A x 43560 sf/ac x (1 ft/12 in))*	DCV=	21,308	cu-ft
Part 3: Calculate capture efficiency				
6	Storage Volume of BMP (cistern, vault, etc.)	V	22,322	cu- ft
7	Storage Volume as a fraction of DCV, V_{frac} = V/CDV	V_{frac}	1.05	
8	Final equivalent volume as a fraction of DCV from combination of HSCs and harvest and use BMPs, $X_2 = X_1 + V_{frac}$	X_2	0	
9	Using Figure E-8 or the figure within the worksheet below, determine the capture efficiency of the harvest and use BMPs and any upstream HSCs	Y_2	0	%

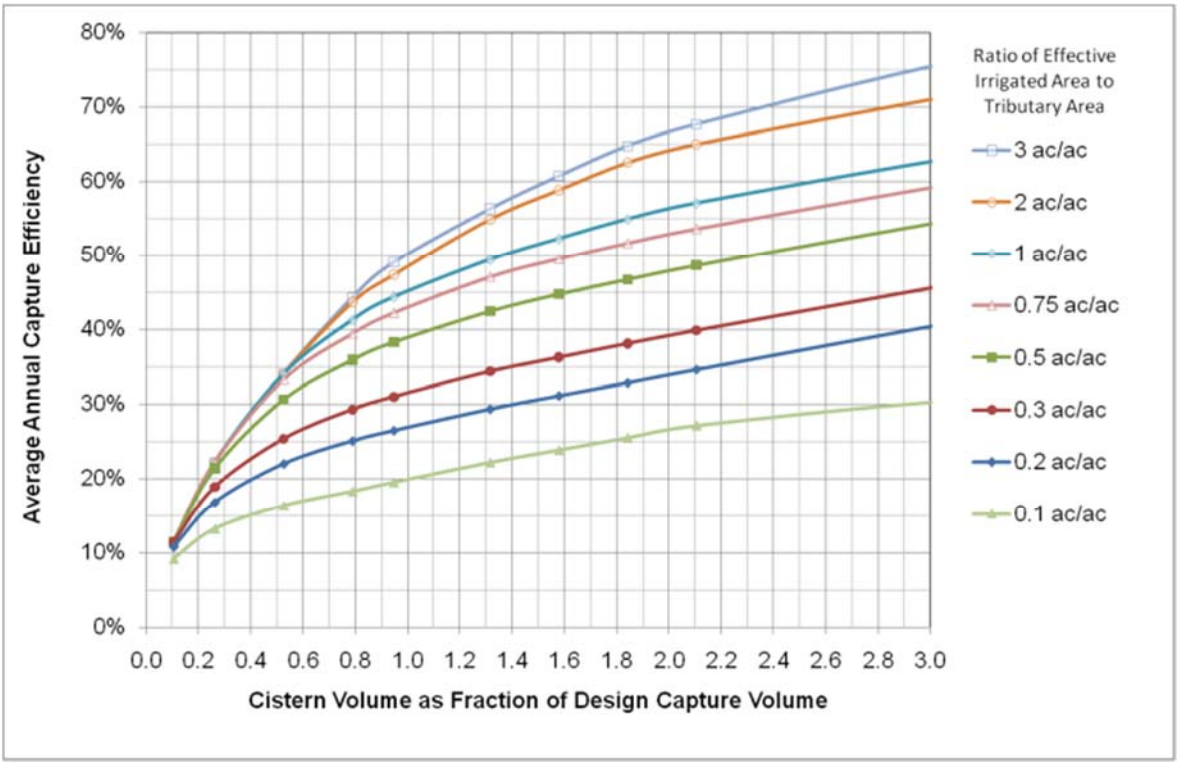
Worksheet 10: Nomograph Method for Determining Capture Efficiency of Harvest and Use BMPs

Supporting Calculations

Describe system:

SYSTEM NOT FEASIBLE FOR REUSE. FULL DCV IS Needed for stormwater, but irrigation demand would require a standing water condition.

Graphical Operations



Provide supporting graphical operations.

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		☒ x	
3	Landscape irrigation		□	
4	Other:_____		□	
5	What is the design capture storm depth? (**Figure III.1**)	d	0.225	inches
6	What is the project size?	A	9.46	ac
7	What is the acreage of impervious area?	IA	7.28	ac
	For projects with both toilet flushing and indoor demand			
8	What is the minimum use required for partial capture? (**Table X.6**)			gpd
9	What is the project estimated minimum 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**)		1,281	
12	What is the project estimated TUTIA?		165	

Worksheet J: Summary of Harvested Water Demand and Feasibility

13	Is partial capture potentially feasible? (Line 12 > Line 11?)	No	
	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:

The project will employ less than 1281 employees.
Reuse is not feasible.

Worksheet I: Summary of Groundwater-related Feasibility Criteria

1	Is project large or small? (as defined by **Table VIII.2**) circle one	(Large)		Small
2	What is the tributary area to the BMP?	A	9.46	acres
3	What type of BMP is proposed?	Filterra Bioscape Vaults and Bioretention		
4	What is the infiltrating surface area of the proposed BMP?	A_{BMP}	2,123	sq-ft
5	What land use activities are present in the tributary area (list all) Light Industrial facility used for packing and delivery of goods. Delivery vehicles will be parked onsite when not in use.			
6	What land use-based risk category is applicable?	L	(M)	H
7	If M or H, what pretreatment and source isolation BMPs have been considered and are proposed (describe all): Engineered soil in filterra units			
8	What minimum separation to mounded seasonally high groundwater applies to the proposed BMP? See Section **VIII.2** (circle one)	(5 ft)		10 ft
9	Provide rationale for selection of applicable minimum separation to seasonally high mounded groundwater: Based on VIII.2 of TGD for Biofilters/Planters			
10	What is separation from the infiltrating surface to seasonally high groundwater?	SHGWT	4	ft
11	What is separation from the infiltrating surface to mounded seasonally high groundwater?	Mounded SHGWT	<4	ft
12	Describe assumptions and methods used for mounding analysis: Seasonal High Water Table determined from NOC maps.			
13	Is the site within a plume protection boundary (See **Figure**	Y	(N)	N/A

Worksheet I: Summary of Groundwater-related Feasibility Criteria

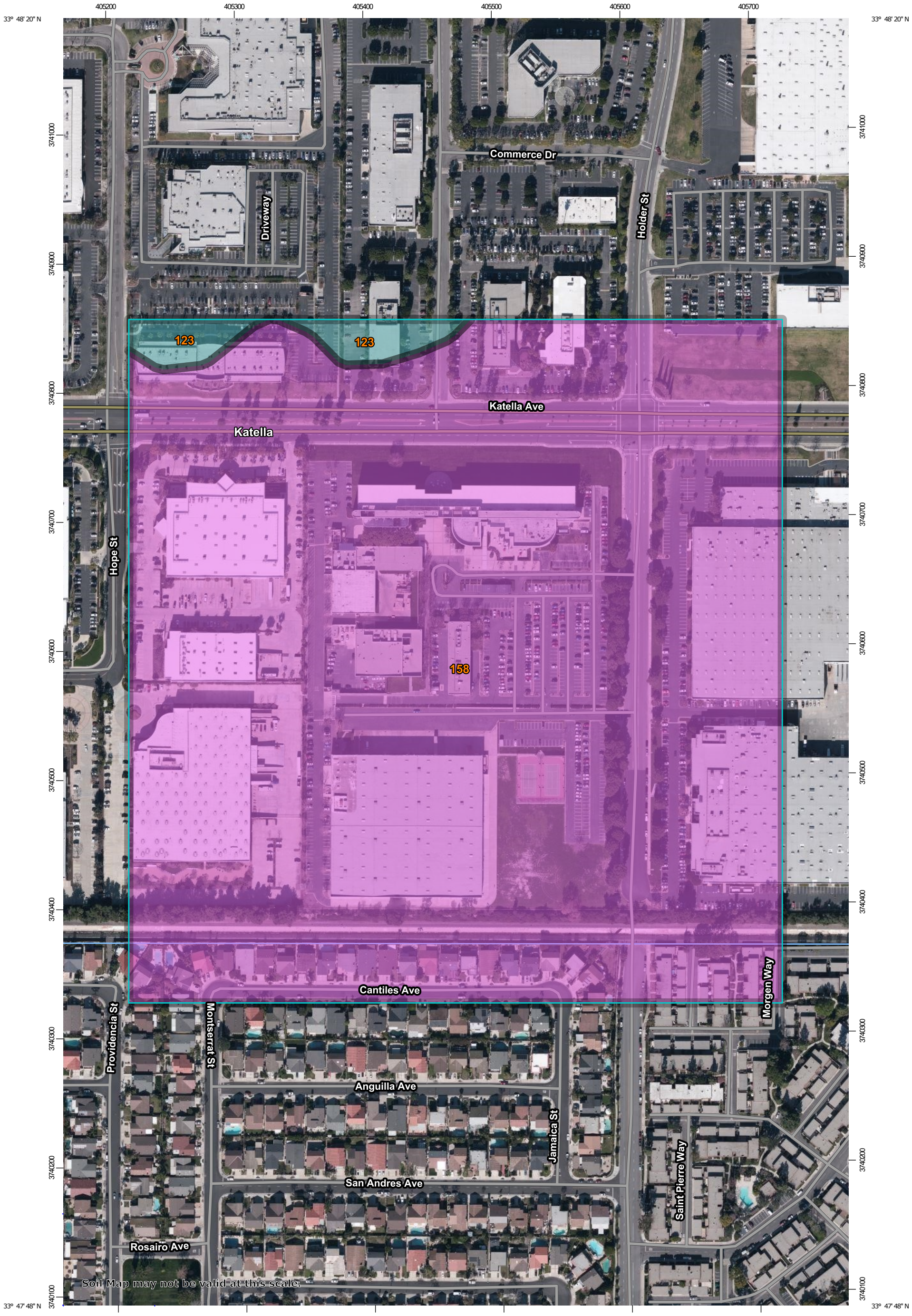
	VIII.2)?	
14	Is the site within a selenium source area or other natural plume area (See Figure VIII.2)?	Y (N) N/A
15	Is the site within 250 feet of a contaminated site?	Y (N) N/A
16	If site-specific study has been prepared, provide citation and briefly summarize relevant findings:	
17	Is the site within 100 feet of a water supply well, spring, septic system?	(Y) N N/A
18	Is infiltration feasible on the site relative to groundwater-related criteria?	Y (N)
Provide rationale for feasibility determination: The depth from the bottom of the infiltration layer to the SHGWT is less than 5'.		

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

Attachment E

Geotechnical Investigation

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



Map Scale: 1:2,790 if printed on B portrait (11" x 17") sheet.

Meters: 0 40 80 160 240

Feet: 0 100 200 400 600

N

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 13, Sep 16, 2019

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

Date(s) aerial images were photographed: Apr 13, 2018—Jan 25, 2019

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
123	Bolsa silt loam, drained	C	1.5	2.3%
158	Hueneme fine sandy loam, drained	A	65.2	97.7%
Totals for Area of Interest			**66.7**	**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

GEOTECHNICAL INVESTIGATION
TWO PROPOSED WAREHOUSES

SWC Katella Avenue and Holder Street
Cypress, California
For
Greenlaw Partners

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

October 3, 2019

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

Greenlaw Partners
c/o Duke Realty
200 Spectrum Center Drive, Suite 1600
Irvine, California 92618

Attention: Mr. Mikheel Davankar

Project No.: **19G186-1**

Subject: **Geotechnical Investigation**
Two Proposed Warehouses
SWC Katella Avenue and Holder Street
Cypress, California

Gentlemen:

In accordance with your request, we have conducted a geotechnical investigation at the subject site. We are pleased to present this report summarizing the conclusions and recommendations developed from our investigation.

We sincerely appreciate the opportunity to be of service on this project. We look forward to providing additional consulting services during the course of the project. If we may be of further assistance in any manner, please contact our office.

Respectfully Submitted,

SOUTHERN CALIFORNIA GEOTECHNICAL, INC.

Daniel W. Nielsen, RCE 77915
Senior Engineer



Robert G. Trazo, GE 2655
Principal Engineer



Distribution: (1) Addressee

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1.0 EXECUTIVE SUMMARY

Presented below is a brief summary of the conclusions and recommendations of this investigation. Since this summary is not all inclusive, it should be read in complete context with the entire report.

Geotechnical Design Considerations

- The borings encountered artificial fill soils and native alluvium. The fill soils extend to depths of 2½ to 4± feet and are considered to consist of undocumented fill soils. Some of the native alluvial soils possess low strengths and densities and the results of consolidation testing indicate that some of these soils are compressible.
- All of the borings encountered groundwater at depths of 5 to 6½± feet. The static groundwater table at this site is considered to be present at a depth of 5 to 6½± at the time of subsurface exploration.
- The subject site is located within an area mapped as a liquefaction hazard zone by the state of California. Our site-specific liquefaction evaluation included four (4) CPT soundings advanced to depths of 60 to 70± feet. Potentially liquefiable soils were encountered at all of the CPT locations.
- The potential liquefaction-induced settlements at the boring CPT locations range between 1.8 and 3.6± inches.
- Potentially liquefiable soils were encountered at depths ranging between 5 and 50± feet. Some of the potentially liquefiable strata are present at relatively shallow depths of about 5 to 12± feet. The foundation loads of the new structures are expected to influence the potentially liquefiable soils present at these depths. Additionally, based on the presence of compressible soils with the upper 22± feet, static settlements are expected to be in excess of the tolerable limits.
- The most feasible method of mitigating potential static and dynamic settlements at this site is considered to be remedial grading of the near surface soils in conjunction with ground improvement of the compressible and potentially liquefiable soils located beneath the groundwater table. Based on the groundwater levels and the soil conditions, techniques such as deep soil mixing or grout injection are considered the most applicable for ground improvement. A specialty contractor should be contacted for specifics of design build ground improvement methods.
- This report presents recommendations for the use conventional shallow foundations, assuming that the liquefiable and compressible soils within at least the upper 12 feet below existing grades, 12 feet below proposed building pad grade, and at least 10 feet below the proposed foundation bearing grade. Within the influence zones of any foundations. The overexcavation should also extend to a depth of at least 2 times the footing width below the foundation bearing grade. Overexcavation and recompaction of the near-surface fill and alluvial soils should be performed within the upper 4± feet below existing site grades.

Site Preparation

- Demolition of the some of the existing structures and pavements will be required in order to facilitate construction of the new buildings. Demolition should also include all utilities and any other subsurface improvements that will not remain in place for use with the new development. Debris resultant from demolition should be disposed of offsite. Concrete and

asphalt debris may be pulverized to a maximum 2-inch particle size, well mixed with the on-site soils, and incorporated into new structural fills, or it may be crushed into miscellaneous base (CMB). Alternatively, concrete and asphalt debris may be crushed to particles sizes of 2 to 4 inches and used to stabilize overexcavation subgrades.

- Initial site preparation should include stripping of the existing grass, trees, and weed growth present in some areas the site. Stripping should also include removal of any tree root masses. The actual extent of site stripping should be determined in the field by the geotechnical engineer, based on the organic content and stability of the materials encountered.
- Remedial grading is recommended to be performed within the new building pad areas to remove the existing fill soils (which extend to depths of 2½ to 4± feet at the boring locations) in their entirety. Additionally, overexcavation should extend to a depth of 4 feet below existing grade and to a depth of at least 3 feet below proposed pad grade.
- The ground improvement contractor should determine if the
- After overexcavation has been completed, the resulting subgrade soils should be evaluated by the geotechnical engineer to identify any additional soils that should be overexcavated, moisture conditioned (or air dried), and recompacted to at least 90 percent of the ASTM D-1557 maximum dry density. The previously excavated soils may then be replaced as compacted structural fill.
- The new parking area subgrade soils are recommended to be scarified to a depth of 12± inches, thoroughly moisture conditioned and recompacted to at least 90 percent of the ASTM D-1557 maximum dry density.

Building Foundations

- Conventional shallow foundations, supported in newly placed compacted fill.
- 2,000 lbs/ft^2 maximum allowable soil bearing pressure. A greater foundation bearing pressure may be allowed based on the ground improvement technique used.
- Minimum longitudinal steel reinforcement within strip footings: Six (6) No. 5 rebars (3 top and 3 bottom) due to the presence of liquefiable soils. Additional reinforcement may be necessary for structural considerations.

Building Floor Slab

- Conventional Slab-on-Grade, 6 inches thick.
- Modulus of Subgrade Reaction: k = 100 psi/in
- Reinforcement consisting of No. 3 rebars at 18 inches on center in both directions due to the presence of liquefiable soils. The actual floor slab reinforcement should be determined by the structural engineer, based on the imposed slab loading.

Pavements

ASPHALT PAVEMENTS (R = 30)					
Materials	**Thickness (inches)**				
	Automobile Parking (TI = 4.0)	Automobile Drive Lanes (TI = 5.0)	Truck Traffic		
			(TI = 6.0)	(TI = 7.0)	(TI = 8.0)
Asphalt Concrete	3	3	3½	4	5
Aggregate Base	3	6	8	10	11
Compacted Subgrade	12	12	12	12	12

PORTLAND CEMENT CONCRETE PAVEMENTS			
Materials	**Thickness (inches)**		
	Automobile and Light Truck Traffic (TI = 5.0 & 6.0)	Truck Traffic	
		(TI = 7.0)	(TI = 8.0)
PCC	5	5½	6½
Compacted Subgrade (95% minimum compaction)	12	12	12

2.0 SCOPE OF SERVICES

The scope of services performed for this project was in accordance with our Proposal No. 19P324, dated August 16, 2019. The scope of services included a visual site reconnaissance, subsurface exploration, field and laboratory testing, and geotechnical engineering analysis to provide criteria for preparing the design of the building foundations, building floor slabs, and parking lot pavements along with site preparation recommendations and construction considerations for the proposed development. Based on the location of this site, this investigation also included a site-specific liquefaction evaluation. The evaluation of the environmental aspects of this site was beyond the scope of services for this geotechnical investigation.

3.0 SITE AND PROJECT DESCRIPTION

3.1 Site Conditions

The subject site is located at the southwest corner of Katella Avenue and Holder Street in Cypress, California. The site is bounded to the north by Katella Avenue, to the east by Holder Street, to the south by the Stanton Storm Channel, and to the west by three commercial/industrial buildings.

The site consists of a rectangular-shaped parcel, 22.3± acres in size. The site is presently occupied by Mitsubishi Motors and developed with an office building, three (3) commercial/industrial buildings, and a warehouse. The office building is located in the northern portion of the site and is 3-stories in height with a footprint area of approximately 60,000 ft². The three (3) commercial/industrial buildings, ranging from 10,800± ft² to 25,000± ft² in size, are located in the west-central areas of the site. A warehouse building, 140,000± ft² in size is present in the southwestern area of the site. Dock high doors and a truck well are located along the northern wall of the warehouse building. A tennis court is present in the southeastern area of the site. The ground surface cover surrounding the buildings generally consists of asphaltic concrete pavements in the parking and drive lanes, Portland cement concrete pavements in the loading dock areas, and landscape planters throughout the site. However, the ground surface cover on the north side of the office building consists of turf grass and in the southeastern portion of the site, east of the warehouse building, the ground surface cover consists of exposed soil with sparse to moderate grass and weed growth.

Detailed topographic information was not available at the time of this report. However, based on topographic information obtained from Google Earth, the site topography ranges from 42± feet mean sea level (msl) in the east-central area, to 35± feet msl in the southeastern area of the site. The paved areas of the site gently slope downward to the west, at gradients of 1± percent in the southwestern and east-central areas to gradients of 2 to 3± percent near the northwestern corner of the site. The vacant area east of the warehouse slopes downward to the southeast at a gradient of less than 1± percent.

3.2 Proposed Development

Based on site plan provided to our office by the client, the proposed development will consist of two (2) warehouse buildings, 237,920± ft² and 234,720± ft² in size located in the north and south areas of the site. Dock-high doors will be constructed along the south side of the northern warehouse and along the north side of the southern warehouse. An alternative site plan was also provided to our office, indicating that the proposed development may also consist of reusing the existing warehouse located in the southwest portion of the site, and remainder of the site will be redeveloped as a parking lot for automobiles and trucks.

The buildings will be surrounded by asphaltic concrete pavements in the automobile parking and drive areas, and Portland cement concrete pavements in the truck traffic areas. Areas of

landscaped planters and concrete flatwork are expected throughout the site.

Detailed structural information is not currently available. It is assumed that the new buildings will be of concrete tilt-up construction, typically supported on a conventional shallow foundation system, with a slab-on-grade floor(s). Based on the assumed construction, maximum column and wall loads are expected to be on the order of 100 kips and 4 to 7 kips per linear foot, respectively.

No significant amounts of below grade construction, such as basements or crawl spaces, are expected to be included in the proposed development. Based on the assumed topography, cuts and fills up to 1 to 3± feet are expected to be necessary to achieve the proposed site grades.

4.0 SUBSURFACE EXPLORATION

4.1 Scope of Exploration/Sampling Methods

The subsurface exploration conducted for this project consisted of eight (8) borings advanced to depths of 15 to 51½± feet below existing site grades. Boring Nos. B-1 and B-6 were extended to a depth of 50 to 51½± feet as part of the liquefaction evaluation. In addition to the borings, four (4) Cone Penetration Test (CPT) soundings were advanced to depths of 60 to 70± feet at the site as part of the liquefaction evaluation.

Hollow Stem Auger Borings

The borings were advanced with hollow-stem augers, by a conventional truck-mounted drilling rig. Representative bulk and relatively undisturbed soil samples were taken during drilling. Relatively undisturbed samples were taken with a split barrel "California Sampler" containing a series of one inch long, 2.416± inch diameter brass rings. This sampling method is described in ASTM Test Method D-3550. Samples were also taken using a 1.4± inch inside diameter split spoon sampler, in general accordance with ASTM D-1586. Both of these samplers are driven into the ground with successive blows of a 140-pound weight falling 30 inches. The blow counts obtained during driving are recorded for further analysis. Bulk samples were collected in plastic bags to retain their original moisture content. The relatively undisturbed ring samples were placed in molded plastic sleeves that were then sealed and transported to our laboratory.

Cone Penetration Test (CPT) Soundings

The CPT soundings were performed by Kehoe Testing and Engineering (KTE) under the supervision of a member of our staff. The cone system used for this project was manufactured by Vertek. The CPT soundings were performed in general accordance with ASTM standards (D-5778). The cone penetrometers were pushed using a 30-ton CPT rig. The instruments used during the CPT soundings recorded the cone tip resistance, sleeve friction, and dynamic core pressure at 2.5-centimeter depth intervals. The CPT soundings were advanced to depths of 50± feet. It should be noted that prior to performing the CPT sounding at CPT-4, a portable coring rig equipped with a 5-inch-diameter diamond-tipped core barrel was used to core through the existing PCC pavements. A more complete description of the CPT program as well as the results of the data interpretation are provided in the report prepared by KTE, enclosed in Appendix F of this report. The CPT soundings do not result in any recovered soil samples. However, correlations have been developed that utilize the cone resistance and the sleeve friction to estimate the soil type that is present at each 2.5-centimeter interval in the subsurface profile. These soil classifications are presented graphically on the CPT output forms enclosed in Appendix F.

The data generated by the cone penetrometer equipment has been interpreted by KTE using CPeT-IT, V2.3.18, published by Geologismiki Geotechnical Software. The CPeT-IT program output as well as more details regarding the interpretation procedure are presented a report prepared by KTE, which is provided in Appendix F of this report.

General

The approximate locations of the borings and CPT soundings are indicated on the Boring and CPT Location Plan, included as Plate 2 in Appendix A of this report. The Boring Logs, which illustrate the conditions encountered at the boring locations, as well as the results of some of the laboratory testing, are included in Appendix B.

4.2 Geotechnical Conditions

Pavements

Asphaltic concrete pavements were present at the ground surface at all of the boring locations, with the exception of Boring Nos. B-5 and B-6. At the boring locations, the pavement section consists of 3 to 4± inches of asphaltic concrete, underlain by 4 to 5± inches of aggregate base.

Artificial Fill

Artificial fill soils were encountered beneath the pavements at Boring Nos. B-4, B-7, and B-8, and at the ground surface of Boring No. B-5, extending to depths of 2½ to 4± feet below the existing site grades. The fill soils generally consist of silty fine sand with occasional trace to little clay content. However, some of the fill soils encountered at Boring No. B-7 consisted of medium dense to very stiff fine sandy clay to clayey fine sand. The fill soils possess a mottled and disturbed appearance, resulting in their classification as artificial fill.

The soils encountered directly beneath the pavements at Boring Nos. B-2 and at the ground surface at Boring No. B-6, extending to depths of 2½ and 5½± feet respectively, were classified at possible fill. These soils possess variable densities and a slightly disturbed appearance, but they also possess similar compositions to some of the native alluvium encountered at the site and lack obvious indicators of fill, such as artificial debris or extensive mottling/disturbance, resulting in their classification as possible fill.

Alluvium

Native alluvial soils were encountered at the ground surface or beneath the pavements and/or fill materials at all of the boring locations. The native alluvial soils encountered at the boring and CPT locations generally consist of interbedded layers of sands, silts, and clays. In general, loose to medium dense fine sand and silty sand layers were encountered within the upper 4 to 6½± feet at most of the boring and CPT locations. These sand and silty sand layers are generally underlain by interbedded strata of very loose to medium dense silty sands, clayey sands, sandy silts, and very soft to very stiff silty clays, sandy clays, and clayey silts, extending to depths. At depths greater than 33± feet, occasional dense sand layers were encountered at the boring locations.

Groundwater

Free water was encountered during drilling at all of the boring locations between 5 to 8½± feet below ground surface. Delayed groundwater level readings were taken at Boring Nos. B-1, B-3,

and B-6 at times ranging between 2½ to 4½± hours after the completion of these borings. At these boring locations, water was present at depths between 5 and 6½± feet below ground surface during the final measurement. Delayed readings were not practical at some of the other borings due to caving within the open boreholes after the augers were withdrawn. Based on the moisture contents of the recovered soil samples and the delayed water measurements taken within the open boreholes, the static groundwater table is considered to have been present at depths of 5 to 6½± feet below the existing site grades at the time of subsurface exploration.

As part of our research, we reviewed available groundwater data in order to determine the historic high groundwater level for the site. The primary reference used to determine the historic groundwater depths in this area is CGS Open File Report 98-10, which indicates that the historic high groundwater level for the site was 11± feet below the ground surface.

We attempted to research more recent water level data at the California Department of Water Resources website, http://www.water.ca.gov/waterdatalibrary/. However, the nearest monitoring well is located approximately 6,767± feet north of the site. The well data available for this location is not consistent with the water levels measured at this site, so this well is considered irrelevant for the subject site. Water level readings within this monitoring well indicates high groundwater levels of 48½± feet (March, 2019) below the ground surface.

5.0 LABORATORY TESTING

The soil samples recovered from the subsurface exploration were returned to our laboratory for further testing to determine selected physical and engineering properties of the soils. The tests are briefly discussed below. It should be noted that the test results are specific to the actual samples tested, and variations could be expected at other locations and depths.

Classification

All recovered soil samples were classified using the Unified Soil Classification System (USCS), in accordance with ASTM D-2488. The field identifications were then supplemented with additional visual classifications and/or by laboratory testing. The USCS classifications are shown on the Boring Logs and are periodically referenced throughout this report.

Dry Density and Moisture Content

The density has been determined for selected relatively undisturbed ring samples. These densities were determined in general accordance with the method presented in ASTM D-2937. The results are recorded as dry unit weight in pounds per cubic foot. The moisture contents are determined in accordance with ASTM D-2216, and are expressed as a percentage of the dry weight. These test results are presented on the Boring Logs.

Consolidation

Selected soil samples have been tested to determine their consolidation potential, in accordance with ASTM D-2435. The testing apparatus is designed to accept either natural or remolded samples in a one-inch high ring, approximately 2.416 inches in diameter. Each sample is then loaded incrementally in a geometric progression and the resulting deflection is recorded at selected time intervals. Porous stones are in contact with the top and bottom of the sample to permit the addition or release of pore water. The samples are typically inundated with water at an intermediate load to determine their potential for collapse or heave. The results of the consolidation testing are plotted on Plates C-1 through C-8 in Appendix C of this report.

Soluble Sulfates

Representative samples of the near-surface soils were submitted to a subcontracted analytical laboratory for determination of soluble sulfate content. Soluble sulfates are naturally present in soils, and if the concentration is high enough, can result in degradation of concrete which comes into contact with these soils. The results of the soluble sulfate testing are presented below and are discussed further in a subsequent section of this report.

Sample Identification	Soluble Sulfates (%)	Severity	Class
B-3 @ 0 to 5 feet	<0.001	Not Applicable	S0
B-4 @ 0 to 5 feet	0.023	Not Applicable	S0

Corrosivity Testing

Representative bulk samples of the near-surface soils were submitted to a subcontracted analytical laboratory for determination of electrical resistivity, pH, and chloride concentrations. The resistivity of the soils is a measure of their potential to attack buried metal improvements such as utility lines. The results of the resistivity and pH testing are presented below:

Sample Identification	Resistivity (ohm-cm)	pH	Chlorides (mg/kg)
B-3 @ 0 to 5 feet	5200	8.6	8.9
B-4 @ 0 to 3 feet	1,520	8.3	68

Expansion Index

The expansion potential of the on-site soils was determined in general accordance with ASTM D-4829 as required by the California Building Code (CBC). The testing apparatus is designed to accept a 4-inch diameter, 1-in high, remolded sample. The sample is initially remolded to 50± 1 percent saturation and then loaded with a surcharge equivalent to 144 pounds per square foot. The sample is then inundated with water, and allowed to swell against the surcharge. The resultant swell or consolidation is recorded after a 24-hour period. The results of the EI testing are as follows:

Sample Identification	Expansion Index	Expansive Potential
B-4 @ 0 to 5 feet	8	Very Low

Maximum Dry Density and Optimum Moisture Content

A representative bulk sample was tested for its maximum dry density and optimum moisture content. The results have been obtained using the Modified Proctor procedure, per ASTM D-1557. These tests are generally used to compare the in-situ densities of undisturbed field samples, and for later compaction testing. Additional testing of other soil type or soil mixes may be necessary at a later date. The results of the testing are plotted on Plate C-9 in Appendix C of this report.

6.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the results of our review, field exploration, laboratory testing and geotechnical analysis, the proposed development is considered feasible from a geotechnical standpoint. The recommendations contained in this report should be taken into the design, construction, and grading considerations.

The recommendations are contingent upon all grading and foundation construction activities being monitored by the geotechnical engineer of record. The recommendations are provided with the assumption that an adequate program of client consultation, construction monitoring, and testing will be performed during the final design and construction phases to verify compliance with these recommendations. Maintaining Southern California Geotechnical, Inc., (SCG) as the geotechnical consultant from the beginning to the end of the project will provide continuity of services. The geotechnical engineering firm providing testing and observation services shall assume the responsibility of Geotechnical Engineer of Record.

The Grading Guide Specifications, included as Appendix D, should be considered part of this report, and should be incorporated into the project specifications. The contractor and/or owner of the development should bring to the attention of the geotechnical engineer any conditions that differ from those stated in this report, or which may be detrimental for the development.

6.1 Seismic Design Considerations

The subject site is located in an area which is subject to strong ground motions due to earthquakes. The performance of a site specific seismic hazards analysis was beyond the scope of this investigation. However, numerous faults capable of producing significant ground motions are located near the subject site. Due to economic considerations, it is not generally considered reasonable to design a structure that is not susceptible to earthquake damage. Therefore, significant damage to structures may be unavoidable during large earthquakes. The proposed structures should, however, be designed to resist structural collapse and thereby provide reasonable protection from serious injury, catastrophic property damage and loss of life.

Faulting and Seismicity

Research of available maps indicates that the subject site is not located within an Alquist-Priolo Earthquake Fault Zone. Furthermore, SCG did not identify any evidence of faulting during the geotechnical investigation. Therefore, the possibility of significant fault rupture on the site is considered to be low.

The potential for other geologic hazards such as seismically induced settlement, tsunamis, inundation, seiches, flooding, and subsidence affecting the site is considered low.

Seismic Design Parameters

The California Building Code (CBC) provides procedures for earthquake resistant structural design that include considerations for on-site soil conditions, occupancy, and the configuration of the structure including the structural system and height. The seismic design parameters presented below are based on the soil profile and the proximity of known faults with respect to the subject site.

Based on standards in place at the time of this report, the proposed development is expected to be designed in accordance with the requirements of the 2016 edition of the California Building Code (CBC). However, it is also possible that the proposed development may be designed using the 2019 CBC, which will be adopted on January 1, 2020. Therefore, this report provides design parameters for both the 2016 CBC and the 2019 CBC. Other design consultants should verify the version of the code under which the proposed development will be submitted.

The 2016 and 2019 CBC Seismic Design Parameters have been generated using the SEAOC/OSHPD Seismic Design Maps Tool, a web-based software application available at the website www.seismicmaps.org. This software application calculates seismic design parameters in accordance with several building code reference documents, including ASCE 7-10 and ASCE 7-16, upon which the 2016 CBC and 2019 CBC are based, respectively. The application utilizes a database of risk-targeted maximum considered earthquake (MCE_R) site accelerations at 0.01-degree intervals for each of the code documents. The tables below were created using data obtained from the application. The output generated from this program is included as Plates E-1A (2016 CBC) and E-1B (2019 CBC) in Appendix E of this report. Based on this output, the following parameters may be utilized for the subject site:

2016 CBC SEISMIC DESIGN PARAMETERS

Parameter		Value
Mapped Spectral Acceleration at 0.2 sec Period	S_S	1.484
Mapped Spectral Acceleration at 1.0 sec Period	S_1	0.541
Site Class	---	D*
Site Modified Spectral Acceleration at 0.2 sec Period	S_{MS}	1.484
Site Modified Spectral Acceleration at 1.0 sec Period	S_{M1}	0.812
Design Spectral Acceleration at 0.2 sec Period	S_{DS}	0.989
Design Spectral Acceleration at 1.0 sec Period	S_{D1}	0.541

*The 2016 and 2019 CBC require that Site Class F be assigned to any profile containing soils vulnerable to potential failure or collapse under seismic loading, such as liquefiable soils. For Site Class F, the site coefficients are to be determined in accordance with Section 11.4.7 of ASCE 7-10/ASCE 7-16. However, Section 20.3.1 of ASCE 7-10/ASCE 7-16 indicates that for sites with structures having a fundamental period of vibration equal to or less than 0.5 seconds, the site coefficient factors (F_a and F_v) may be determined using the standard procedures. Based on the proposed construction, we expect that the proposed building and building addition will possess periods of vibration less than 0.5 seconds. The seismic design parameters tabulated above were calculated using the site coefficient factors for Site Class D, assuming that the fundamental period of both of the structures is less than 0.5 seconds. However, the results of the liquefaction evaluation indicate that the subject site is underlain by potentially liquefiable soils. Therefore, if the proposed structure has a fundamental period greater than 0.5 seconds, a site-specific seismic hazards analysis will be required and additional subsurface exploration will be necessary.

The 2019 CBC requires that a site-specific ground motion study be performed in accordance with Section 11.4.8 of ASCE 7-16 for Site Class D sites with a mapped S_1 value greater than 0.2. However, Section 11.4.8 of ASCE 7-16 also indicates an exception to the requirement for a site-specific ground motion hazard analysis for certain structures on Site Class D sites. The commentary for Section 11 of ASCE 7-16 (Page 534 of Section C11 of ASCE 7-16) indicates that "In general, this exception effectively limits the requirements for site-specific hazard analysis to very tall and or flexible structures at Site Class D sites." **Based on our understanding of the proposed development, the seismic design parameters presented below were calculated assuming that the exception in Section 11.8.4 applies to the proposed structures at this site. However, the structural engineer should verify that this exception is applicable to the proposed structures.** Based on the exception, the spectral response accelerations presented below were calculated using the site coefficients (F_a and F_v) from Tables 1613.2.3(1) and 1613.2.3(2) presented in Section 16.4.4 of the 2019 CBC.

2019 CBC SEISMIC DESIGN PARAMETERS

Parameter		Value
Mapped MCE_R Acceleration at 0.2 sec Period	S_S	1.440
Mapped MCE_R Acceleration at 1.0 sec Period	S_1	0.510
Site Class	---	D*
Site Modified Spectral Acceleration at 0.2 sec Period	S_{MS}	1.440
Site Modified Spectral Acceleration at 1.0 sec Period	S_{M1}	0.913
Design Spectral Acceleration at 0.2 sec Period	S_{DS}	0.960
Design Spectral Acceleration at 1.0 sec Period	S_{D1}	0.609

*Please refer to the note located beneath the 2016 CBC Seismic Design Parameters table.

It should be noted that the site coefficient F_v and the parameters S_{M1} and S_{D1} were not included in the SEAOC/OSHPD Seismic Design Maps Tool output for the 2019 CBC. We calculated these parameters-based on Table 1613.2.3(2) in Section 16.4.4 of the 2019 CBC using the value of S_1 obtained from the Seismic Design Maps Tool, assuming that a site-specific ground motion hazards analysis is not required for the proposed buildings at this site.

Ground Motion Parameters

For the liquefaction evaluation, we utilized a site acceleration consistent with maximum considered earthquake ground motions, as required by the 2016 CBC. The peak ground acceleration (PGA_M) was determined in accordance with Section 11.8.3 of ASCE 7-10. The parameter PGA_M is the maximum considered earthquake geometric mean (MCE_G) PGA, multiplied by the appropriate site coefficient from Table 11.8-1 of ASCE 7-10. The web-based software application SEAOC/OSHPD Seismic Design Maps Tool (described in the previous section) was used to determine PGA_M, based on ASCE 7-10 as the building code reference document. A portion of the program output is included as Plate E-1A in Appendix E of this report. As indicated on Plate E-1A, the PGA_M for this site is 0.541g. An associated earthquake magnitude was obtained from the USGS Unified Hazard Tool, Interactive Deaggregation application available on the USGS website. The deaggregated modal magnitude is 7.3, based on the peak ground acceleration and soil classification D for a return period of 3,134 years.

It should be noted that the 2019 CBC requires that different ground motion parameters be used for the liquefaction evaluation. Therefore, if this project will be designed in accordance with the 2019 CBC, the ground motion parameters and the liquefaction evaluation should be updated to the 2019 standards.

Liquefaction

Research of the Los Alamitos Quadrangle, California 7.5 Minute Seismic Hazard Zone Map, published by the California Geological Survey, indicates that the site is located in a designated liquefaction hazard zone. Therefore, the scope of this investigation included a detailed liquefaction evaluation in order to determine the site-specific liquefaction potential.

Liquefaction is the loss of strength in generally cohesionless, saturated soils when the pore-water pressure induced in the soil by a seismic event becomes equal to or exceeds the overburden pressure. The primary factors which influence the potential for liquefaction include groundwater table elevation, soil type and plasticity characteristics, relative density of the soil, initial confining pressure, and intensity and duration of ground shaking. The depth within which the occurrence of liquefaction may impact surface improvements is generally identified as the upper 50 feet below the existing ground surface. Liquefaction potential is greater in saturated, loose, poorly graded fine sands with a mean (d_{50}) grain size in the range of 0.075 to 0.2 mm (Seed and Idriss, 1971). Non-sensitive clayey (cohesive) soils which possess a plasticity index of at least 18 (Bray and Sancio, 2006) are generally not considered to be susceptible to liquefaction, nor are those soils which are above the historic static groundwater table.

The liquefaction analysis was conducted in accordance with the requirements of Special Publication 117A (CDMG, 2008), and currently accepted practice (SCEC, 1997). The liquefaction potential of the subject site was evaluated using the empirical method developed by Boulanger and Idriss (Boulanger and Idriss, 2008, 2014). This method predicts the earthquake-induced liquefaction potential of the site based on a given design earthquake magnitude and peak ground acceleration at the subject site. This procedure essentially compares the cyclic resistance ratio (CRR) [the cyclic stress ratio required to induce liquefaction for a cohesionless soil stratum at a given depth] with the earthquake-induced cyclic stress ratio (CSR) at that depth from a specified design earthquake (defined by a peak ground surface acceleration and an associated earthquake moment magnitude). CRR is determined as a function of the corrected SPT N-value $(N_1)_{60\text{-}cs}$, adjusted for fines content and/or the corrected CPT tip stress, $q_{c1N\text{-}cs}$. The factor of safety against liquefaction is defined as CRR/CSR. Based on Special Publication 117A, a factor of safety of at least 1.3 is required in order to demonstrate that a given soil stratum is non-liquefiable. Additionally, in accordance with Special Publication 117A, clayey soils which do not meet the criteria for liquefiable soils defined by Bray and Sancio (2006), loose soils with a plasticity index (PI) less than 12 and moisture content greater than 85 percent of the liquid limit, are considered to be insusceptible to liquefaction. Non-sensitive soils with a PI greater than 18 are also considered non-liquefiable.

The liquefaction potential for the on-site soils was evaluated using data obtained at the four (4) CPT locations. This data was analyzed using the computer program Cliq V2.2.1.11, which was developed by Geologismiki, copyright 2006. The analysis method is based on Boulanger and Idriss 2014. The liquefaction potential of the site was analyzed utilizing a PGA_M of 0.611g for a

magnitude 7.3 seismic event. A copy of the program output is presented in Appendix H of this report. As part of the liquefaction evaluation, Boring Nos. B-1 and B-6 were extended to depths of 50± feet in order to provide samples for laboratory testing and correlation with the results of the CPT.

If liquefiable soils are identified, the potential settlements that could occur as a result of liquefaction are determined using the equation for volumetric strain due to post-cyclic reconsolidation (Yoshimine et. al, 2006). This procedure uses an empirical relationship between the induced cyclic shear strain and the cyclic resistance ratio to determine the expected volumetric strain of saturated sands subjected to earthquake shaking.

Conclusions and Recommendations

The results of the liquefaction analysis have identified potentially liquefiable soils at all four (4) of the CPT soundings performed at the site. Soils which are located above the historic groundwater table or possess factors of safety of at least 1.3 are considered non-liquefiable. Several clayey strata located below the ground water table are also considered to be non-liquefiable due to their cohesive characteristics and the results of the Atterberg limits testing with respect to the criteria of Bray and Sancio (2006). Settlement analyses were conducted for each of the potentially liquefiable strata. The results of the dynamic settlement analyses are included the CLIQ program output in Appendix H and are presented below:

- CPT-1: 2.71± inches
- CPT-2: 3.59± inches
- CPT-3: 2.90± inches
- CPT-4: 1.85± inches

Based on these total settlements, differential settlements of up to 2± inches should be expected to occur during a liquefaction inducing seismic event. The estimated differential settlement could be assumed to occur across a distance of 50 feet, indicating a maximum angular distortion of about 0.003 inches per inch.

Shallow Liquefiable Layers

The majority of the liquefaction induced settlement is projected to occur at depths of less than 22± feet and all of the borings and CPTs identified liquefiable soils between depths of 5 and 15± feet below the existing site grades. Based on these considerations, we expect that liquefiable soils will be present within the influence zones of new foundations. Additionally, based on Ishihara's criteria, liquefaction of the near surface soils could result in surface manifestations, including sand boils.

The consequences of soil liquefaction occurring within the zone of influence of a foundation can result in the loss of bearing capacity and/or punching failure. An isolated column footing with typical structural loads could settle rapidly during a liquefaction inducing seismic event. The magnitude of the settlement below a loaded column can be much higher than the dynamic settlements presented above for free-field conditions.

The presence of groundwater at depths of 5 to 6½± feet will make remedial grading impractical to mitigate liquefiable soils present within the foundation influence zones of the new structures. Extensive dewatering would be required to facilitate overexcavation and recompaction of the existing soils present in the foundation influence zones.

Based on the presence of shallow liquefiable soil layers, we do not recommend that the new buildings be supported on conventional shallow foundations without mitigation of the near surface liquefaction potential of the soils within the building areas. Therefore, we recommend that ground improvement techniques be used to improve the near surface soils present within the influence of any foundation elements. Designing the proposed buildings to remain completely undamaged during a major seismic event is not considered to be economically feasible. The ground improvement program should be designed to mitigate potentially liquefiable soil layers within the foundation influence zones. Additional geotechnical design considerations regarding the recommended ground improvement, such as the presence of compressible soils below the ground water table, are discussed in a subsequent section of this report.

Any utility connections to the structures should be designed to withstand the estimated dynamic settlements. It should also be noted that minor to moderate repairs, including releveling, restoration of utility connections, repair of damaged drywall and stucco, etc., would likely be required after occurrence of a major earthquake.

The use of shallow foundation systems in conjunction with the recommend ground improvement, as described in this report, is typical for buildings of these types, where they are underlain by the extent of liquefiable soils encountered at this site. The post-liquefaction damage that could occur within the buildings is expected to be typical of similar buildings in the vicinity of this project. Other geotechnical and structural options are available, including the use of deep foundations such as driven piles, and drilled piers, but are considered to be less economically feasible.

Lateral Spreading

No significant slopes or free faces are present at within several hundred feet the subject site, with the exception of a concrete lined drainage channel located about 40± feet south of the southern property line of the subject site. Based on the fact that the only slopes near the subject site are covered with concrete, lateral spreading is not considered to be a significant design concern for this project.

6.2 Geotechnical Design Considerations

General

Some of the borings encountered artificial fill soils and soils classified as possible fill, extending to depths of 3 to 4½± feet at the boring locations. These soils possess variable densities and strengths and some of these foils possess a disturbed, mottled appearance. Additionally, no documentation regarding the placement and compaction of the existing fill soil soils has been provided to our office. The fill soils are therefore considered to be undocumented fill. The fill soils

are underlain by native alluvium which possesses variable strengths and composition. Based on the results of laboratory testing, some of the native alluvial soils possess very unfavorable consolidation characteristics and relatively low strengths.

The results of our site-specific liquefaction evaluation indicate that some potentially liquefiable soil layers are present between depths of 5 and 15± feet. These liquefiable layers are expected to be located within the foundation influence zone of a building supported by conventional shallow foundations. As discussed in the previous section, liquefaction can result in a loss of bearing capacity and excessive settlements of foundation elements supported on liquefiable soils. Therefore, liquefiable layers present within the influence zone of any new building foundations should mitigated if conventional shallow foundations will be used for the proposed buildings at this site.

Based on the presence of undocumented fill materials and low strength, compressible and potentially liquefiable soils, the near surface soils, in their present condition, are not considered suitable for support of the foundations and floor slabs of the new structures. The presence of shallow groundwater, present at depths as shallow as 5 to 6½± feet will make remedial grading of the compressible native alluvium impractical without extensive dewatering.

Based on conversations with the client, we understand that consideration is being given to the use of ground improvement techniques at this site. The grading and foundation design parameters provided in the subsequent sections of this report assume that the soils in at least the upper 12± feet below existing site grades will be improved using ground improvement techniques.

Settlement

The recommended ground improvement measures will improve the highly compressible alluvium and the liquefiable soils present within the foundation influence zones of the new buildings. The native soils that will remain in place below the recommended depth of ground improvement will not be subject to significant load increases from the foundations of the new structures. Provided that the ground improvement and recommended remedial grading is completed, the post-construction settlements of the proposed structures are expected to be within tolerable limits for conventional shallow foundations.

Soluble Sulfates

The results of the soluble sulfate testing, as discussed in Section 5.0 of this report, indicate soluble sulfate concentrations of up to 0.023 percent. These concentrations are considered to be negligible or "not applicable" with respect to the American Concrete Institute (ACI) Publication 318-05 Building Code Requirements for Structural Concrete and Commentary, Section 4.3. Therefore, specialized concrete mix designs are not considered to be necessary, with regard to sulfate protection purposes. It is, however, recommended that additional soluble sulfate testing be conducted at the completion of rough grading to verify the soluble sulfate concentrations of the soils which are present at the proposed building pad grades.

Corrosion Potential

The results of the electrical resistivity and pH testing indicate that two samples of the on-site soils have resistivities of 1,520 and 5,200 ohm-cm and pH values of 8.3 and 8.6. These test results have been evaluated in accordance with guidelines published by the Ductile Iron Pipe Research Association (DIPRA). The DIPRA guidelines consist of a point system by which characteristics of the soils are used to quantify the corrosivity characteristics of the site. Resistivity and pH are two of the five factors that enter into the evaluation procedure. Relative soil moisture content as well as redox potential and sulfides are also included. Although redox potential and sulfide testing were not part of the scope of services for this project, we have evaluated the corrosivity characteristics of the on-site soils using resistivity, pH and moisture content. Based on these factors, and utilizing the DIPRA procedure, **some of the on-site soils are considered to be corrosive to ductile iron pipes and other buried metal improvements. Therefore, it is expected that polyethylene encasement will be required for iron pipes.** If a more detailed evaluation is desired, redox potential and sulfide content should be determined for the on-site soils. Since SCG does not practice in the area of corrosion engineering, it is recommended that the client contact a corrosion engineer to provide a more thorough evaluation.

Expansion

The near surface soils at this site generally consist of silty sands. Laboratory testing performed on a representative sample of these materials indicate that they possess a very low expansion potential (EI =8). Based on the very low expansive classification, no design considerations related to expansive soils are considered warranted for this site.

Shrinkage/Subsidence

Removal and recompaction of the near-surface native fill soils is estimated to result in an average shrinkage of 12 to 18 percent. However, the estimated shrinkage of the individual soil layers at the site is highly variable, locally ranging from 4 to 22 percent shrinkage. It should be noted that the potential shrinkage estimate is based on dry density testing performed on small-diameter samples taken at the boring locations. If a more accurate and precise shrinkage estimate is desired, SCG can perform a shrinkage study involving several excavated test-pits where in-place densities are determined using in-situ testing methods instead of laboratory density testing on small-diameter samples. Please contact SCG for details and a cost estimate regarding a shrinkage study, if desired.

Minor ground subsidence is expected to occur in the soils below the zone of removal, due to settlement and machinery working. The subsidence is estimated to be 0.1± feet.

These estimates are based on previous experience and the subsurface conditions encountered at the boring locations. The actual amount of subsidence is expected to be variable and will be dependent on the type of machinery used, repetitions of use, and dynamic effects, all of which are difficult to assess precisely.

Grading and Foundation Plan Review

As discussed previously, detailed foundation plans and grading plans were not available at the time of this report. It is therefore recommended that we be provided with copies of the plans, when they become available, for review with regard to the conclusions, recommendations, and assumptions contained within this report.

6.3 Site Grading Recommendations

The grading recommendations presented below are based on the subsurface conditions encountered at the boring locations and our understanding of the proposed development. We recommend that all grading activities be completed in accordance with the Grading Guide Specifications included as Appendix D of this report, unless superseded by site-specific recommendations presented below.

Demolition and Site Stripping

The proposed development will require demolition of the existing pavements and structures. Additionally, any existing improvements that will not remain in place for use with the new development should be removed in their entirety. This should include all utilities, and any other subsurface improvements associated with the existing pavements. Existing improvements which are to remain in place with the new development should be protected from damage by construction traffic.

Debris resultant from demolition should be disposed of offsite. Concrete and asphalt debris may be re-used within compacted fills, provided they are pulverized to a maximum particle size of less than 2 inches, and thoroughly mixed with the on-site soils. Existing asphalt and concrete materials may also be crushed into miscellaneous base (CMB) and re-used at the site. Alternatively, concrete and asphalt debris may be crushed to particle sizes of 2 to 4 inches and used to stabilize unstable overexcavation subgrades.

Detailed structural information regarding the existing buildings has not been provided to our office. Therefore, the foundation systems supporting the existing building are presently unknown by SCG. If the existing buildings are supported on deep foundation systems, the deep foundation elements located within the proposed building areas should be cut off at a depth of at least 2 feet below the bottom of the planned overexcavation. Where drilled pier foundations are encountered within proposed pavement areas, they should be cut off at a depth of at least 2 feet below the proposed pavement subgrade or at a depth of at least 1 foot below the bottom of any planned utilities.

Demolition of some landscape planters is also expected to be required. Any vegetation or organic soils within these planters should be disposed of off-site. Turf grass and other grass and weed growth should be stripped from the site in its entirety. Removal of some trees may also be required. Where trees are removed, the removal should also include any associated root masses. The actual extent of site stripping should be determined in the field by the geotechnical engineer, based on the organic content and stability of the materials encountered.

Ground Improvement

Ground improvement is recommended to mitigate the potential settlements of compressible native alluvial soils present within the influence zones of new foundations as well as a portion of the potential the dynamic settlements of the near-surface liquefiable soils. Based on the groundwater levels and the soil conditions, techniques such as deep soil mixing or grout injection are considered the most applicable for ground improvement. A specialty contractor should be contacted for specifics of design-build ground improvement methods. Ground improvement should be designed to mitigate potential liquefiable soil layers and compressible soils present within at least the upper 12 feet below existing site grades and should also extend to a depth of at least 10 feet below proposed foundation bearing grades. The depth of ground improvement should also extend to a depth equal to 2 times the width of the proposed footings, below the foundation bearing grade. The actual design of the ground improvement method should be performed by the design-build contractor who is specialized and experienced with these methods. Ground improvement methods are designed and implemented by specialty contractors on a design–build basis where the contractors are ultimately fully responsible for the effectiveness of their mitigation measures over the life of the project.

Treatment of Existing Soils: Building Pads

Remedial grading should be performed within the proposed building pad areas in order to remove the near surface fill soils and a portion of the existing potentially compressible/collapsible native alluvium. The ground improvement contractor should determine whether or not the overexcavation should be performed before the ground improvement measures are implemented. It is recommended that the overexcavation extend to a depth of at least 4 feet below existing grade, and to a depth of at least 4 feet below proposed grade (if practical based on groundwater conditions), whichever is greater. Within the influence zones of the new foundations, the overexcavation should extend to a depth of at least 3 feet below proposed foundation bearing grade. The overexcavation should also extend to a depth sufficient to remove all undocumented fill soils.

The overexcavation areas should extend at least 5 feet beyond the building perimeter, and to an extent equal to the depth of fill below the new foundations. If the proposed structure incorporates any exterior columns (such as for a canopy or overhang) the area of overexcavation should also encompass these areas.

Following completion of the overexcavation, the subgrade soils within the overexcavation areas should be evaluated by the geotechnical engineer to verify their suitability to serve as the structural fill subgrade, as well as to support the foundation loads of the new structure. This evaluation should include proofrolling and probing to identify any soft, loose or otherwise unstable soils that must be removed. Some localized areas of deeper excavation may be required if additional fill materials or loose, porous, overly moist, or low-density native soils are encountered at the base of the overexcavation.

Based on conditions encountered at the exploratory boring locations, very moist soils will be encountered at or near the base of the recommended overexcavation. Stabilization of the exposed overexcavation subgrade soils may be necessary. Scarification and air drying of these materials may be sufficient to obtain a stable subgrade. However, if highly

unstable soils are identified, and if the construction schedule does not allow for delays associated with drying, mechanical stabilization, usually consisting of coarse crushed stone or geotextile, could be necessary. In this event, the geotechnical engineer should be contacted for supplementary recommendations. Typically, an unstable subgrade can be stabilized using a suitable geotextile fabric, such as Mirafi 580I, HP 570 or HP 270, and/or a 12 to 18-inch thick layer of coarse (2 to 4 inch particle size) crushed stone. Crushed asphalt and concrete debris resultant from demolition could also be used as a subgrade stabilization material. Other options, including lime treatment, are also available.

After a suitable overexcavation subgrade has been achieved, the exposed soils should be scarified to a depth of at least 12 inches, and moisture conditioned to 0 to 4 percent above optimum moisture content. The subgrade soils should then be recompacted to at least 90 percent of the ASTM D-1557 maximum dry density. The previously excavated soils may then be replaced as compacted structural fill, provided that they are dried to within 0 to 4 percent above the optimum moisture content. The use of an imported select fill material may be desirable if the construction schedule does not allow for drying of the on-site soils.

Treatment of Existing Soils: Retaining Walls and Site Walls

The existing soils within the areas of proposed retaining and non-retaining site walls should be overexcavated to a depth of at least 3 feet below foundation bearing grade and replaced as compacted structural fill as discussed above for the proposed building pad. Any undocumented fill soils within any of these foundation areas should be removed in their entirety. The overexcavation areas should extend at least 5 feet beyond the foundation perimeters, and to an extent equal to the depth of fill below the new foundations. Erection pads are considered to be part of the foundation system, and therefore these overexcavation recommendations apply to erection pads also. The overexcavation subgrade soils should be evaluated by the geotechnical engineer prior to scarifying, moisture conditioning, and recompacting the upper 12 inches of exposed subgrade soils, as discussed for the building areas. The previously excavated soils may then be replaced as compacted structural fill.

If the full lateral extent of overexcavation is not achievable for the proposed walls, foundation elements must be redesigned using a lower bearing pressure. If the vertical extent of the overexcavation can not be completed due to the presence of groundwater, ground improvement may be necessary for these retaining walls. The geotechnical engineer of record should be contacted for recommendations pertaining to either of these conditions.

Treatment of Existing Soils: Parking Areas

Based on economic considerations, overexcavation of the existing soils in the new parking and drive areas is not considered warranted, with the exception of areas where lower strength, or unstable soils are identified by the geotechnical engineer during grading. Subgrade preparation in the new parking and drive areas should initially consist of removal of all soils disturbed during stripping and demolition operations.

The geotechnical engineer should then evaluate the subgrade to identify any areas of additional unsuitable soils. Any such materials should be removed to a level of firm and unyielding soil. The exposed subgrade soils should then be scarified to a depth of 12± inches, moisture conditioned

to at least 0 to 4 percent above optimum, and recompacted to at least 90 percent of the ASTM D-1557 maximum dry density. Based on the presence of variable strength surficial soils throughout the site, it is expected that some isolated areas of additional overexcavation may be required to remove zones of lower strength, unsuitable soils.

The grading recommendations presented above for the proposed parking area assume that the owner and/or developer can tolerate minor amounts of settlement within the proposed parking areas. The grading recommendations presented above do not completely mitigate the extent of the existing fill soils and low strength alluvium in the parking areas. As such, settlement and associated pavement distress could occur. Typically, repair of such distressed areas involves significantly lower costs than completely mitigating these soils at the time of construction. If the owner cannot tolerate the risk of such settlements, the parking and drive areas should be mitigated in a manner similar to that described for the building pads.

Fill Placement

- Fill soils should be placed in thin (6± inches), near-horizontal lifts, moisture conditioned to 0 to 4 percent above the optimum moisture content, and compacted. **Drying of some the onsite soils will be required before placement and compaction as fill.**
- On-site soils may be used for fill provided they are cleaned of any debris to the satisfaction of the geotechnical engineer.
- All grading and fill placement activities should be completed in accordance with the requirements of the 2016 CBC and the grading code of the city of Cypress.
- All fill soils should be compacted to at least 90 percent of the ASTM D-1557 maximum dry density. Fill soils should be well mixed.
- Compaction tests should be performed periodically by the geotechnical engineer as random verification of compaction and moisture content. These tests are intended to aid the contractor. Since the tests are taken at discrete locations and depths, they may not be indicative of the entire fill and therefore should not relieve the contractor of his responsibility to meet the job specifications.

Imported Structural Fill

All imported structural fill should consist of very low expansive (EI < 20), well graded soils possessing at least 10 percent fines (that portion of the sample passing the No. 200 sieve). Additional specifications for structural fill are presented in the Grading Guide Specifications, included as Appendix D.

Utility Trench Backfill

In general, all utility trench backfill should be compacted to at least 90 percent of the ASTM D-1557 maximum dry density. Compacted trench backfill should conform to the requirements of the local grading code, and more restrictive requirements may be indicated by the city of Cypress. All utility trench backfills should be witnessed by the geotechnical engineer. The trench backfill soils should be compaction tested where possible; probed and visually evaluated elsewhere.

Utility trenches which parallel a footing, and extending below a 1h:1v plane projected from the outside edge of the footing should be backfilled with structural fill soils, compacted to at least 90 percent of the ASTM D-1557 standard. Pea gravel backfill should not be used for these trenches.

6.4 Construction Considerations

Excavation Considerations

The near surface soils in the upper 5± feet generally consist of sands, silty sands, sandy silts, and occasional clayey sands and sandy clays. Some of these materials may be subject to caving within shallow excavations. Where caving occurs within shallow excavations, flattened excavation slopes may be sufficient to provide excavation stability. On a preliminary basis, temporary excavation slopes should be made no steeper than 2:1v. **The contractor should take all necessary precautions during grading and foundation construction to prevent damage to structures and improvements which are adjacent to the proposed development.** Deeper excavations may require some form of external stabilization such as shoring or bracing. Maintaining adequate moisture content within the near-surface soils will improve excavation stability. All excavation activities on this site should be conducted in accordance with Cal-OSHA regulations.

Moisture Sensitive Subgrade Soils

The near surface soils possess appreciable silt content and occasional clay content and will become unstable if exposed to significant moisture infiltration or disturbance by construction traffic. If grading occurs during a period of relatively wet weather, an increase in subgrade instability should also be expected. The site should, therefore, be graded to prevent ponding of surface water and to prevent water from running into excavations.

As discussed in Section 6.3 of this report, unstable subgrade soils are likely to be encountered at the base of the overexcavations within the proposed building and addition areas. The extent of unstable subgrade soils will to a large degree depend on methods used by the contractor to avoid adding additional moisture to these soils or disturbing soils which already possess high moisture contents. If grading occurs during a period of relatively wet weather, an increase in subgrade instability should also be expected.

If the construction schedule dictates that site grading will occur during a period of wet weather, allowances should be made for costs and delays associated with drying the on-site soils or import of a drier, less moisture sensitive fill material. Grading during wet or cool weather may also increase the depth of overexcavation in the pad areas as well as the need for and/or the thickness of the crushed stone stabilization layer, discussed in Section 6.3 of this report.

Groundwater

Based on the conditions encountered in the borings, the groundwater table is considered to have existed at a depth of 5 to 6½± feet at the time of subsurface exploration. Therefore, based on the current groundwater depths, we excavations extending to depths of 5 feet or more may

encounter the water table. Dewatering will likely be required in excavations of grater than 5 feet below the existing site grades.

6.5 Foundation Design and Construction

Based on the preceding grading recommendations, it is assumed that the new building pad will be underlain by newly placed structural fill soils placed within 4 feet of the existing site grades. Additionally, the compressible native alluvium present beneath the groundwater table will be improved using ground improvement techniques. Based on this subsurface profile, the proposed structure may be supported on shallow foundations.

Foundation Design Parameters

New square and rectangular footings may be designed as follows:

- Maximum, net allowable soil bearing pressure: 2,000 lbs/ft^2. A greater foundation bearing pressure may be allowed based on the ground improvement technique used.

- Minimum wall/column footing width: 14 inches/24 inches.

- Minimum longitudinal steel reinforcement within strip footings: Six (6) No. 5 rebars (3 top and 3 bottom) due to the presence of liquefiable soils.

- Minimum foundation embedment: 12 inches into suitable structural fill soils, and at least 18 inches below adjacent exterior grade. Interior column footings may be placed immediately beneath the floor slab.

- It is recommended that the perimeter building foundations be continuous across all exterior doorways. Any flatwork adjacent to the exterior doors should be doweled into the perimeter foundations in a manner determined by the structural engineer.

The allowable bearing pressures presented above may be increased by 1/3 when considering short duration wind loads. However, based on the presence of shallow liquefiable soils, we do not recommend an increase in the allowable bearing capacity for seismic loads. The minimum steel reinforcement recommended above is based on standard geotechnical practice. Additional rigidity may be necessary for structural considerations. The actual design of the foundations should be determined by the structural engineer.

Foundation Construction

The foundation subgrade soils should be evaluated at the time of overexcavation, as discussed in Section 6.3 of this report. It is further recommended that the foundation subgrade soils be evaluated by the geotechnical engineer immediately prior to steel or concrete placement. Soils suitable for direct foundation support should consist of newly placed structural fill compacted at least 90 percent of the ASTM D-1557 maximum dry density. Any unsuitable materials should be removed to a depth of suitable bearing compacted structural fill, with the resulting excavations

backfilled with compacted fill soils. As an alternative, lean concrete slurry (500 to 1,500 psi) may be used to backfill such isolated overexcavations.

The foundation subgrade soils should also be properly moisture conditioned to 0 to 4 percent above the Modified Proctor optimum, to a depth of at least 12 inches below bearing grade. Since it is typically not feasible to increase the moisture content of the floor slab and foundation subgrade soils once rough grading has been completed, care should be taken to maintain the moisture content of the building pad subgrade soils throughout the construction process.

Estimated Foundation Settlements

Post-construction total and differential static settlements of shallow foundations designed and constructed in accordance with the previously presented recommendations are estimated to be less than 1.0 and 0.5 inches, respectively, under static conditions. Differential movements are expected to occur over a 30-foot span, thereby resulting in an angular distortion of less than 0.002 inches per inch. These settlements are in addition to the liquefaction-induced settlements previously discussed in Section 6.1 of this report. However, the likelihood of these two settlements combining is considered remote. The static settlements are expected to occur in a relatively short period of time after the building loads being applied to the foundations, during and immediately subsequent to construction. It should be noted that the projected potential dynamic settlement is related to a major seismic event and a conservative historic high groundwater level.

Lateral Load Resistance

Lateral load resistance will be developed by a combination of friction acting at the base of foundations and slabs and the passive earth pressure developed by footings below grade. The following friction and passive pressure may be used to resist lateral forces:

- Passive Earth Pressure: 240 lbs/ft^3
- Friction Coefficient: 0.27

These are allowable values, and include a factor of safety. When combining friction and passive resistance, the passive pressure component should be reduced by one-third. These values assume that footings will be poured directly against compacted structural fill. The maximum allowable passive pressure is 2,500 lbs/ft^2.

6.6 Floor Slab Design and Construction

Subgrades which will support new floor slabs should be prepared in accordance with the recommendations contained in the ***Site Grading Recommendations*** section of this report. Based on the anticipated grading which will occur at this site, and based on the design considerations presented in Section 6.1 of this report, the floor of the proposed structure may be constructed as a conventional slab-on-grade supported on newly placed structural fill, extending to a depth of at least 4 feet below proposed finished pad grade. Based on geotechnical considerations, the floor slab may be designed as follows:

- Minimum slab thickness: 6 inches

- Modulus of Subgrade Reaction: k = 100 psi/in.

- Minimum slab reinforcement: Minimum slab reinforcement: No. 3 bars at 16 inches on-center, in both directions, due to the presence of potentially liquefiable and low expansive soils at the site. The actual floor slab reinforcement should be determined by the structural engineer, based on the imposed loading, and the liquefaction-induced settlements.

- Slab underlayment: If moisture sensitive floor coverings will be used then minimum slab underlayment should consist of a moisture vapor barrier constructed below the entire slab area where such moisture sensitive floor coverings are expected. The moisture vapor barrier should meet or exceed the Class A rating as defined by ASTM E 1745-97 and have a permeance rating less than 0.01 perms as described in ASTM E 96-95 and ASTM E 154-88. A polyolefin material such as Stego® Wrap Vapor Barrier or equivalent will meet these specifications. The moisture vapor barrier should be properly constructed in accordance with all applicable manufacturer specifications. Given that a rock free subgrade is anticipated and that a capillary break is not required, sand below the barrier is not required. The need for sand and/or the amount of sand above the moisture vapor barrier should be specified by the structural engineer or concrete contractor. The selection of sand above the barrier is not a geotechnical engineering issue and hence outside our purview. Where moisture sensitive floor coverings are not anticipated, the vapor barrier may be eliminated.

- Moisture condition the floor slab subgrade soils to 2 to 4 percent above the Modified Proctor optimum moisture content, to a depth of 12 inches. The moisture content of the floor slab subgrade soils should be verified by the geotechnical engineer within 24 hours prior to concrete placement.

- Proper concrete curing techniques should be utilized to reduce the potential for slab curling or the formation of excessive shrinkage cracks.

The actual design of the floor slabs should be completed by the structural engineer to verify adequate thickness and reinforcement. The steel reinforcement recommendations presented above are based on standard geotechnical practice, given the magnitude of predicted liquefaction-induced settlements, and the structure type proposed for the site. Additional rigidity may be necessary for structural considerations, or to resist the effects of the liquefaction-induced differential settlements discussed in Section 6.1.

6.7 Retaining Wall Design and Construction

Although not indicated on the site plan, some small (less than 6 feet in height) retaining walls may be required to facilitate the new site grades and in loading docks. The parameters recommended for use in the design of these walls are presented below.

Retaining Wall Design Parameters

Based on the soil conditions encountered at the boring locations, the following parameters may be used in the design of new retaining walls for this site. We have provided parameters assuming the use of on-site soils for retaining wall backfill. The near-surface soils generally consist of silty sands, sands and occasional fine sandy silts. Based on their classification, these materials are expected to possess a friction angle of at least 29 degrees when compacted to at least 90 percent of the ASTM D-1557 maximum dry density. Soils consisting of silty clays and clayey silts likely possess lower strengths and should not be used to backfill retaining walls.

If desired, SCG could provide design parameters for an alternative select backfill material behind the retaining walls. The use of select backfill material could result in lower lateral earth pressures. In order to use the design parameters for the imported select fill, this material must be placed within the entire active failure wedge. This wedge is defined as extending from the heel of the retaining wall upwards at an angle of approximately 60° from horizontal. If select backfill material behind the retaining wall is desired, SCG should be contacted for supplementary recommendations.

RETAINING WALL DESIGN PARAMETERS

Design Parameter		**Soil Type**
		On-site Silty Sands and fine Sands
Internal Friction Angle (ϕ)		29°
Unit Weight		125 lbs/ft^3
Equivalent Fluid Pressure:	Active Condition (level backfill)	44 lbs/ft^3
	Active Condition (2h:1v backfill)	73 lbs/ft^3
	At-Rest Condition (level backfill)	64 lbs/ft^3

The walls should be designed using a soil-footing coefficient of friction of 0.27 and an equivalent passive pressure of 240 lbs/ft^3. The structural engineer should incorporate appropriate factors of safety in the design of the retaining walls.

The active earth pressure may be used for the design of retaining walls that do not directly support structures or support soils that in turn support structures and which will be allowed to deflect. The at-rest earth pressure should be used for walls that will not be allowed to deflect such as those which will support foundation bearing soils, or which will support foundation loads directly.

Where the soils on the toe side of the retaining wall are not covered by a "hard" surface such as a structure or pavement, the upper 1 foot of soil should be neglected when calculating passive resistance due to the potential for the material to become disturbed or degraded during the life of the structure.

Seismic Lateral Earth Pressures

In addition to the lateral earth pressures presented in the previous section, retaining walls which are more than 6 feet in height should be designed for a seismic lateral earth pressure, in accordance with the 2016 CBC. Based on the current site plan, it is not expected that any walls in excess of 6 feet in height will be required for this project. If any such walls are proposed, our office should be contacted for supplementary design recommendations.

Retaining Wall Foundation Design

The retaining wall foundations should be supported within newly placed compacted structural fill, extending to a depth of at least 3 feet below the proposed bearing grade. Foundations to support new retaining walls should be designed in accordance with the general Foundation Design Parameters presented in a previous section of this report.

Backfill Material

Retaining wall backfill soils should consist of imported select structural fill possessing an expansion index less than 20. All backfill material placed within 3 feet of the back wall face should have a particle size no greater than 3 inches. The retaining wall backfill materials should be well graded.

It is recommended that a minimum 1 foot thick layer of free-draining granular material (less than 5 percent passing the No. 200 sieve) be placed against the face of the retaining walls. This material should extend from the top of the retaining wall footing to within 1 foot of the ground surface on the back side of the retaining wall. This material should be approved by the geotechnical engineer. In lieu of the 1 foot thick layer of free-draining material, a properly installed prefabricated drainage composite such as the MiraDRAIN 6000XL (or approved equivalent), which is specifically designed for use behind retaining walls, may be used. If the layer of free-draining material is not covered by an impermeable surface, such as a structure or pavement, a 12-inch thick layer of a low permeability soil should be placed over the backfill to reduce surface water migration to the underlying soils. The layer of free draining granular material should be separated from the backfill soils by a suitable geotextile, approved by the geotechnical engineer.

All retaining wall backfill should be placed and compacted under engineering-controlled conditions in the necessary layer thicknesses to ensure an in-place density between 90 and 93 percent of the maximum dry density as determined by the Modified Proctor test (ASTM D1557). Care should be taken to avoid over-compaction of the soils behind the retaining walls, and the use of heavy compaction equipment should be avoided.

Subsurface Drainage

As previously indicated, the retaining wall design parameters are based upon drained backfill conditions. Consequently, some form of permanent drainage system will be necessary in conjunction with the appropriate backfill material. Subsurface drainage may consist of either:

- A weep hole drainage system typically consisting of a series of 4-inch diameter holes in the wall situated slightly above the ground surface elevation on the exposed side of the

wall and at an approximate 8-foot on-center spacing. The weep holes should include a 2 cubic foot pocket of open graded gravel, surrounded by an approved geotextile fabric, at each weep hole location.

- A 4-inch diameter perforated pipe surrounded by 2 cubic feet of gravel per linear foot of drain placed behind the wall, above the retaining wall footing. The gravel layer should be wrapped in a suitable geotextile fabric to reduce the potential for migration of fines. The footing drain should be extended to daylight or tied into a storm drainage system.

Weep holes or a footing drain will not be required for building stem walls.

6.8 Pavement Design Parameters

Site preparation in the pavement area should be completed as previously recommended in the ***Site Grading Recommendations*** section of this report. The subsequent pavement recommendations assume proper drainage and construction monitoring, and are based on either PCA or CALTRANS design parameters for a twenty (20) year design period. However, these designs also assume a routine pavement maintenance program to obtain the anticipated 20-year pavement service life.

Pavement Subgrades

It is anticipated that the new pavements will be primarily supported on a layer of compacted structural fill, consisting of scarified, thoroughly moisture conditioned and recompacted existing soils. The near surface soils generally consist of silty fine sands, fine sands, and occasional fine sandy silts. These soils are generally considered to possess fair to good pavement support characteristics with an estimated R-values ranging from 30 to 40. The subsequent pavement design is therefore based upon an assumed R-value of 30. Any fill material imported to the site should have support characteristics equal to or greater than that of the on-site soils and be placed and compacted under engineering controlled conditions. It is recommended that R-value testing be performed after completion of rough grading. Depending upon the results of the R-value testing, it may be feasible to use thinner pavement sections in some areas of the site.

Asphaltic Concrete

Presented below are the recommended thicknesses for new flexible pavement structures consisting of asphaltic concrete over a granular base. The pavement designs are based on the traffic indices (TI's) indicated. The client and/or civil engineer should verify that these TI's are representative of the anticipated traffic volumes. If the client and/or civil engineer determine that the expected traffic volume will exceed the applicable traffic index, we should be contacted for supplementary recommendations. The design traffic indices equate to the following approximate daily traffic volumes over a 20-year design life, assuming six operational traffic days per week.

Traffic Index	No. of Heavy Trucks per Day
4.0	0
5.0	1
6.0	3
7.0	11
8.0	35

For the purpose of the traffic volumes indicated above, a truck is defined as a 5-axle tractor trailer unit with one 8-kip axle and two 32-kip tandem axles. All of the traffic indices allow for 1,000 automobiles per day.

ASPHALT PAVEMENTS (R = 30)					
Materials	**Thickness (inches)**				
	Automobile Parking (TI = 4.0)	Automobile Drive Lanes (TI = 5.0)	Truck Traffic		
			(TI = 6.0)	(TI = 7.0)	(TI = 8.0)
Asphalt Concrete	3	3	3½	4	5
Aggregate Base	3	6	8	10	11
Compacted Subgrade	12	12	12	12	12

The aggregate base course should be compacted to at least 95 percent of the ASTM D-1557 maximum dry density. The asphaltic concrete should be compacted to at least 95 percent of the Marshall maximum density, as determined by ASTM D-2726. The aggregate base course may consist of crushed aggregate base (CAB) or crushed miscellaneous base (CMB), which is a recycled gravel, asphalt and concrete material. The gradation, R-Value, Sand Equivalent, and Percentage Wear of the CAB or CMB should comply with appropriate specifications contained in the current edition of the "Greenbook" Standard Specifications for Public Works Construction.

Portland Cement Concrete

The preparation of the subgrade soils within concrete pavement areas should be performed as previously described for proposed asphalt pavement areas. The minimum recommended thicknesses for the Portland Cement Concrete pavement sections are as follows:

PORTLAND CEMENT CONCRETE PAVEMENTS			
Materials	**Thickness (inches)**		
	Automobile and Light Truck Traffic (TI = 5.0 & 6.0)	Truck Traffic	
		(TI = 7.0)	(TI = 8.0)
PCC	5	5½	6
Compacted Subgrade (95% minimum compaction)	12	12	12

The concrete should have a 28-day compressive strength of at least 3,000 psi. The maximum joint spacing within all of the PCC pavements is recommended to be equal to or less than 30 times the pavement thickness.

7.0 GENERAL COMMENTS

This report has been prepared as an instrument of service for use by the client, in order to aid in the evaluation of this property and to assist the architects and engineers in the design and preparation of the project plans and specifications. This report may be provided to the contractor(s) and other design consultants to disclose information relative to the project. However, this report is not intended to be utilized as a specification in and of itself, without appropriate interpretation by the project architect, civil engineer, and/or structural engineer. The reproduction and distribution of this report must be authorized by the client and Southern California Geotechnical, Inc. Furthermore, any reliance on this report by an unauthorized third party is at such party's sole risk, and we accept no responsibility for damage or loss which may occur. The client(s)' reliance upon this report is subject to the Engineering Services Agreement, incorporated into our proposal for this project.

The analysis of this site was based on a subsurface profile interpolated from limited discrete soil samples. While the materials encountered in the project area are considered to be representative of the total area, some variations should be expected between boring locations and sample depths. If the conditions encountered during construction vary significantly from those detailed herein, we should be contacted immediately to determine if the conditions alter the recommendations contained herein.

This report has been based on assumed or provided characteristics of the proposed development. It is recommended that the owner, client, architect, structural engineer, and civil engineer carefully review these assumptions to ensure that they are consistent with the characteristics of the proposed development. If discrepancies exist, they should be brought to our attention to verify that they do not affect the conclusions and recommendations contained herein. We also recommend that the project plans and specifications be submitted to our office for review to verify that our recommendations have been correctly interpreted.

The analysis, conclusions, and recommendations contained within this report have been promulgated in accordance with generally accepted professional geotechnical engineering practice. No other warranty is implied or expressed.

8.0 REFERENCES

California Division of Mines and Geology (CDMG), "Guidelines for Evaluating and Mitigating Seismic Hazards in California," State of California, Department of Conservation, Division of Mines and Geology, Special Publication 117A, 2008.

Idriss, I. M. and Boulanger, R.W., "Soil Liquefaction During Earthquakes", Earthquake Engineering Research Institute, 2008.

National Research Council (NRC), "Liquefaction of Soils During Earthquakes," Committee on Earthquake Engineering, National Research Council, Washington D. C., Report No. CETS-EE-001, 1985.

Seed, H. B., and Idriss, I. M., "Simplified Procedure for Evaluating Soil Liquefaction Potential using field Performance Data," Journal of the Soil Mechanics and Foundations Division, American Society of Civil Engineers, September 1971, pp. 1249-1273.

Sadigh, K., Chang, C. –Y., Egan, J. A., Makdisi. F., Youngs, R. R., "*Attenuation Relationships for Shallow Crustal Earthquakes Based on California Strong Motion Data"*, Seismological Research Letters, Seismological Society of America, Volume 68, Number 1, January/ February 1997, pp. 180-189.

Southern California Earthquake Center (SCEC), University of Southern California, "Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Liquefaction in California," Committee formed 1997.

Tokimatsu K., and Seed, H. B., "Evaluation of Settlements in Sands Due to Earthquake Shaking," Journal of the Geotechnical Engineering Division, American society of Civil Engineers, Volume 113, No. 8, August 1987, pp. 861-878.

Tokimatsu, K. and Yoshimi, Y., "*Empirical Correlations of Soil Liquefaction Based on SPT N-value and Fines Content,"* Seismological Research Letters, Eastern Section Seismological Society Of America, Volume 63, Number 1, p. 73.

Youd, T. L. and Idriss, I. M. (Editors), "Proceedings of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils," Salt Lake City, UT, January 5-6 1996, NCEER Technical Report NCEER-97-0022, Buffalo, NY.

APPENDIX A



SOURCE: LOS ANGELES COUNTY
THOMAS GUIDE, 2013

SITE LOCATION MAP

TWO PROPOSED WAREHOUSES

CYPRESS, CALIFORNIA

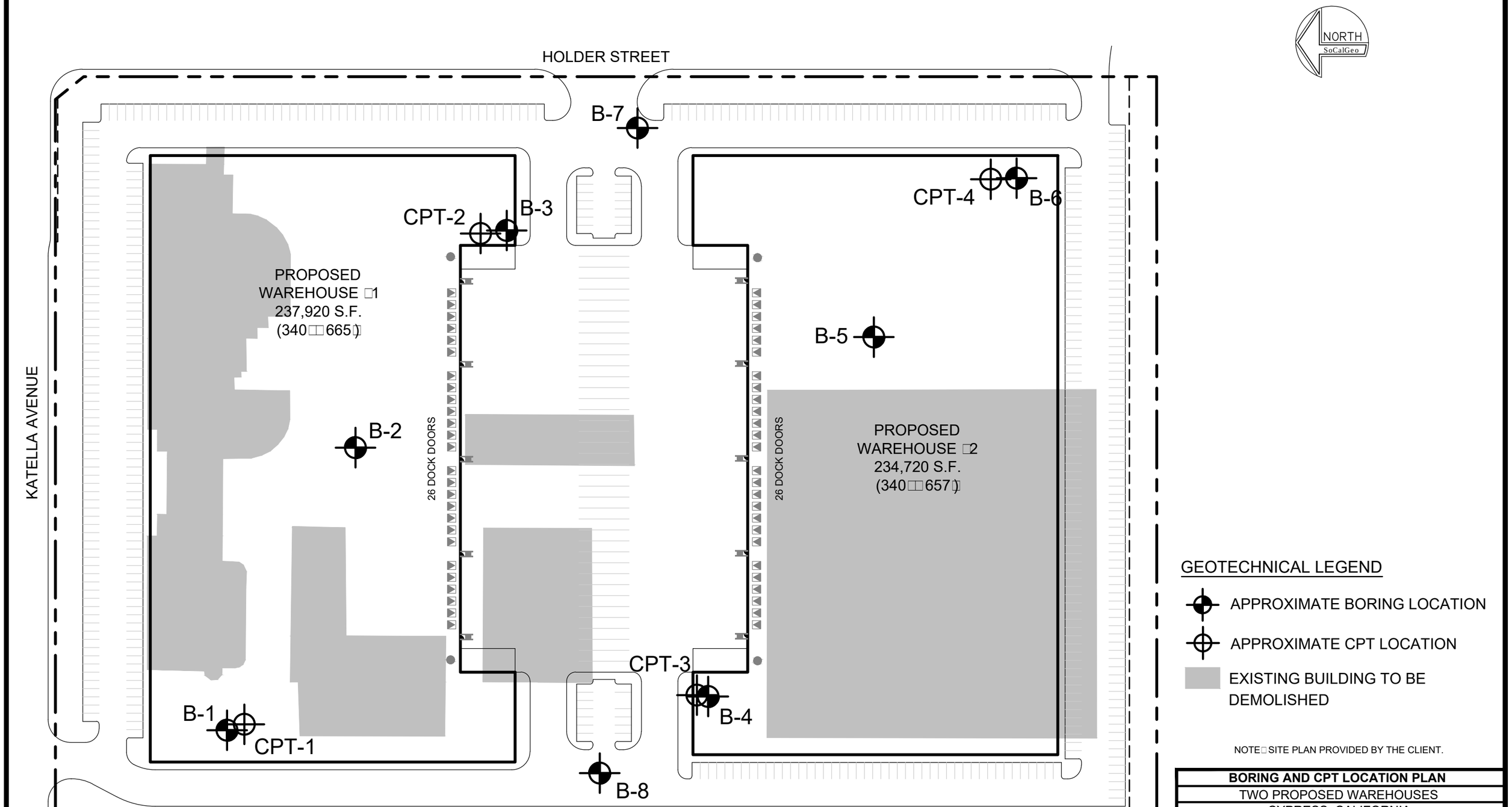
SCALE: 1" = 2400'

DRAWN: JH
CHKD: RGT

SCG PROJECT
19G186-1

PLATE 1

SOUTHERN CALIFORNIA GEOTECHNICAL



GEOTECHNICAL LEGEND

- APPROXIMATE BORING LOCATION
- APPROXIMATE CPT LOCATION
- EXISTING BUILDING TO BE DEMOLISHED

NOTE□ SITE PLAN PROVIDED BY THE CLIENT.

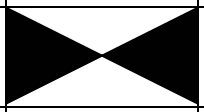
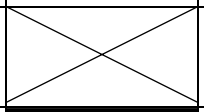
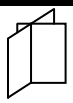
BORING AND CPT LOCATION PLAN
TWO PROPOSED WAREHOUSES
CYPRESS, CALIFORNIA

SCALE□1" = 100□	
DRAWN□JH CHKD□RGT	
SCG PROJECT 19G186-1	
PLATE 2	

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL

APPENDIX B

BORING LOG LEGEND

SAMPLE TYPE	GRAPHICAL SYMBOL	SAMPLE DESCRIPTION
AUGER		SAMPLE COLLECTED FROM AUGER CUTTINGS, NO FIELD MEASUREMENT OF SOIL STRENGTH. (DISTURBED)
CORE		ROCK CORE SAMPLE: TYPICALLY TAKEN WITH A DIAMOND-TIPPED CORE BARREL. TYPICALLY USED ONLY IN HIGHLY CONSOLIDATED BEDROCK.
GRAB		SOIL SAMPLE TAKEN WITH NO SPECIALIZED EQUIPMENT, SUCH AS FROM A STOCKPILE OR THE GROUND SURFACE. (DISTURBED)
CS		CALIFORNIA SAMPLER: 2-1/2 INCH I.D. SPLIT BARREL SAMPLER, LINED WITH 1-INCH HIGH BRASS RINGS. DRIVEN WITH SPT HAMMER. (RELATIVELY UNDISTURBED)
NSR		NO RECOVERY: THE SAMPLING ATTEMPT DID NOT RESULT IN RECOVERY OF ANY SIGNIFICANT SOIL OR ROCK MATERIAL.
SPT		STANDARD PENETRATION TEST: SAMPLER IS A 1.4 INCH INSIDE DIAMETER SPLIT BARREL, DRIVEN 18 INCHES WITH THE SPT HAMMER. (DISTURBED)
SH		SHELBY TUBE: TAKEN WITH A THIN WALL SAMPLE TUBE, PUSHED INTO THE SOIL AND THEN EXTRACTED. (UNDISTURBED)
VANE		VANE SHEAR TEST: SOIL STRENGTH OBTAINED USING A 4 BLADED SHEAR DEVICE. TYPICALLY USED IN SOFT CLAYS-NO SAMPLE RECOVERED.

COLUMN DESCRIPTIONS

DEPTH: Distance in feet below the ground surface.

SAMPLE: Sample Type as depicted above.

BLOW COUNT: Number of blows required to advance the sampler 12 inches using a 140 lb hammer with a 30-inch drop. 50/3" indicates penetration refusal (>50 blows) at 3 inches. WH indicates that the weight of the hammer was sufficient to push the sampler 6 inches or more.

POCKET PEN.: Approximate shear strength of a cohesive soil sample as measured by pocket penetrometer.

GRAPHIC LOG: Graphic Soil Symbol as depicted on the following page.

DRY DENSITY: Dry density of an undisturbed or relatively undisturbed sample in lbs/ft^3.

MOISTURE CONTENT: Moisture content of a soil sample, expressed as a percentage of the dry weight.

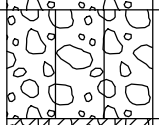
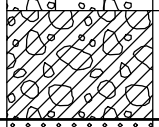
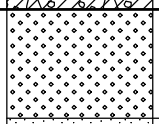
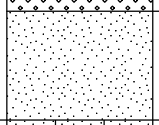
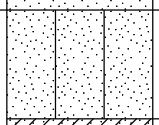
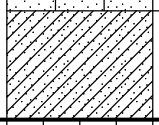
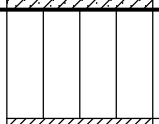
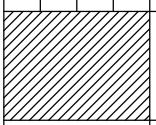
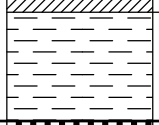
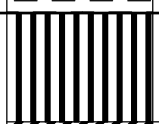
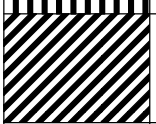
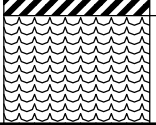
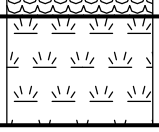
LIQUID LIMIT: The moisture content above which a soil behaves as a liquid.

PLASTIC LIMIT: The moisture content above which a soil behaves as a plastic.

PASSING #200 SIEVE: The percentage of the sample finer than the #200 standard sieve.

UNCONFINED SHEAR: The shear strength of a cohesive soil sample, as measured in the unconfined state.

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

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-1

JOB NO.: 19G186
PROJECT: Two Proposed Warehouses
LOCATION: Cypress, California

DRILLING DATE: 8/28/19
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Jamie Hayward

WATER DEPTH: 5 feet
CAVE DEPTH: 5 feet
READING TAKEN: 4½ hours After Comp.

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION SURFACE ELEVATION: --- MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	COMMENTS
					4± inches Asphaltic concrete; 5± inches of Aggregate base							
		31			ALLUVIUM: Light Gray fine Sand, trace Silt, medium dense-damp	111	6					
		21			Light Gray Brown Silty fine Sand, medium dense-damp	107	4					
5		8			Light Gray Brown fine to medium Sand, trace to little Silt, loose-wet	98	17			5		
		5	1.5		Gray Brown Silt, little Clay, soft-wet	92	29			95		
		3			Gray Brown Silty fine Sand, very loose-wet	98	27			18		
10												
		4			Gray Brown Silty fine Sand to fine Sandy Silt, some Clay, very loose-wet		26			47		
					Thinly interbedded lenses of Gray Brown Silty fine Sand and Clayey Silt, very loose/very soft-wet							
15		1					29			85		
		3			Gray to Gray Brown fine Sandy Clay, soft-wet	98	26			65		
		5					25			52		
							27			69		
20		8				78	24			67		
					Gray Silty Clay, little fine Sand, medium stiff-wet							
		11				103	24			77		
25		9					22	32	19			
							24			78		
		8				105	22					
					Gray Brown Silty Clay, medium stiff to stiff-wet							
		9					31	46	23			
					@ 29 feet, little to some fine Sand		23			70		
30		8			@ 30 feet, little fine Sand, loose	93	29			82		
		36					19					
					Gray Silty fine Sand, dense-wet		21					

TBL 19G186.GPJ SOCALGEO.GDT 10/3/19

TEST BORING LOG

PLATE B-1a

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-1

JOB NO.: 19G186
PROJECT: Two Proposed Warehouses
LOCATION: Cypress, California

DRILLING DATE: 8/28/19
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Jamie Hayward

WATER DEPTH: 5 feet
CAVE DEPTH: 5 feet
READING TAKEN: 4½ hours After Comp.

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION (Continued)	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	COMMENTS
					Gray Silty fine Sand, dense-very moist							
		18			@ 38.5 feet, little Clay, medium dense		31					
40					Interbedded lenses of Gray Silty Clay and Silty fine Sand, medium dense/very stiff-wet		30					
					Gray Brown Silty fine Sand, medium dense-wet							
		17			Gray Silt, medium dense-wet		33			30		
45							30			98		
					Gray fine Sand, little Silt, dense-wet							
		36					26					
50					Gray fine to medium Sand, trace Silt, dense-wet		21					
					Boring Terminated at 50'							

TBL 19G186.GPJ SOCALGEO.GDT 10/3/19

TEST BORING LOG

PLATE B-1b

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-2

JOB NO.: 19G186
PROJECT: Two Proposed Warehouses
LOCATION: Cypress, California

DRILLING DATE: 8/29/19
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Jamie Hayward

WATER DEPTH: 5 feet
CAVE DEPTH: 5½ feet
READING TAKEN: At Completion

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION SURFACE ELEVATION: --- MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	COMMENTS
					4± inches Asphaltic concrete; 4± inches of Aggregate base							
		33			POSSIBLE FILL: Dark Gray Brown Silty fine Sand to fine Sandy Silt, trace fine Gravel, trace Iron oxide staining, medium dense-moist to very moist	102	13					
		18	3.0		ALLUVIUM: Interbedded lenses of fine Sandy Clay and fine Sand, medium dense/very stiff-very moist	115	17					
5		9			Gray Brown to Dark Gray Brown Silty fine Sand, little Clay, loose-wet	100	23					
		8	1.5		Dark Gray Brown Silty Clay, trace Iron oxide staining, stiff-wet	94	28					
		12			Gray Brown Silty fine Sand, loose-wet		24					
10												
					Gray Brown fine Sand, loose-wet							
		6					24					
					Interbedded lenses of Gray Brown Silty fine Sand and Silty Clay, loose/medium stiff to stiff-wet		24					
15		12			Gray Brown Silty fine Sand, trace Clay, medium dense-wet	99	24					
					Gray Brown fine Sand, trace Silt, loose-wet							
		7				95	24					
20												
25		5					25					
					Boring Terminated at 26.5'							

TBL 19G186.GPJ SOCALGEO.GDT 10/3/19

TEST BORING LOG **PLATE B-2**

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-3

JOB NO.: 19G186
PROJECT: Two Proposed Warehouses
LOCATION: Cypress, California

DRILLING DATE: 8/29/19
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Jamie Hayward

WATER DEPTH: 5 feet
CAVE DEPTH: 13 feet
READING TAKEN: 5½ hours After Comp.

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION SURFACE ELEVATION: --- MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	COMMENTS
					3± inches Asphaltic concrete; 4± inches of Aggregate base							
		10			ALLUVIUM: Gray Brown fine Sand, trace medium Sand, very loose to medium dense-very moist		14					
		2	2.0				23					
5		3			Gray Brown Silty Clay, occasional thin fine Sand lenses, very soft/very loose-wet		34					No Sample Recovered
		3					37					
		3			Dark Brown to Dark Gray Brown fine Sandy Silt, very loose-wet	89	39					
		10	1.0		Dark Brown Silty Clay, medium stiff-wet		30					
10												
					Dark Gray Brown fine Sandy Clay, medium stiff-wet							
		5					25					
15		23			Dark Gray Silty fine Sand, medium dense-wet	106	22					
					Dark Gray Silty Clay, very soft-wet							
		1					32					
20		6			Gray Brown Silty fine Sand, trace to little Clay, loose-wet	92	31					
					Dark Gray Brown fine Sandy Clay to Silty Clay, medium stiff-wet							
		7					24					
25		15			Gray Brown Silty fine Sand, medium dense-wet	102	26					
					Boring Terminated at 26'							

TBL 19G186.GPJ SOCALGEO.GDT 10/3/19

TEST BORING LOG

PLATE B-3

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-4

JOB NO.: 19G186
PROJECT: Two Proposed Warehouses
LOCATION: Cypress, California

DRILLING DATE: 8/29/19
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Jamie Hayward

WATER DEPTH: 5½ feet
CAVE DEPTH: 5½ feet
READING TAKEN: At Completion

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION SURFACE ELEVATION: --- MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	COMMENTS
					4± inches Asphaltic concrete; 4± inches of Aggregate base							
		24			FILL: Dark Gray Brown Silty fine Sand, trace to little Clay, mottled, very stiff-very moist	111	17					EI = 8 @ 0 to 5 feet
		15			ALLUVIUM: Light Gray fine Sand, medium dense-moist	98	7					
5		10	2.0		Dark Gray Brown fine Sandy Clay, medium stiff-very moist to wet	99	20					
					Light Gray fine Sand, loose-wet							
		6			Dark Gray Brown Silty Clay, little fine Sand, medium stiff-wet	96	26					
		13			Gray Brown Silty fine Sand, trace Clay, loose to medium dense-wet	97	26					
10												
		10					28					
15		10				100	25					
					Brown to Gray Brown fine Sand, trace Silty, very loose-wet							
		2					31					
20					Gray Brown Silty Clay, soft to stiff-wet		30					
		14			Gray Silty fine Sand to fine Sandy Silt, loose-wet	90	34					
		14			Dark Gray Brown Silty Clay, stiff-wet	100	25					
					Dark Gray fine Sand Clay, stiff-wet							
25		13				100	25					
					Boring Terminated at 26'							

TBL 19G186.GPJ SOCALGEO.GDT 10/3/19

TEST BORING LOG

PLATE B-4

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-5

JOB NO.: 19G186
PROJECT: Two Proposed Warehouses
LOCATION: Cypress, California

DRILLING DATE: 8/28/19
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Jamie Hayward

WATER DEPTH: 7 feet
CAVE DEPTH: 12½ feet
READING TAKEN: At Completion

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION SURFACE ELEVATION: --- MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	COMMENTS
		45			FILL: Brown to Gray Brown fine Sandy Silt, little Clay, mottled, dense-moist to very moist	117	14					
		22			ALLUVIUM: Gray Brown Silty fine Sand, trace Iron oxide staining, medium dense-very moist	116	14					
5		11			Gray fine Sand, trace to little Silt, trace medium Sand, loose-very moist to wet	96	14					
		8			Gray Brown fine Sandy Silt, trace Clay, loose-wet	95	26					
10		14										No Sample Recovered
					Gray Brown Silty fine Sand, loose-wet							
		9					27					
15		13				100	23					
		12				89	31					
20					Boring Terminated at 20'							

TBL 19G186.GPJ SOCALGEO.GDT 10/3/19

TEST BORING LOG

PLATE B-5

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-6

JOB NO.: 19G186
PROJECT: Two Proposed Warehouses
LOCATION: Cypress, California

DRILLING DATE: 8/28/19
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Jamie Hayward

WATER DEPTH: 6½ feet
CAVE DEPTH: 23 feet
READING TAKEN: 2½ hours After Comp.

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION SURFACE ELEVATION: --- MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	COMMENTS
		18			POSSIBLE FILL: Gray Brown Silty fine Sand, trace to little Clay, loose to medium dense-damp to very moist	108	5					
		14				101	18					
5		14				99	13			28		
					ALLUVIUM: Gray Brown Silty fine to medium Sand, loose-moist to very moist							
		7			Gray Brown Silty Clay to Clayey Silt, medium stiff-wet	87	33			94		
		6			Gray Brown Clayey fine Sand to fine Sandy Clay, loose/medium stiff-wet	97	25					
10												
		7					23			62		
					Dark Gray Brown Silty fine Sand, loose-wet							
15		14				106	20					
					Gray to Gray Brown Silty Clay, little fine Sand, trace Iron oxide staining, medium stiff to stiff-wet							
		8					27	36	20	85		
20		7	1.5			97	27					
		12	2.0			100	22					
					Gray Brown Silty fine Sand to fine Sandy Silt, 3 inch Silty Clay layer, medium dense-wet							
25		17					22			70		
30		21			Gray Brown fine to medium Sand, medium dense-wet		25					
					Gray Brown fine Sandy Silt, trace Clay, medium dense-wet		22			74		

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TEST BORING LOG

PLATE B-6a

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-6

JOB NO.: 19G186
PROJECT: Two Proposed Warehouses
LOCATION: Cypress, California

DRILLING DATE: 8/28/19
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Jamie Hayward

WATER DEPTH: 6½ feet
CAVE DEPTH: 23 feet
READING TAKEN: 2½ hours After Comp.

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION (Continued)	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	COMMENTS
		11			Gray Brown fine Sandy Silt, trace Clay, medium dense-wet		29					
40		16					26			80		
			1.0		Gray Brown Silty Clay to Clayey Silt, little fine Sand, medium stiff to stiff-wet		23			87		
45		47			Gray Brown fine to medium Sand, dense-wet		26 21					
50		26			@ 50 feet, 3 inch Gray Silty Clay layer		21					
					Boring Terminated at 51½'							

TBL 19G186.GPJ SOCALGEO.GDT 10/3/19

TEST BORING LOG

PLATE B-6b

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-7

JOB NO.: 19G186
PROJECT: Two Proposed Warehouses
LOCATION: Cypress, California

DRILLING DATE: 8/28/19
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Jamie Hayward

WATER DEPTH: 5½ feet
CAVE DEPTH: 7½ feet
READING TAKEN: At Completion

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION SURFACE ELEVATION: --- MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	COMMENTS
					4± inches Asphaltic concrete; 4± inches of Aggregate base							
		17	2.5		FILL: Gray Brown Silty fine Sand, trace Iron oxide staining, mottled, medium dense-very moist		15					
					FILL: Dark Gray Clayey fine Sand to fine Sandy Clay, hydrocarbon odor, medium dense to very stiff-very moist		12					
		11			ALLUVIUM: Gray Brown Silty fine Sand, mottled, medium dense-very moist		17					
5												
		11			Gray Brown Silty Clay, trace Iron oxide staining, stiff-wet		35					
		12			Gray Brown Silty fine Sand to fine Sandy Silt, little Clay, little Iron oxide staining, medium dense-wet		25					
10												
					Interbedded lenses of Gray Brown fine Sandy Silt and Silty Clay, trace Iron oxide staining, loose/medium stiff-wet							
		6					28					
15		6				99	25					
					Boring Terminated at 16'							

TBL 19G186.GPJ SOCALGEO.GDT 10/3/19

TEST BORING LOG

PLATE B-7

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-8

JOB NO.: 19G186
PROJECT: Two Proposed Warehouses
LOCATION: Cypress, California

DRILLING DATE: 8/29/19
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Jamie Hayward

WATER DEPTH: 6 feet
CAVE DEPTH: 6 feet
READING TAKEN: At Completion

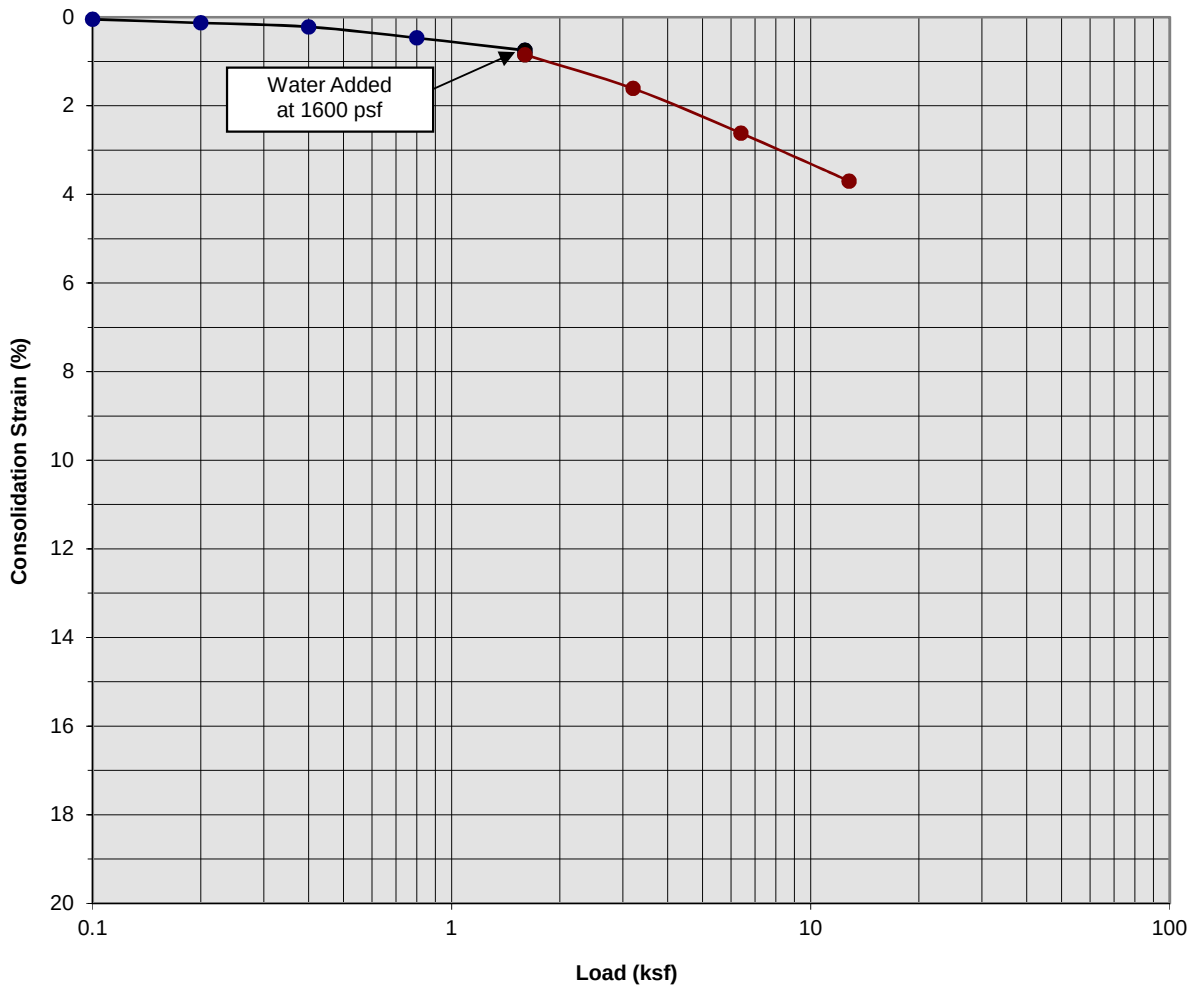
FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION SURFACE ELEVATION: --- MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	COMMENTS
					4± inches Asphaltic concrete; 4± inches of Aggregate base							
		22			FILL: Dark Gray Silty fine Sand, little Clay, medium dense-moist to very moist		12					
		10			@ 3.5 feet, trace Clay		15					
					ALLUVIUM: Dark Gray Silty Clay, little fine Sand, stiff-very moist		21					
5							11					
					Light Gray Brown fine Sand, medium dense-very moist to wet							
		5	1.5		Dark Gray Silty Clay, medium stiff-wet		25					
		6	1.5		Dark Gray Silty Clay to Clayey Silt, medium stiff-wet	99	25					
		12			Dark Gray Silty fine Sand, little Clay, medium dense-wet		23					
					Gray Brown fine Sand, little Silt, medium dense-wet		26					
10												
		11					27					
15					Boring Terminated at 15'							

TBL 19G186.GPJ SOCALGEO.GDT 10/3/19

TEST BORING LOG **PLATE B-8**

APPENDIX C

Consolidation/Collapse Test Results



Classification: Light Gray Brown Silty fine Sand

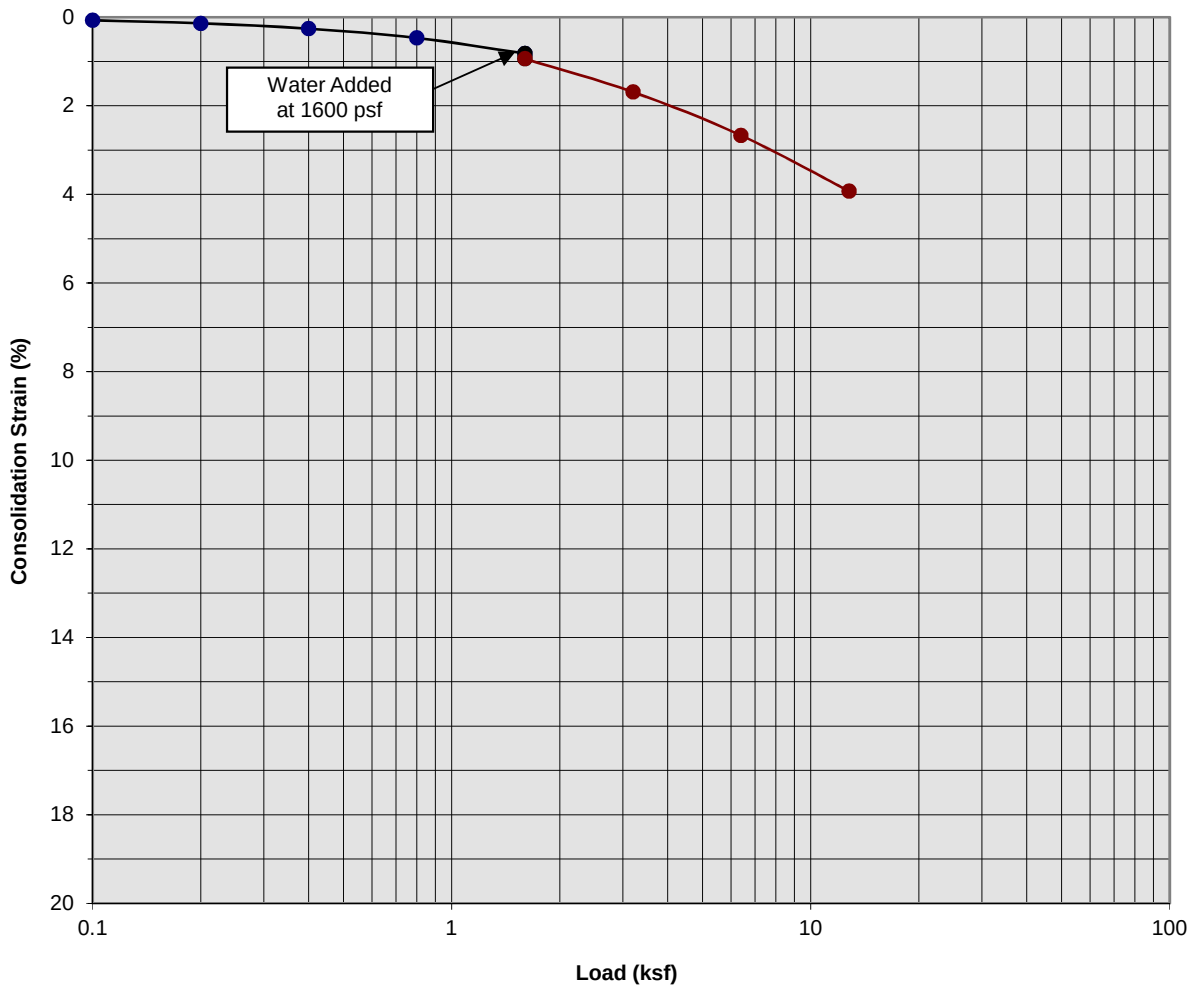
Boring Number:	B-1	Initial Moisture Content (%)	5
Sample Number:	---	Final Moisture Content (%)	20
Depth (ft)	3 to 4	Initial Dry Density (pcf)	106.2
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	109.9
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.10

Two Proposed Warehouses
Cypress, California
Project No. 19G186-1

PLATE C- 1

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

Consolidation/Collapse Test Results



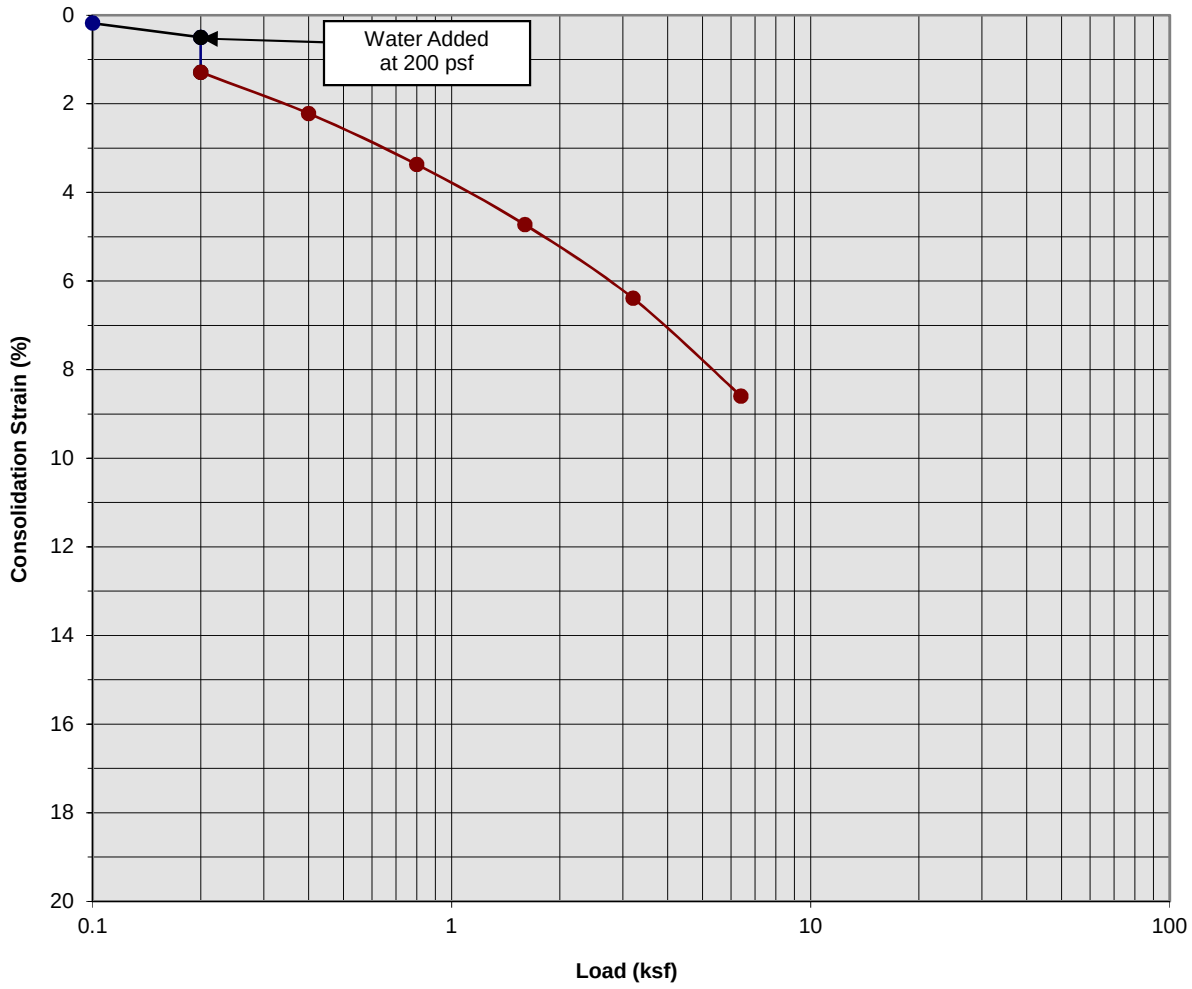
Classification: Light Gray Brown fine to medium Sand, trace to little Silt

Boring Number:	B-1	Initial Moisture Content (%)	17
Sample Number:	---	Final Moisture Content (%)	22
Depth (ft)	5 to 6	Initial Dry Density (pcf)	98.4
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	98.7
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.12

Two Proposed Warehouses
Cypress, California
Project No. 19G186-1
PLATE C- 2

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

Consolidation/Collapse Test Results



Classification: Gray Brown Silt, little Clay

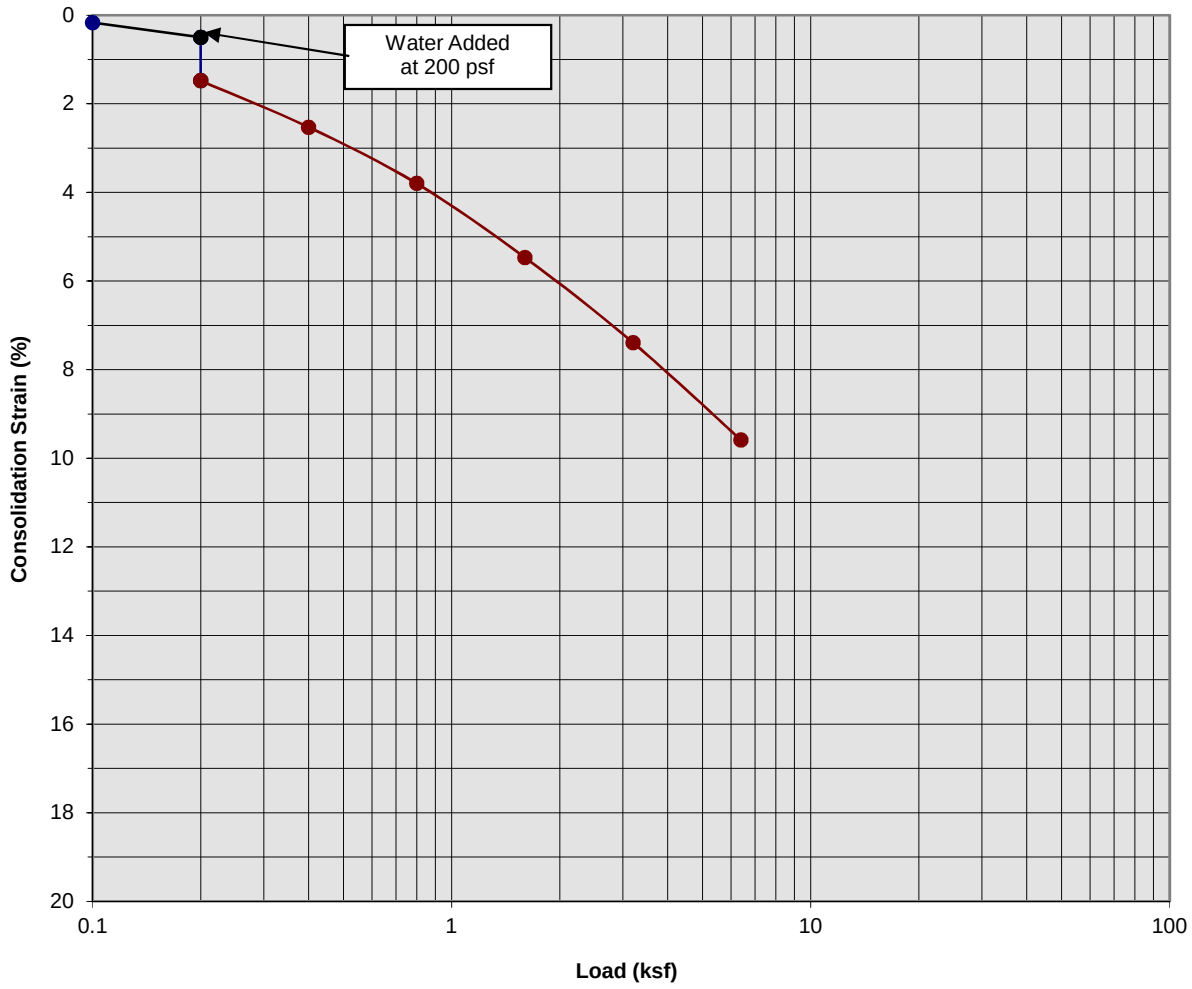
Boring Number:	B-1	Initial Moisture Content (%)	30
Sample Number:	---	Final Moisture Content (%)	27
Depth (ft)	7 to 8	Initial Dry Density (pcf)	93.0
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	92.1
Specimen Thickness (in)	1.0	Percent Collapse (%)	1.36

Two Proposed Warehouses
Cypress, California
Project No. 19G186-1

PLATE C- 3

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

Consolidation/Collapse Test Results



Classification: Gray Brown Silty fine Sand

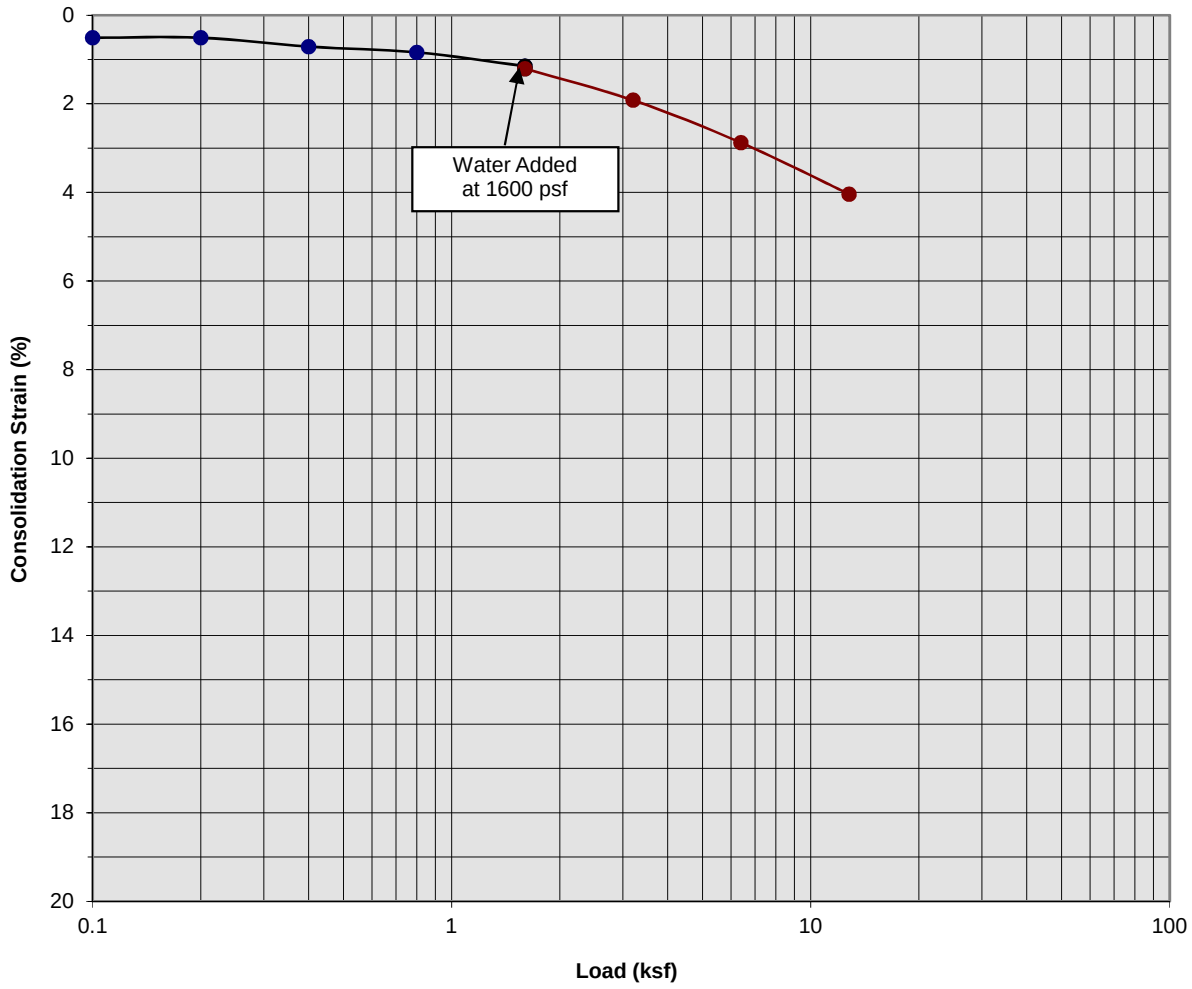
Boring Number:	B-1	Initial Moisture Content (%)	27
Sample Number:	---	Final Moisture Content (%)	22
Depth (ft)	9 to 10	Initial Dry Density (pcf)	98.7
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	84.3
Specimen Thickness (in)	1.0	Percent Collapse (%)	1.67

Two Proposed Warehouses
Cypress, California
Project No. 19G186-1

PLATE C- 4

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

Consolidation/Collapse Test Results



Classification: POSSIBLE FILL: Gray Brown Silty Fine Sand

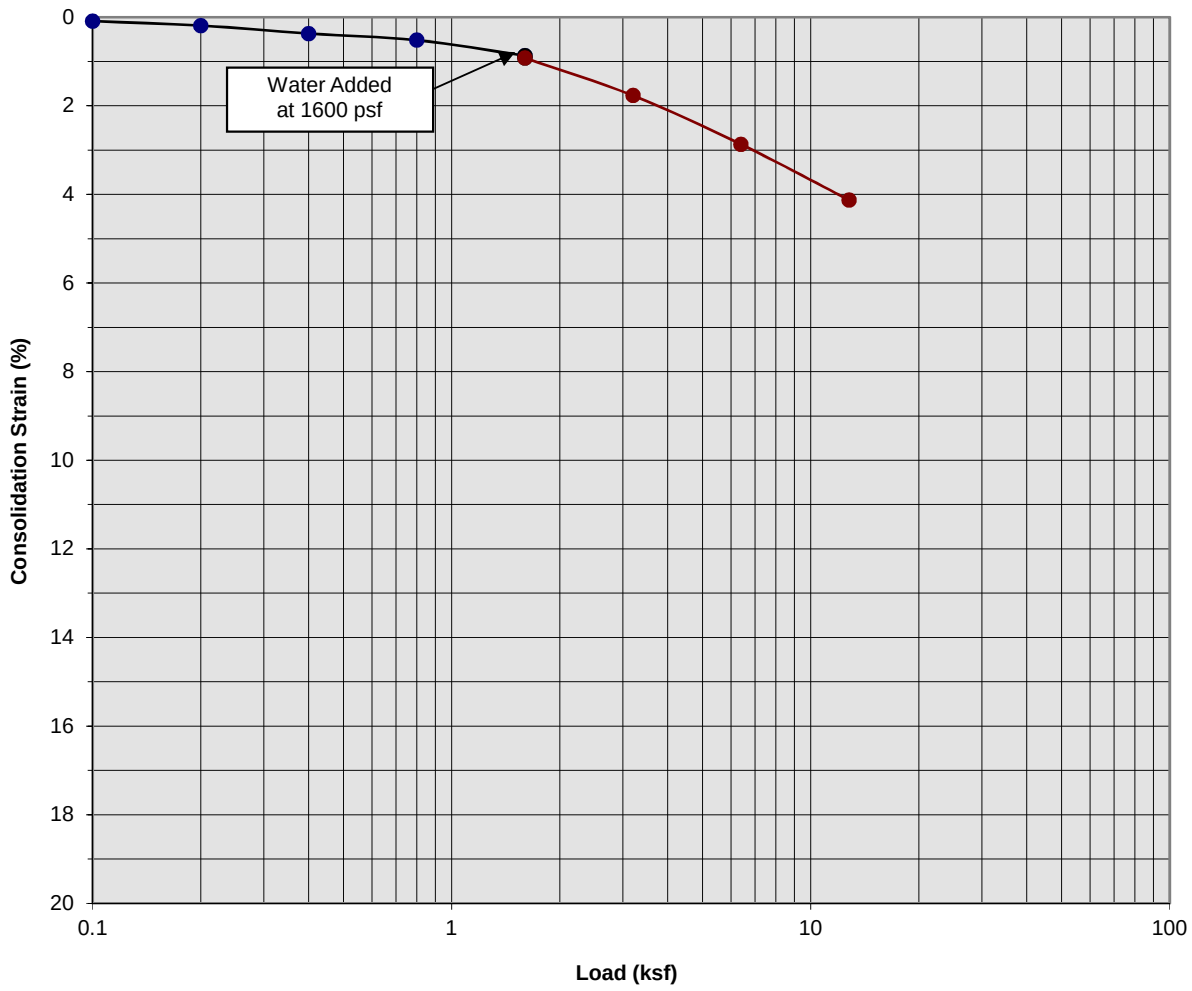
Boring Number:	B-6	Initial Moisture Content (%)	18
Sample Number:	---	Final Moisture Content (%)	26
Depth (ft)	3 to 4	Initial Dry Density (pcf)	96.6
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	99.7
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.06

Two Proposed Warehouses
Cypress, California
Project No. 19G186-1

PLATE C- 5

SoCalGeo
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Consolidation/Collapse Test Results



Classification: Silty fine to medium Sand

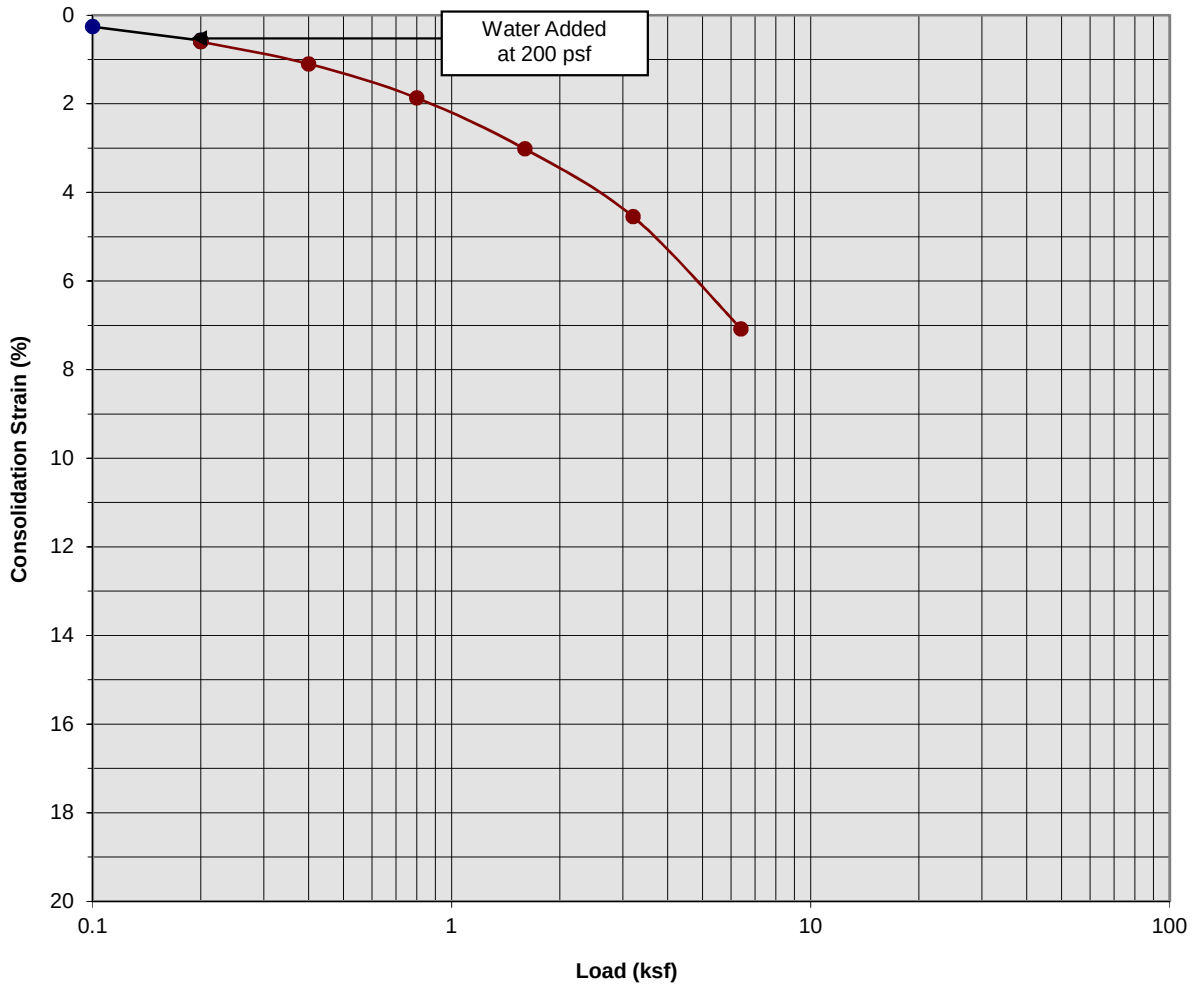
Boring Number:	B-6	Initial Moisture Content (%)	13
Sample Number:	---	Final Moisture Content (%)	17
Depth (ft)	5 to 6	Initial Dry Density (pcf)	99.2
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	103.7
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.05

Two Proposed Warehouses
Cypress, California
Project No. 19G186-1

PLATE C- 6

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

Consolidation/Collapse Test Results



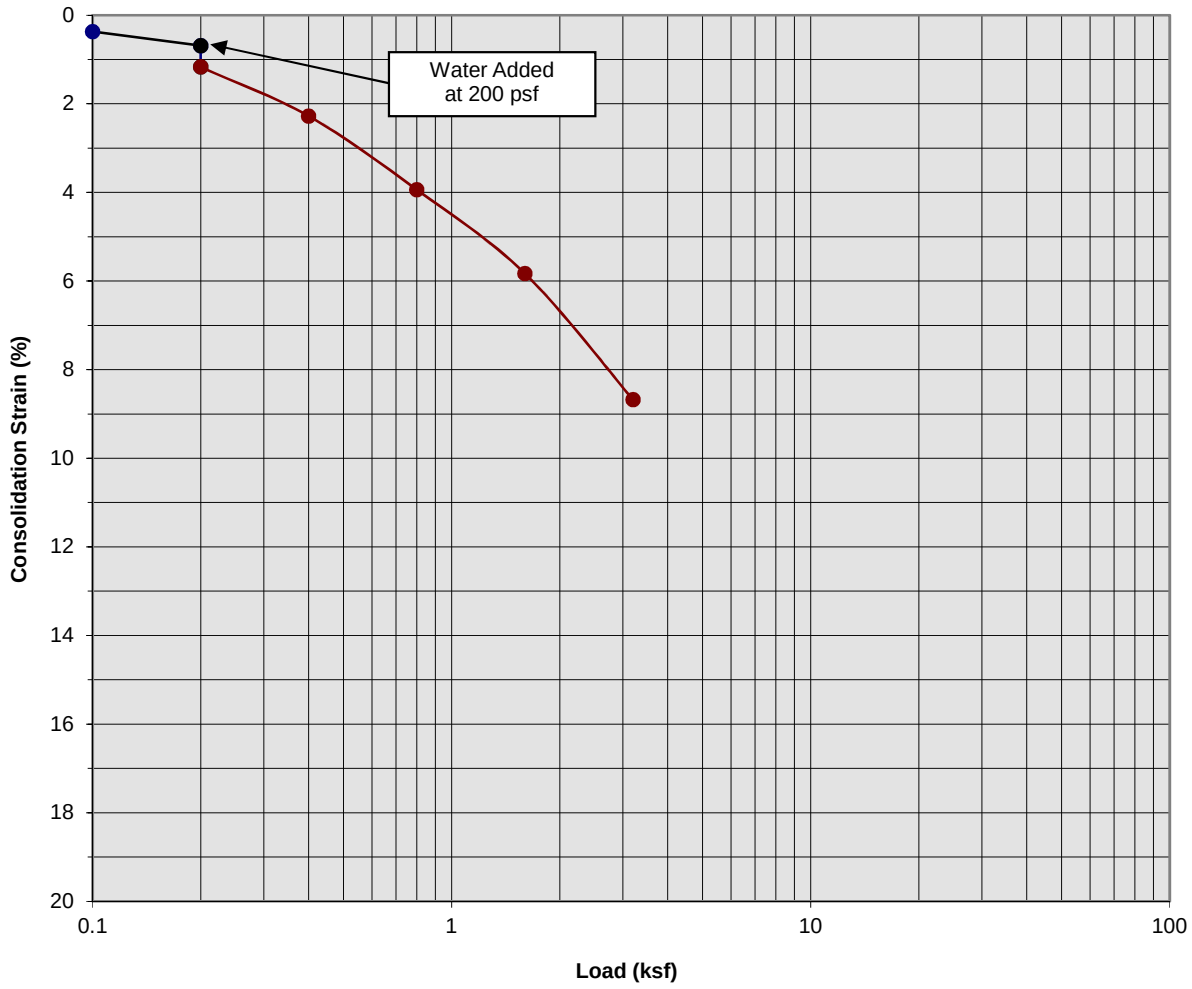
Classification: Gray Brown Silty Clay to Clayey Silt

Boring Number:	B-6	Initial Moisture Content (%)	33
Sample Number:	---	Final Moisture Content (%)	31
Depth (ft)	7 to 8	Initial Dry Density (pcf)	88.7
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	76.1
Specimen Thickness (in)	1.0	Percent Collapse (%)	1.15

Two Proposed Warehouses
Cypress, California
Project No. 19G186-1
PLATE C- 7

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

Consolidation/Collapse Test Results



Classification: Gray Brown Clayey fine Sand to fine Sandy Clay

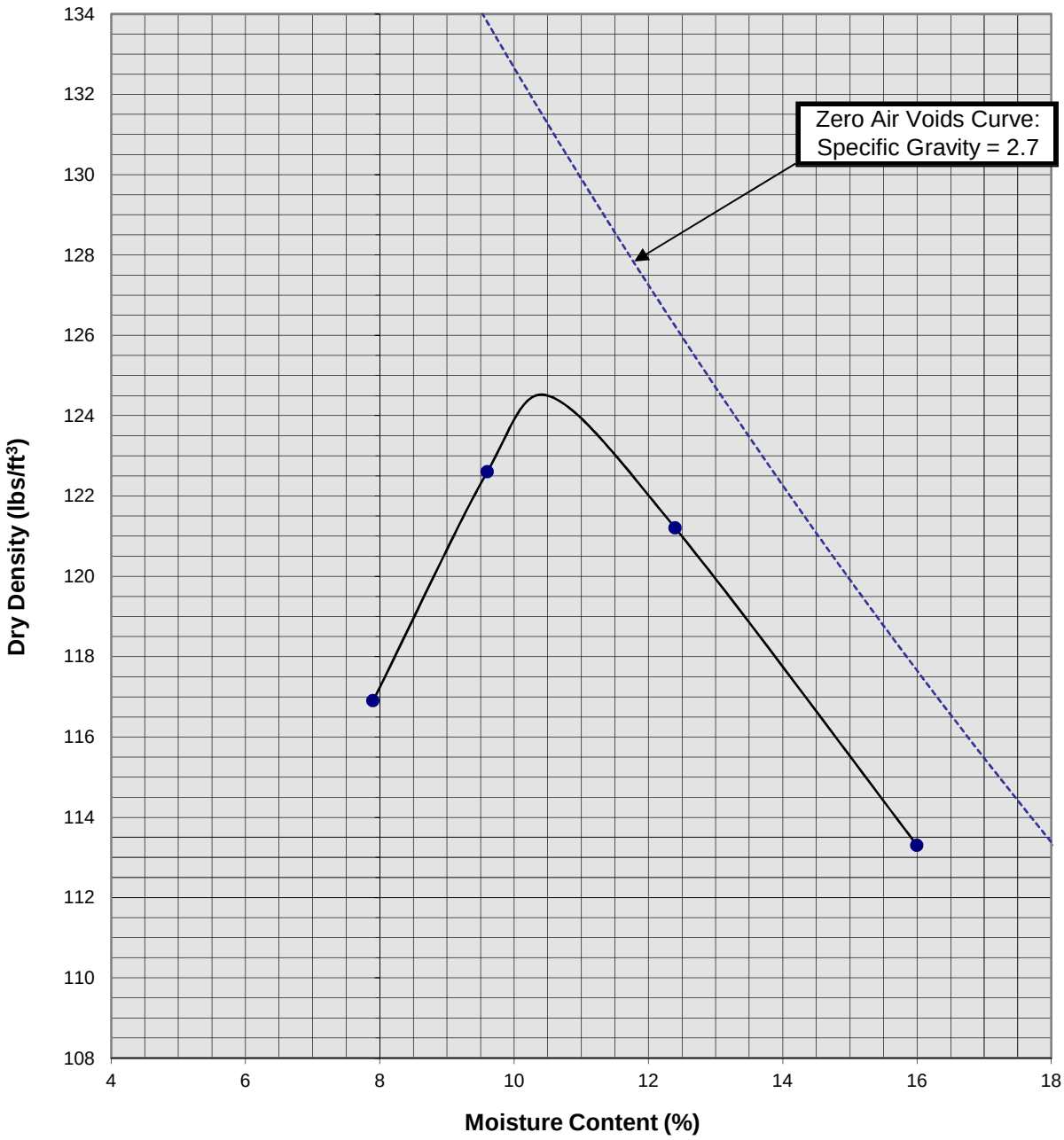
Boring Number:	B-6	Initial Moisture Content (%)	26
Sample Number:	---	Final Moisture Content (%)	22
Depth (ft)	9 to 10	Initial Dry Density (pcf)	97.6
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	97.3
Specimen Thickness (in)	1.0	Percent Collapse (%)	1.89

Two Proposed Warehouses
Cypress, California
Project No. 19G186-1

PLATE C- 8

SoCalGeo
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A California Corporation

Moisture/Density Relationship
ASTM D-1557



Soil ID Number	B-6 @ 0-5'
Optimum Moisture (%)	10.5
Maximum Dry Density (pcf)	124.5
Soil Classification	Gray Brown Silty fine Sand, trace to little Clay

Two Proposed Warehouses
Cypress, California
Project No. 19G186-1

PLATE C-9

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

APPENDIX D

GRADING GUIDE SPECIFICATIONS

These grading guide specifications are intended to provide typical procedures for grading operations. They are intended to supplement the recommendations contained in the geotechnical investigation report for this project. Should the recommendations in the geotechnical investigation report conflict with the grading guide specifications, the more site specific recommendations in the geotechnical investigation report will govern.

General

- The Earthwork Contractor is responsible for the satisfactory completion of all earthwork in accordance with the plans and geotechnical reports, and in accordance with city, county, and applicable building codes.

- The Geotechnical Engineer is the representative of the Owner/Builder for the purpose of implementing the report recommendations and guidelines. These duties are not intended to relieve the Earthwork Contractor of any responsibility to perform in a workman-like manner, nor is the Geotechnical Engineer to direct the grading equipment or personnel employed by the Contractor.

- The Earthwork Contractor is required to notify the Geotechnical Engineer of the anticipated work and schedule so that testing and inspections can be provided. If necessary, work may be stopped and redone if personnel have not been scheduled in advance.

- The Earthwork Contractor is required to have suitable and sufficient equipment on the job-site to process, moisture condition, mix and compact the amount of fill being placed to the approved compaction. In addition, suitable support equipment should be available to conform with recommendations and guidelines in this report.

- Canyon cleanouts, overexcavation areas, processed ground to receive fill, key excavations, subdrains and benches should be observed by the Geotechnical Engineer prior to placement of any fill. It is the Earthwork Contractor's responsibility to notify the Geotechnical Engineer of areas that are ready for inspection.

- Excavation, filling, and subgrade preparation should be performed in a manner and sequence that will provide drainage at all times and proper control of erosion. Precipitation, springs, and seepage water encountered shall be pumped or drained to provide a suitable working surface. The Geotechnical Engineer must be informed of springs or water seepage encountered during grading or foundation construction for possible revision to the recommended construction procedures and/or installation of subdrains.

Site Preparation

- The Earthwork Contractor is responsible for all clearing, grubbing, stripping and site preparation for the project in accordance with the recommendations of the Geotechnical Engineer.

- If any materials or areas are encountered by the Earthwork Contractor which are suspected of having toxic or environmentally sensitive contamination, the Geotechnical Engineer and Owner/Builder should be notified immediately.

- Major vegetation should be stripped and disposed of off-site. This includes trees, brush, heavy grasses and any materials considered unsuitable by the Geotechnical Engineer.

- Underground structures such as basements, cesspools or septic disposal systems, mining shafts, tunnels, wells and pipelines should be removed under the inspection of the Geotechnical Engineer and recommendations provided by the Geotechnical Engineer and/or city, county or state agencies. If such structures are known or found, the Geotechnical Engineer should be notified as soon as possible so that recommendations can be formulated.

- Any topsoil, slopewash, colluvium, alluvium and rock materials which are considered unsuitable by the Geotechnical Engineer should be removed prior to fill placement.

- Remaining voids created during site clearing caused by removal of trees, foundations basements, irrigation facilities, etc., should be excavated and filled with compacted fill.

- Subsequent to clearing and removals, areas to receive fill should be scarified to a depth of 10 to 12 inches, moisture conditioned and compacted

- The moisture condition of the processed ground should be at or slightly above the optimum moisture content as determined by the Geotechnical Engineer. Depending upon field conditions, this may require air drying or watering together with mixing and/or discing.

Compacted Fills

- Soil materials imported to or excavated on the property may be utilized in the fill, provided each material has been determined to be suitable in the opinion of the Geotechnical Engineer. Unless otherwise approved by the Geotechnical Engineer, all fill materials shall be free of deleterious, organic, or frozen matter, shall contain no chemicals that may result in the material being classified as “contaminated,” and shall be very low to non-expansive with a maximum expansion index (EI) of 50. The top 12 inches of the compacted fill should have a maximum particle size of 3 inches, and all underlying compacted fill material a maximum 6-inch particle size, except as noted below.

- All soils should be evaluated and tested by the Geotechnical Engineer. Materials with high expansion potential, low strength, poor gradation or containing organic materials may require removal from the site or selective placement and/or mixing to the satisfaction of the Geotechnical Engineer.

- Rock fragments or rocks less than 6 inches in their largest dimensions, or as otherwise determined by the Geotechnical Engineer, may be used in compacted fill, provided the distribution and placement is satisfactory in the opinion of the Geotechnical Engineer.

- Rock fragments or rocks greater than 12 inches should be taken off-site or placed in accordance with recommendations and in areas designated as suitable by the Geotechnical Engineer. These materials should be placed in accordance with Plate D-8 of these Grading Guide Specifications and in accordance with the following recommendations:

    - Rocks 12 inches or more in diameter should be placed in rows at least 15 feet apart, 15 feet from the edge of the fill, and 10 feet or more below subgrade. Spaces should be left between each rock fragment to provide for placement and compaction of soil around the fragments.

    - Fill materials consisting of soil meeting the minimum moisture content requirements and free of oversize material should be placed between and over the rows of rock or

concrete. Ample water and compactive effort should be applied to the fill materials as they are placed in order that all of the voids between each of the fragments are filled and compacted to the specified density.

- Subsequent rows of rocks should be placed such that they are not directly above a row placed in the previous lift of fill. A minimum 5-foot offset between rows is recommended.

- To facilitate future trenching, oversized material should not be placed within the range of foundation excavations, future utilities or other underground construction unless specifically approved by the soil engineer and the developer/owner representative.

- Fill materials approved by the Geotechnical Engineer should be placed in areas previously prepared to receive fill and in evenly placed, near horizontal layers at about 6 to 8 inches in loose thickness, or as otherwise determined by the Geotechnical Engineer for the project.

- Each layer should be moisture conditioned to optimum moisture content, or slightly above, as directed by the Geotechnical Engineer. After proper mixing and/or drying, to evenly distribute the moisture, the layers should be compacted to at least 90 percent of the maximum dry density in compliance with ASTM D-1557-78 unless otherwise indicated.

- Density and moisture content testing should be performed by the Geotechnical Engineer at random intervals and locations as determined by the Geotechnical Engineer. These tests are intended as an aid to the Earthwork Contractor, so he can evaluate his workmanship, equipment effectiveness and site conditions. The Earthwork Contractor is responsible for compaction as required by the Geotechnical Report(s) and governmental agencies.

- Fill areas unused for a period of time may require moisture conditioning, processing and recompaction prior to the start of additional filling. The Earthwork Contractor should notify the Geotechnical Engineer of his intent so that an evaluation can be made.

- Fill placed on ground sloping at a 5-to-1 inclination (horizontal-to-vertical) or steeper should be benched into bedrock or other suitable materials, as directed by the Geotechnical Engineer. Typical details of benching are illustrated on Plates D-2, D-4, and D-5.

- Cut/fill transition lots should have the cut portion overexcavated to a depth of at least 3 feet and rebuilt with fill (see Plate D-1), as determined by the Geotechnical Engineer.

- All cut lots should be inspected by the Geotechnical Engineer for fracturing and other bedrock conditions. If necessary, the pads should be overexcavated to a depth of 3 feet and rebuilt with a uniform, more cohesive soil type to impede moisture penetration.

- Cut portions of pad areas above buttresses or stabilizations should be overexcavated to a depth of 3 feet and rebuilt with uniform, more cohesive compacted fill to impede moisture penetration.

- Non-structural fill adjacent to structural fill should typically be placed in unison to provide lateral support. Backfill along walls must be placed and compacted with care to ensure that excessive unbalanced lateral pressures do not develop. The type of fill material placed adjacent to below grade walls must be properly tested and approved by the Geotechnical Engineer with consideration of the lateral earth pressure used in the design.

Foundations

- The foundation influence zone is defined as extending one foot horizontally from the outside edge of a footing, and proceeding downward at a ½ horizontal to 1 vertical (0.5:1) inclination.

- Where overexcavation beneath a footing subgrade is necessary, it should be conducted so as to encompass the entire foundation influence zone, as described above.

- Compacted fill adjacent to exterior footings should extend at least 12 inches above foundation bearing grade. Compacted fill within the interior of structures should extend to the floor subgrade elevation.

Fill Slopes

- The placement and compaction of fill described above applies to all fill slopes. Slope compaction should be accomplished by overfilling the slope, adequately compacting the fill in even layers, including the overfilled zone and cutting the slope back to expose the compacted core

- Slope compaction may also be achieved by backrolling the slope adequately every 2 to 4 vertical feet during the filling process as well as requiring the earth moving and compaction equipment to work close to the top of the slope. Upon completion of slope construction, the slope face should be compacted with a sheepsfoot connected to a sideboom and then grid rolled. This method of slope compaction should only be used if approved by the Geotechnical Engineer.

- Sandy soils lacking in adequate cohesion may be unstable for a finished slope condition and therefore should not be placed within 15 horizontal feet of the slope face.

- All fill slopes should be keyed into bedrock or other suitable material. Fill keys should be at least 15 feet wide and inclined at 2 percent into the slope. For slopes higher than 30 feet, the fill key width should be equal to one-half the height of the slope (see Plate D-5).

- All fill keys should be cleared of loose slough material prior to geotechnical inspection and should be approved by the Geotechnical Engineer and governmental agencies prior to filling.

- The cut portion of fill over cut slopes should be made first and inspected by the Geotechnical Engineer for possible stabilization requirements. The fill portion should be adequately keyed through all surficial soils and into bedrock or suitable material. Soils should be removed from the transition zone between the cut and fill portions (see Plate D-2).

Cut Slopes

- All cut slopes should be inspected by the Geotechnical Engineer to determine the need for stabilization. The Earthwork Contractor should notify the Geotechnical Engineer when slope cutting is in progress at intervals of 10 vertical feet. Failure to notify may result in a delay in recommendations.

- Cut slopes exposing loose, cohesionless sands should be reported to the Geotechnical Engineer for possible stabilization recommendations.

- All stabilization excavations should be cleared of loose slough material prior to geotechnical inspection. Stakes should be provided by the Civil Engineer to verify the location and dimensions of the key. A typical stabilization fill detail is shown on Plate D-5.

- Stabilization key excavations should be provided with subdrains. Typical subdrain details are shown on Plates D-6.

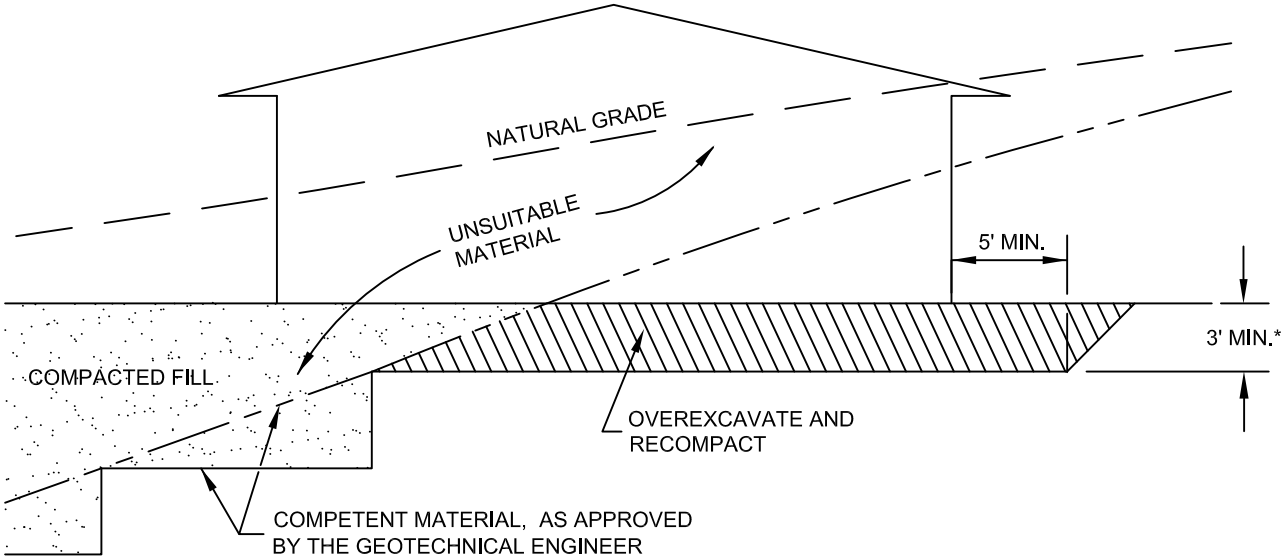
Subdrains

- Subdrains may be required in canyons and swales where fill placement is proposed. Typical subdrain details for canyons are shown on Plate D-3. Subdrains should be installed after approval of removals and before filling, as determined by the Soils Engineer.

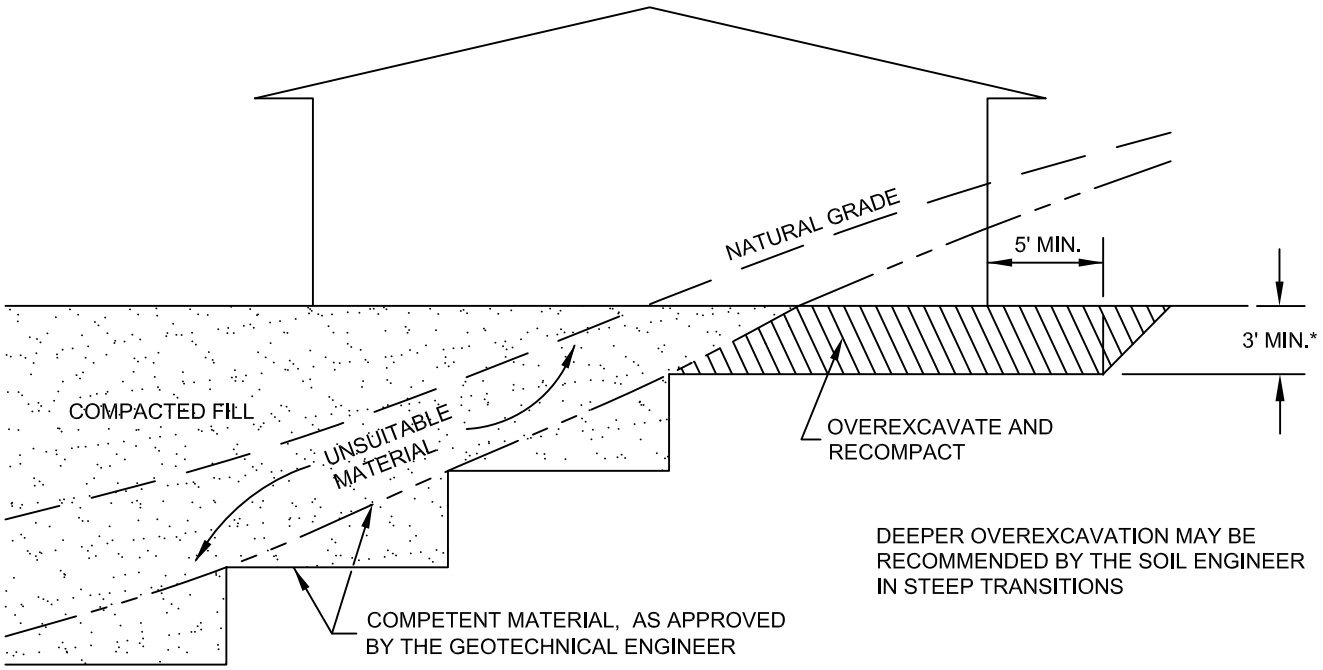
- Plastic pipe may be used for subdrains provided it is Schedule 40 or SDR 35 or equivalent. Pipe should be protected against breakage, typically by placement in a square-cut (backhoe) trench or as recommended by the manufacturer.

- Filter material for subdrains should conform to CALTRANS Specification 68-1.025 or as approved by the Geotechnical Engineer for the specific site conditions. Clean ¾-inch crushed rock may be used provided it is wrapped in an acceptable filter cloth and approved by the Geotechnical Engineer. Pipe diameters should be 6 inches for runs up to 500 feet and 8 inches for the downstream continuations of longer runs. Four-inch diameter pipe may be used in buttress and stabilization fills.

CUT LOT



CUT/FILL LOT (TRANSITION)



*SEE TEXT OF REPORT FOR SPECIFIC RECOMMENDATION. ACTUAL DEPTH OF OVEREXCAVATION MAY BE GREATER.

TRANSITION LOT DETAIL

GRADING GUIDE SPECIFICATIONS

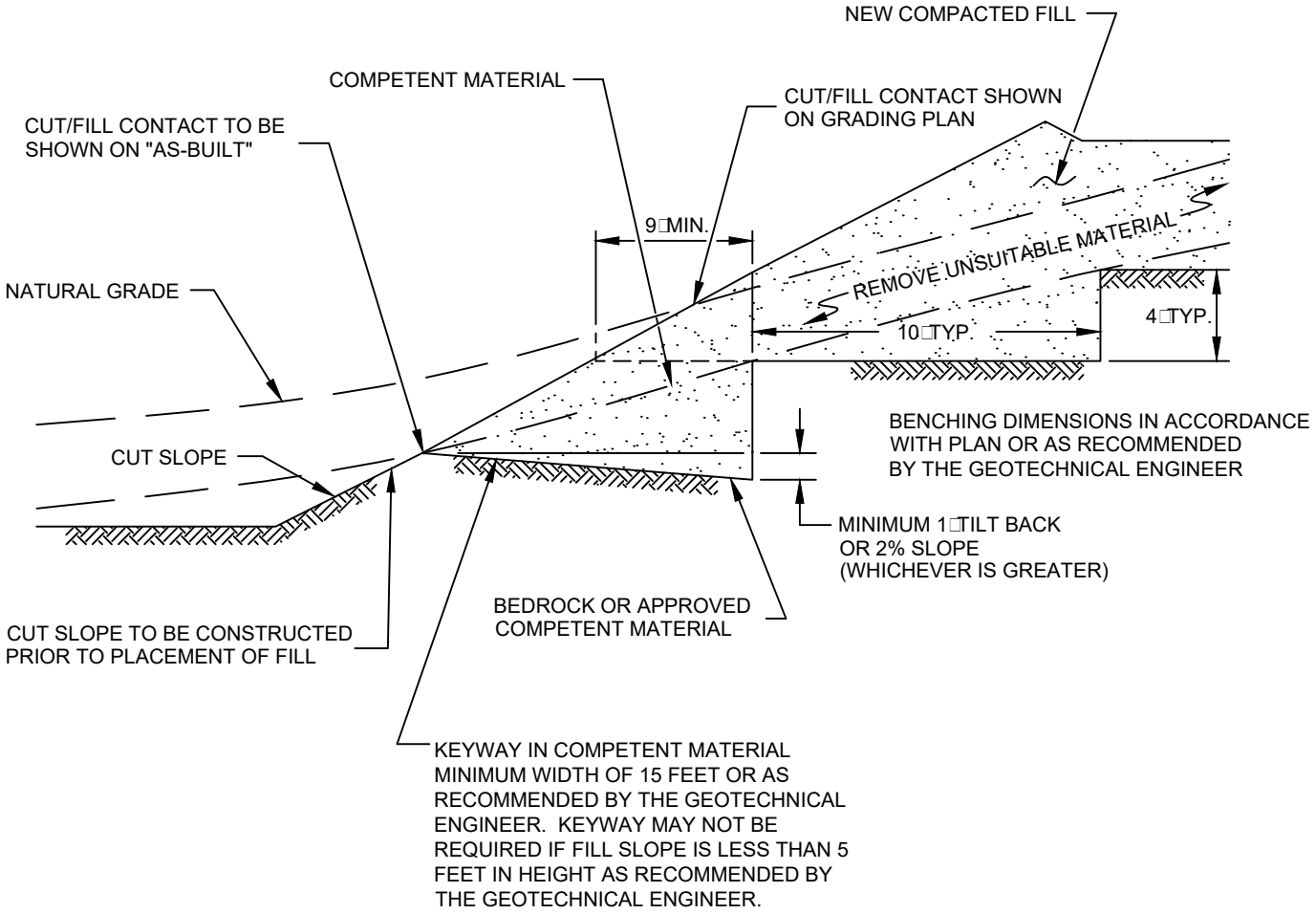
NOT TO SCALE

DRAWN: JAS
CHKD: GKM

PLATE D-1

SoCalGeo

SOUTHERN CALIFORNIA GEOTECHNICAL



FILL ABOVE CUT SLOPE DETAIL

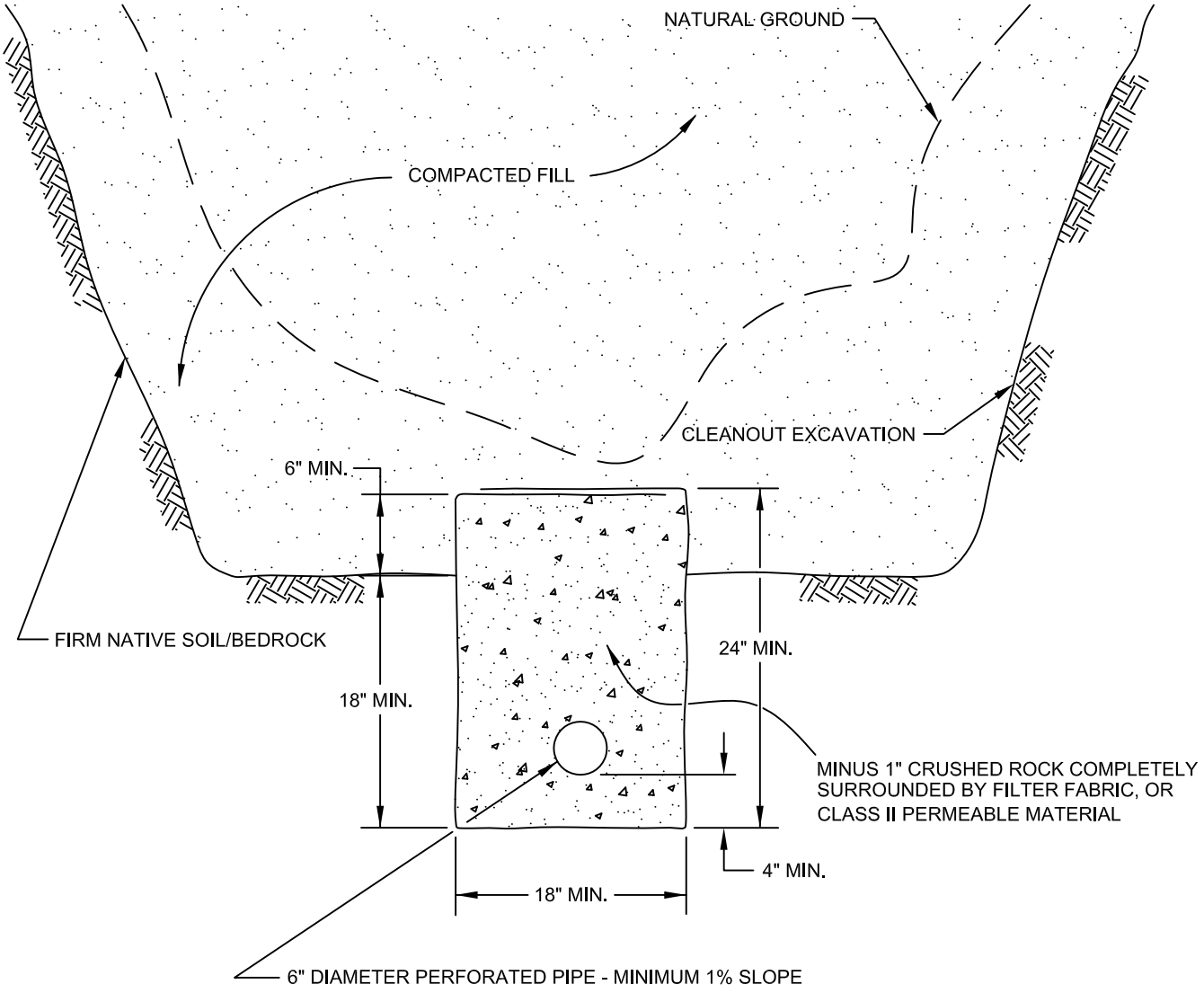
GRADING GUIDE SPECIFICATIONS

NOT TO SCALE

DRAWN JAS
CHKD GKM

PLATE D-2

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL



PIPE MATERIAL	DEPTH OF FILL OVER SUBDRAIN
ADS (CORRUGATED POLETHYLENE)	8
TRANSITE UNDERDRAIN	20
PVC OR ABS: SDR 35	35
SDR 21	100

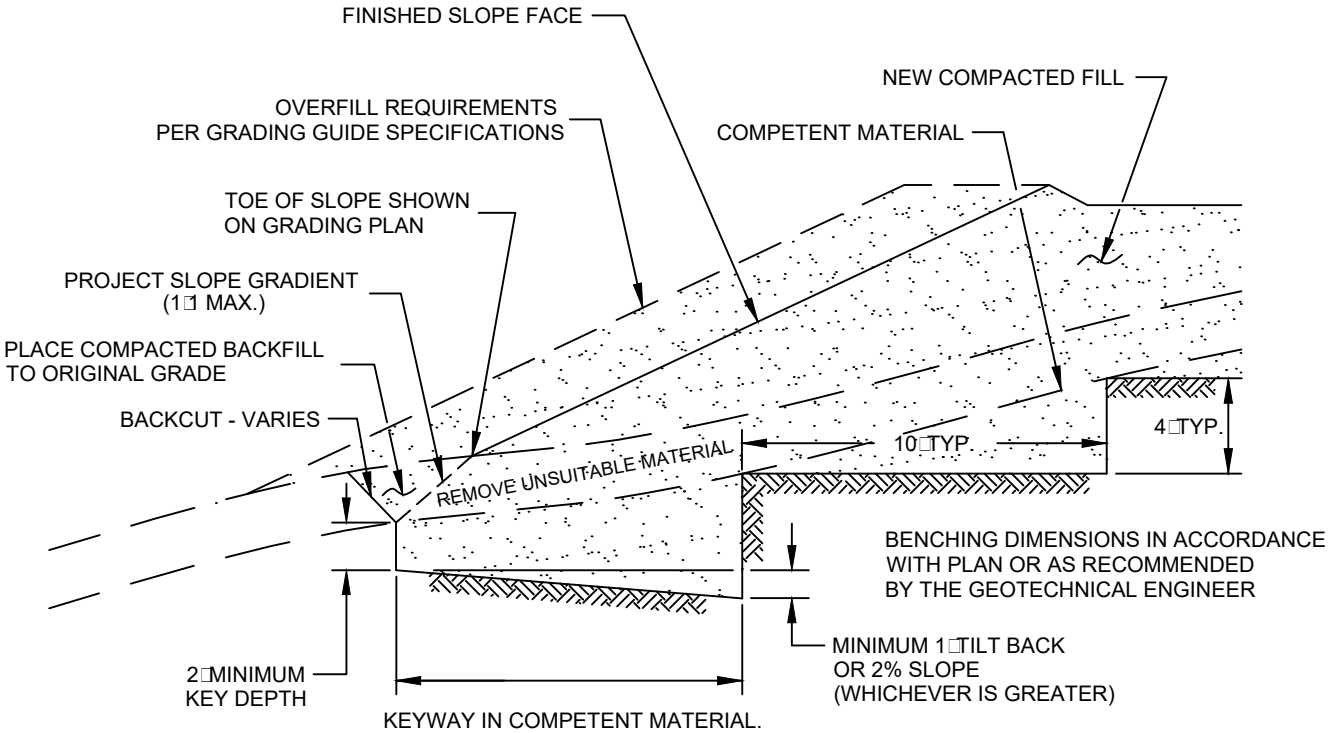
SCHEMATIC ONLY
NOT TO SCALE

CANYON SUBDRAIN DETAIL
GRADING GUIDE SPECIFICATIONS

NOT TO SCALE
DRAWN: JAS
CHKD: GKM

PLATE D-3

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL



NOTE:
BENCHING SHALL BE REQUIRED WHEN NATURAL SLOPES ARE EQUAL TO OR STEEPER THAN 5:1 OR WHEN RECOMMENDED BY THE GEOTECHNICAL ENGINEER.

FILL ABOVE NATURAL SLOPE DETAIL

GRADING GUIDE SPECIFICATIONS

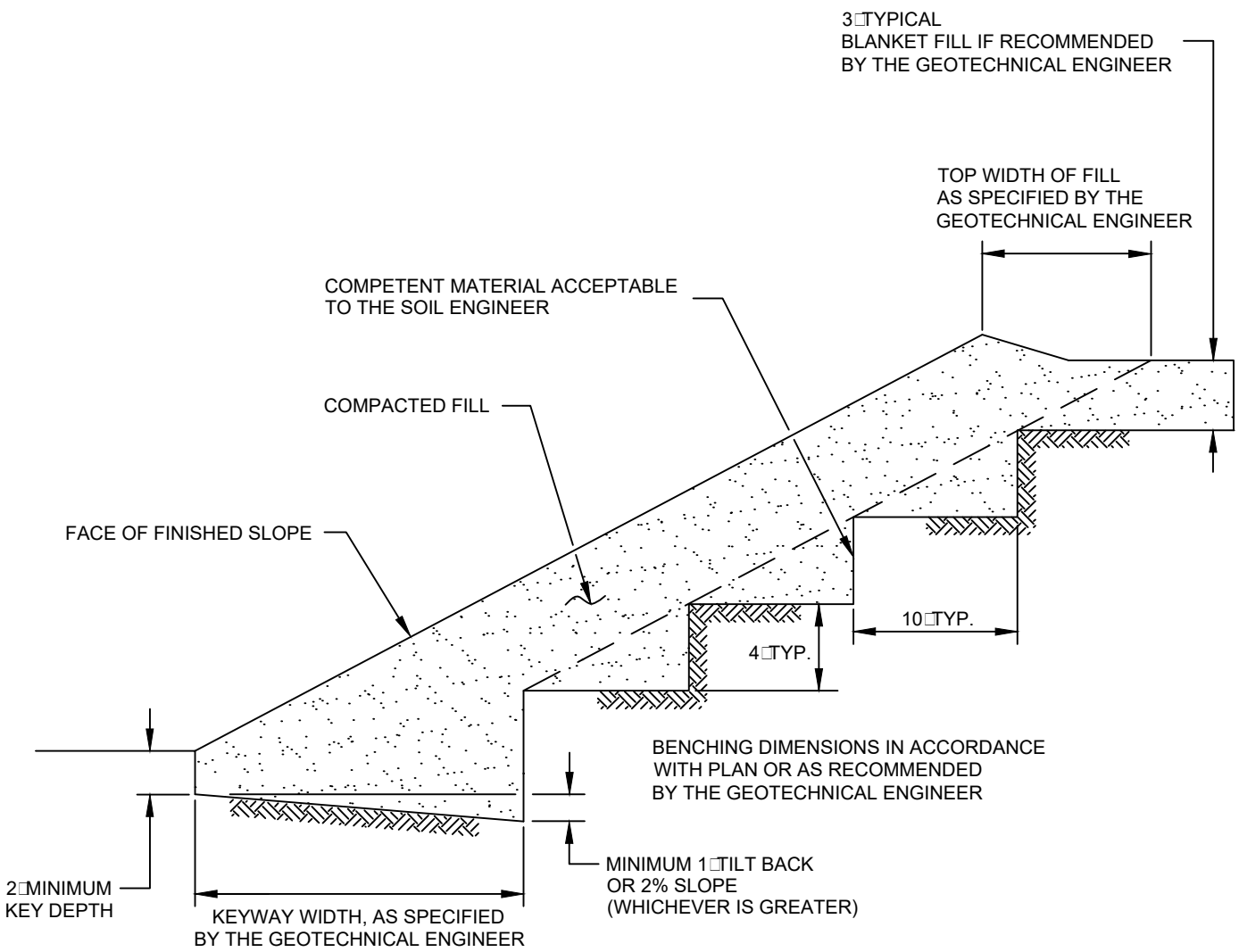
NOT TO SCALE

DRAWN: JAS
CHKD: GKM

PLATE D-4

SoCalGeo

SOUTHERN CALIFORNIA GEOTECHNICAL



STABILIZATION FILL DETAIL

GRADING GUIDE SPECIFICATIONS

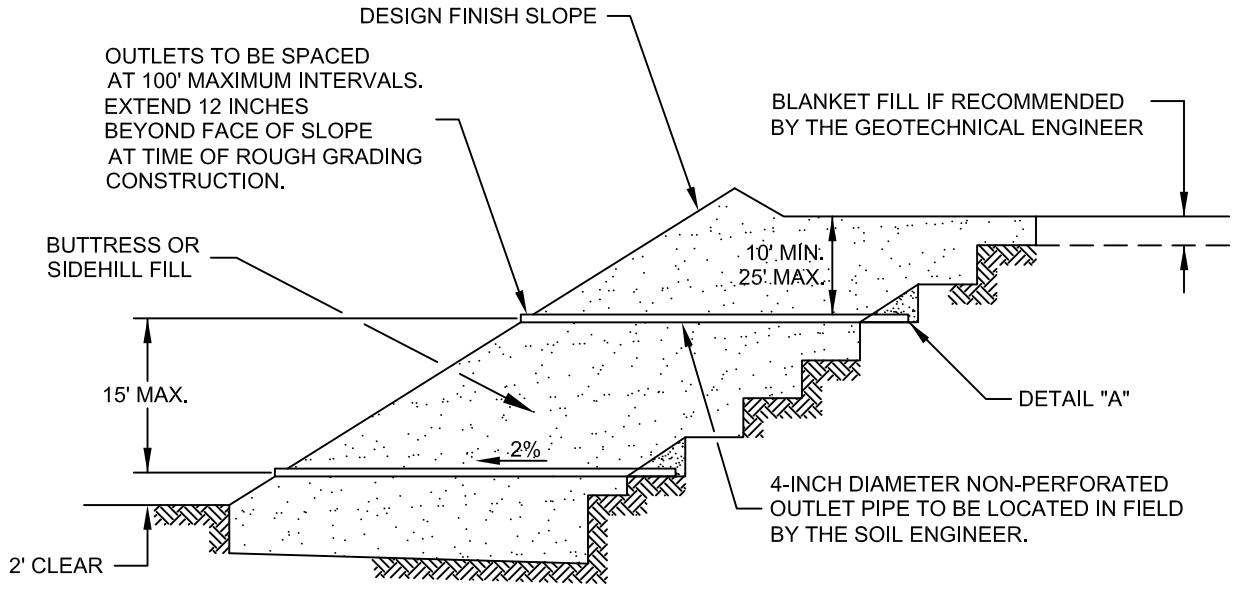
NOT TO SCALE

DRAWN JAS
CHKD GKM

PLATE D-5

SoCalGeo

SOUTHERN CALIFORNIA GEOTECHNICAL



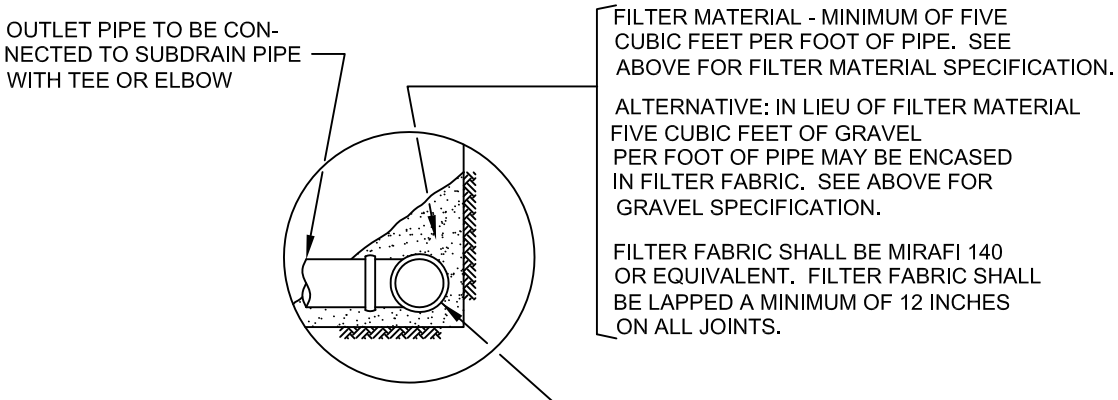
"FILTER MATERIAL" TO MEET FOLLOWING SPECIFICATION OR APPROVED EQUIVALENT: (CONFORMS TO EMA STD. PLAN 323)

SIEVE SIZE	PERCENTAGE PASSING
1"	100
3/4"	90-100
3/8"	40-100
NO. 4	25-40
NO. 8	18-33
NO. 30	5-15
NO. 50	0-7
NO. 200	0-3

"GRAVEL" TO MEET FOLLOWING SPECIFICATION OR APPROVED EQUIVALENT:

SIEVE SIZE	MAXIMUM PERCENTAGE PASSING
1 1/2"	100
NO. 4	50
NO. 200	8

SAND EQUIVALENT = MINIMUM OF 50



DETAIL "A"

NOTES:
1. TRENCH FOR OUTLET PIPES TO BE BACKFILLED WITH ON-SITE SOIL.

SLOPE FILL SUBDRAINS

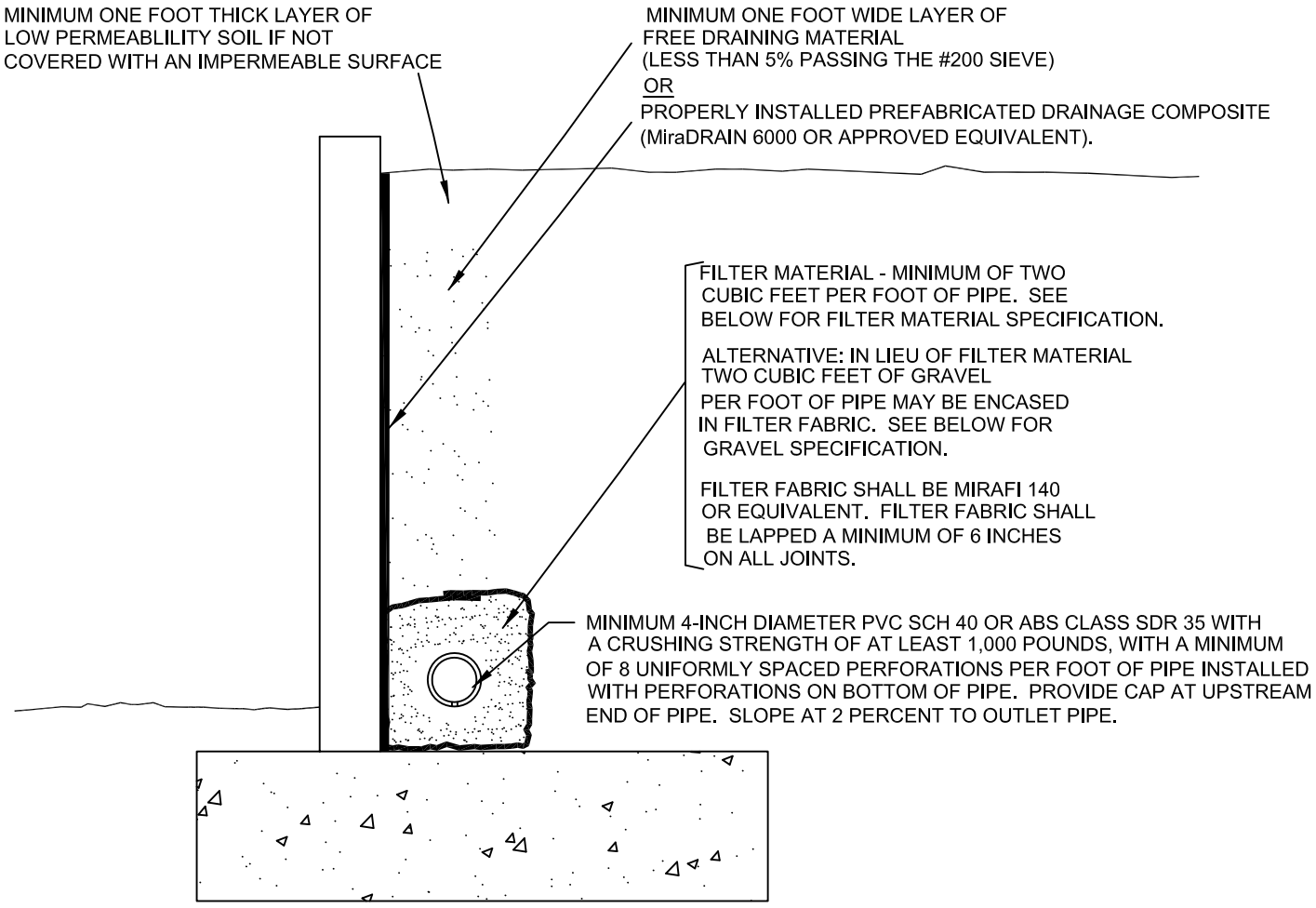
GRADING GUIDE SPECIFICATIONS

NOT TO SCALE

DRAWN: JAS
CHKD: GKM

PLATE D-6

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL



"FILTER MATERIAL" TO MEET FOLLOWING SPECIFICATION OR APPROVED EQUIVALENT: (CONFORMS TO EMA STD. PLAN 323)

SIEVE SIZE	PERCENTAGE PASSING
1"	100
3/4"	90-100
3/8"	40-100
NO. 4	25-40
NO. 8	18-33
NO. 30	5-15
NO. 50	0-7
NO. 200	0-3

"GRAVEL" TO MEET FOLLOWING SPECIFICATION OR APPROVED EQUIVALENT:

SIEVE SIZE	MAXIMUM PERCENTAGE PASSING
1 1/2"	100
NO. 4	50
NO. 200	8

SAND EQUIVALENT = MINIMUM OF 50

RETAINING WALL BACKDRAINS

GRADING GUIDE SPECIFICATIONS

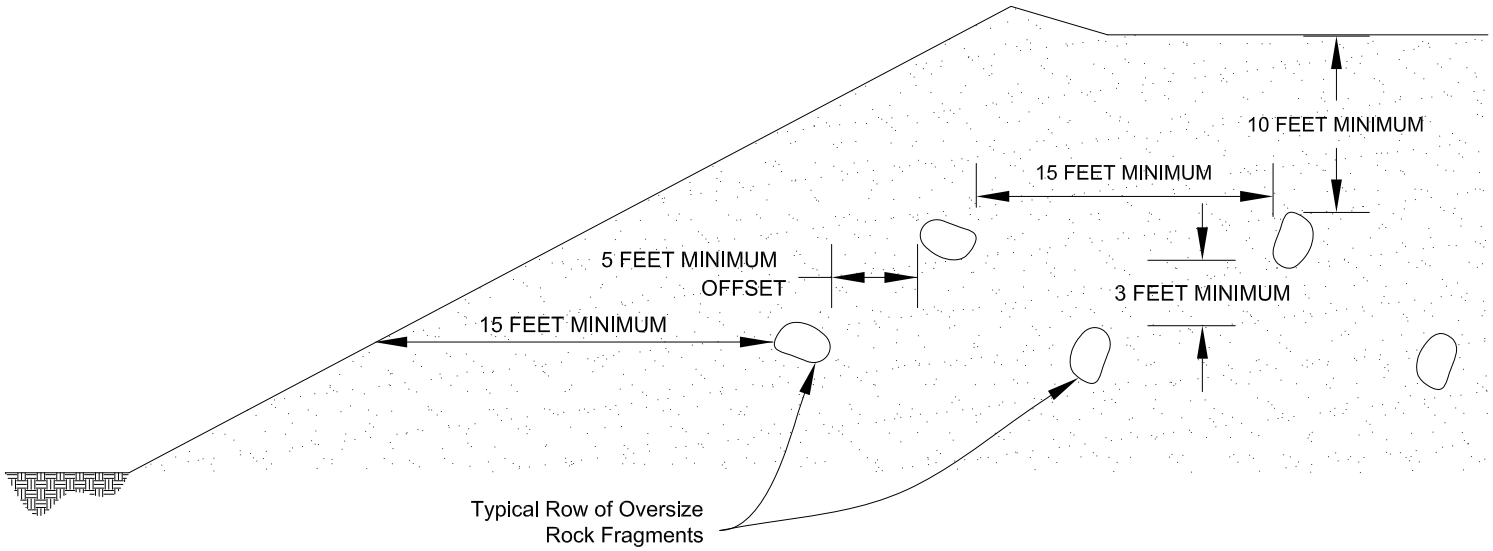
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CHKD: GKM

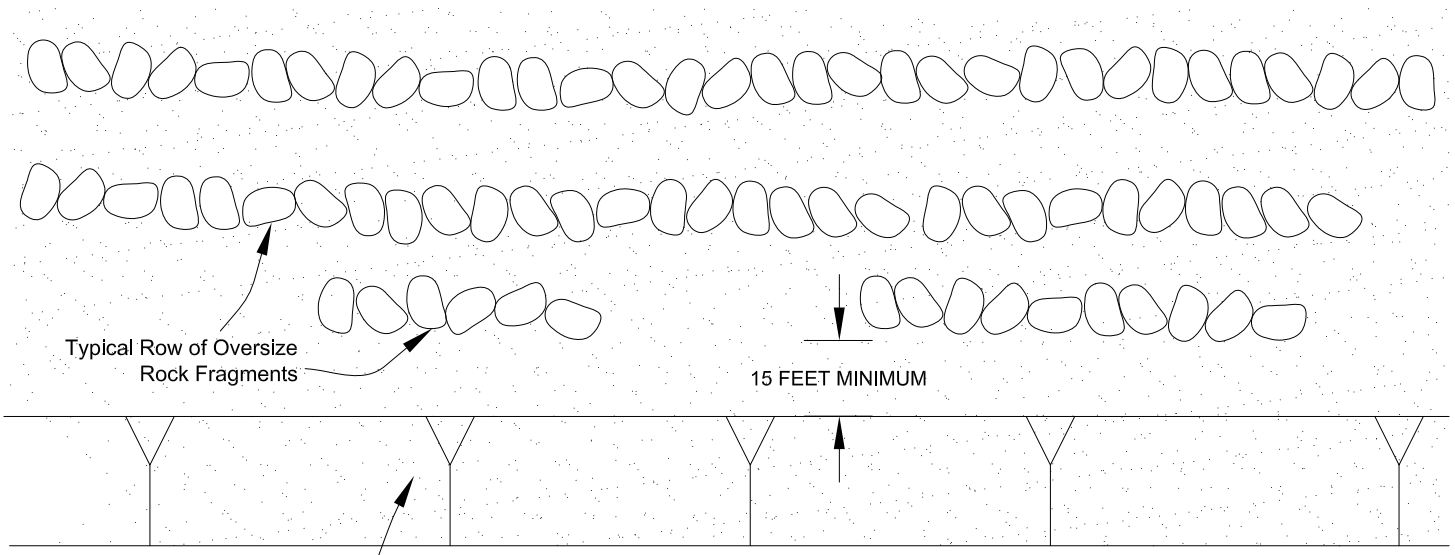
PLATE D-7

SoCalGeo

SOUTHERN CALIFORNIA GEOTECHNICAL



Section View



Plan View

PLACEMENT OF OVERSIZED MATERIAL

GRADING GUIDE SPECIFICATIONS

NOT TO SCALE

DRAWN: PM
CHKD: GKM

PLATE D-8

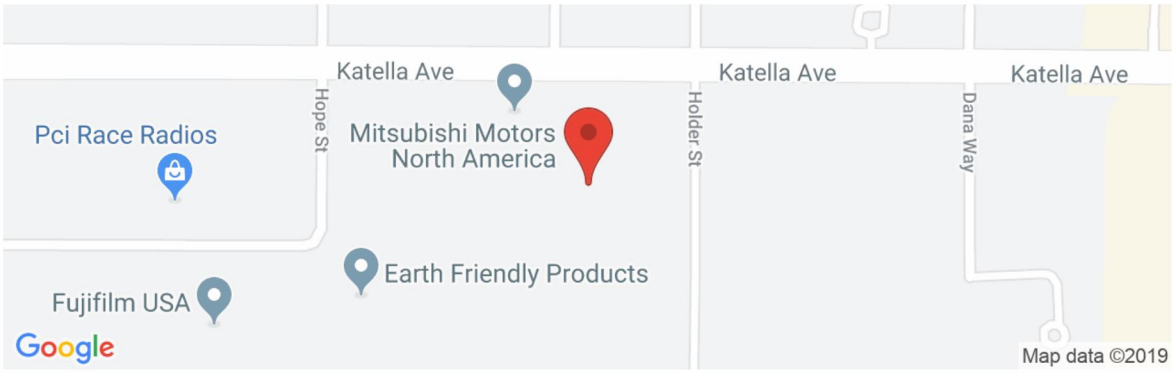
SoCalGeo

SOUTHERN CALIFORNIA GEOTECHNICAL

APPENDIX E

OSHPD

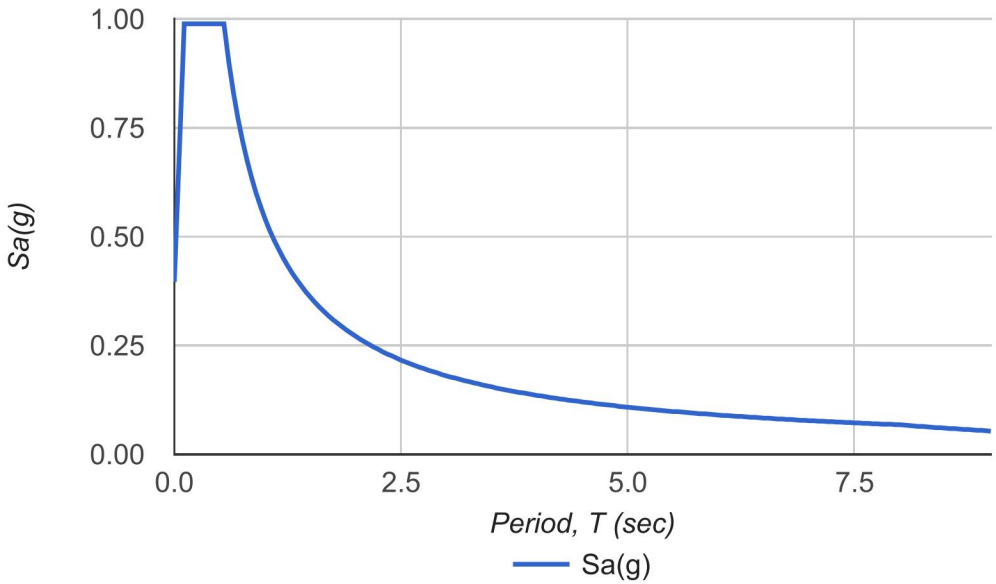
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Date	9/4/2019, 1:07:27 PM
Design Code Reference Document	ASCE7-10
Risk Category	II
Site Class	D - Stiff Soil

Type	Value	Description	Type	Value	Description
S_S	1.484	MCE_R ground motion. (for 0.2 second period)	SDC	D	Seismic design category
S_1	0.541	MCE_R ground motion. (for 1.0s period)	F_a	1	Site amplification factor at 0.2 second
S_{MS}	1.484	Site-modified spectral acceleration value	F_v	1.5	Site amplification factor at 1.0 second
S_{M1}	0.812	Site-modified spectral acceleration value	PGA	0.541	MCE_G peak ground acceleration
S_{DS}	0.989	Numeric seismic design value at 0.2 second SA	F_{PGA}	1	Site amplification factor at PGA
S_{D1}	0.541	Numeric seismic design value at 1.0 second SA	PGA_M	0.541	Site modified peak ground acceleration

Design Response Spectrum



SOURCE: SEAOC/OSHPD S[illegible] D[illegible] M[illegible] T[illegible]
[illegible]

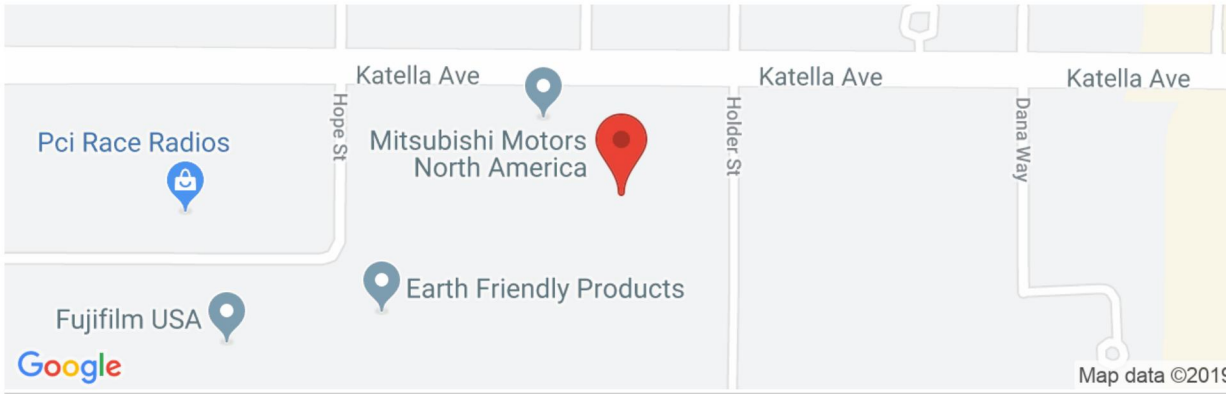
SEISMIC DESIGN PARAMETERS - 2016 CBC
TWO PROPOSED WAREHOUSES
CYPRESS, CALIFORNIA

DRAWN: JH
CHKD: RGT
SCG PROJECT 19G186-1
PLATE E-1A

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL

OSHPD

Latitude, Longitude: 33.801729, -118.020989



Date	9/13/2019, 9:41:27 AM
Design Code Reference Document	ASCE7-16
Risk Category	III
Site Class	D - Stiff Soil

Type	Value	Description
S_S	1.44	MCE_R ground motion. (for 0.2 second period)
S_1	0.51	MCE_R ground motion. (for 1.0s period)
S_{MS}	1.44	Site-modified spectral acceleration value
S_{M1}	null -See Section 11.4.8	Site-modified spectral acceleration value
S_{DS}	0.96	Numeric seismic design value at 0.2 second SA
S_{D1}	null -See Section 11.4.8	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	null -See Section 11.4.8	Seismic design category
F_a	1	Site amplification factor at 0.2 second
F_v	null -See Section 11.4.8	Site amplification factor at 1.0 second
PGA	0.617	MCE_G peak ground acceleration
F_{PGA}	1.1	Site amplification factor at PGA
PGA_M	0.678	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	1.44	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	1.579	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	2.465	Factored deterministic acceleration value. (0.2 second)
S1RT	0.51	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.557	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.835	Factored deterministic acceleration value. (1.0 second)
PGAd	0.998	Factored deterministic acceleration value. (Peak Ground Acceleration)
C_{RS}	0.912	Mapped value of the risk coefficient at short periods
C_{R1}	0.916	Mapped value of the risk coefficient at a period of 1 s

SOURCE□SEAOC/OSHPD S□□□ □D□□□□ M□□□T□□□
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SEISMIC DESIGN PARAMETERS - 2019 CBC
TWO PROPOSED WAREHOUSES
CYPRESS, CALIFORNIA

DRAWN□JH
CHKD□RGT
SCG PROJECT
19G186-1
PLATE E-1B

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL

APPENDIX F

SUMMARY

OF

CONE PENETRATION TEST DATA

Project:

6400 Katella Avenue
Cypress, CA
August 27, 2019

Prepared for:

Mr. Daryl Kas
Southern California Geotechnical, Inc.
22885 E. Savi Ranch Parkway, Ste E
Yorba Linda, CA 92887
Office (714) 685-1115 / Fax (714) 685-1118

Prepared by:

KEHOE TESTING & ENGINEERING
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Huntington Beach, CA 92649-1518
Office (714) 901-7270 / Fax (714) 901-7289
www.kehoetesting.com

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1. **INTRODUCTION**
2. **SUMMARY OF FIELD WORK**
3. **FIELD EQUIPMENT & PROCEDURES**
4. **CONE PENETRATION TEST DATA & INTERPRETATION**

APPENDIX

- CPT Plots
- CPT Classification/Soil Behavior Chart
- Pore Pressure Dissipation Graphs
- CPT Data Files (sent via email)

SUMMARY

OF

CONE PENETRATION TEST DATA

1. INTRODUCTION

This report presents the results of a Cone Penetration Test (CPT) program carried out for the project located at 6400 Katella Avenue in Cypress, California. The work was performed by Kehoe Testing & Engineering (KTE) on August 27, 2019. The scope of work was performed as directed by Southern California Geotechnical, Inc. personnel.

2. SUMMARY OF FIELD WORK

The fieldwork consisted of performing CPT soundings at four locations to determine the soil lithology. A summary is provided in **TABLE 2.1**.

LOCATION	DEPTH OF CPT (ft)	COMMENTS/NOTES:
CPT-1	65	
CPT-2	70	
CPT-3	65	
CPT-4	60	

TABLE 2.1 - Summary of CPT Soundings

3. FIELD EQUIPMENT & PROCEDURES

The CPT soundings were carried out by **KTE** using an integrated electronic cone system manufactured by Vertek. The CPT soundings were performed in accordance with ASTM standards (D5778). The cone penetrometers were pushed using a 30-ton CPT rig. The cone used during the program was a 15 cm^2 cone and recorded the following parameters at approximately 2.5 cm depth intervals:

- Cone Resistance (qc)
- Sleeve Friction (fs)
- Dynamic Pore Pressure (u)
- Inclination
- Penetration Speed
- Pore Pressure Dissipation (at selected depths)

The above parameters were recorded and viewed in real time using a laptop computer. Data is stored at the KTE office for up to 2 years for future analysis and reference. A complete set of baseline readings was taken prior to each sounding to determine temperature shifts and any zero load offsets. Monitoring base line readings ensures that the cone electronics are operating properly.

4. CONE PENETRATION TEST DATA & INTERPRETATION

The Cone Penetration Test data is presented in graphical form in the attached Appendix. These plots were generated using the CPeT-IT program. Penetration depths are referenced to ground surface. The soil classification on the CPT plots is derived from the attached CPT Classification Chart (Robertson) and presents major soil lithologic changes. The stratigraphic interpretation is based on relationships between cone resistance (qc), sleeve friction (fs), and penetration pore pressure (u). The friction ratio (Rf), which is sleeve friction divided by cone resistance, is a calculated parameter that is used along with cone resistance to infer soil behavior type. Generally, cohesive soils (clays) have high friction ratios, low cone resistance and generate excess pore water pressures. Cohesionless soils (sands) have lower friction ratios, high cone bearing and generate little (or negative) excess pore water pressures.

The CPT data files have also been provided. These files can be imported in CPeT-IT (software by GeoLogismiki) and other programs to calculate various geotechnical parameters.

It should be noted that it is not always possible to clearly identify a soil type based on qc, fs and u. In these situations, experience, judgement and an assessment of the pore pressure data should be used to infer the soil behavior type.

If you have any questions regarding this information, please do not hesitate to call our office at (714) 901-7270.

Sincerely,

KEHOE TESTING & ENGINEERING



Steven P. Kehoe
President

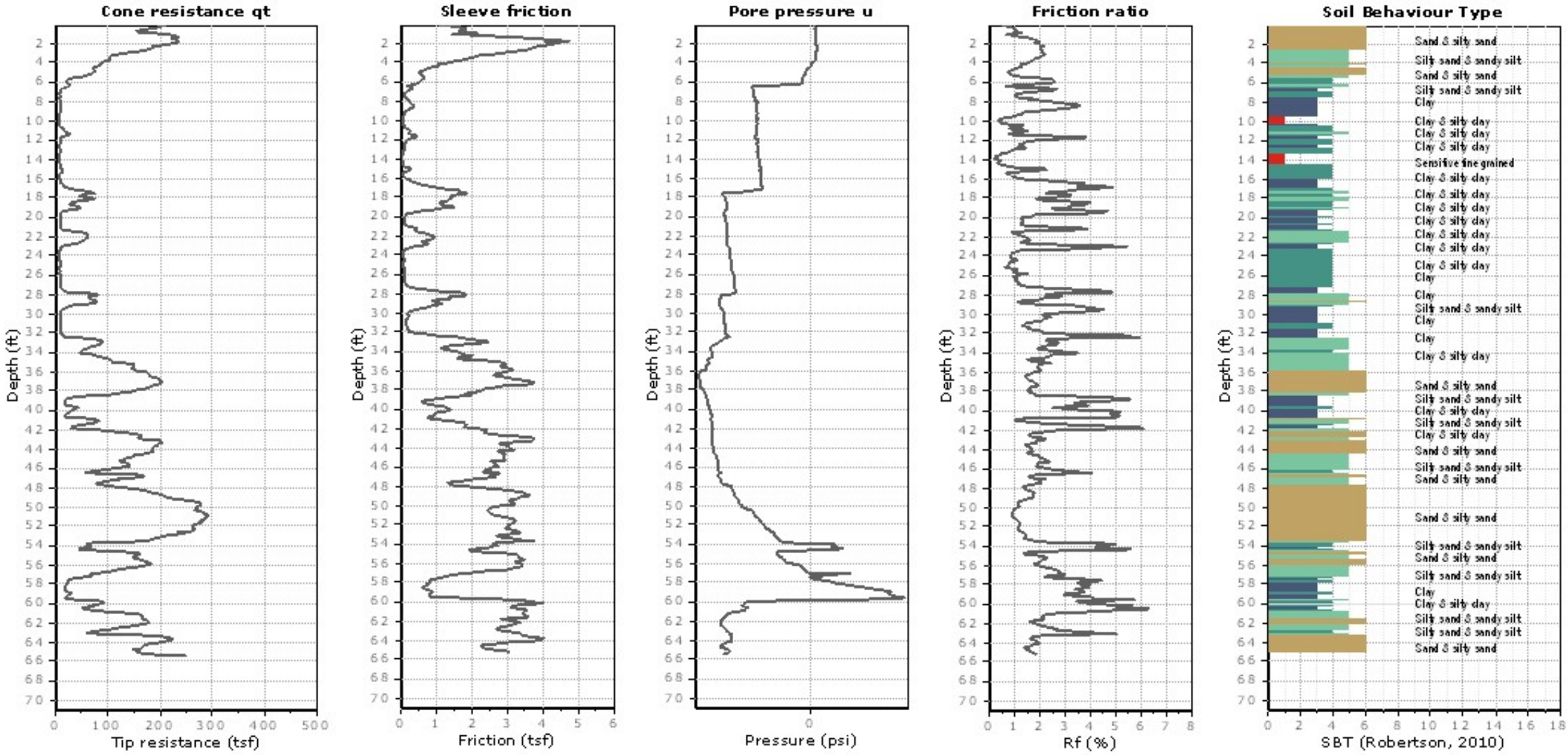
09/03/19-hh-0871

APPENDIX

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

Project: **Southern California Geotechnical** **CPT-1**

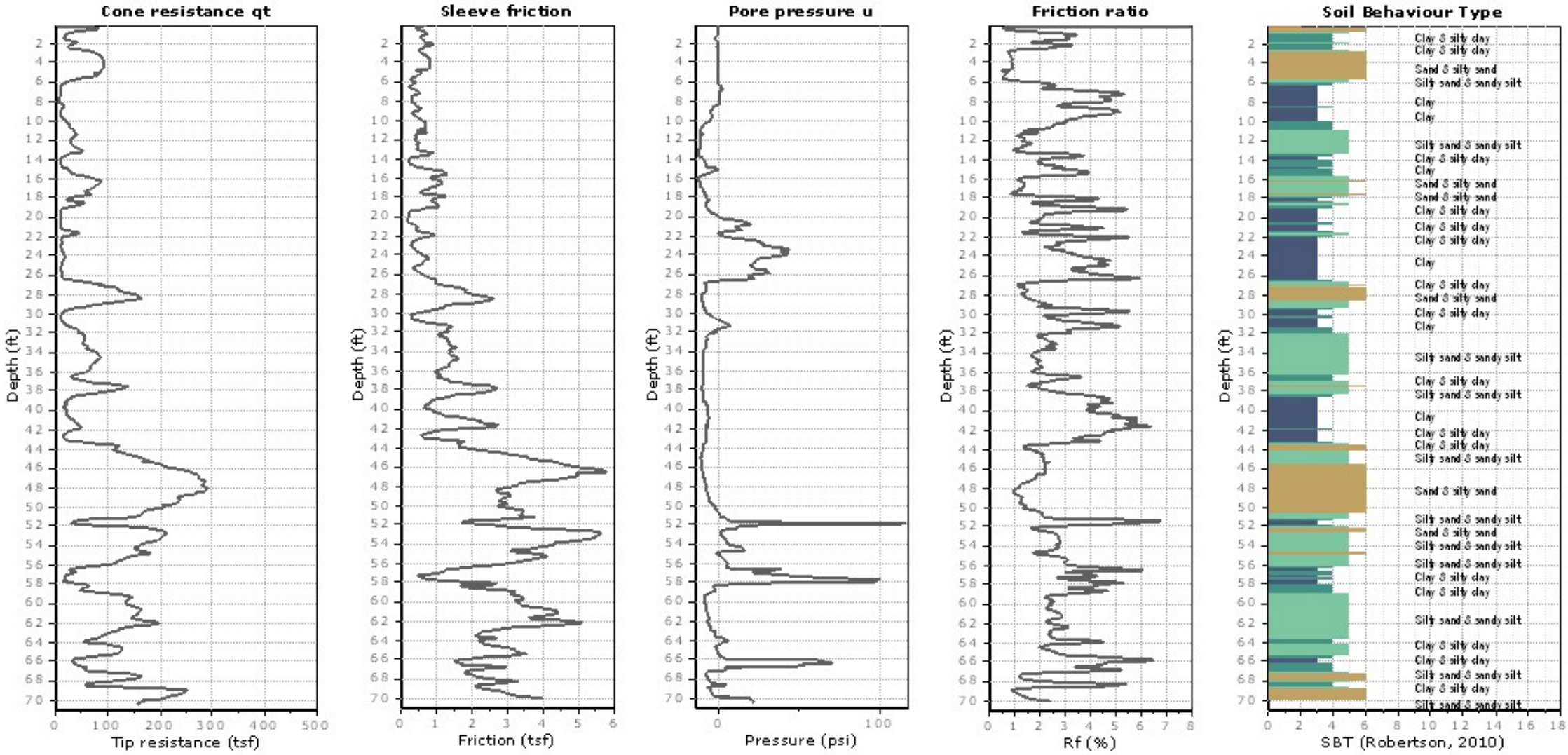
Location: **6400 Katella Ave, Cypress, CA** Total depth: 65.49 ft, Date: 8/27/2019



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Project: **Southern California Geotechnical** **CPT-2**

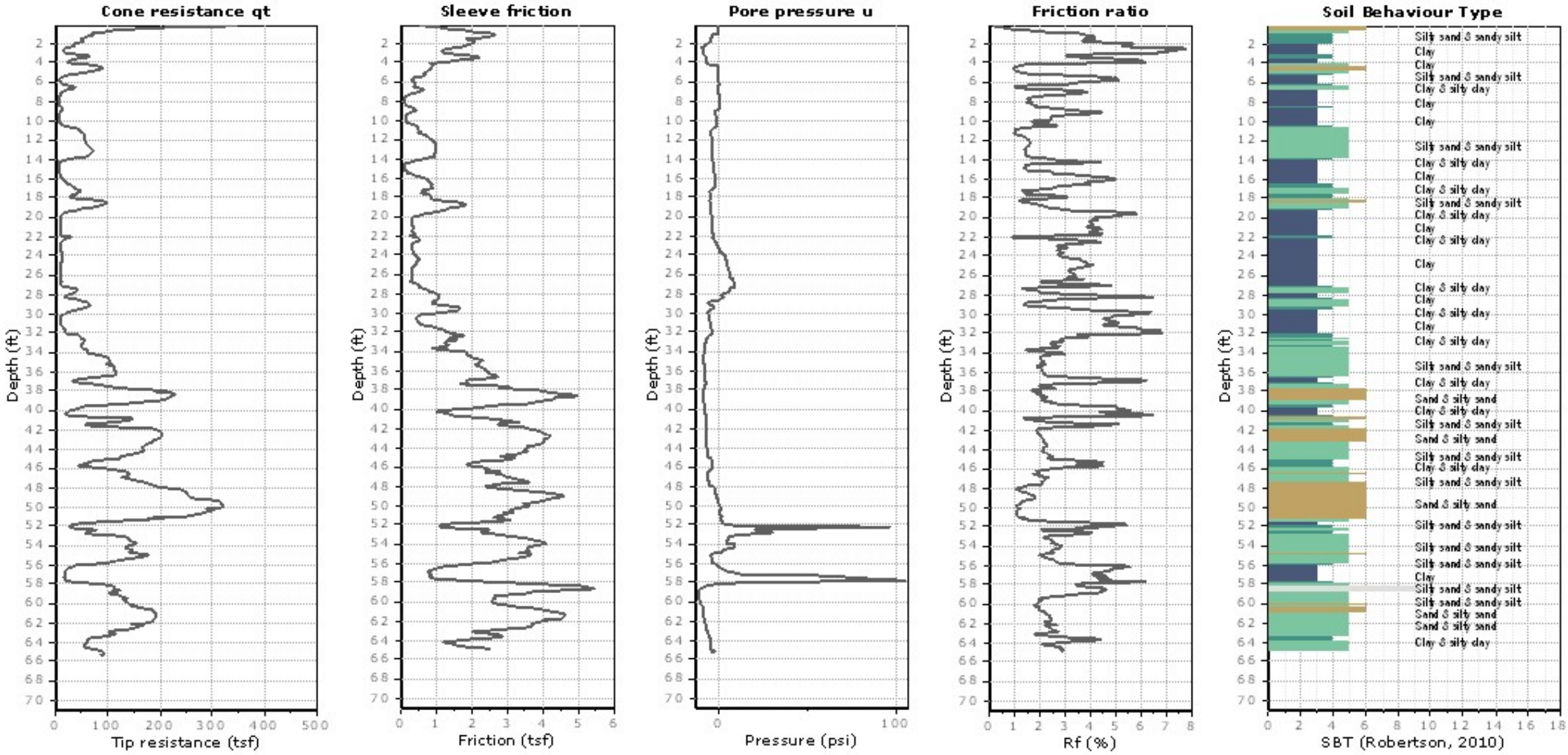
Location: **6400 Katella Ave, Cypress, CA** Total depth: 70.43 ft, Date: 8/27/2019



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Project: **Southern California Geotechnical** **CPT-3**

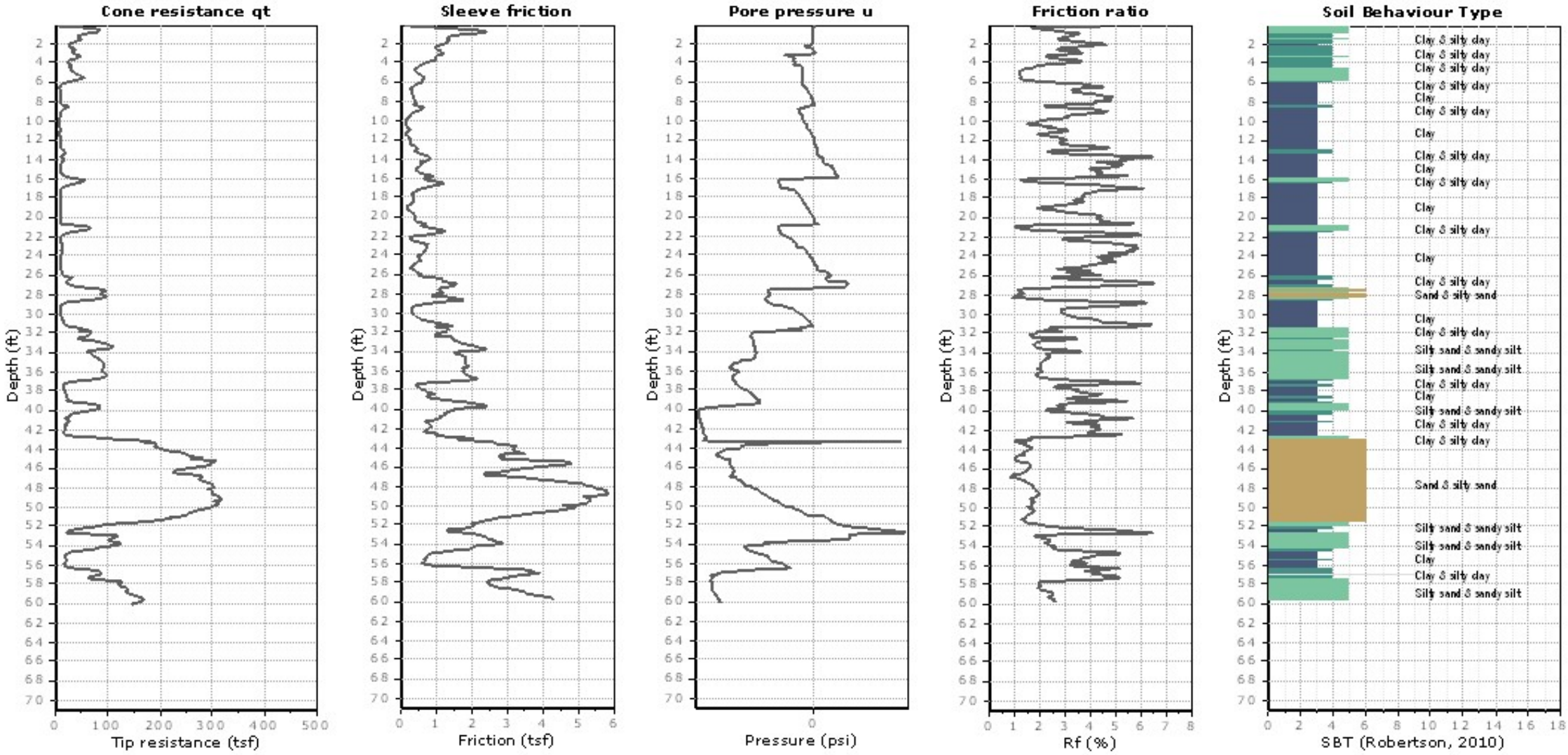
Location: **6400 Katella Ave, Cypress, CA** Total depth: 65.30 ft, Date: 8/27/2019



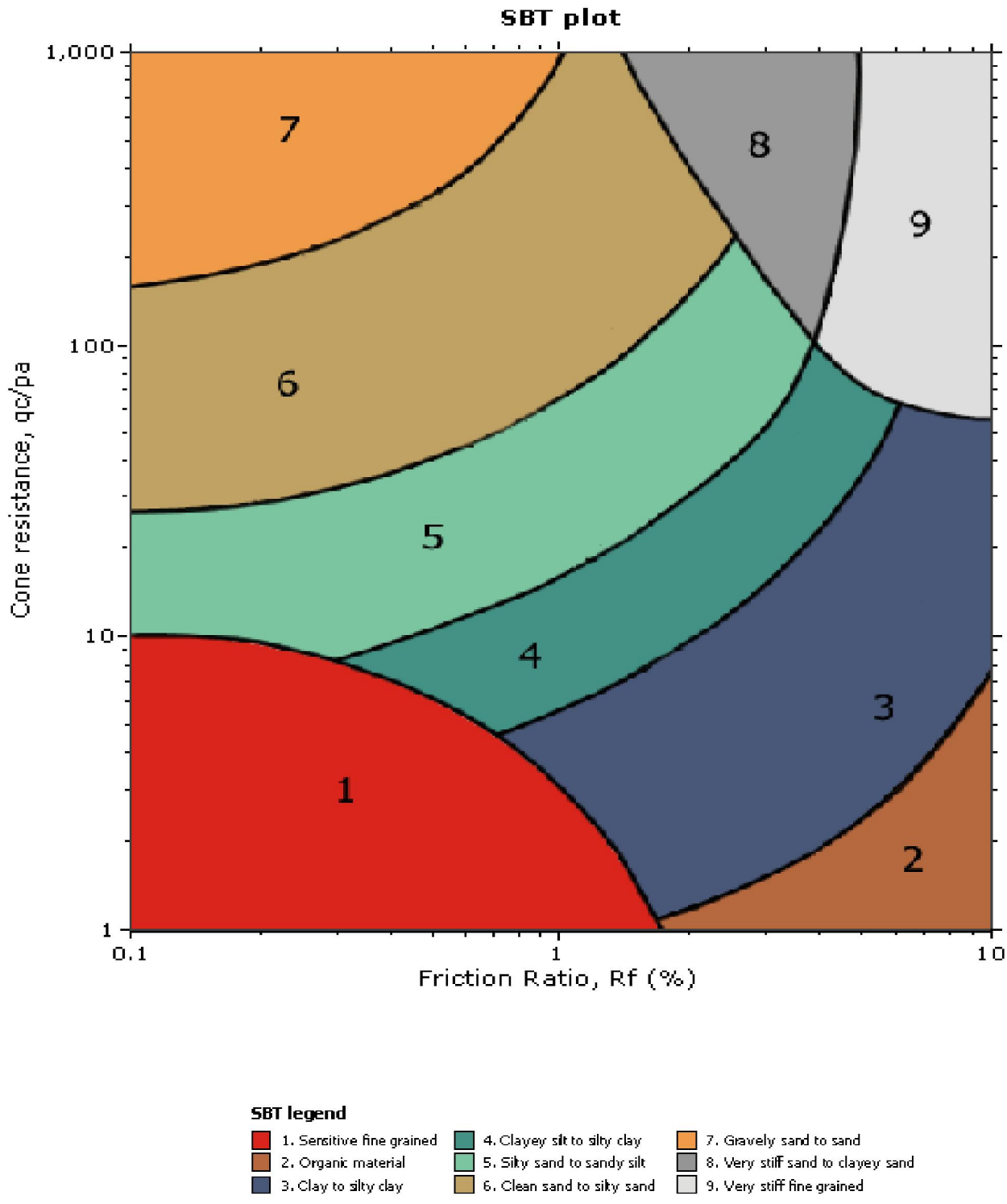
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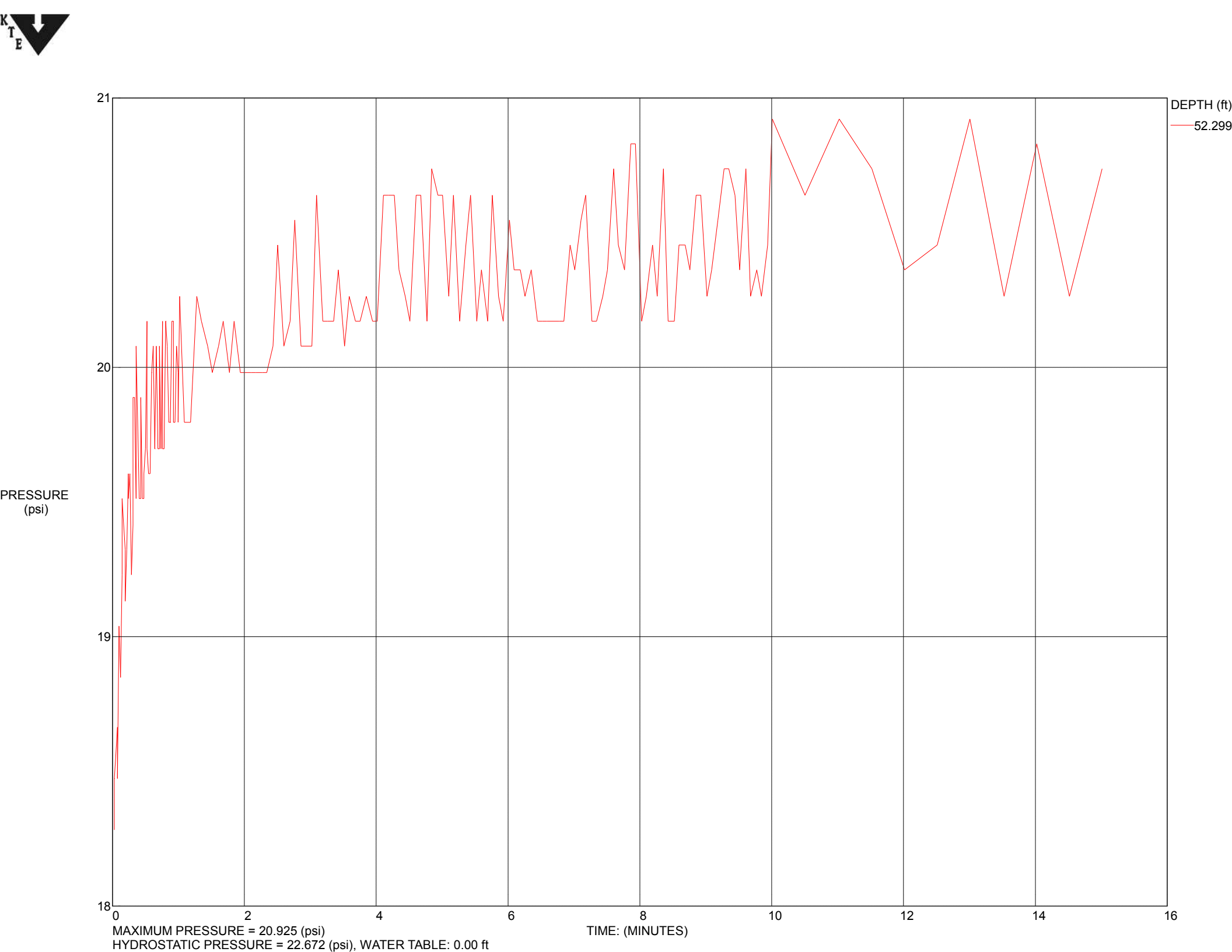
Project: **Southern California Geotechnical** **CPT-4**

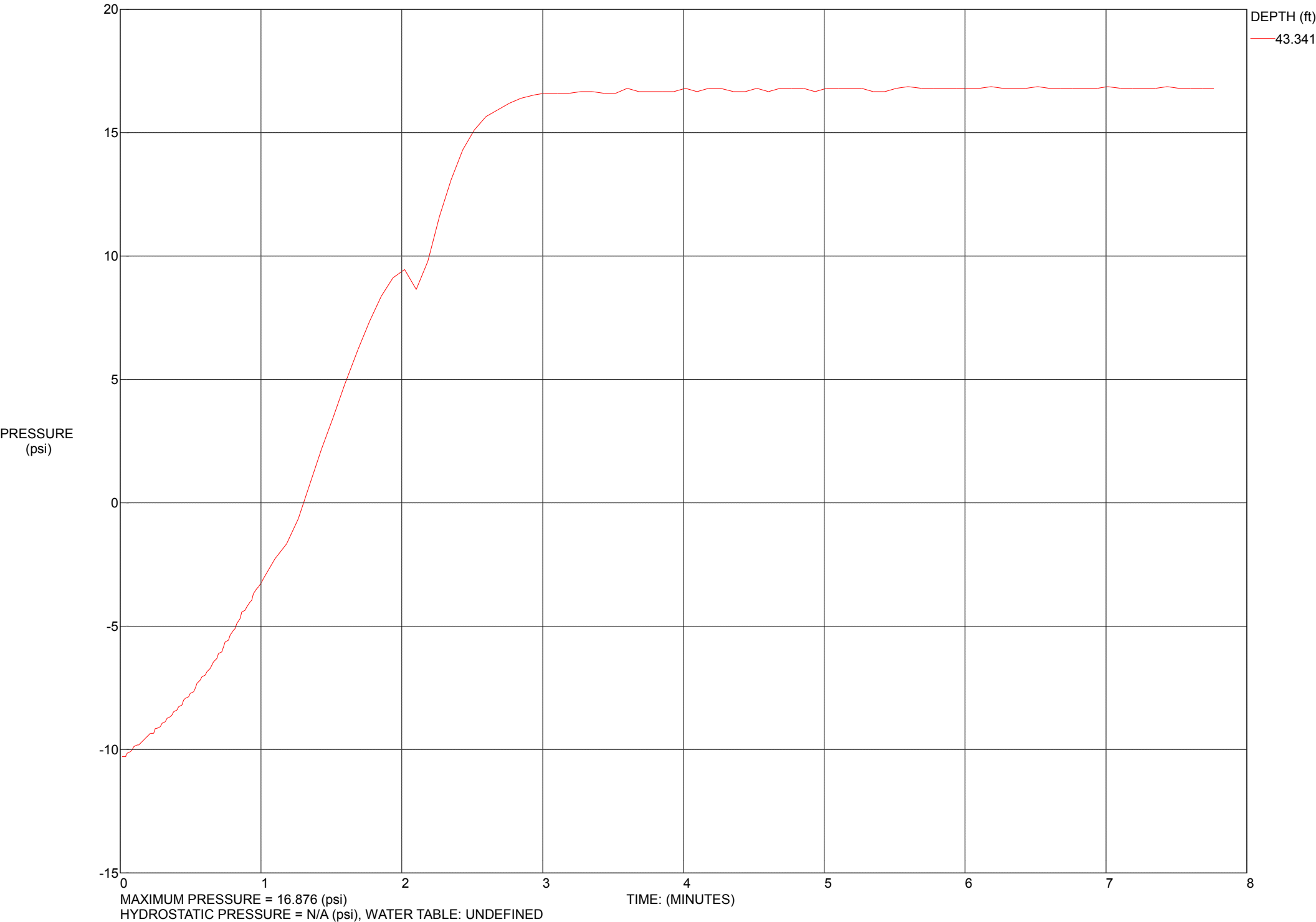
Location: **6400 Katella Ave, Cypress, CA** Total depth: 60.13 ft, Date: 8/27/2019



Kehoe Testing and Engineering
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21
20
19
18
PRESSURE
(psi)
DEPTH (ft)
52.299
0
2
4
6
8
10
12
14
16
TIME: (MINUTES)
MAXIMUM PRESSURE = 20.925 (psi)
HYDROSTATIC PRESSURE = 22.672 (psi), WATER TABLE: 0.00 ft



MAXIMUM PRESSURE = 16.876 (psi)
HYDROSTATIC PRESSURE = N/A (psi), WATER TABLE: UNDEFINED

APPENDIX G

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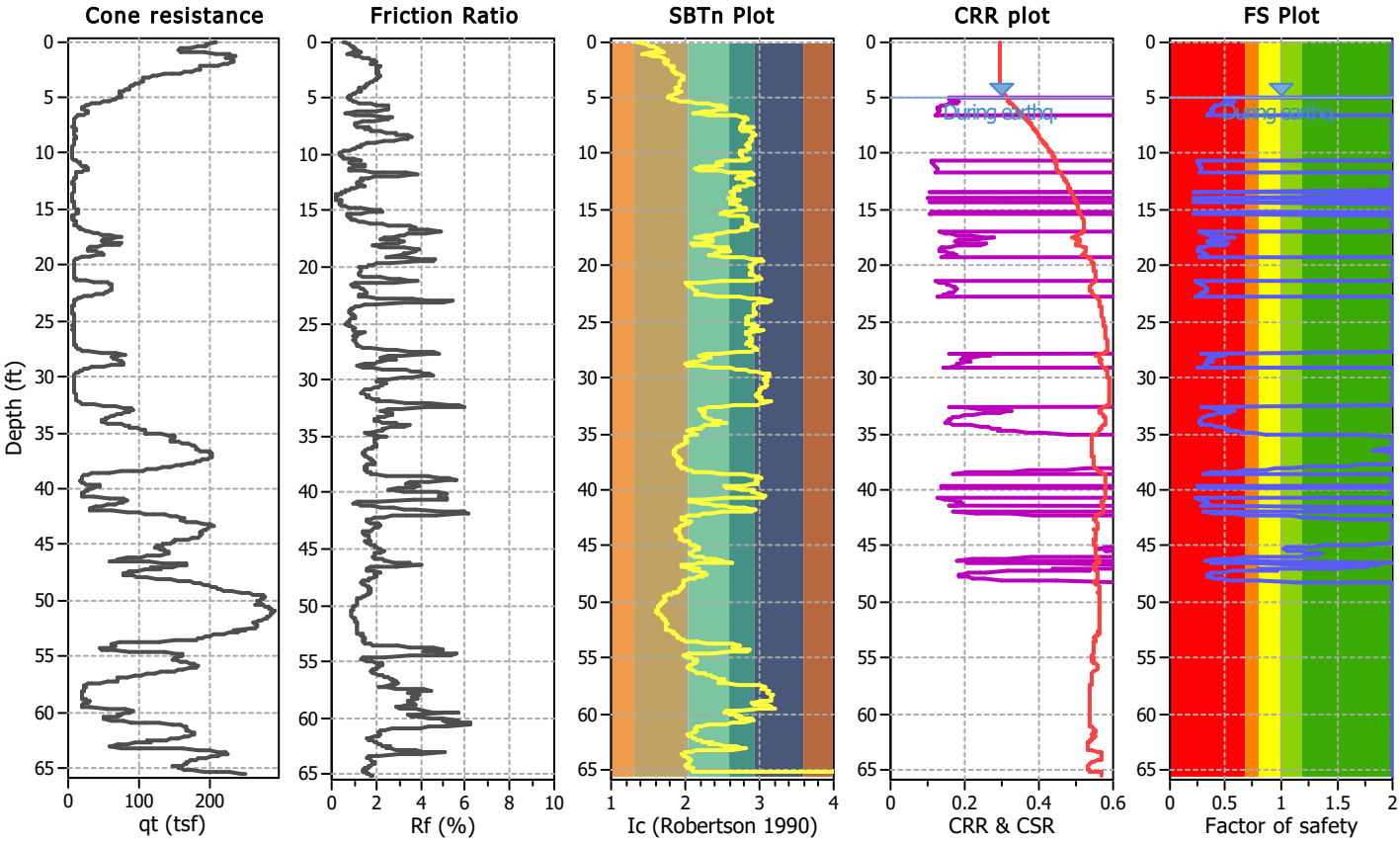
LIQUEFACTION ANALYSIS REPORT

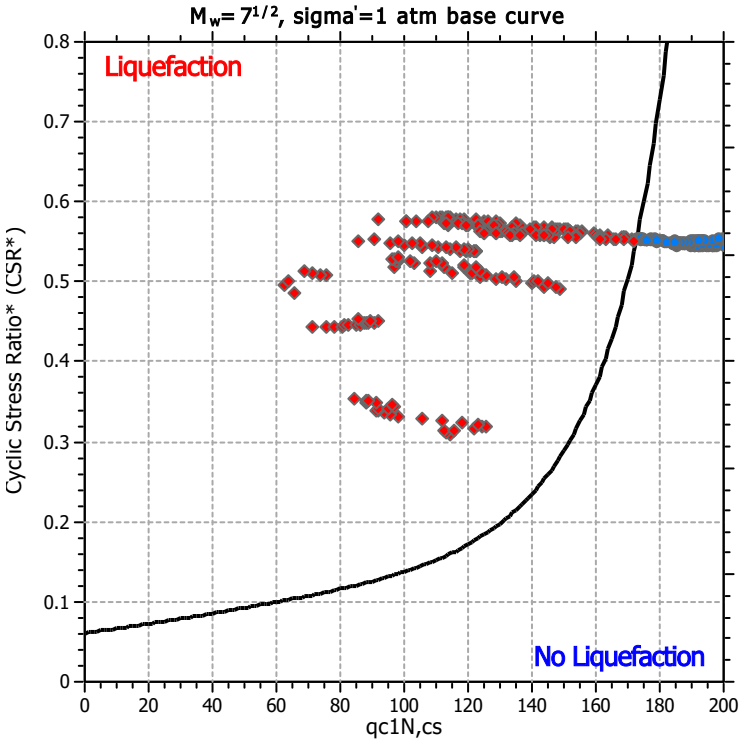
Project title : Proposed Commercial/Industrial Development **Location : Cypress, CA**

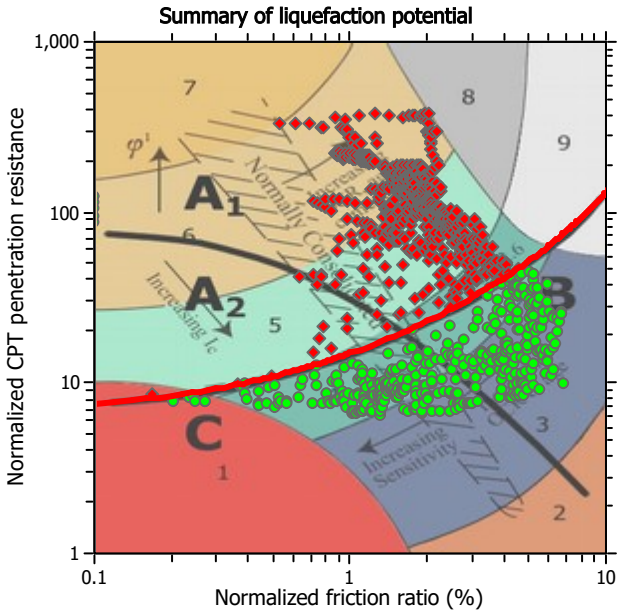
CPT file : CPT-1

Input parameters and analysis data

Analysis method:	**B&I (2014)**	**G.W.T. (in-situ):**	**5.00 ft**	**Use fill:**	**No**	**Clay like behavior applied:**	**Sands only**
Fines correction method:	**B&I (2014)**	**G.W.T. (earthq.):**	**5.00 ft**	**Fill height:**	**N/A**	**Limit depth applie**	**Yes**
Points to test:	**Based on Ic value**	**Average results interva**	**1**	**Fill weight:**	**N/A**	**Limit depth:**	**50.00 ft**
Earthquake magnitude M_w:	**7.30**	**Ic cut-off value:**	**2.60**	**Trans. detect. applied:**	**No**	**MSF method:**	**Method base**
Peak ground acceleration:	**0.54**	**Unit weight calculation**	**Based on SBT**	**K_σ applied:**	**Yes**		

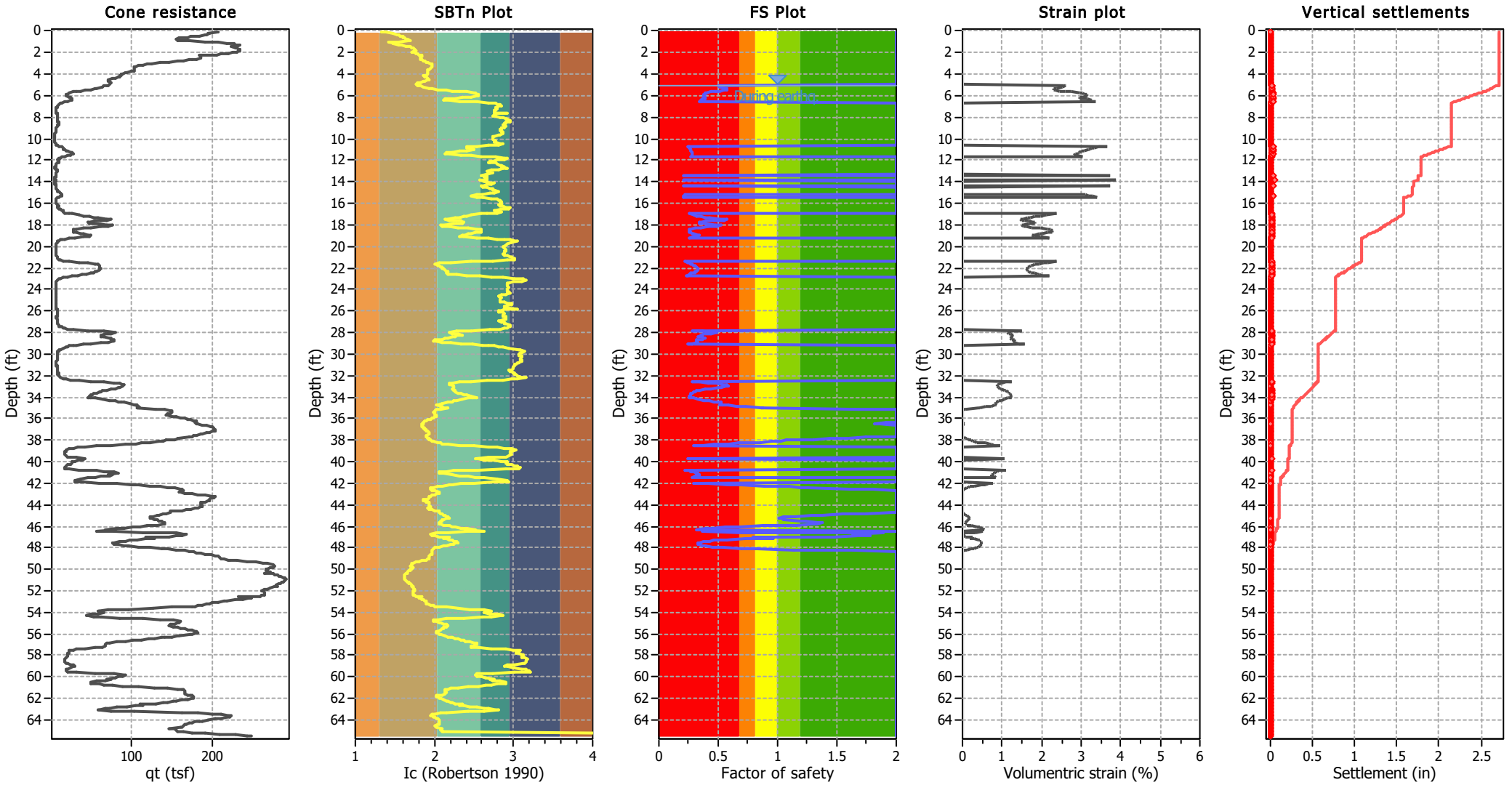






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

:: Post-earthquake settlement due to soil liquefaction ::

Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)
5.01	114.55	0.52	2.55	0.92	0.03	5.06	113.17	0.51	2.58	0.91	0.01
5.12	112.67	0.50	2.59	0.91	0.02	5.19	115.40	0.51	2.52	0.91	0.02
5.27	122.18	0.56	2.37	0.91	0.02	5.34	124.59	0.57	2.32	0.91	0.02
5.41	125.42	0.58	2.30	0.91	0.02	5.48	122.97	0.55	2.35	0.91	0.02
5.54	118.32	0.52	2.44	0.91	0.02	5.59	111.91	0.48	2.59	0.91	0.02
5.65	105.73	0.44	2.74	0.90	0.02	5.73	98.42	0.41	2.95	0.90	0.03
5.80	95.71	0.40	3.03	0.90	0.02	5.84	93.79	0.39	3.09	0.90	0.02
5.93	91.79	0.38	3.15	0.90	0.03	6.00	91.54	0.38	3.16	0.90	0.02
6.05	91.84	0.37	3.14	0.90	0.02	6.13	94.71	0.38	3.04	0.90	0.03
6.19	96.58	0.39	2.98	0.90	0.02	6.25	96.56	0.39	2.98	0.89	0.02
6.33	90.94	0.36	3.16	0.89	0.03	6.39	88.35	0.35	3.24	0.89	0.02
6.45	88.33	0.35	3.24	0.89	0.02	6.51	88.48	0.35	3.23	0.89	0.02
6.58	84.54	0.34	3.38	0.89	0.03	6.65	22.25	2.00	0.00	0.89	0.00
6.70	18.65	2.00	0.00	0.89	0.00	6.78	16.85	2.00	0.00	0.89	0.00
6.84	15.49	2.00	0.00	0.88	0.00	6.89	14.65	2.00	0.00	0.88	0.00
6.98	13.82	2.00	0.00	0.88	0.00	7.04	12.85	2.00	0.00	0.88	0.00
7.09	12.31	2.00	0.00	0.88	0.00	7.17	11.20	2.00	0.00	0.88	0.00
7.23	10.65	2.00	0.00	0.88	0.00	7.29	11.20	2.00	0.00	0.88	0.00
7.35	11.07	2.00	0.00	0.88	0.00	7.43	11.20	2.00	0.00	0.87	0.00
7.49	11.47	2.00	0.00	0.87	0.00	7.56	12.16	2.00	0.00	0.87	0.00
7.62	9.69	2.00	0.00	0.87	0.00	7.68	13.27	2.00	0.00	0.87	0.00
7.76	14.11	2.00	0.00	0.87	0.00	7.82	14.65	2.00	0.00	0.87	0.00
7.88	15.34	2.00	0.00	0.87	0.00	7.95	15.20	2.00	0.00	0.87	0.00
8.01	14.51	2.00	0.00	0.86	0.00	8.07	13.96	2.00	0.00	0.86	0.00
8.14	13.27	2.00	0.00	0.86	0.00	8.21	14.03	2.00	0.00	0.86	0.00
8.27	13.42	2.00	0.00	0.86	0.00	8.34	14.11	2.00	0.00	0.86	0.00
8.40	14.38	2.00	0.00	0.86	0.00	8.48	16.18	2.00	0.00	0.86	0.00
8.54	16.45	2.00	0.00	0.86	0.00	8.62	16.03	2.00	0.00	0.85	0.00
8.68	16.03	2.00	0.00	0.85	0.00	8.76	14.65	2.00	0.00	0.85	0.00
8.82	13.42	2.00	0.00	0.85	0.00	8.87	12.85	2.00	0.00	0.85	0.00
8.95	12.03	2.00	0.00	0.85	0.00	9.01	11.89	2.00	0.00	0.85	0.00
9.06	11.34	2.00	0.00	0.85	0.00	9.15	11.07	2.00	0.00	0.84	0.00
9.19	10.93	2.00	0.00	0.84	0.00	9.25	10.51	2.00	0.00	0.84	0.00
9.34	9.96	2.00	0.00	0.84	0.00	9.39	9.69	2.00	0.00	0.84	0.00
9.48	9.00	2.00	0.00	0.84	0.00	9.53	8.58	2.00	0.00	0.84	0.00
9.61	8.58	2.00	0.00	0.84	0.00	9.66	8.58	2.00	0.00	0.84	0.00
9.74	8.71	2.00	0.00	0.83	0.00	9.81	8.58	2.00	0.00	0.83	0.00
9.85	8.43	2.00	0.00	0.83	0.00	9.94	8.43	2.00	0.00	0.83	0.00
9.99	8.43	2.00	0.00	0.83	0.00	10.04	8.43	2.00	0.00	0.83	0.00
10.13	8.16	2.00	0.00	0.83	0.00	10.18	8.52	2.00	0.00	0.83	0.00
10.25	8.58	2.00	0.00	0.83	0.00	10.32	9.13	2.00	0.00	0.83	0.00
10.38	9.54	2.00	0.00	0.82	0.00	10.44	9.69	2.00	0.00	0.82	0.00
10.51	10.06	2.00	0.00	0.82	0.00	10.58	10.99	2.00	0.00	0.82	0.00
10.64	13.50	2.00	0.00	0.82	0.00	10.71	71.55	0.24	3.65	0.82	0.03
10.79	75.66	0.25	3.46	0.82	0.03	10.83	78.42	0.26	3.34	0.82	0.02
10.89	80.62	0.26	3.24	0.82	0.02	10.97	81.41	0.26	3.21	0.81	0.03
11.03	82.30	0.26	3.17	0.81	0.02	11.10	84.84	0.27	3.07	0.81	0.03
11.16	86.38	0.27	3.02	0.81	0.02	11.23	87.32	0.27	2.98	0.81	0.03

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)
11.29	88.30	0.28	2.94	0.81	0.02	11.37	88.99	0.28	2.92	0.81	0.03
11.43	90.76	0.28	2.86	0.81	0.02	11.50	91.81	0.28	2.82	0.81	0.03
11.56	89.30	0.28	2.90	0.80	0.02	11.62	85.32	0.27	3.02	0.80	0.02
11.69	20.41	2.00	0.00	0.80	0.00	11.75	17.28	2.00	0.00	0.80	0.00
11.82	15.26	2.00	0.00	0.80	0.00	11.89	14.49	2.00	0.00	0.80	0.00
11.95	15.37	2.00	0.00	0.80	0.00	12.02	15.48	2.00	0.00	0.80	0.00
12.08	16.21	2.00	0.00	0.80	0.00	12.15	15.81	2.00	0.00	0.79	0.00
12.21	14.93	2.00	0.00	0.79	0.00	12.27	12.39	2.00	0.00	0.79	0.00
12.34	11.75	2.00	0.00	0.79	0.00	12.44	10.33	2.00	0.00	0.79	0.00
12.50	9.55	2.00	0.00	0.79	0.00	12.56	9.03	2.00	0.00	0.79	0.00
12.62	9.53	2.00	0.00	0.79	0.00	12.68	8.87	2.00	0.00	0.79	0.00
12.75	9.49	2.00	0.00	0.78	0.00	12.82	9.99	2.00	0.00	0.78	0.00
12.88	10.74	2.00	0.00	0.78	0.00	12.95	12.12	2.00	0.00	0.78	0.00
13.01	12.99	2.00	0.00	0.78	0.00	13.07	12.48	2.00	0.00	0.78	0.00
13.13	11.46	2.00	0.00	0.78	0.00	13.20	10.57	2.00	0.00	0.78	0.00
13.26	11.45	2.00	0.00	0.78	0.00	13.32	10.81	2.00	0.00	0.77	0.00
13.39	65.49	0.21	3.74	0.77	0.03	13.46	9.92	2.00	0.00	0.77	0.00
13.53	9.15	2.00	0.00	0.77	0.00	13.60	8.91	2.00	0.00	0.77	0.00
13.66	8.39	2.00	0.00	0.77	0.00	13.72	8.38	2.00	0.00	0.77	0.00
13.79	8.38	2.00	0.00	0.77	0.00	13.89	62.37	0.20	3.87	0.76	0.05
13.92	8.48	2.00	0.00	0.76	0.00	13.99	8.99	2.00	0.00	0.76	0.00
14.06	8.58	2.00	0.00	0.76	0.00	14.13	8.43	2.00	0.00	0.76	0.00
14.19	8.81	2.00	0.00	0.76	0.00	14.26	9.30	2.00	0.00	0.76	0.00
14.32	9.80	2.00	0.00	0.76	0.00	14.38	64.05	0.20	3.73	0.76	0.03
14.44	10.28	2.00	0.00	0.76	0.00	14.51	10.01	2.00	0.00	0.75	0.00
14.57	9.99	2.00	0.00	0.75	0.00	14.64	9.98	2.00	0.00	0.75	0.00
14.70	10.33	2.00	0.00	0.75	0.00	14.78	11.53	2.00	0.00	0.75	0.00
14.84	12.11	2.00	0.00	0.75	0.00	14.91	12.93	2.00	0.00	0.75	0.00
14.97	14.10	2.00	0.00	0.75	0.00	15.05	16.33	2.00	0.00	0.75	0.00
15.11	17.62	2.00	0.00	0.74	0.00	15.17	19.03	2.00	0.00	0.74	0.00
15.22	75.90	0.22	3.13	0.74	0.02	15.30	74.05	0.22	3.20	0.74	0.03
15.37	71.22	0.21	3.31	0.74	0.03	15.42	68.93	0.21	3.41	0.74	0.02
15.50	12.33	2.00	0.00	0.74	0.00	15.55	10.39	2.00	0.00	0.74	0.00
15.63	9.28	2.00	0.00	0.74	0.00	15.69	8.90	2.00	0.00	0.73	0.00
15.76	8.77	2.00	0.00	0.73	0.00	15.82	8.75	2.00	0.00	0.73	0.00
15.88	9.11	2.00	0.00	0.73	0.00	15.95	9.93	2.00	0.00	0.73	0.00
16.02	10.40	2.00	0.00	0.73	0.00	16.09	11.56	2.00	0.00	0.73	0.00
16.15	13.31	2.00	0.00	0.73	0.00	16.21	13.76	2.00	0.00	0.73	0.00
16.28	13.26	2.00	0.00	0.72	0.00	16.35	13.12	2.00	0.00	0.72	0.00
16.41	12.86	2.00	0.00	0.72	0.00	16.48	14.23	2.00	0.00	0.72	0.00
16.56	17.64	2.00	0.00	0.72	0.00	16.60	19.90	2.00	0.00	0.72	0.00
16.67	21.46	2.00	0.00	0.72	0.00	16.73	20.95	2.00	0.00	0.72	0.00
16.81	22.01	2.00	0.00	0.72	0.00	16.87	24.64	2.00	0.00	0.71	0.00
16.95	30.84	2.00	0.00	0.71	0.00	17.00	96.80	0.26	2.36	0.71	0.01
17.09	107.93	0.29	2.11	0.71	0.02	17.14	114.84	0.32	1.97	0.71	0.01
17.23	123.55	0.36	1.82	0.71	0.02	17.29	128.99	0.39	1.74	0.71	0.01
17.35	135.06	0.43	1.65	0.71	0.01	17.41	143.86	0.51	1.53	0.70	0.01
17.47	148.77	0.57	1.47	0.70	0.01	17.55	147.21	0.55	1.49	0.70	0.01

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)
17.61	139.78	0.47	1.58	0.70	0.01	17.67	132.12	0.41	1.68	0.70	0.01
17.73	125.53	0.36	1.77	0.70	0.01	17.80	120.71	0.34	1.84	0.70	0.02
17.87	121.04	0.34	1.83	0.70	0.01	17.93	130.82	0.40	1.68	0.70	0.01
18.00	140.80	0.48	1.55	0.69	0.01	18.06	144.95	0.52	1.50	0.69	0.01
18.13	141.60	0.48	1.53	0.69	0.01	18.19	134.29	0.42	1.62	0.69	0.01
18.26	123.90	0.35	1.77	0.69	0.01	18.32	112.39	0.30	1.96	0.69	0.02
18.39	103.04	0.27	2.14	0.69	0.02	18.45	98.37	0.26	2.25	0.69	0.02
18.51	97.20	0.25	2.27	0.69	0.02	18.57	96.83	0.25	2.28	0.69	0.02
18.64	96.25	0.25	2.29	0.68	0.02	18.73	102.09	0.27	2.15	0.68	0.02
18.79	107.82	0.28	2.03	0.68	0.01	18.86	112.15	0.30	1.94	0.68	0.02
18.92	118.50	0.32	1.83	0.68	0.01	18.99	122.29	0.34	1.76	0.68	0.01
19.06	118.46	0.32	1.82	0.68	0.01	19.12	110.03	0.29	1.97	0.68	0.02
19.19	98.28	0.26	2.21	0.67	0.02	19.25	28.27	2.00	0.00	0.67	0.00
19.31	22.51	2.00	0.00	0.67	0.00	19.36	18.16	2.00	0.00	0.67	0.00
19.43	14.61	2.00	0.00	0.67	0.00	19.49	12.45	2.00	0.00	0.67	0.00
19.56	10.61	2.00	0.00	0.67	0.00	19.64	10.05	2.00	0.00	0.67	0.00
19.71	9.83	2.00	0.00	0.67	0.00	19.77	9.61	2.00	0.00	0.67	0.00
19.84	9.38	2.00	0.00	0.66	0.00	19.89	9.37	2.00	0.00	0.66	0.00
19.96	9.36	2.00	0.00	0.66	0.00	20.02	9.36	2.00	0.00	0.66	0.00
20.08	9.02	2.00	0.00	0.66	0.00	20.18	8.89	2.00	0.00	0.66	0.00
20.24	8.67	2.00	0.00	0.66	0.00	20.30	8.66	2.00	0.00	0.66	0.00
20.35	8.66	2.00	0.00	0.66	0.00	20.43	8.65	2.00	0.00	0.65	0.00
20.49	8.75	2.00	0.00	0.65	0.00	20.56	8.74	2.00	0.00	0.65	0.00
20.62	8.73	2.00	0.00	0.65	0.00	20.68	8.94	2.00	0.00	0.65	0.00
20.74	9.14	2.00	0.00	0.65	0.00	20.80	9.24	2.00	0.00	0.65	0.00
20.90	9.64	2.00	0.00	0.65	0.00	20.96	9.95	2.00	0.00	0.64	0.00
21.02	10.36	2.00	0.00	0.64	0.00	21.08	10.87	2.00	0.00	0.64	0.00
21.15	11.28	2.00	0.00	0.64	0.00	21.21	12.10	2.00	0.00	0.64	0.00
21.28	14.18	2.00	0.00	0.64	0.00	21.34	19.04	2.00	0.00	0.64	0.00
21.41	85.86	0.22	2.38	0.64	0.02	21.46	95.52	0.24	2.14	0.64	0.01
21.52	100.09	0.25	2.04	0.64	0.02	21.61	105.46	0.27	1.93	0.63	0.02
21.68	110.51	0.28	1.83	0.63	0.01	21.74	114.45	0.30	1.76	0.63	0.01
21.80	117.48	0.31	1.71	0.63	0.01	21.87	119.23	0.31	1.68	0.63	0.01
21.93	120.72	0.32	1.66	0.63	0.01	21.99	122.09	0.33	1.63	0.63	0.01
22.06	122.77	0.33	1.62	0.63	0.01	22.12	122.55	0.33	1.62	0.63	0.01
22.18	121.85	0.33	1.63	0.62	0.01	22.27	120.21	0.32	1.65	0.62	0.02
22.33	118.50	0.31	1.67	0.62	0.01	22.40	116.08	0.30	1.71	0.62	0.01
22.45	112.87	0.29	1.76	0.62	0.01	22.52	108.45	0.27	1.83	0.62	0.02
22.59	104.89	0.26	1.89	0.62	0.02	22.65	102.24	0.26	1.94	0.62	0.01
22.72	97.87	0.24	2.02	0.61	0.02	22.78	90.63	0.23	2.18	0.61	0.02
22.84	24.27	2.00	0.00	0.61	0.00	22.91	18.88	2.00	0.00	0.61	0.00
22.97	14.76	2.00	0.00	0.61	0.00	23.05	11.62	2.00	0.00	0.61	0.00
23.10	11.01	2.00	0.00	0.61	0.00	23.17	9.77	2.00	0.00	0.61	0.00
23.23	9.27	2.00	0.00	0.61	0.00	23.33	9.04	2.00	0.00	0.60	0.00
23.39	8.74	2.00	0.00	0.60	0.00	23.45	8.52	2.00	0.00	0.60	0.00
23.52	8.22	2.00	0.00	0.60	0.00	23.58	7.91	2.00	0.00	0.60	0.00
23.64	7.70	2.00	0.00	0.60	0.00	23.70	7.48	2.00	0.00	0.60	0.00
23.77	7.38	2.00	0.00	0.60	0.00	23.82	7.38	2.00	0.00	0.60	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)
23.92	7.37	2.00	0.00	0.59	0.00	23.97	7.36	2.00	0.00	0.59	0.00
24.04	7.36	2.00	0.00	0.59	0.00	24.10	7.45	2.00	0.00	0.59	0.00
24.17	7.44	2.00	0.00	0.59	0.00	24.23	7.43	2.00	0.00	0.59	0.00
24.30	7.53	2.00	0.00	0.59	0.00	24.36	7.72	2.00	0.00	0.59	0.00
24.42	7.92	2.00	0.00	0.59	0.00	24.48	8.32	2.00	0.00	0.59	0.00
24.55	8.91	2.00	0.00	0.58	0.00	24.63	9.01	2.00	0.00	0.58	0.00
24.70	8.80	2.00	0.00	0.58	0.00	24.76	8.49	2.00	0.00	0.58	0.00
24.82	8.48	2.00	0.00	0.58	0.00	24.88	8.48	2.00	0.00	0.58	0.00
24.95	8.47	2.00	0.00	0.58	0.00	25.01	8.47	2.00	0.00	0.58	0.00
25.07	8.26	2.00	0.00	0.58	0.00	25.14	8.35	2.00	0.00	0.57	0.00
25.22	7.84	2.00	0.00	0.57	0.00	25.29	7.74	2.00	0.00	0.57	0.00
25.35	7.43	2.00	0.00	0.57	0.00	25.42	7.32	2.00	0.00	0.57	0.00
25.48	7.61	2.00	0.00	0.57	0.00	25.54	8.21	2.00	0.00	0.57	0.00
25.61	8.40	2.00	0.00	0.57	0.00	25.67	8.50	2.00	0.00	0.56	0.00
25.73	8.68	2.00	0.00	0.56	0.00	25.79	7.49	2.00	0.00	0.56	0.00
25.87	9.44	2.00	0.00	0.56	0.00	25.94	9.84	2.00	0.00	0.56	0.00
25.99	10.13	2.00	0.00	0.56	0.00	26.05	10.02	2.00	0.00	0.56	0.00
26.14	9.32	2.00	0.00	0.56	0.00	26.20	9.12	2.00	0.00	0.56	0.00
26.27	9.11	2.00	0.00	0.55	0.00	26.33	9.10	2.00	0.00	0.55	0.00
26.39	9.09	2.00	0.00	0.55	0.00	26.46	9.09	2.00	0.00	0.55	0.00
26.52	8.68	2.00	0.00	0.55	0.00	26.58	8.67	2.00	0.00	0.55	0.00
26.64	8.67	2.00	0.00	0.55	0.00	26.73	9.05	2.00	0.00	0.55	0.00
26.79	9.43	2.00	0.00	0.55	0.00	26.86	10.10	2.00	0.00	0.54	0.00
26.92	10.49	2.00	0.00	0.54	0.00	26.98	10.27	2.00	0.00	0.54	0.00
27.04	10.17	2.00	0.00	0.54	0.00	27.11	9.97	2.00	0.00	0.54	0.00
27.17	10.53	2.00	0.00	0.54	0.00	27.23	10.81	2.00	0.00	0.54	0.00
27.33	11.37	2.00	0.00	0.54	0.00	27.39	12.22	2.00	0.00	0.54	0.00
27.45	13.64	2.00	0.00	0.53	0.00	27.51	15.90	2.00	0.00	0.53	0.00
27.57	18.33	2.00	0.00	0.53	0.00	27.63	20.57	2.00	0.00	0.53	0.00
27.70	24.19	2.00	0.00	0.53	0.00	27.76	31.20	2.00	0.00	0.53	0.00
27.85	113.74	0.28	1.48	0.53	0.01	27.91	132.36	0.36	1.26	0.53	0.01
27.97	145.43	0.47	1.13	0.53	0.01	28.03	146.69	0.48	1.12	0.53	0.01
28.10	142.22	0.44	1.15	0.52	0.01	28.15	135.02	0.38	1.22	0.52	0.01
28.22	129.70	0.35	1.27	0.52	0.01	28.28	133.55	0.37	1.23	0.52	0.01
28.35	126.92	0.33	1.30	0.52	0.01	28.41	130.51	0.35	1.26	0.52	0.01
28.51	135.40	0.38	1.20	0.52	0.01	28.57	134.93	0.38	1.21	0.52	0.01
28.62	131.92	0.36	1.23	0.51	0.01	28.71	124.92	0.32	1.31	0.51	0.01
28.76	123.48	0.32	1.32	0.51	0.01	28.83	124.89	0.32	1.30	0.51	0.01
28.89	126.03	0.33	1.29	0.51	0.01	28.96	123.11	0.31	1.32	0.51	0.01
29.02	114.01	0.28	1.42	0.51	0.01	29.08	103.93	0.25	1.57	0.51	0.01
29.15	34.56	2.00	0.00	0.51	0.00	29.21	29.56	2.00	0.00	0.50	0.00
29.27	25.19	2.00	0.00	0.50	0.00	29.33	22.72	2.00	0.00	0.50	0.00
29.40	19.96	2.00	0.00	0.50	0.00	29.46	16.84	2.00	0.00	0.50	0.00
29.56	13.35	2.00	0.00	0.50	0.00	29.62	12.23	2.00	0.00	0.50	0.00
29.68	10.66	2.00	0.00	0.50	0.00	29.74	9.73	2.00	0.00	0.50	0.00
29.80	9.18	2.00	0.00	0.49	0.00	29.89	8.89	2.00	0.00	0.49	0.00
29.92	8.79	2.00	0.00	0.49	0.00	30.02	8.78	2.00	0.00	0.49	0.00
30.08	8.77	2.00	0.00	0.49	0.00	30.14	8.76	2.00	0.00	0.49	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)
30.21	8.67	2.00	0.00	0.49	0.00	30.27	8.84	2.00	0.00	0.49	0.00
30.34	8.83	2.00	0.00	0.49	0.00	30.39	8.83	2.00	0.00	0.48	0.00
30.45	8.82	2.00	0.00	0.48	0.00	30.51	8.72	2.00	0.00	0.48	0.00
30.61	8.35	2.00	0.00	0.48	0.00	30.67	8.25	2.00	0.00	0.48	0.00
30.74	8.15	2.00	0.00	0.48	0.00	30.80	8.15	2.00	0.00	0.48	0.00
30.86	8.14	2.00	0.00	0.48	0.00	30.92	8.13	2.00	0.00	0.48	0.00
30.99	8.22	2.00	0.00	0.47	0.00	31.04	8.30	2.00	0.00	0.47	0.00
31.13	8.21	2.00	0.00	0.47	0.00	31.19	8.38	2.00	0.00	0.47	0.00
31.26	8.64	2.00	0.00	0.47	0.00	31.31	8.90	2.00	0.00	0.47	0.00
31.37	9.26	2.00	0.00	0.47	0.00	31.43	9.43	2.00	0.00	0.47	0.00
31.53	9.87	2.00	0.00	0.47	0.00	31.59	9.86	2.00	0.00	0.46	0.00
31.65	9.86	2.00	0.00	0.46	0.00	31.71	9.85	2.00	0.00	0.46	0.00
31.78	9.84	2.00	0.00	0.46	0.00	31.84	10.10	2.00	0.00	0.46	0.00
31.90	10.00	2.00	0.00	0.46	0.00	31.96	10.61	2.00	0.00	0.46	0.00
32.05	11.67	2.00	0.00	0.46	0.00	32.11	11.92	2.00	0.00	0.46	0.00
32.16	12.01	2.00	0.00	0.45	0.00	32.25	15.79	2.00	0.00	0.45	0.00
32.31	17.71	2.00	0.00	0.45	0.00	32.37	20.16	2.00	0.00	0.45	0.00
32.44	25.82	2.00	0.00	0.45	0.00	32.50	36.15	2.00	0.00	0.45	0.00
32.56	114.18	0.27	1.25	0.45	0.01	32.63	128.98	0.34	1.10	0.45	0.01
32.70	140.57	0.42	1.00	0.45	0.01	32.77	148.22	0.49	0.94	0.44	0.01
32.81	151.83	0.53	0.91	0.44	0.00	32.88	154.55	0.57	0.89	0.44	0.01
32.96	154.99	0.58	0.88	0.44	0.01	33.04	153.94	0.56	0.89	0.44	0.01
33.10	151.05	0.52	0.90	0.44	0.01	33.15	148.94	0.50	0.92	0.44	0.00
33.22	143.73	0.44	0.95	0.44	0.01	33.29	136.54	0.39	1.01	0.44	0.01
33.36	129.99	0.34	1.06	0.43	0.01	33.43	124.72	0.32	1.10	0.43	0.01
33.48	122.39	0.31	1.12	0.43	0.01	33.55	119.05	0.29	1.16	0.43	0.01
33.62	116.27	0.28	1.18	0.43	0.01	33.69	113.64	0.27	1.21	0.43	0.01
33.77	112.13	0.27	1.22	0.43	0.01	33.81	111.51	0.27	1.23	0.43	0.01
33.88	109.92	0.26	1.24	0.43	0.01	33.94	112.93	0.27	1.20	0.42	0.01
34.02	108.59	0.26	1.25	0.42	0.01	34.09	113.59	0.27	1.19	0.42	0.01
34.13	117.78	0.29	1.14	0.42	0.01	34.20	126.42	0.33	1.05	0.42	0.01
34.27	135.25	0.38	0.98	0.42	0.01	34.34	141.45	0.42	0.93	0.42	0.01
34.41	145.99	0.47	0.89	0.42	0.01	34.45	147.75	0.49	0.88	0.42	0.00
34.52	150.63	0.52	0.86	0.41	0.01	34.60	151.18	0.53	0.85	0.41	0.01
34.68	150.16	0.51	0.85	0.41	0.01	34.72	151.66	0.53	0.84	0.41	0.00
34.79	155.59	0.59	0.82	0.41	0.01	34.86	159.46	0.65	0.72	0.41	0.01
34.93	163.52	0.74	0.59	0.41	0.01	34.99	168.56	0.87	0.42	0.41	0.00
35.05	168.93	0.88	0.41	0.41	0.00	35.11	185.56	1.69	0.06	0.40	0.00
35.19	192.88	2.00	0.00	0.40	0.00	35.27	195.76	2.00	0.00	0.40	0.00
35.34	196.85	2.00	0.00	0.40	0.00	35.37	196.66	2.00	0.00	0.40	0.00
35.44	195.11	2.00	0.00	0.40	0.00	35.52	192.55	2.00	0.00	0.40	0.00
35.60	191.47	2.00	0.00	0.40	0.00	35.63	190.98	2.00	0.00	0.40	0.00
35.70	193.69	2.00	0.00	0.39	0.00	35.77	197.66	2.00	0.00	0.39	0.00
35.85	202.16	2.00	0.00	0.39	0.00	35.92	204.60	2.00	0.00	0.39	0.00
35.99	205.03	2.00	0.00	0.39	0.00	36.03	204.44	2.00	0.00	0.39	0.00
36.10	202.09	2.00	0.00	0.39	0.00	36.17	198.02	2.00	0.00	0.39	0.00
36.25	192.79	2.00	0.00	0.39	0.00	36.32	189.88	2.00	0.00	0.38	0.00
36.35	188.41	1.92	0.01	0.38	0.00	36.43	187.27	1.82	0.03	0.38	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)
36.51	187.82	1.87	0.02	0.38	0.00	36.58	190.26	2.00	0.00	0.38	0.00
36.65	195.36	2.00	0.00	0.38	0.00	36.71	200.48	2.00	0.00	0.38	0.00
36.80	205.99	2.00	0.00	0.38	0.00	36.83	208.26	2.00	0.00	0.38	0.00
36.90	212.31	2.00	0.00	0.37	0.00	36.97	215.88	2.00	0.00	0.37	0.00
37.04	219.42	2.00	0.00	0.37	0.00	37.10	222.69	2.00	0.00	0.37	0.00
37.15	224.09	2.00	0.00	0.37	0.00	37.21	225.35	2.00	0.00	0.37	0.00
37.29	225.35	2.00	0.00	0.37	0.00	37.36	222.63	2.00	0.00	0.37	0.00
37.44	219.62	2.00	0.00	0.37	0.00	37.48	213.22	2.00	0.00	0.36	0.00
37.55	198.18	2.00	0.00	0.36	0.00	37.62	193.93	2.00	0.00	0.36	0.00
37.69	190.20	2.00	0.00	0.36	0.00	37.76	186.28	1.74	0.04	0.36	0.00
37.81	184.29	1.59	0.07	0.36	0.00	37.87	181.96	1.44	0.11	0.36	0.00
37.95	179.54	1.30	0.15	0.36	0.00	38.03	174.65	1.07	0.23	0.36	0.00
38.06	173.53	1.03	0.26	0.35	0.00	38.13	171.19	0.95	0.31	0.35	0.00
38.20	168.19	0.86	0.38	0.35	0.00	38.28	160.28	0.67	0.60	0.35	0.01
38.32	154.96	0.58	0.70	0.35	0.00	38.39	145.95	0.47	0.75	0.35	0.01
38.46	133.69	0.37	0.82	0.35	0.01	38.53	118.23	0.29	0.94	0.35	0.01
38.59	39.41	2.00	0.00	0.35	0.00	38.66	31.55	2.00	0.00	0.34	0.00
38.72	25.71	2.00	0.00	0.34	0.00	38.81	20.92	2.00	0.00	0.34	0.00
38.88	18.27	2.00	0.00	0.34	0.00	38.92	18.02	2.00	0.00	0.34	0.00
38.99	17.85	2.00	0.00	0.34	0.00	39.05	17.04	2.00	0.00	0.34	0.00
39.13	16.24	2.00	0.00	0.34	0.00	39.20	16.06	2.00	0.00	0.34	0.00
39.28	15.74	2.00	0.00	0.33	0.00	39.31	15.96	2.00	0.00	0.33	0.00
39.38	16.58	2.00	0.00	0.33	0.00	39.45	18.14	2.00	0.00	0.33	0.00
39.53	19.22	2.00	0.00	0.33	0.00	39.60	22.98	2.00	0.00	0.33	0.00
39.64	28.56	2.00	0.00	0.33	0.00	39.70	100.62	0.24	1.04	0.33	0.01
39.77	100.61	0.24	1.04	0.33	0.01	39.84	35.26	2.00	0.00	0.32	0.00
39.92	30.42	2.00	0.00	0.32	0.00	39.99	26.70	2.00	0.00	0.32	0.00
40.06	24.09	2.00	0.00	0.32	0.00	40.09	23.69	2.00	0.00	0.32	0.00
40.16	23.66	2.00	0.00	0.32	0.00	40.24	22.47	2.00	0.00	0.32	0.00
40.31	19.88	2.00	0.00	0.32	0.00	40.38	17.91	2.00	0.00	0.32	0.00
40.45	16.96	2.00	0.00	0.31	0.00	40.52	16.25	2.00	0.00	0.31	0.00
40.59	15.91	2.00	0.00	0.31	0.00	40.63	16.30	2.00	0.00	0.31	0.00
40.70	20.01	2.00	0.00	0.31	0.00	40.78	91.83	0.22	1.08	0.31	0.01
40.84	107.55	0.26	0.92	0.31	0.01	40.88	112.44	0.27	0.87	0.31	0.00
40.95	116.84	0.29	0.84	0.31	0.01	41.02	123.04	0.31	0.79	0.30	0.01
41.10	127.26	0.33	0.76	0.30	0.01	41.16	123.75	0.32	0.78	0.30	0.01
41.23	129.68	0.35	0.74	0.30	0.01	41.29	127.92	0.34	0.74	0.30	0.01
41.37	122.99	0.31	0.77	0.30	0.01	41.41	120.10	0.30	0.79	0.30	0.00
41.48	113.23	0.28	0.84	0.30	0.01	41.55	42.03	2.00	0.00	0.30	0.00
41.61	33.41	2.00	0.00	0.29	0.00	41.68	27.51	2.00	0.00	0.29	0.00
41.76	27.67	2.00	0.00	0.29	0.00	41.84	26.14	2.00	0.00	0.29	0.00
41.87	27.83	2.00	0.00	0.29	0.00	41.94	36.12	2.00	0.00	0.29	0.00
42.01	119.20	0.30	0.77	0.29	0.01	42.08	139.54	0.41	0.65	0.29	0.01
42.15	155.00	0.58	0.57	0.29	0.00	42.19	161.38	0.69	0.47	0.28	0.00
42.26	169.56	0.89	0.28	0.28	0.00	42.33	175.28	1.10	0.18	0.28	0.00
42.41	177.66	1.20	0.14	0.28	0.00	42.47	178.85	1.26	0.13	0.28	0.00
42.55	184.78	1.61	0.05	0.28	0.00	42.59	187.30	1.81	0.02	0.28	0.00
42.66	193.55	2.00	0.00	0.28	0.00	42.73	199.35	2.00	0.00	0.28	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)
42.79	202.61	2.00	0.00	0.27	0.00	42.86	206.21	2.00	0.00	0.27	0.00
42.94	211.90	2.00	0.00	0.27	0.00	43.01	217.08	2.00	0.00	0.27	0.00
43.05	219.06	2.00	0.00	0.27	0.00	43.12	222.29	2.00	0.00	0.27	0.00
43.18	223.40	2.00	0.00	0.27	0.00	43.25	223.28	2.00	0.00	0.27	0.00
43.33	221.98	2.00	0.00	0.27	0.00	43.41	218.48	2.00	0.00	0.26	0.00
43.44	210.84	2.00	0.00	0.26	0.00	43.51	192.18	2.00	0.00	0.26	0.00
43.58	190.79	2.00	0.00	0.26	0.00	43.65	192.87	2.00	0.00	0.26	0.00
43.72	196.92	2.00	0.00	0.26	0.00	43.78	199.78	2.00	0.00	0.26	0.00
43.84	201.79	2.00	0.00	0.26	0.00	43.91	202.67	2.00	0.00	0.26	0.00
43.98	202.85	2.00	0.00	0.25	0.00	44.05	203.48	2.00	0.00	0.25	0.00
44.12	204.71	2.00	0.00	0.25	0.00	44.19	206.10	2.00	0.00	0.25	0.00
44.23	206.72	2.00	0.00	0.25	0.00	44.30	203.15	2.00	0.00	0.25	0.00
44.37	191.13	2.00	0.00	0.25	0.00	44.44	192.72	2.00	0.00	0.25	0.00
44.51	193.92	2.00	0.00	0.25	0.00	44.58	194.17	2.00	0.00	0.24	0.00
44.62	189.48	2.00	0.00	0.24	0.00	44.71	189.92	2.00	0.00	0.24	0.00
44.77	189.26	1.98	0.00	0.24	0.00	44.85	186.40	1.74	0.03	0.24	0.00
44.91	183.73	1.54	0.05	0.24	0.00	44.98	181.04	1.38	0.08	0.24	0.00
45.02	179.38	1.29	0.10	0.24	0.00	45.10	176.54	1.15	0.13	0.24	0.00
45.17	174.14	1.05	0.16	0.23	0.00	45.24	173.03	1.01	0.18	0.23	0.00
45.31	173.66	1.04	0.17	0.23	0.00	45.38	174.18	1.06	0.16	0.23	0.00
45.41	174.08	1.05	0.16	0.23	0.00	45.49	177.40	1.19	0.12	0.23	0.00
45.56	178.26	1.23	0.11	0.23	0.00	45.63	180.36	1.34	0.08	0.23	0.00
45.70	181.01	1.38	0.08	0.23	0.00	45.77	180.27	1.34	0.08	0.22	0.00
45.81	179.55	1.30	0.09	0.22	0.00	45.89	176.55	1.15	0.12	0.22	0.00
45.95	168.93	0.88	0.22	0.22	0.00	46.02	160.89	0.69	0.37	0.22	0.00
46.09	153.71	0.57	0.44	0.22	0.00	46.16	144.02	0.45	0.47	0.22	0.00
46.20	136.97	0.40	0.50	0.22	0.00	46.27	123.56	0.32	0.55	0.22	0.00
46.35	134.50	0.38	0.50	0.21	0.00	46.41	48.34	2.00	0.00	0.21	0.00
46.49	132.63	0.37	0.51	0.21	0.00	46.55	161.50	0.70	0.34	0.21	0.00
46.59	175.40	1.10	0.13	0.21	0.00	46.66	188.19	1.88	0.01	0.21	0.00
46.73	184.96	1.63	0.04	0.21	0.00	46.80	186.25	1.73	0.03	0.21	0.00
46.87	186.92	1.78	0.02	0.21	0.00	46.94	185.59	1.68	0.03	0.20	0.00
47.00	182.61	1.47	0.06	0.20	0.00	47.06	165.65	0.79	0.25	0.20	0.00
47.12	171.73	0.97	0.17	0.20	0.00	47.19	162.97	0.73	0.30	0.20	0.00
47.26	153.80	0.57	0.40	0.20	0.00	47.34	145.26	0.47	0.43	0.20	0.00
47.38	141.20	0.43	0.44	0.20	0.00	47.44	134.04	0.38	0.46	0.20	0.00
47.51	128.45	0.34	0.48	0.19	0.00	47.58	124.82	0.33	0.49	0.19	0.00
47.65	125.27	0.33	0.49	0.19	0.00	47.73	128.86	0.35	0.47	0.19	0.00
47.79	133.16	0.37	0.45	0.19	0.00	47.84	136.45	0.39	0.44	0.19	0.00
47.93	143.46	0.45	0.41	0.19	0.00	47.99	151.41	0.54	0.38	0.19	0.00
48.07	161.07	0.69	0.31	0.19	0.00	48.11	166.44	0.81	0.22	0.18	0.00
48.18	176.10	1.14	0.11	0.18	0.00	48.25	185.01	1.64	0.03	0.18	0.00
48.32	192.39	2.00	0.00	0.18	0.00	48.39	198.95	2.00	0.00	0.18	0.00
48.43	201.94	2.00	0.00	0.18	0.00	48.50	206.98	2.00	0.00	0.18	0.00
48.57	211.65	2.00	0.00	0.18	0.00	48.65	214.50	2.00	0.00	0.18	0.00
48.71	216.08	2.00	0.00	0.17	0.00	48.78	217.96	2.00	0.00	0.17	0.00
48.83	219.31	2.00	0.00	0.17	0.00	48.90	220.77	2.00	0.00	0.17	0.00
48.97	220.48	2.00	0.00	0.17	0.00	49.04	218.58	2.00	0.00	0.17	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)
49.10	215.35	2.00	0.00	0.17	0.00	49.15	212.71	2.00	0.00	0.17	0.00
49.22	209.73	2.00	0.00	0.17	0.00	49.29	212.34	2.00	0.00	0.16	0.00
49.36	218.83	2.00	0.00	0.16	0.00	49.43	225.93	2.00	0.00	0.16	0.00
49.50	232.29	2.00	0.00	0.16	0.00	49.57	237.37	2.00	0.00	0.16	0.00
49.65	239.18	2.00	0.00	0.16	0.00	49.68	239.87	2.00	0.00	0.16	0.00
49.75	239.17	2.00	0.00	0.16	0.00	49.82	237.01	2.00	0.00	0.16	0.00
49.89	233.79	2.00	0.00	0.15	0.00	49.96	231.31	2.00	0.00	0.15	0.00
50.03	228.91	2.00	0.00	0.15	0.00	50.07	229.26	2.00	0.00	0.15	0.00
50.14	230.03	2.00	0.00	0.15	0.00	50.21	231.77	2.00	0.00	0.15	0.00
50.28	233.37	2.00	0.00	0.15	0.00	50.36	226.49	2.00	0.00	0.15	0.00
50.43	237.25	2.00	0.00	0.15	0.00	50.46	238.91	2.00	0.00	0.14	0.00
50.53	241.98	2.00	0.00	0.14	0.00	50.60	243.00	2.00	0.00	0.14	0.00
50.66	244.85	2.00	0.00	0.14	0.00	50.73	247.45	2.00	0.00	0.14	0.00
50.81	249.27	2.00	0.00	0.14	0.00	50.88	250.46	2.00	0.00	0.14	0.00
50.95	251.08	2.00	0.00	0.14	0.00	50.99	248.97	2.00	0.00	0.14	0.00
51.06	249.01	2.00	0.00	0.13	0.00	51.13	246.61	2.00	0.00	0.13	0.00
51.20	244.92	2.00	0.00	0.13	0.00	51.27	244.47	2.00	0.00	0.13	0.00
51.34	242.46	2.00	0.00	0.13	0.00	51.38	241.25	2.00	0.00	0.13	0.00
51.45	238.53	2.00	0.00	0.13	0.00	51.52	238.32	2.00	0.00	0.13	0.00
51.58	239.11	2.00	0.00	0.13	0.00	51.66	236.61	2.00	0.00	0.12	0.00
51.73	231.77	2.00	0.00	0.12	0.00	51.80	227.19	2.00	0.00	0.12	0.00
51.87	223.58	2.00	0.00	0.12	0.00	51.94	220.64	2.00	0.00	0.12	0.00
52.00	221.58	2.00	0.00	0.12	0.00	52.04	221.68	2.00	0.00	0.12	0.00
52.11	224.40	2.00	0.00	0.12	0.00	52.18	224.28	2.00	0.00	0.12	0.00
52.24	224.17	2.00	0.00	0.11	0.00	52.32	224.04	2.00	0.00	0.11	0.00
52.39	222.79	2.00	0.00	0.11	0.00	52.46	220.41	2.00	0.00	0.11	0.00
52.52	217.70	2.00	0.00	0.11	0.00	52.57	206.68	2.00	0.00	0.11	0.00
52.64	211.66	2.00	0.00	0.11	0.00	52.71	211.45	2.00	0.00	0.11	0.00
52.78	210.92	2.00	0.00	0.11	0.00	52.85	209.44	2.00	0.00	0.10	0.00
52.92	206.47	2.00	0.00	0.10	0.00	52.95	204.58	2.00	0.00	0.10	0.00
53.03	200.19	2.00	0.00	0.10	0.00	53.10	193.72	2.00	0.00	0.10	0.00
53.17	189.24	2.00	0.00	0.10	0.00	53.24	190.71	2.00	0.00	0.10	0.00
53.31	195.06	2.00	0.00	0.10	0.00	53.37	199.56	2.00	0.00	0.10	0.00
53.44	201.82	2.00	0.00	0.09	0.00	53.48	201.09	2.00	0.00	0.09	0.00
53.55	191.47	2.00	0.00	0.09	0.00	53.62	174.62	2.00	0.00	0.09	0.00
53.70	147.45	2.00	0.00	0.09	0.00	53.76	55.34	2.00	0.00	0.09	0.00
53.83	46.15	2.00	0.00	0.09	0.00	53.90	46.38	2.00	0.00	0.09	0.00
53.96	46.90	2.00	0.00	0.09	0.00	54.01	48.07	2.00	0.00	0.08	0.00
54.08	51.26	2.00	0.00	0.08	0.00	54.15	45.70	2.00	0.00	0.08	0.00
54.22	38.40	2.00	0.00	0.08	0.00	54.29	34.34	2.00	0.00	0.08	0.00
54.36	35.13	2.00	0.00	0.08	0.00	54.43	41.62	2.00	0.00	0.08	0.00
54.47	48.44	2.00	0.00	0.08	0.00	54.53	132.73	2.00	0.00	0.08	0.00
54.61	150.82	2.00	0.00	0.07	0.00	54.67	160.44	2.00	0.00	0.07	0.00
54.74	166.59	2.00	0.00	0.07	0.00	54.81	174.29	2.00	0.00	0.07	0.00
54.89	183.61	2.00	0.00	0.07	0.00	54.96	188.02	2.00	0.00	0.07	0.00
55.00	188.80	2.00	0.00	0.07	0.00	55.07	188.20	2.00	0.00	0.07	0.00
55.13	187.05	2.00	0.00	0.07	0.00	55.20	186.38	2.00	0.00	0.06	0.00
55.27	186.62	2.00	0.00	0.06	0.00	55.34	189.27	2.00	0.00	0.06	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)
55.42	192.95	2.00	0.00	0.06	0.00	55.45	194.98	2.00	0.00	0.06	0.00
55.52	199.02	2.00	0.00	0.06	0.00	55.58	202.20	2.00	0.00	0.06	0.00
55.65	204.75	2.00	0.00	0.06	0.00	55.72	204.47	2.00	0.00	0.06	0.00
55.78	202.77	2.00	0.00	0.05	0.00	55.85	204.18	2.00	0.00	0.05	0.00
55.93	205.06	2.00	0.00	0.05	0.00	56.00	204.10	2.00	0.00	0.05	0.00
56.04	202.93	2.00	0.00	0.05	0.00	56.11	195.36	2.00	0.00	0.05	0.00
56.20	193.14	2.00	0.00	0.05	0.00	56.26	188.46	2.00	0.00	0.05	0.00
56.33	182.74	2.00	0.00	0.05	0.00	56.37	179.46	2.00	0.00	0.04	0.00
56.43	172.31	2.00	0.00	0.04	0.00	56.51	164.80	2.00	0.00	0.04	0.00
56.58	156.75	2.00	0.00	0.04	0.00	56.65	148.31	2.00	0.00	0.04	0.00
56.72	138.89	2.00	0.00	0.04	0.00	56.79	128.98	2.00	0.00	0.04	0.00
56.86	120.25	2.00	0.00	0.04	0.00	56.89	117.35	2.00	0.00	0.04	0.00
56.96	115.94	2.00	0.00	0.03	0.00	57.03	116.24	2.00	0.00	0.03	0.00
57.10	115.75	2.00	0.00	0.03	0.00	57.16	114.59	2.00	0.00	0.03	0.00
57.23	110.88	2.00	0.00	0.03	0.00	57.30	102.69	2.00	0.00	0.03	0.00
57.37	31.72	2.00	0.00	0.03	0.00	57.45	23.03	2.00	0.00	0.03	0.00
57.48	19.99	2.00	0.00	0.03	0.00	57.55	17.10	2.00	0.00	0.02	0.00
57.62	16.51	2.00	0.00	0.02	0.00	57.69	16.69	2.00	0.00	0.02	0.00
57.76	16.55	2.00	0.00	0.02	0.00	57.83	15.66	2.00	0.00	0.02	0.00
57.90	14.95	2.00	0.00	0.02	0.00	57.98	14.62	2.00	0.00	0.02	0.00
58.01	14.68	2.00	0.00	0.02	0.00	58.07	14.55	2.00	0.00	0.02	0.00
58.14	14.16	2.00	0.00	0.01	0.00	58.21	13.33	2.00	0.00	0.01	0.00
58.28	12.70	2.00	0.00	0.01	0.00	58.36	12.63	2.00	0.00	0.01	0.00
58.43	12.50	2.00	0.00	0.01	0.00	58.50	12.55	2.00	0.00	0.01	0.00
58.53	12.55	2.00	0.00	0.01	0.00	58.60	12.66	2.00	0.00	0.01	0.00
58.66	12.91	2.00	0.00	0.01	0.00	58.73	13.41	2.00	0.00	0.00	0.00
58.80	14.46	2.00	0.00	0.00	0.00	58.87	17.03	2.00	0.00	0.00	0.00
58.93	20.24	2.00	0.00	0.00	0.00	59.00	20.99	2.00	0.00	0.00	0.00
59.08	19.71	2.00	0.00	0.00	0.00	59.15	17.30	2.00	0.00	0.00	0.00
59.22	14.84	2.00	0.00	0.00	0.00	59.29	13.65	2.00	0.00	0.00	0.00
59.32	13.65	2.00	0.00	0.00	0.00	59.39	13.64	2.00	0.00	0.00	0.00
59.45	13.63	2.00	0.00	0.00	0.00	59.52	14.74	2.00	0.00	0.00	0.00
59.58	22.37	2.00	0.00	0.00	0.00	59.66	39.84	2.00	0.00	0.00	0.00
59.73	126.16	2.00	0.00	0.00	0.00	59.79	137.24	2.00	0.00	0.00	0.00
59.86	139.52	2.00	0.00	0.00	0.00	59.93	137.75	2.00	0.00	0.00	0.00
60.00	133.06	2.00	0.00	0.00	0.00	60.07	60.28	2.00	0.00	0.00	0.00
60.11	59.10	2.00	0.00	0.00	0.00	60.17	52.08	2.00	0.00	0.00	0.00
60.24	55.17	2.00	0.00	0.00	0.00	60.32	50.10	2.00	0.00	0.00	0.00
60.39	41.55	2.00	0.00	0.00	0.00	60.45	36.11	2.00	0.00	0.00	0.00
60.52	35.99	2.00	0.00	0.00	0.00	60.59	35.87	2.00	0.00	0.00	0.00
60.66	44.09	2.00	0.00	0.00	0.00	60.70	48.83	2.00	0.00	0.00	0.00
60.77	57.07	2.00	0.00	0.00	0.00	60.84	136.69	2.00	0.00	0.00	0.00
60.91	153.55	2.00	0.00	0.00	0.00	60.98	170.24	2.00	0.00	0.00	0.00
61.05	183.00	2.00	0.00	0.00	0.00	61.11	191.34	2.00	0.00	0.00	0.00
61.19	195.23	2.00	0.00	0.00	0.00	61.22	196.43	2.00	0.00	0.00	0.00
61.30	197.75	2.00	0.00	0.00	0.00	61.37	197.78	2.00	0.00	0.00	0.00
61.43	198.05	2.00	0.00	0.00	0.00	61.50	198.10	2.00	0.00	0.00	0.00
61.57	198.30	2.00	0.00	0.00	0.00	61.65	197.24	2.00	0.00	0.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)
61.72	193.50	2.00	0.00	0.00	0.00	61.76	190.96	2.00	0.00	0.00	0.00
61.82	192.49	2.00	0.00	0.00	0.00	61.89	195.45	2.00	0.00	0.00	0.00
61.96	197.91	2.00	0.00	0.00	0.00	62.03	198.76	2.00	0.00	0.00	0.00
62.10	197.27	2.00	0.00	0.00	0.00	62.17	192.42	2.00	0.00	0.00	0.00
62.24	187.61	2.00	0.00	0.00	0.00	62.28	185.20	2.00	0.00	0.00	0.00
62.35	180.15	2.00	0.00	0.00	0.00	62.41	174.63	2.00	0.00	0.00	0.00
62.48	168.59	2.00	0.00	0.00	0.00	62.55	152.68	2.00	0.00	0.00	0.00
62.62	155.06	2.00	0.00	0.00	0.00	62.68	146.43	2.00	0.00	0.00	0.00
62.76	137.37	2.00	0.00	0.00	0.00	62.82	127.55	2.00	0.00	0.00	0.00
62.89	52.59	2.00	0.00	0.00	0.00	62.93	48.93	2.00	0.00	0.00	0.00
63.00	43.52	2.00	0.00	0.00	0.00	63.07	41.67	2.00	0.00	0.00	0.00
63.13	54.99	2.00	0.00	0.00	0.00	63.19	146.83	2.00	0.00	0.00	0.00
63.28	192.52	2.00	0.00	0.00	0.00	63.34	203.99	2.00	0.00	0.00	0.00
63.41	211.77	2.00	0.00	0.00	0.00	63.48	215.25	2.00	0.00	0.00	0.00
63.55	219.28	2.00	0.00	0.00	0.00	63.59	222.35	2.00	0.00	0.00	0.00
63.66	228.46	2.00	0.00	0.00	0.00	63.73	230.94	2.00	0.00	0.00	0.00
63.80	231.01	2.00	0.00	0.00	0.00	63.87	228.13	2.00	0.00	0.00	0.00
63.94	222.86	2.00	0.00	0.00	0.00	64.00	216.39	2.00	0.00	0.00	0.00
64.08	208.74	2.00	0.00	0.00	0.00	64.12	205.19	2.00	0.00	0.00	0.00
64.19	199.37	2.00	0.00	0.00	0.00	64.26	194.23	2.00	0.00	0.00	0.00
64.33	189.76	2.00	0.00	0.00	0.00	64.39	186.58	2.00	0.00	0.00	0.00
64.46	180.69	2.00	0.00	0.00	0.00	64.54	174.80	2.00	0.00	0.00	0.00
64.57	173.90	2.00	0.00	0.00	0.00	64.64	173.45	2.00	0.00	0.00	0.00
64.71	174.04	2.00	0.00	0.00	0.00	64.77	169.75	2.00	0.00	0.00	0.00
64.85	173.84	2.00	0.00	0.00	0.00	64.92	175.80	2.00	0.00	0.00	0.00
64.99	178.85	2.00	0.00	0.00	0.00	65.03	181.16	2.00	0.00	0.00	0.00
65.10	188.74	2.00	0.00	0.00	0.00	65.17	138.91	2.00	0.00	0.00	0.00
65.25	153.18	2.00	0.00	0.00	0.00	65.31	167.71	2.00	0.00	0.00	0.00
65.39	183.07	2.00	0.00	0.00	0.00	65.45	195.65	2.00	0.00	0.00	0.00
65.49	199.50	2.00	0.00	0.00	0.00						

Total estimated settlement: 2.71

Abbreviations

$Q_{tn,cs}$: Equivalent clean sand normalized cone resistance
FS: Factor of safety against liquefaction
e_v (%): Post-liquefaction volumentric strain
DF: e_v depth weighting factor
Settlement: Calculated settlement

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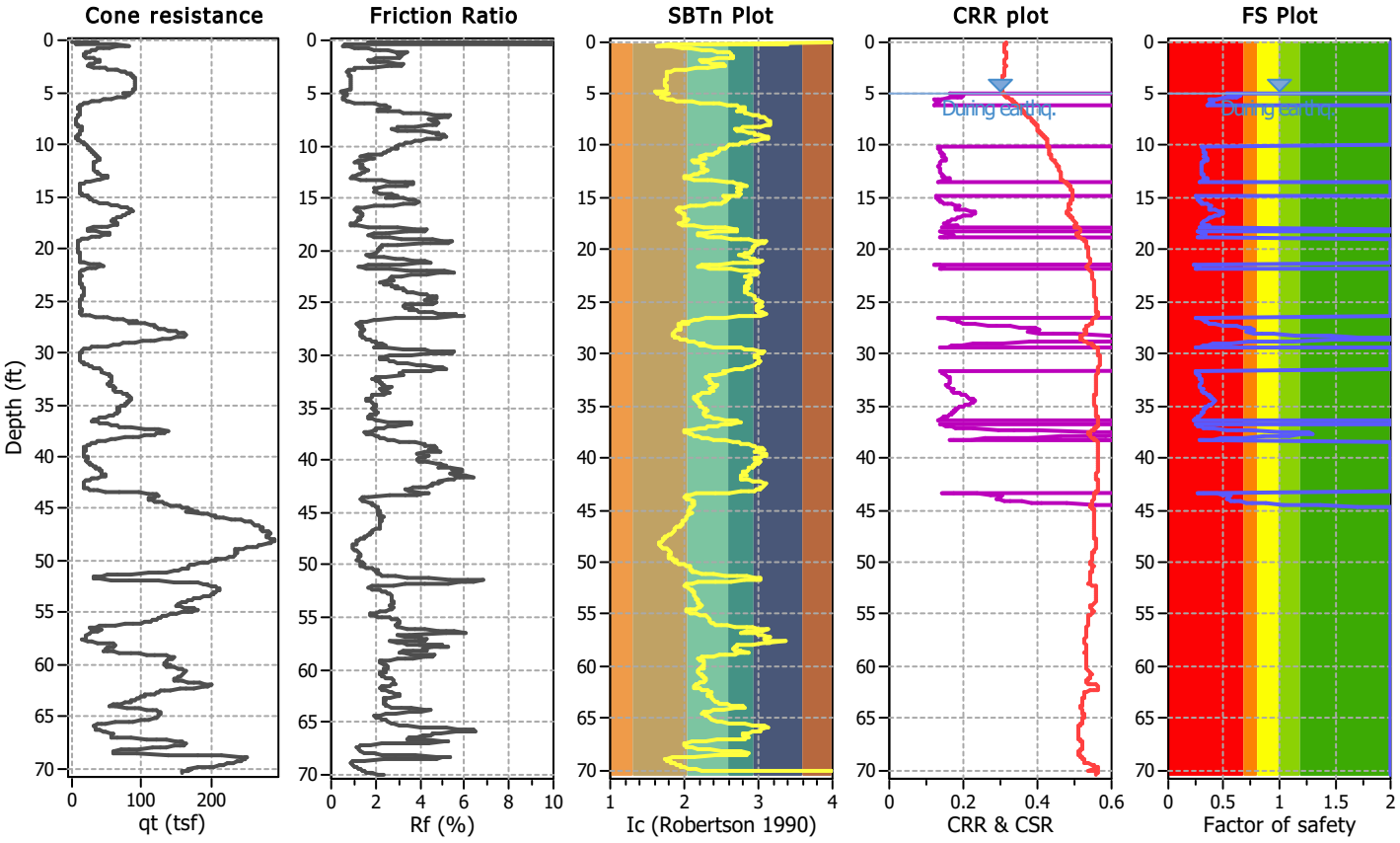
LIQUEFACTION ANALYSIS REPORT

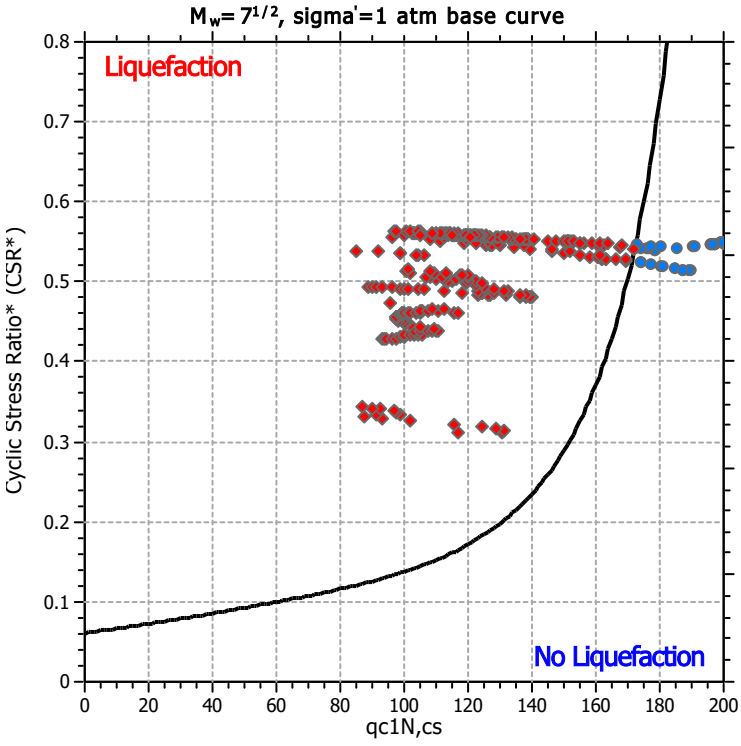
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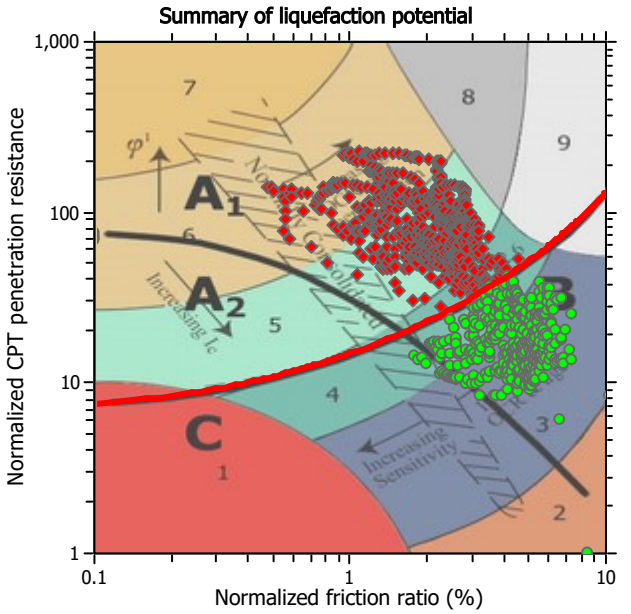
CPT file : CPT-2

Input parameters and analysis data

Analysis method:	**B&I (2014)**	**G.W.T. (in-situ):**	**5.00 ft**	**Use fill:**	**No**	**Clay like behavior applied:**	**Sands only**
Fines correction method:	**B&I (2014)**	**G.W.T. (earthq.):**	**5.00 ft**	**Fill height:**	**N/A**	**Limit depth applie**	**Yes**
Points to test:	**Based on Ic value**	**Average results interva**	**1**	**Fill weight:**	**N/A**	**Limit depth:**	**50.00 ft**
Earthquake magnitude M_w:	**7.30**	**Ic cut-off value:**	**2.60**	**Trans. detect. applied:**	**No**	**MSF method:**	**Method base**
Peak ground acceleration:	**0.54**	**Unit weight calculation**	**Based on SBT**	**K_σ applied:**	**Yes**		

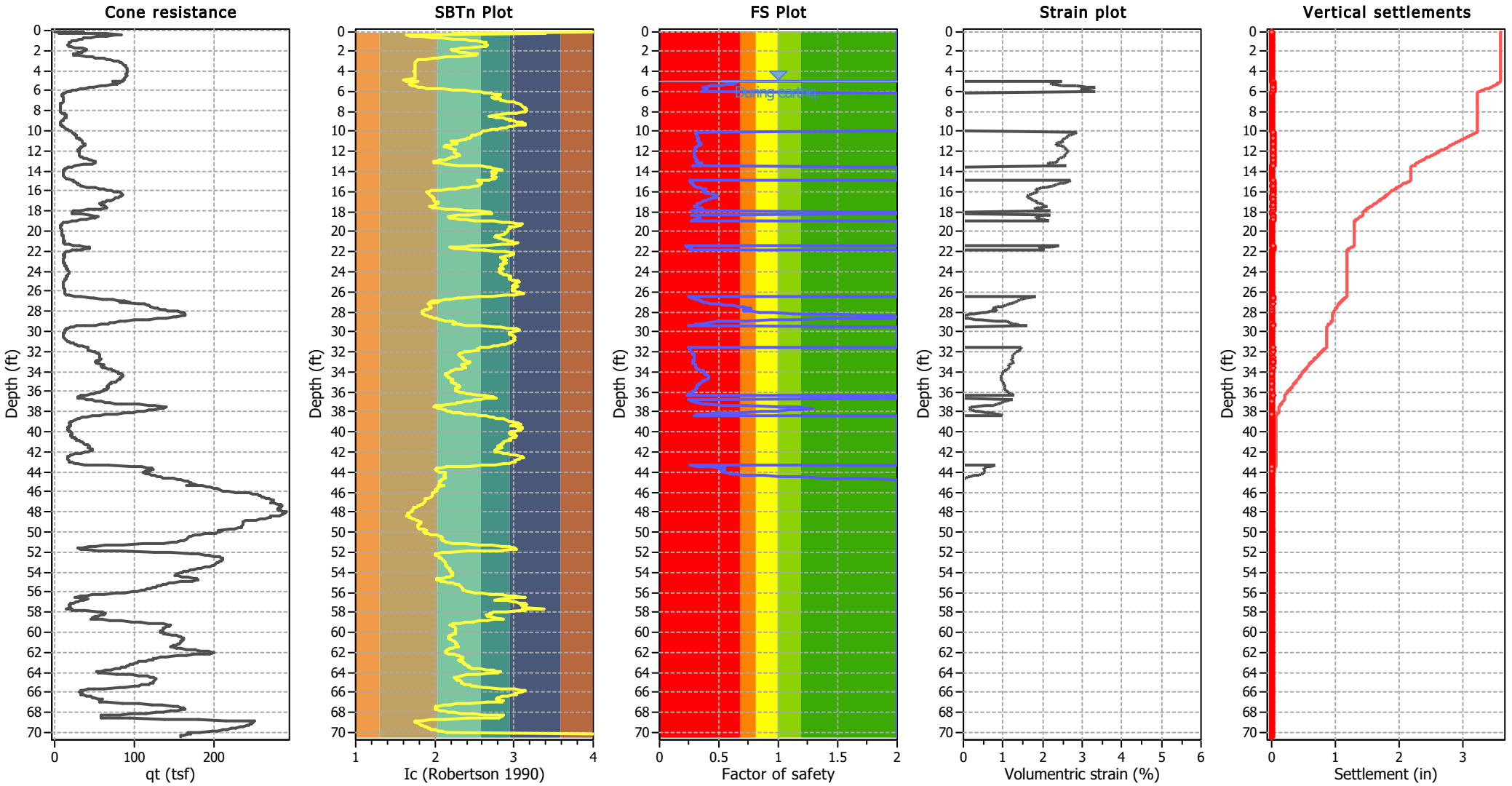






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

:: Post-earthquake settlement due to soil liquefaction ::

Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)
5.06	116.71	0.53	2.50	0.91	0.02	5.13	130.43	0.64	2.22	0.91	0.02
5.19	131.12	0.64	2.20	0.91	0.02	5.28	129.05	0.62	2.23	0.91	0.02
5.34	124.50	0.57	2.32	0.91	0.02	5.39	115.81	0.51	2.51	0.91	0.01
5.47	102.14	0.43	2.85	0.91	0.03	5.53	93.31	0.39	3.12	0.91	0.02
5.61	87.39	0.37	3.33	0.90	0.03	5.67	91.28	0.38	3.18	0.90	0.02
5.72	98.47	0.41	2.95	0.90	0.02	5.80	97.79	0.40	2.96	0.90	0.03
5.86	96.86	0.40	2.99	0.90	0.02	5.94	92.51	0.38	3.13	0.90	0.03
6.00	89.98	0.37	3.21	0.90	0.02	6.06	86.84	0.36	3.32	0.90	0.02
6.13	24.84	2.00	0.00	0.90	0.00	6.19	21.40	2.00	0.00	0.90	0.00
6.26	18.91	2.00	0.00	0.89	0.00	6.32	17.26	2.00	0.00	0.89	0.00
6.38	15.60	2.00	0.00	0.89	0.00	6.45	15.33	2.00	0.00	0.89	0.00
6.50	15.33	2.00	0.00	0.89	0.00	6.59	16.29	2.00	0.00	0.89	0.00
6.65	17.80	2.00	0.00	0.89	0.00	6.72	18.22	2.00	0.00	0.89	0.00
6.78	17.67	2.00	0.00	0.89	0.00	6.83	18.49	2.00	0.00	0.88	0.00
6.90	18.36	2.00	0.00	0.88	0.00	6.99	17.38	2.00	0.00	0.88	0.00
7.04	16.98	2.00	0.00	0.88	0.00	7.11	16.15	2.00	0.00	0.88	0.00
7.17	14.91	2.00	0.00	0.88	0.00	7.23	14.22	2.00	0.00	0.88	0.00
7.29	13.11	2.00	0.00	0.88	0.00	7.35	12.42	2.00	0.00	0.88	0.00
7.44	11.31	2.00	0.00	0.87	0.00	7.50	10.91	2.00	0.00	0.87	0.00
7.57	10.49	2.00	0.00	0.87	0.00	7.63	10.22	2.00	0.00	0.87	0.00
7.68	10.22	2.00	0.00	0.87	0.00	7.74	10.22	2.00	0.00	0.87	0.00
7.82	10.22	2.00	0.00	0.87	0.00	7.89	10.22	2.00	0.00	0.87	0.00
7.95	10.22	2.00	0.00	0.87	0.00	8.03	10.35	2.00	0.00	0.86	0.00
8.09	10.62	2.00	0.00	0.86	0.00	8.16	12.00	2.00	0.00	0.86	0.00
8.22	14.77	2.00	0.00	0.86	0.00	8.29	19.33	2.00	0.00	0.86	0.00
8.34	20.42	2.00	0.00	0.86	0.00	8.42	22.77	2.00	0.00	0.86	0.00
8.48	24.15	2.00	0.00	0.86	0.00	8.54	23.75	2.00	0.00	0.86	0.00
8.61	22.22	2.00	0.00	0.85	0.00	8.68	20.29	2.00	0.00	0.85	0.00
8.74	19.87	2.00	0.00	0.85	0.00	8.81	18.07	2.00	0.00	0.85	0.00
8.87	17.95	2.00	0.00	0.85	0.00	8.94	16.42	2.00	0.00	0.85	0.00
9.00	15.04	2.00	0.00	0.85	0.00	9.08	12.56	2.00	0.00	0.85	0.00
9.14	12.00	2.00	0.00	0.85	0.00	9.20	11.31	2.00	0.00	0.84	0.00
9.27	11.04	2.00	0.00	0.84	0.00	9.32	11.04	2.00	0.00	0.84	0.00
9.41	12.69	2.00	0.00	0.84	0.00	9.46	14.35	2.00	0.00	0.84	0.00
9.53	15.60	2.00	0.00	0.84	0.00	9.58	17.26	2.00	0.00	0.84	0.00
9.66	19.46	2.00	0.00	0.84	0.00	9.72	21.34	2.00	0.00	0.84	0.00
9.79	23.10	2.00	0.00	0.83	0.00	9.85	24.71	2.00	0.00	0.83	0.00
9.94	28.43	2.00	0.00	0.83	0.00	10.00	31.36	2.00	0.00	0.83	0.00
10.07	93.06	0.30	2.87	0.83	0.02	10.12	93.51	0.30	2.85	0.83	0.02
10.18	94.39	0.30	2.82	0.83	0.02	10.25	95.94	0.31	2.77	0.83	0.02
10.31	97.69	0.31	2.72	0.83	0.02	10.38	99.00	0.32	2.68	0.82	0.02
10.44	99.85	0.32	2.65	0.82	0.02	10.50	100.25	0.32	2.63	0.82	0.02
10.57	100.24	0.32	2.63	0.82	0.02	10.66	101.57	0.32	2.59	0.82	0.03
10.71	102.88	0.33	2.55	0.82	0.02	10.77	104.39	0.33	2.51	0.82	0.02
10.85	105.72	0.33	2.48	0.82	0.02	10.92	104.39	0.33	2.51	0.81	0.02
10.98	102.89	0.32	2.54	0.81	0.02	11.03	105.16	0.33	2.48	0.81	0.02
11.11	107.26	0.34	2.43	0.81	0.02	11.17	108.71	0.34	2.39	0.81	0.02
11.23	110.05	0.35	2.36	0.81	0.02	11.31	110.49	0.35	2.34	0.81	0.02

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)
11.37	109.63	0.34	2.36	0.81	0.02	11.44	105.27	0.33	2.46	0.81	0.02
11.50	101.97	0.31	2.54	0.81	0.02	11.57	100.91	0.31	2.56	0.80	0.02
11.64	100.58	0.31	2.56	0.80	0.02	11.70	100.10	0.31	2.57	0.80	0.02
11.77	99.21	0.30	2.59	0.80	0.02	11.83	98.27	0.30	2.61	0.80	0.02
11.89	97.80	0.30	2.62	0.80	0.02	11.96	97.37	0.30	2.63	0.80	0.02
12.02	97.29	0.29	2.63	0.80	0.02	12.09	97.47	0.29	2.62	0.80	0.02
12.15	97.60	0.29	2.62	0.79	0.02	12.22	98.55	0.30	2.59	0.79	0.02
12.28	98.88	0.30	2.57	0.79	0.02	12.37	99.19	0.30	2.56	0.79	0.03
12.43	99.37	0.30	2.55	0.79	0.02	12.49	99.37	0.30	2.55	0.79	0.02
12.55	100.01	0.30	2.53	0.79	0.02	12.62	101.48	0.30	2.49	0.79	0.02
12.67	102.15	0.30	2.47	0.79	0.02	12.74	104.05	0.31	2.42	0.78	0.02
12.81	104.91	0.31	2.39	0.78	0.02	12.89	105.44	0.31	2.38	0.78	0.02
12.94	105.41	0.31	2.38	0.78	0.01	13.01	104.99	0.31	2.38	0.78	0.02
13.07	107.62	0.32	2.32	0.78	0.02	13.13	110.86	0.33	2.25	0.78	0.02
13.20	115.53	0.35	2.15	0.78	0.02	13.26	116.70	0.36	2.12	0.78	0.02
13.35	112.27	0.34	2.20	0.77	0.02	13.39	108.65	0.32	2.28	0.77	0.01
13.49	95.78	0.28	2.59	0.77	0.03	13.54	29.52	2.00	0.00	0.77	0.00
13.60	26.17	2.00	0.00	0.77	0.00	13.66	23.85	2.00	0.00	0.77	0.00
13.72	21.52	2.00	0.00	0.77	0.00	13.79	17.38	2.00	0.00	0.77	0.00
13.85	17.60	2.00	0.00	0.77	0.00	13.94	16.04	2.00	0.00	0.76	0.00
13.99	16.03	2.00	0.00	0.76	0.00	14.06	16.02	2.00	0.00	0.76	0.00
14.12	15.99	2.00	0.00	0.76	0.00	14.18	15.03	2.00	0.00	0.76	0.00
14.26	15.01	2.00	0.00	0.76	0.00	14.33	15.45	2.00	0.00	0.76	0.00
14.39	16.14	2.00	0.00	0.76	0.00	14.45	16.35	2.00	0.00	0.76	0.00
14.51	16.32	2.00	0.00	0.75	0.00	14.58	16.88	2.00	0.00	0.75	0.00
14.64	17.53	2.00	0.00	0.75	0.00	14.72	19.10	2.00	0.00	0.75	0.00
14.78	20.21	2.00	0.00	0.75	0.00	14.84	22.47	2.00	0.00	0.75	0.00
14.91	88.76	0.25	2.71	0.75	0.02	14.97	89.88	0.25	2.67	0.75	0.02
15.04	91.02	0.26	2.63	0.75	0.02	15.10	93.37	0.26	2.56	0.74	0.02
15.17	96.31	0.27	2.48	0.74	0.02	15.23	98.71	0.28	2.42	0.74	0.02
15.29	100.07	0.28	2.38	0.74	0.02	15.36	101.27	0.28	2.35	0.74	0.02
15.45	104.58	0.29	2.26	0.74	0.03	15.49	106.17	0.30	2.23	0.74	0.01
15.58	112.56	0.32	2.09	0.74	0.02	15.64	117.93	0.34	1.99	0.73	0.01
15.70	123.00	0.37	1.90	0.73	0.01	15.76	126.87	0.39	1.83	0.73	0.01
15.82	126.48	0.39	1.84	0.73	0.01	15.89	124.63	0.38	1.86	0.73	0.01
15.95	124.45	0.37	1.86	0.73	0.01	16.02	123.59	0.37	1.87	0.73	0.01
16.08	123.05	0.37	1.88	0.73	0.01	16.15	127.96	0.39	1.80	0.73	0.01
16.21	131.59	0.42	1.74	0.73	0.01	16.30	136.28	0.46	1.67	0.72	0.02
16.37	138.34	0.47	1.64	0.72	0.01	16.42	139.56	0.48	1.62	0.72	0.01
16.48	139.75	0.49	1.62	0.72	0.01	16.54	139.30	0.48	1.62	0.72	0.01
16.61	138.06	0.47	1.64	0.72	0.01	16.67	136.34	0.45	1.66	0.72	0.01
16.77	132.72	0.42	1.70	0.72	0.02	16.80	131.34	0.41	1.72	0.72	0.01
16.88	128.10	0.39	1.77	0.71	0.02	16.95	125.02	0.37	1.81	0.71	0.01
17.01	122.31	0.36	1.85	0.71	0.01	17.07	122.53	0.36	1.84	0.71	0.02
17.13	119.60	0.34	1.89	0.71	0.01	17.20	115.10	0.32	1.97	0.71	0.02
17.26	114.01	0.32	1.98	0.71	0.01	17.36	112.76	0.31	2.00	0.71	0.02
17.42	109.98	0.30	2.05	0.70	0.02	17.45	107.97	0.29	2.09	0.70	0.01
17.52	106.71	0.29	2.11	0.70	0.02	17.62	116.43	0.33	1.92	0.70	0.02

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)
17.68	122.39	0.35	1.82	0.70	0.01	17.75	124.39	0.36	1.79	0.70	0.01
17.80	119.95	0.34	1.85	0.70	0.01	17.86	111.84	0.31	1.99	0.70	0.01
17.92	101.73	0.27	2.20	0.70	0.01	18.01	30.00	2.00	0.00	0.69	0.00
18.05	28.45	2.00	0.00	0.69	0.00	18.14	26.85	2.00	0.00	0.69	0.00
18.20	27.33	2.00	0.00	0.69	0.00	18.25	31.41	2.00	0.00	0.69	0.00
18.31	100.54	0.27	2.20	0.69	0.02	18.38	109.66	0.30	2.01	0.69	0.01
18.47	117.68	0.33	1.86	0.69	0.02	18.53	119.97	0.34	1.82	0.69	0.01
18.59	119.98	0.34	1.82	0.68	0.01	18.65	117.99	0.33	1.85	0.68	0.01
18.74	112.95	0.31	1.93	0.68	0.02	18.80	107.84	0.29	2.03	0.68	0.01
18.86	101.40	0.27	2.15	0.68	0.02	18.92	32.94	2.00	0.00	0.68	0.00
18.98	26.22	2.00	0.00	0.68	0.00	19.05	20.98	2.00	0.00	0.68	0.00
19.10	17.65	2.00	0.00	0.68	0.00	19.19	13.57	2.00	0.00	0.67	0.00
19.25	11.78	2.00	0.00	0.67	0.00	19.32	11.35	2.00	0.00	0.67	0.00
19.36	10.59	2.00	0.00	0.67	0.00	19.45	10.16	2.00	0.00	0.67	0.00
19.51	9.94	2.00	0.00	0.67	0.00	19.57	10.14	2.00	0.00	0.67	0.00
19.63	9.92	2.00	0.00	0.67	0.00	19.71	10.12	2.00	0.00	0.67	0.00
19.77	10.22	2.00	0.00	0.66	0.00	19.83	10.21	2.00	0.00	0.66	0.00
19.90	10.29	2.00	0.00	0.66	0.00	19.98	10.39	2.00	0.00	0.66	0.00
20.04	10.47	2.00	0.00	0.66	0.00	20.10	10.57	2.00	0.00	0.66	0.00
20.16	10.77	2.00	0.00	0.66	0.00	20.22	10.87	2.00	0.00	0.66	0.00
20.29	10.74	2.00	0.00	0.66	0.00	20.37	11.98	2.00	0.00	0.65	0.00
20.44	12.59	2.00	0.00	0.65	0.00	20.49	13.30	2.00	0.00	0.65	0.00
20.55	12.97	2.00	0.00	0.65	0.00	20.63	13.05	2.00	0.00	0.65	0.00
20.69	13.55	2.00	0.00	0.65	0.00	20.76	13.73	2.00	0.00	0.65	0.00
20.81	13.82	2.00	0.00	0.65	0.00	20.89	13.38	2.00	0.00	0.65	0.00
20.95	14.18	2.00	0.00	0.64	0.00	21.02	13.34	2.00	0.00	0.64	0.00
21.07	13.13	2.00	0.00	0.64	0.00	21.13	12.00	2.00	0.00	0.64	0.00
21.22	12.69	2.00	0.00	0.64	0.00	21.28	15.61	2.00	0.00	0.64	0.00
21.34	21.50	2.00	0.00	0.64	0.00	21.41	85.01	0.22	2.41	0.64	0.02
21.47	91.61	0.24	2.23	0.64	0.02	21.54	98.99	0.25	2.06	0.63	0.02
21.60	104.34	0.27	1.95	0.63	0.02	21.67	106.24	0.27	1.91	0.63	0.02
21.74	104.05	0.27	1.95	0.63	0.02	21.80	98.57	0.25	2.06	0.63	0.02
21.87	31.46	2.00	0.00	0.63	0.00	21.94	25.11	2.00	0.00	0.63	0.00
22.00	20.48	2.00	0.00	0.63	0.00	22.07	17.11	2.00	0.00	0.63	0.00
22.14	15.52	2.00	0.00	0.62	0.00	22.20	14.51	2.00	0.00	0.62	0.00
22.26	13.89	2.00	0.00	0.62	0.00	22.33	13.19	2.00	0.00	0.62	0.00
22.39	13.47	2.00	0.00	0.62	0.00	22.45	13.56	2.00	0.00	0.62	0.00
22.52	14.33	2.00	0.00	0.62	0.00	22.59	14.62	2.00	0.00	0.62	0.00
22.65	14.11	2.00	0.00	0.62	0.00	22.72	13.10	2.00	0.00	0.61	0.00
22.79	12.80	2.00	0.00	0.61	0.00	22.85	12.79	2.00	0.00	0.61	0.00
22.92	12.08	2.00	0.00	0.61	0.00	22.98	12.07	2.00	0.00	0.61	0.00
23.05	12.05	2.00	0.00	0.61	0.00	23.12	12.04	2.00	0.00	0.61	0.00
23.18	12.72	2.00	0.00	0.61	0.00	23.23	13.80	2.00	0.00	0.61	0.00
23.33	13.65	2.00	0.00	0.60	0.00	23.36	14.53	2.00	0.00	0.60	0.00
23.45	14.89	2.00	0.00	0.60	0.00	23.52	15.55	2.00	0.00	0.60	0.00
23.56	15.54	2.00	0.00	0.60	0.00	23.65	15.61	2.00	0.00	0.60	0.00
23.72	16.45	2.00	0.00	0.60	0.00	23.78	17.40	2.00	0.00	0.60	0.00
23.84	17.38	2.00	0.00	0.60	0.00	23.90	18.03	2.00	0.00	0.59	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)
23.96	18.67	2.00	0.00	0.59	0.00	24.02	19.13	2.00	0.00	0.59	0.00
24.11	19.57	2.00	0.00	0.59	0.00	24.18	19.64	2.00	0.00	0.59	0.00
24.24	19.43	2.00	0.00	0.59	0.00	24.30	18.93	2.00	0.00	0.59	0.00
24.36	18.15	2.00	0.00	0.59	0.00	24.42	17.18	2.00	0.00	0.59	0.00
24.48	16.60	2.00	0.00	0.59	0.00	24.54	16.29	2.00	0.00	0.58	0.00
24.64	15.98	2.00	0.00	0.58	0.00	24.70	15.59	2.00	0.00	0.58	0.00
24.76	15.18	2.00	0.00	0.58	0.00	24.83	14.69	2.00	0.00	0.58	0.00
24.88	14.02	2.00	0.00	0.58	0.00	24.94	13.24	2.00	0.00	0.58	0.00
25.03	12.37	2.00	0.00	0.58	0.00	25.07	12.36	2.00	0.00	0.58	0.00
25.16	11.50	2.00	0.00	0.57	0.00	25.20	11.49	2.00	0.00	0.57	0.00
25.29	11.48	2.00	0.00	0.57	0.00	25.35	11.75	2.00	0.00	0.57	0.00
25.41	12.21	2.00	0.00	0.57	0.00	25.47	11.44	2.00	0.00	0.57	0.00
25.54	11.99	2.00	0.00	0.57	0.00	25.60	12.54	2.00	0.00	0.57	0.00
25.67	12.53	2.00	0.00	0.56	0.00	25.73	13.35	2.00	0.00	0.56	0.00
25.80	14.09	2.00	0.00	0.56	0.00	25.87	14.44	2.00	0.00	0.56	0.00
25.94	14.24	2.00	0.00	0.56	0.00	26.00	13.94	2.00	0.00	0.56	0.00
26.06	13.56	2.00	0.00	0.56	0.00	26.12	12.71	2.00	0.00	0.56	0.00
26.19	13.43	2.00	0.00	0.56	0.00	26.25	13.33	2.00	0.00	0.56	0.00
26.32	16.08	2.00	0.00	0.55	0.00	26.38	20.29	2.00	0.00	0.55	0.00
26.44	26.84	2.00	0.00	0.55	0.00	26.51	96.21	0.24	1.84	0.55	0.02
26.61	108.14	0.27	1.63	0.55	0.02	26.64	111.39	0.28	1.58	0.55	0.01
26.74	118.79	0.31	1.47	0.55	0.02	26.80	122.63	0.32	1.42	0.55	0.01
26.86	125.38	0.34	1.38	0.54	0.01	26.92	126.63	0.34	1.36	0.54	0.01
26.98	127.73	0.35	1.35	0.54	0.01	27.04	130.30	0.36	1.32	0.54	0.01
27.11	134.13	0.39	1.27	0.54	0.01	27.17	139.45	0.43	1.22	0.54	0.01
27.26	146.25	0.49	1.15	0.54	0.01	27.31	150.29	0.54	1.11	0.54	0.01
27.39	155.12	0.61	1.07	0.54	0.01	27.45	158.19	0.67	0.98	0.53	0.01
27.50	160.45	0.71	0.86	0.53	0.01	27.56	162.10	0.75	0.77	0.53	0.01
27.64	162.95	0.76	0.73	0.53	0.01	27.71	162.13	0.75	0.77	0.53	0.01
27.78	161.17	0.72	0.81	0.53	0.01	27.83	160.48	0.71	0.85	0.53	0.01
27.89	160.36	0.71	0.86	0.53	0.01	27.97	163.19	0.77	0.71	0.53	0.01
28.03	166.00	0.84	0.59	0.52	0.00	28.09	169.63	0.95	0.46	0.52	0.00
28.17	174.64	1.13	0.31	0.52	0.00	28.23	177.68	1.28	0.23	0.52	0.00
28.28	180.83	1.45	0.15	0.52	0.00	28.36	184.72	1.72	0.07	0.52	0.00
28.41	187.56	1.95	0.01	0.52	0.00	28.51	189.90	2.00	0.00	0.52	0.00
28.56	189.68	2.00	0.00	0.52	0.00	28.61	187.70	1.97	0.01	0.52	0.00
28.70	181.18	1.47	0.14	0.51	0.00	28.76	174.42	1.12	0.31	0.51	0.00
28.81	169.55	0.94	0.45	0.51	0.00	28.89	160.94	0.72	0.80	0.51	0.01
28.96	152.11	0.56	1.04	0.51	0.01	29.01	146.12	0.49	1.09	0.51	0.01
29.09	137.46	0.41	1.16	0.51	0.01	29.16	129.61	0.36	1.24	0.51	0.01
29.21	126.04	0.34	1.27	0.50	0.01	29.29	119.36	0.31	1.34	0.50	0.01
29.34	112.37	0.28	1.43	0.50	0.01	29.42	99.99	0.25	1.61	0.50	0.02
29.48	28.55	2.00	0.00	0.50	0.00	29.55	24.72	2.00	0.00	0.50	0.00
29.60	20.89	2.00	0.00	0.50	0.00	29.68	16.97	2.00	0.00	0.50	0.00
29.75	15.38	2.00	0.00	0.50	0.00	29.81	14.50	2.00	0.00	0.49	0.00
29.88	13.45	2.00	0.00	0.49	0.00	29.94	13.26	2.00	0.00	0.49	0.00
30.01	12.65	2.00	0.00	0.49	0.00	30.07	12.28	2.00	0.00	0.49	0.00
30.13	12.01	2.00	0.00	0.49	0.00	30.20	11.83	2.00	0.00	0.49	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)
30.26	11.82	2.00	0.00	0.49	0.00	30.32	11.81	2.00	0.00	0.49	0.00
30.41	11.11	2.00	0.00	0.48	0.00	30.47	11.10	2.00	0.00	0.48	0.00
30.53	11.26	2.00	0.00	0.48	0.00	30.60	11.42	2.00	0.00	0.48	0.00
30.66	11.92	2.00	0.00	0.48	0.00	30.72	12.52	2.00	0.00	0.48	0.00
30.79	12.68	2.00	0.00	0.48	0.00	30.87	13.95	2.00	0.00	0.48	0.00
30.92	15.14	2.00	0.00	0.48	0.00	30.99	16.48	2.00	0.00	0.47	0.00
31.05	17.92	2.00	0.00	0.47	0.00	31.11	19.60	2.00	0.00	0.47	0.00
31.20	23.40	2.00	0.00	0.47	0.00	31.26	24.90	2.00	0.00	0.47	0.00
31.32	26.49	2.00	0.00	0.47	0.00	31.38	28.99	2.00	0.00	0.47	0.00
31.44	31.17	2.00	0.00	0.47	0.00	31.50	33.83	2.00	0.00	0.47	0.00
31.59	100.81	0.25	1.48	0.46	0.01	31.64	102.75	0.25	1.45	0.46	0.01
31.70	103.56	0.25	1.43	0.46	0.01	31.77	103.28	0.25	1.43	0.46	0.01
31.83	103.10	0.25	1.43	0.46	0.01	31.90	103.11	0.25	1.43	0.46	0.01
31.98	109.73	0.27	1.34	0.46	0.01	32.04	110.24	0.27	1.33	0.46	0.01
32.12	111.59	0.28	1.31	0.46	0.01	32.18	112.90	0.28	1.29	0.45	0.01
32.24	113.57	0.28	1.28	0.45	0.01	32.31	114.76	0.29	1.26	0.45	0.01
32.37	115.28	0.29	1.25	0.45	0.01	32.43	115.92	0.29	1.24	0.45	0.01
32.50	115.67	0.29	1.24	0.45	0.01	32.57	115.44	0.29	1.24	0.45	0.01
32.63	115.74	0.29	1.23	0.45	0.01	32.70	116.09	0.29	1.23	0.45	0.01
32.75	116.88	0.29	1.22	0.44	0.01	32.83	115.71	0.29	1.22	0.44	0.01
32.89	114.46	0.29	1.24	0.44	0.01	32.94	113.37	0.28	1.25	0.44	0.01
33.02	111.70	0.28	1.26	0.44	0.01	33.07	111.26	0.28	1.26	0.44	0.01
33.15	112.52	0.28	1.25	0.44	0.01	33.20	114.34	0.29	1.22	0.44	0.01
33.28	119.15	0.30	1.17	0.44	0.01	33.34	120.33	0.31	1.15	0.43	0.01
33.40	120.04	0.31	1.15	0.43	0.01	33.48	119.54	0.31	1.15	0.43	0.01
33.54	118.69	0.30	1.16	0.43	0.01	33.63	119.78	0.31	1.14	0.43	0.01
33.68	121.92	0.32	1.12	0.43	0.01	33.76	125.32	0.33	1.08	0.43	0.01
33.82	127.03	0.34	1.07	0.43	0.01	33.86	128.59	0.35	1.05	0.43	0.01
33.92	130.79	0.36	1.03	0.43	0.01	34.01	133.10	0.37	1.00	0.42	0.01
34.06	133.65	0.38	1.00	0.42	0.01	34.15	133.33	0.38	1.00	0.42	0.01
34.21	133.97	0.38	0.99	0.42	0.01	34.26	134.98	0.39	0.98	0.42	0.01
34.35	137.22	0.40	0.96	0.42	0.01	34.40	138.17	0.41	0.95	0.42	0.01
34.48	138.81	0.42	0.94	0.42	0.01	34.54	138.74	0.41	0.94	0.41	0.01
34.62	138.27	0.41	0.94	0.41	0.01	34.67	137.57	0.41	0.94	0.41	0.01
34.72	137.00	0.40	0.95	0.41	0.01	34.81	135.12	0.39	0.96	0.41	0.01
34.86	133.83	0.38	0.96	0.41	0.01	34.91	132.46	0.37	0.97	0.41	0.01
35.00	130.63	0.36	0.99	0.41	0.01	35.04	129.28	0.35	0.99	0.41	0.01
35.13	127.05	0.34	1.01	0.40	0.01	35.18	125.74	0.33	1.02	0.40	0.01
35.24	124.65	0.33	1.03	0.40	0.01	35.31	123.81	0.32	1.03	0.40	0.01
35.37	122.79	0.32	1.04	0.40	0.01	35.45	121.76	0.31	1.04	0.40	0.01
35.53	122.76	0.32	1.03	0.40	0.01	35.58	120.74	0.31	1.05	0.40	0.01
35.63	121.36	0.31	1.04	0.40	0.01	35.72	119.68	0.31	1.05	0.39	0.01
35.77	118.67	0.30	1.06	0.39	0.01	35.85	116.88	0.29	1.07	0.39	0.01
35.90	115.62	0.29	1.08	0.39	0.01	35.96	113.95	0.28	1.10	0.39	0.01
36.03	111.24	0.28	1.12	0.39	0.01	36.09	108.53	0.27	1.15	0.39	0.01
36.16	104.72	0.26	1.19	0.39	0.01	36.22	101.73	0.25	1.22	0.39	0.01
36.30	96.83	0.24	1.28	0.38	0.01	36.35	32.86	2.00	0.00	0.38	0.00
36.43	29.65	2.00	0.00	0.38	0.00	36.48	28.13	2.00	0.00	0.38	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)
36.57	26.52	2.00	0.00	0.38	0.00	36.62	27.45	2.00	0.00	0.38	0.00
36.70	33.11	2.00	0.00	0.38	0.00	36.75	97.61	0.24	1.24	0.38	0.01
36.82	104.22	0.25	1.16	0.38	0.01	36.88	108.87	0.27	1.10	0.37	0.01
36.96	114.53	0.29	1.04	0.37	0.01	37.04	119.40	0.30	0.99	0.37	0.01
37.09	123.31	0.32	0.96	0.37	0.01	37.17	131.27	0.36	0.89	0.37	0.01
37.21	138.04	0.41	0.84	0.37	0.00	37.29	150.77	0.53	0.76	0.37	0.01
37.34	156.41	0.62	0.72	0.37	0.00	37.41	162.75	0.74	0.54	0.37	0.00
37.49	172.79	1.02	0.27	0.36	0.00	37.53	176.30	1.17	0.20	0.36	0.00
37.60	178.47	1.27	0.16	0.36	0.00	37.67	178.93	1.29	0.15	0.36	0.00
37.74	176.79	1.19	0.19	0.36	0.00	37.82	174.32	1.08	0.23	0.36	0.00
37.87	171.89	0.99	0.28	0.36	0.00	37.94	167.40	0.85	0.39	0.36	0.00
38.01	160.64	0.69	0.60	0.36	0.01	38.06	154.70	0.59	0.71	0.35	0.00
38.14	145.25	0.47	0.76	0.35	0.01	38.20	136.27	0.40	0.82	0.35	0.00
38.28	121.99	0.32	0.92	0.35	0.01	38.33	114.76	0.29	0.98	0.35	0.01
38.40	41.96	2.00	0.00	0.35	0.00	38.47	36.55	2.00	0.00	0.35	0.00
38.55	32.57	2.00	0.00	0.35	0.00	38.60	30.31	2.00	0.00	0.35	0.00
38.67	27.12	2.00	0.00	0.34	0.00	38.73	25.32	2.00	0.00	0.34	0.00
38.80	23.23	2.00	0.00	0.34	0.00	38.86	22.29	2.00	0.00	0.34	0.00
38.93	20.13	2.00	0.00	0.34	0.00	38.98	18.50	2.00	0.00	0.34	0.00
39.06	16.89	2.00	0.00	0.34	0.00	39.11	16.11	2.00	0.00	0.34	0.00
39.19	15.33	2.00	0.00	0.34	0.00	39.25	17.45	2.00	0.00	0.33	0.00
39.33	18.27	2.00	0.00	0.33	0.00	39.38	17.96	2.00	0.00	0.33	0.00
39.45	16.35	2.00	0.00	0.33	0.00	39.51	15.35	2.00	0.00	0.33	0.00
39.59	13.74	2.00	0.00	0.33	0.00	39.64	13.74	2.00	0.00	0.33	0.00
39.72	13.72	2.00	0.00	0.33	0.00	39.78	13.71	2.00	0.00	0.33	0.00
39.85	14.46	2.00	0.00	0.32	0.00	39.91	15.50	2.00	0.00	0.32	0.00
39.97	16.70	2.00	0.00	0.32	0.00	40.03	18.04	2.00	0.00	0.32	0.00
40.09	19.24	2.00	0.00	0.32	0.00	40.16	19.45	2.00	0.00	0.32	0.00
40.22	18.83	2.00	0.00	0.32	0.00	40.31	17.98	2.00	0.00	0.32	0.00
40.38	17.96	2.00	0.00	0.32	0.00	40.44	18.26	2.00	0.00	0.31	0.00
40.50	19.14	2.00	0.00	0.31	0.00	40.57	20.64	2.00	0.00	0.31	0.00
40.63	21.59	2.00	0.00	0.31	0.00	40.70	22.55	2.00	0.00	0.31	0.00
40.77	22.91	2.00	0.00	0.31	0.00	40.83	24.17	2.00	0.00	0.31	0.00
40.89	26.71	2.00	0.00	0.31	0.00	40.96	29.18	2.00	0.00	0.31	0.00
41.05	30.58	2.00	0.00	0.30	0.00	41.11	31.01	2.00	0.00	0.30	0.00
41.17	32.12	2.00	0.00	0.30	0.00	41.23	33.31	2.00	0.00	0.30	0.00
41.29	34.18	2.00	0.00	0.30	0.00	41.35	35.96	2.00	0.00	0.30	0.00
41.42	37.22	2.00	0.00	0.30	0.00	41.48	37.19	2.00	0.00	0.30	0.00
41.54	36.64	2.00	0.00	0.30	0.00	41.61	36.30	2.00	0.00	0.29	0.00
41.68	40.95	2.00	0.00	0.29	0.00	41.74	41.30	2.00	0.00	0.29	0.00
41.80	40.74	2.00	0.00	0.29	0.00	41.87	39.57	2.00	0.00	0.29	0.00
41.97	36.06	2.00	0.00	0.29	0.00	42.03	32.21	2.00	0.00	0.29	0.00
42.09	27.70	2.00	0.00	0.29	0.00	42.16	23.67	2.00	0.00	0.29	0.00
42.23	20.92	2.00	0.00	0.28	0.00	42.29	18.55	2.00	0.00	0.28	0.00
42.32	17.43	2.00	0.00	0.28	0.00	42.41	15.07	2.00	0.00	0.28	0.00
42.47	14.10	2.00	0.00	0.28	0.00	42.53	13.66	2.00	0.00	0.28	0.00
42.60	13.65	2.00	0.00	0.28	0.00	42.66	13.64	2.00	0.00	0.28	0.00
42.73	13.63	2.00	0.00	0.28	0.00	42.79	14.05	2.00	0.00	0.27	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)
42.85	14.63	2.00	0.00	0.27	0.00	42.95	15.20	2.00	0.00	0.27	0.00
42.98	15.77	2.00	0.00	0.27	0.00	43.08	18.45	2.00	0.00	0.27	0.00
43.14	21.07	2.00	0.00	0.27	0.00	43.19	25.16	2.00	0.00	0.27	0.00
43.26	31.63	2.00	0.00	0.27	0.00	43.32	104.83	0.26	0.81	0.27	0.01
43.38	120.91	0.31	0.70	0.26	0.01	43.47	140.71	0.43	0.59	0.26	0.01
43.53	147.57	0.50	0.55	0.26	0.00	43.60	151.43	0.54	0.54	0.26	0.00
43.66	152.35	0.55	0.53	0.26	0.00	43.72	151.80	0.55	0.53	0.26	0.00
43.78	151.05	0.54	0.53	0.26	0.00	43.84	151.35	0.54	0.53	0.26	0.00
43.92	149.85	0.52	0.53	0.26	0.01	43.97	151.16	0.54	0.52	0.25	0.00
44.05	153.18	0.57	0.51	0.25	0.00	44.10	155.11	0.59	0.50	0.25	0.00
44.18	158.59	0.65	0.45	0.25	0.00	44.26	161.09	0.70	0.41	0.25	0.00
44.30	163.47	0.75	0.35	0.25	0.00	44.37	168.34	0.87	0.25	0.25	0.00
44.43	173.03	1.03	0.18	0.25	0.00	44.50	177.36	1.21	0.12	0.25	0.00
44.56	180.53	1.37	0.09	0.24	0.00	44.63	185.59	1.70	0.03	0.24	0.00
44.70	190.64	2.00	0.00	0.24	0.00	44.76	195.94	2.00	0.00	0.24	0.00
44.83	200.47	2.00	0.00	0.24	0.00	44.89	204.91	2.00	0.00	0.24	0.00
44.96	207.11	2.00	0.00	0.24	0.00	45.03	208.29	2.00	0.00	0.24	0.00
45.09	210.39	2.00	0.00	0.24	0.00	45.17	212.28	2.00	0.00	0.23	0.00
45.22	214.62	2.00	0.00	0.23	0.00	45.29	218.54	2.00	0.00	0.23	0.00
45.35	210.59	2.00	0.00	0.23	0.00	45.42	223.74	2.00	0.00	0.23	0.00
45.49	228.60	2.00	0.00	0.23	0.00	45.55	232.07	2.00	0.00	0.23	0.00
45.62	236.22	2.00	0.00	0.23	0.00	45.68	238.44	2.00	0.00	0.23	0.00
45.75	240.53	2.00	0.00	0.22	0.00	45.80	242.24	2.00	0.00	0.22	0.00
45.87	245.46	2.00	0.00	0.22	0.00	45.94	250.13	2.00	0.00	0.22	0.00
46.01	254.00	2.00	0.00	0.22	0.00	46.07	254.00	2.00	0.00	0.22	0.00
46.13	254.00	2.00	0.00	0.22	0.00	46.21	254.00	2.00	0.00	0.22	0.00
46.28	254.00	2.00	0.00	0.22	0.00	46.33	254.00	2.00	0.00	0.21	0.00
46.40	254.00	2.00	0.00	0.21	0.00	46.47	254.00	2.00	0.00	0.21	0.00
46.53	254.00	2.00	0.00	0.21	0.00	46.60	254.00	2.00	0.00	0.21	0.00
46.66	254.00	2.00	0.00	0.21	0.00	46.73	254.00	2.00	0.00	0.21	0.00
46.80	254.00	2.00	0.00	0.21	0.00	46.86	254.00	2.00	0.00	0.21	0.00
46.93	254.00	2.00	0.00	0.20	0.00	47.00	254.00	2.00	0.00	0.20	0.00
47.05	254.00	2.00	0.00	0.20	0.00	47.12	254.00	2.00	0.00	0.20	0.00
47.19	254.00	2.00	0.00	0.20	0.00	47.26	253.64	2.00	0.00	0.20	0.00
47.33	250.85	2.00	0.00	0.20	0.00	47.39	248.82	2.00	0.00	0.20	0.00
47.46	246.14	2.00	0.00	0.20	0.00	47.52	244.91	2.00	0.00	0.19	0.00
47.57	243.34	2.00	0.00	0.19	0.00	47.64	241.58	2.00	0.00	0.19	0.00
47.71	241.05	2.00	0.00	0.19	0.00	47.78	241.58	2.00	0.00	0.19	0.00
47.84	244.17	2.00	0.00	0.19	0.00	47.91	246.10	2.00	0.00	0.19	0.00
47.97	248.35	2.00	0.00	0.19	0.00	48.03	251.28	2.00	0.00	0.19	0.00
48.11	250.17	2.00	0.00	0.18	0.00	48.18	249.23	2.00	0.00	0.18	0.00
48.24	246.42	2.00	0.00	0.18	0.00	48.31	245.40	2.00	0.00	0.18	0.00
48.37	242.52	2.00	0.00	0.18	0.00	48.43	231.41	2.00	0.00	0.18	0.00
48.50	231.13	2.00	0.00	0.18	0.00	48.57	228.82	2.00	0.00	0.18	0.00
48.64	224.91	2.00	0.00	0.18	0.00	48.69	219.71	2.00	0.00	0.17	0.00
48.76	213.59	2.00	0.00	0.17	0.00	48.83	208.28	2.00	0.00	0.17	0.00
48.89	205.30	2.00	0.00	0.17	0.00	48.97	203.36	2.00	0.00	0.17	0.00
49.03	203.17	2.00	0.00	0.17	0.00	49.10	202.68	2.00	0.00	0.17	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)
49.16	201.40	2.00	0.00	0.17	0.00	49.23	200.25	2.00	0.00	0.17	0.00
49.29	199.22	2.00	0.00	0.16	0.00	49.35	197.77	2.00	0.00	0.16	0.00
49.42	196.76	2.00	0.00	0.16	0.00	49.48	197.25	2.00	0.00	0.16	0.00
49.54	196.21	2.00	0.00	0.16	0.00	49.62	196.02	2.00	0.00	0.16	0.00
49.67	197.58	2.00	0.00	0.16	0.00	49.74	199.57	2.00	0.00	0.16	0.00
49.83	200.05	2.00	0.00	0.16	0.00	49.87	197.19	2.00	0.00	0.15	0.00
49.96	191.04	2.00	0.00	0.15	0.00	50.01	189.06	2.00	0.00	0.15	0.00
50.07	189.58	2.00	0.00	0.15	0.00	50.14	194.31	2.00	0.00	0.15	0.00
50.20	198.40	2.00	0.00	0.15	0.00	50.26	201.18	2.00	0.00	0.15	0.00
50.33	201.75	2.00	0.00	0.15	0.00	50.40	202.06	2.00	0.00	0.15	0.00
50.46	202.48	2.00	0.00	0.14	0.00	50.55	201.96	2.00	0.00	0.14	0.00
50.61	201.92	2.00	0.00	0.14	0.00	50.68	201.17	2.00	0.00	0.14	0.00
50.73	200.34	2.00	0.00	0.14	0.00	50.81	198.14	2.00	0.00	0.14	0.00
50.86	195.98	2.00	0.00	0.14	0.00	50.95	191.38	2.00	0.00	0.14	0.00
51.00	187.96	2.00	0.00	0.14	0.00	51.08	181.71	2.00	0.00	0.13	0.00
51.14	173.33	2.00	0.00	0.13	0.00	51.19	160.56	2.00	0.00	0.13	0.00
51.26	136.87	2.00	0.00	0.13	0.00	51.33	50.19	2.00	0.00	0.13	0.00
51.40	39.68	2.00	0.00	0.13	0.00	51.45	33.06	2.00	0.00	0.13	0.00
51.53	26.76	2.00	0.00	0.13	0.00	51.59	23.85	2.00	0.00	0.13	0.00
51.65	22.57	2.00	0.00	0.12	0.00	51.73	24.76	2.00	0.00	0.12	0.00
51.79	30.11	2.00	0.00	0.12	0.00	51.84	41.57	2.00	0.00	0.12	0.00
51.91	128.11	2.00	0.00	0.12	0.00	51.99	164.68	2.00	0.00	0.12	0.00
52.04	178.07	2.00	0.00	0.12	0.00	52.12	191.57	2.00	0.00	0.12	0.00
52.18	198.68	2.00	0.00	0.12	0.00	52.24	207.54	2.00	0.00	0.11	0.00
52.31	217.79	2.00	0.00	0.11	0.00	52.38	223.02	2.00	0.00	0.11	0.00
52.45	232.17	2.00	0.00	0.11	0.00	52.51	238.71	2.00	0.00	0.11	0.00
52.57	244.12	2.00	0.00	0.11	0.00	52.63	247.67	2.00	0.00	0.11	0.00
52.69	249.57	2.00	0.00	0.11	0.00	52.76	250.68	2.00	0.00	0.11	0.00
52.83	250.38	2.00	0.00	0.10	0.00	52.90	249.41	2.00	0.00	0.10	0.00
52.97	247.56	2.00	0.00	0.10	0.00	53.02	246.62	2.00	0.00	0.10	0.00
53.09	245.59	2.00	0.00	0.10	0.00	53.17	244.45	2.00	0.00	0.10	0.00
53.22	243.16	2.00	0.00	0.10	0.00	53.30	242.03	2.00	0.00	0.10	0.00
53.35	240.64	2.00	0.00	0.10	0.00	53.43	237.38	2.00	0.00	0.09	0.00
53.50	232.51	2.00	0.00	0.09	0.00	53.57	226.43	2.00	0.00	0.09	0.00
53.63	222.22	2.00	0.00	0.09	0.00	53.70	217.01	2.00	0.00	0.09	0.00
53.76	214.27	2.00	0.00	0.09	0.00	53.83	209.43	2.00	0.00	0.09	0.00
53.90	205.61	2.00	0.00	0.09	0.00	53.95	204.05	2.00	0.00	0.09	0.00
54.03	202.06	2.00	0.00	0.08	0.00	54.07	200.46	2.00	0.00	0.08	0.00
54.14	196.09	2.00	0.00	0.08	0.00	54.21	195.08	2.00	0.00	0.08	0.00
54.27	192.59	2.00	0.00	0.08	0.00	54.36	192.60	2.00	0.00	0.08	0.00
54.40	193.56	2.00	0.00	0.08	0.00	54.47	196.31	2.00	0.00	0.08	0.00
54.55	198.27	2.00	0.00	0.08	0.00	54.63	197.73	2.00	0.00	0.07	0.00
54.66	199.02	2.00	0.00	0.07	0.00	54.73	200.90	2.00	0.00	0.07	0.00
54.79	202.05	2.00	0.00	0.07	0.00	54.88	201.24	2.00	0.00	0.07	0.00
54.93	199.53	2.00	0.00	0.07	0.00	54.99	196.34	2.00	0.00	0.07	0.00
55.08	190.70	2.00	0.00	0.07	0.00	55.13	187.35	2.00	0.00	0.07	0.00
55.19	184.36	2.00	0.00	0.06	0.00	55.25	181.32	2.00	0.00	0.06	0.00
55.33	177.08	2.00	0.00	0.06	0.00	55.38	174.87	2.00	0.00	0.06	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)
55.47	171.56	2.00	0.00	0.06	0.00	55.52	168.71	2.00	0.00	0.06	0.00
55.61	165.10	2.00	0.00	0.06	0.00	55.66	163.02	2.00	0.00	0.06	0.00
55.71	161.13	2.00	0.00	0.06	0.00	55.80	157.49	2.00	0.00	0.05	0.00
55.85	154.07	2.00	0.00	0.05	0.00	55.93	148.91	2.00	0.00	0.05	0.00
55.98	143.88	2.00	0.00	0.05	0.00	56.06	133.61	2.00	0.00	0.05	0.00
56.12	123.86	2.00	0.00	0.05	0.00	56.17	46.12	2.00	0.00	0.05	0.00
56.27	34.09	2.00	0.00	0.05	0.00	56.33	28.78	2.00	0.00	0.05	0.00
56.39	23.87	2.00	0.00	0.04	0.00	56.46	19.77	2.00	0.00	0.04	0.00
56.52	18.55	2.00	0.00	0.04	0.00	56.57	19.87	2.00	0.00	0.04	0.00
56.63	26.42	2.00	0.00	0.04	0.00	56.72	29.47	2.00	0.00	0.04	0.00
56.78	26.06	2.00	0.00	0.04	0.00	56.84	22.67	2.00	0.00	0.04	0.00
56.90	20.38	2.00	0.00	0.04	0.00	56.96	18.79	2.00	0.00	0.03	0.00
57.02	16.77	2.00	0.00	0.03	0.00	57.11	14.34	2.00	0.00	0.03	0.00
57.17	13.64	2.00	0.00	0.03	0.00	57.23	13.27	2.00	0.00	0.03	0.00
57.28	12.52	2.00	0.00	0.03	0.00	57.37	12.48	2.00	0.00	0.03	0.00
57.42	12.48	2.00	0.00	0.03	0.00	57.48	12.44	2.00	0.00	0.03	0.00
57.58	13.17	2.00	0.00	0.02	0.00	57.62	9.02	2.00	0.00	0.02	0.00
57.70	14.32	2.00	0.00	0.02	0.00	57.76	15.05	2.00	0.00	0.02	0.00
57.83	18.84	2.00	0.00	0.02	0.00	57.88	26.29	2.00	0.00	0.02	0.00
57.97	39.08	2.00	0.00	0.02	0.00	58.03	43.44	2.00	0.00	0.02	0.00
58.09	45.42	2.00	0.00	0.02	0.00	58.16	45.85	2.00	0.00	0.01	0.00
58.22	44.34	2.00	0.00	0.01	0.00	58.28	42.03	2.00	0.00	0.01	0.00
58.36	39.61	2.00	0.00	0.01	0.00	58.42	37.26	2.00	0.00	0.01	0.00
58.48	34.34	2.00	0.00	0.01	0.00	58.54	36.97	2.00	0.00	0.01	0.00
58.63	32.39	2.00	0.00	0.01	0.00	58.68	36.70	2.00	0.00	0.01	0.00
58.74	43.38	2.00	0.00	0.00	0.00	58.81	49.88	2.00	0.00	0.00	0.00
58.88	130.29	2.00	0.00	0.00	0.00	58.94	141.38	2.00	0.00	0.00	0.00
59.01	150.51	2.00	0.00	0.00	0.00	59.06	159.05	2.00	0.00	0.00	0.00
59.14	172.65	2.00	0.00	0.00	0.00	59.21	177.22	2.00	0.00	0.00	0.00
59.26	179.92	2.00	0.00	0.00	0.00	59.32	181.25	2.00	0.00	0.00	0.00
59.41	180.01	2.00	0.00	0.00	0.00	59.46	178.24	2.00	0.00	0.00	0.00
59.52	176.56	2.00	0.00	0.00	0.00	59.61	175.25	2.00	0.00	0.00	0.00
59.66	175.07	2.00	0.00	0.00	0.00	59.72	174.62	2.00	0.00	0.00	0.00
59.78	173.67	2.00	0.00	0.00	0.00	59.86	171.30	2.00	0.00	0.00	0.00
59.92	171.43	2.00	0.00	0.00	0.00	59.98	171.54	2.00	0.00	0.00	0.00
60.06	174.38	2.00	0.00	0.00	0.00	60.12	177.01	2.00	0.00	0.00	0.00
60.18	173.56	2.00	0.00	0.00	0.00	60.24	181.98	2.00	0.00	0.00	0.00
60.33	186.44	2.00	0.00	0.00	0.00	60.39	189.09	2.00	0.00	0.00	0.00
60.44	191.27	2.00	0.00	0.00	0.00	60.53	194.24	2.00	0.00	0.00	0.00
60.59	195.81	2.00	0.00	0.00	0.00	60.64	196.97	2.00	0.00	0.00	0.00
60.73	197.56	2.00	0.00	0.00	0.00	60.78	197.48	2.00	0.00	0.00	0.00
60.85	197.38	2.00	0.00	0.00	0.00	60.90	196.88	2.00	0.00	0.00	0.00
60.98	196.55	2.00	0.00	0.00	0.00	61.04	196.27	2.00	0.00	0.00	0.00
61.11	195.75	2.00	0.00	0.00	0.00	61.18	194.09	2.00	0.00	0.00	0.00
61.24	191.85	2.00	0.00	0.00	0.00	61.30	189.28	2.00	0.00	0.00	0.00
61.38	185.47	2.00	0.00	0.00	0.00	61.44	184.29	2.00	0.00	0.00	0.00
61.50	184.20	2.00	0.00	0.00	0.00	61.57	187.23	2.00	0.00	0.00	0.00
61.64	191.31	2.00	0.00	0.00	0.00	61.69	196.87	2.00	0.00	0.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)
61.77	206.19	2.00	0.00	0.00	0.00	61.83	213.13	2.00	0.00	0.00	0.00
61.90	222.83	2.00	0.00	0.00	0.00	61.96	228.06	2.00	0.00	0.00	0.00
62.02	230.95	2.00	0.00	0.00	0.00	62.09	229.14	2.00	0.00	0.00	0.00
62.15	224.41	2.00	0.00	0.00	0.00	62.23	212.81	2.00	0.00	0.00	0.00
62.29	203.90	2.00	0.00	0.00	0.00	62.34	194.24	2.00	0.00	0.00	0.00
62.42	181.10	2.00	0.00	0.00	0.00	62.48	173.61	2.00	0.00	0.00	0.00
62.54	167.88	2.00	0.00	0.00	0.00	62.62	162.58	2.00	0.00	0.00	0.00
62.68	160.54	2.00	0.00	0.00	0.00	62.76	158.06	2.00	0.00	0.00	0.00
62.81	154.73	2.00	0.00	0.00	0.00	62.86	151.19	2.00	0.00	0.00	0.00
62.93	144.31	2.00	0.00	0.00	0.00	63.01	142.45	2.00	0.00	0.00	0.00
63.07	139.63	2.00	0.00	0.00	0.00	63.12	136.92	2.00	0.00	0.00	0.00
63.21	134.28	2.00	0.00	0.00	0.00	63.26	132.34	2.00	0.00	0.00	0.00
63.34	130.16	2.00	0.00	0.00	0.00	63.40	128.62	2.00	0.00	0.00	0.00
63.48	126.01	2.00	0.00	0.00	0.00	63.54	124.71	2.00	0.00	0.00	0.00
63.59	123.11	2.00	0.00	0.00	0.00	63.67	119.47	2.00	0.00	0.00	0.00
63.72	50.04	2.00	0.00	0.00	0.00	63.79	44.42	2.00	0.00	0.00	0.00
63.85	40.06	2.00	0.00	0.00	0.00	63.91	36.19	2.00	0.00	0.00	0.00
63.99	37.22	2.00	0.00	0.00	0.00	64.05	42.50	2.00	0.00	0.00	0.00
64.13	121.20	2.00	0.00	0.00	0.00	64.18	131.14	2.00	0.00	0.00	0.00
64.24	135.69	2.00	0.00	0.00	0.00	64.31	142.18	2.00	0.00	0.00	0.00
64.41	149.61	2.00	0.00	0.00	0.00	64.46	153.15	2.00	0.00	0.00	0.00
64.50	155.90	2.00	0.00	0.00	0.00	64.59	159.52	2.00	0.00	0.00	0.00
64.64	160.74	2.00	0.00	0.00	0.00	64.70	161.24	2.00	0.00	0.00	0.00
64.77	161.03	2.00	0.00	0.00	0.00	64.83	160.83	2.00	0.00	0.00	0.00
64.91	160.90	2.00	0.00	0.00	0.00	64.97	160.73	2.00	0.00	0.00	0.00
65.03	160.42	2.00	0.00	0.00	0.00	65.12	157.62	2.00	0.00	0.00	0.00
65.16	155.84	2.00	0.00	0.00	0.00	65.24	149.02	2.00	0.00	0.00	0.00
65.30	145.04	2.00	0.00	0.00	0.00	65.36	140.68	2.00	0.00	0.00	0.00
65.45	61.89	2.00	0.00	0.00	0.00	65.49	57.39	2.00	0.00	0.00	0.00
65.58	41.72	2.00	0.00	0.00	0.00	65.64	33.24	2.00	0.00	0.00	0.00
65.70	27.83	2.00	0.00	0.00	0.00	65.75	24.08	2.00	0.00	0.00	0.00
65.81	21.22	2.00	0.00	0.00	0.00	65.91	21.02	2.00	0.00	0.00	0.00
65.95	20.42	2.00	0.00	0.00	0.00	66.02	21.71	2.00	0.00	0.00	0.00
66.08	21.64	2.00	0.00	0.00	0.00	66.16	20.80	2.00	0.00	0.00	0.00
66.22	21.32	2.00	0.00	0.00	0.00	66.28	23.15	2.00	0.00	0.00	0.00
66.34	25.93	2.00	0.00	0.00	0.00	66.42	29.51	2.00	0.00	0.00	0.00
66.48	31.30	2.00	0.00	0.00	0.00	66.55	32.08	2.00	0.00	0.00	0.00
66.62	36.60	2.00	0.00	0.00	0.00	66.68	39.77	2.00	0.00	0.00	0.00
66.74	38.45	2.00	0.00	0.00	0.00	66.81	38.10	2.00	0.00	0.00	0.00
66.88	38.08	2.00	0.00	0.00	0.00	66.95	37.69	2.00	0.00	0.00	0.00
67.02	44.54	2.00	0.00	0.00	0.00	67.08	123.65	2.00	0.00	0.00	0.00
67.14	138.39	2.00	0.00	0.00	0.00	67.20	147.38	2.00	0.00	0.00	0.00
67.26	153.02	2.00	0.00	0.00	0.00	67.34	157.29	2.00	0.00	0.00	0.00
67.40	159.18	2.00	0.00	0.00	0.00	67.47	162.04	2.00	0.00	0.00	0.00
67.52	164.91	2.00	0.00	0.00	0.00	67.61	166.86	2.00	0.00	0.00	0.00
67.66	167.28	2.00	0.00	0.00	0.00	67.73	167.44	2.00	0.00	0.00	0.00
67.79	167.03	2.00	0.00	0.00	0.00	67.86	165.01	2.00	0.00	0.00	0.00
67.93	161.52	2.00	0.00	0.00	0.00	67.99	156.24	2.00	0.00	0.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)
68.06	149.37	2.00	0.00	0.00	0.00	68.14	134.52	2.00	0.00	0.00	0.00
68.19	55.90	2.00	0.00	0.00	0.00	68.25	46.92	2.00	0.00	0.00	0.00
68.32	38.93	2.00	0.00	0.00	0.00	68.39	38.84	2.00	0.00	0.00	0.00
68.45	38.81	2.00	0.00	0.00	0.00	68.51	38.75	2.00	0.00	0.00	0.00
68.58	131.38	2.00	0.00	0.00	0.00	68.64	158.88	2.00	0.00	0.00	0.00
68.71	170.42	2.00	0.00	0.00	0.00	68.77	162.85	2.00	0.00	0.00	0.00
68.85	177.59	2.00	0.00	0.00	0.00	68.90	183.06	2.00	0.00	0.00	0.00
68.97	181.25	2.00	0.00	0.00	0.00	69.03	182.08	2.00	0.00	0.00	0.00
69.13	181.73	2.00	0.00	0.00	0.00	69.18	183.00	2.00	0.00	0.00	0.00
69.23	185.98	2.00	0.00	0.00	0.00	69.30	190.57	2.00	0.00	0.00	0.00
69.38	196.52	2.00	0.00	0.00	0.00	69.44	200.91	2.00	0.00	0.00	0.00
69.49	204.75	2.00	0.00	0.00	0.00	69.56	205.99	2.00	0.00	0.00	0.00
69.64	205.97	2.00	0.00	0.00	0.00	69.69	207.90	2.00	0.00	0.00	0.00
69.75	211.58	2.00	0.00	0.00	0.00	69.83	213.90	2.00	0.00	0.00	0.00
69.89	213.04	2.00	0.00	0.00	0.00	69.95	205.52	2.00	0.00	0.00	0.00
70.02	195.27	2.00	0.00	0.00	0.00	70.08	129.41	2.00	0.00	0.00	0.00
70.15	125.26	2.00	0.00	0.00	0.00	70.21	121.52	2.00	0.00	0.00	0.00
70.31	117.59	2.00	0.00	0.00	0.00	70.37	117.12	2.00	0.00	0.00	0.00
70.43	118.08	2.00	0.00	0.00	0.00						

Total estimated settlement: 3.59

Abbreviations

$Q_{tn,cs}$:	Equivalent clean sand normalized cone resistance
FS:	Factor of safety against liquefaction
e_v (%):	Post-liquefaction volumentric strain
DF:	e_v depth weighting factor
Settlement:	Calculated settlement

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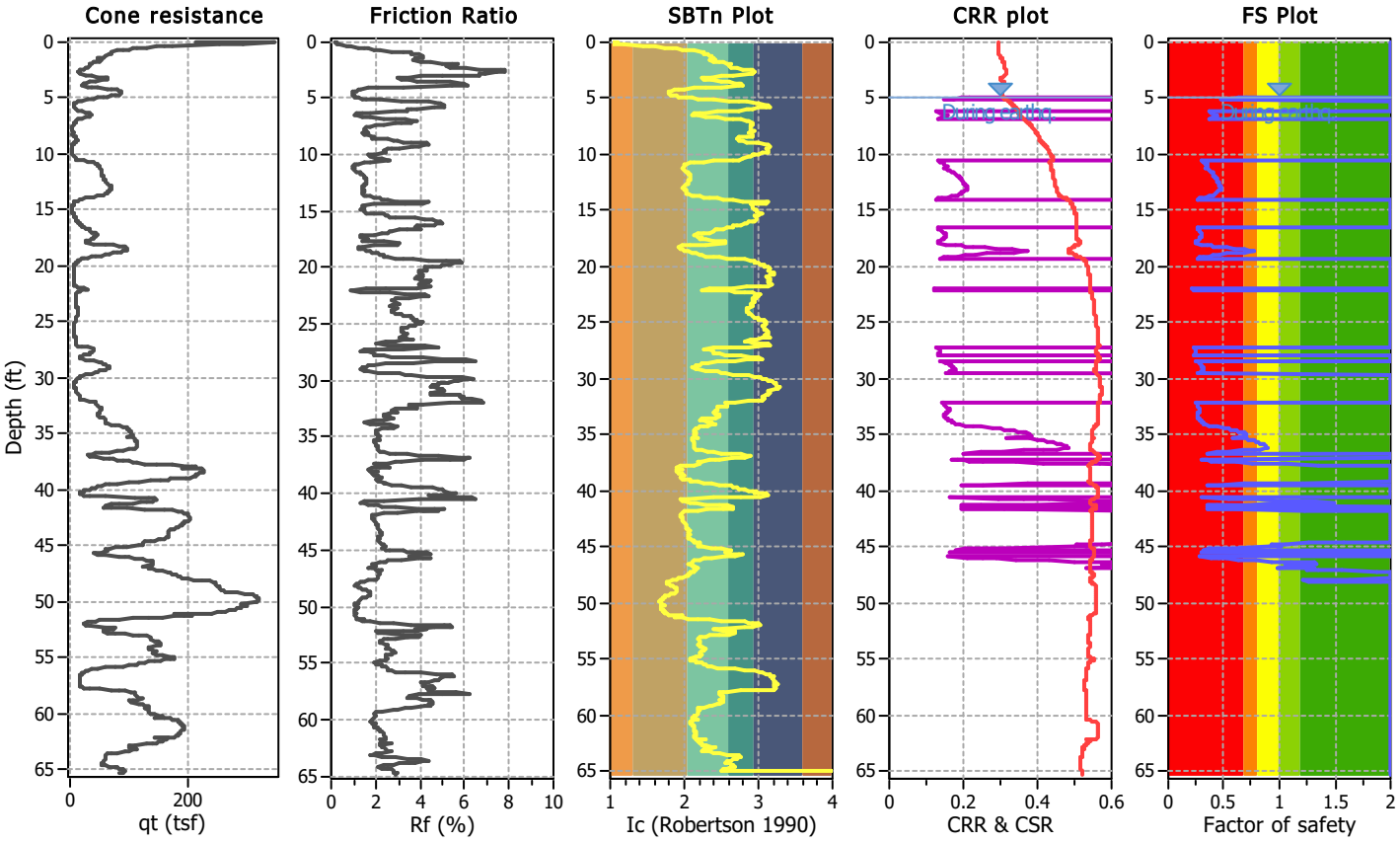
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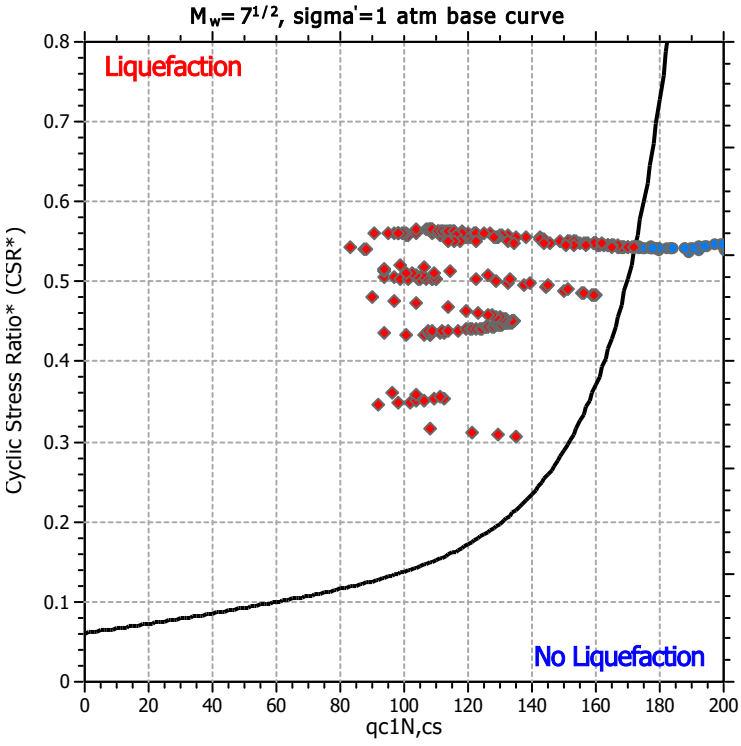
Project title : Proposed Commercial/Industrial Development **Location : Cypress, CA**

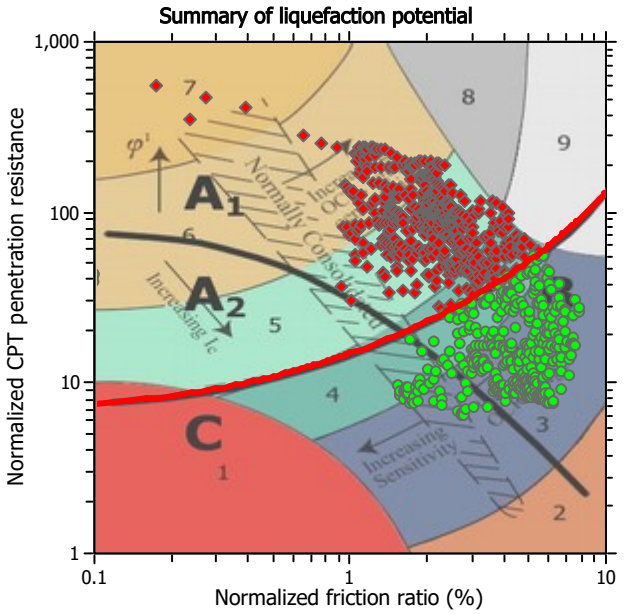
CPT file : CPT-3

Input parameters and analysis data

Analysis method:	**B&I (2014)**	**G.W.T. (in-situ):**	**5.00 ft**	**Use fill:**	**No**	**Clay like behavior applied:**	**Sands only**
Fines correction method:	**B&I (2014)**	**G.W.T. (earthq.):**	**5.00 ft**	**Fill height:**	**N/A**	**Limit depth applie**	**Yes**
Points to test:	**Based on Ic value**	**Average results interva**	**1**	**Fill weight:**	**N/A**	**Limit depth:**	**50.00 ft**
Earthquake magnitude M_w:	**7.30**	**Ic cut-off value:**	**2.60**	**Trans. detect. applied:**	**No**	**MSF method:**	**Method base**
Peak ground acceleration:	**0.54**	**Unit weight calculation**	**Based on SBT**	**K_σ applied:**	**Yes**		

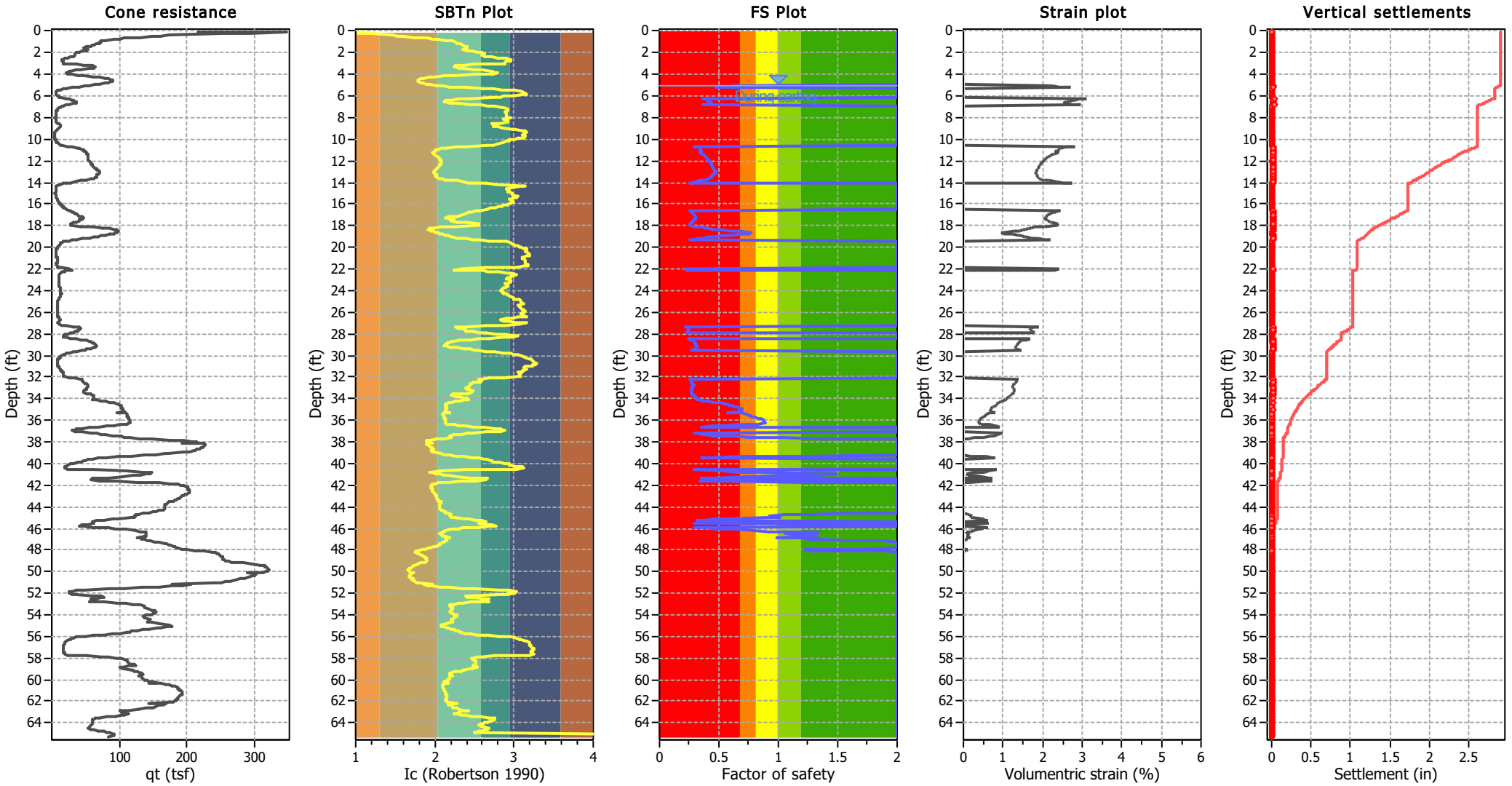






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

:: Post-earthquake settlement due to soil liquefaction ::

Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)
5.01	134.72	0.70	2.14	0.92	0.02	5.06	129.42	0.63	2.24	0.91	0.01
5.12	121.26	0.56	2.40	0.91	0.02	5.19	108.24	0.47	2.70	0.91	0.02
5.28	33.56	2.00	0.00	0.91	0.00	5.33	26.65	2.00	0.00	0.91	0.00
5.38	21.40	2.00	0.00	0.91	0.00	5.47	16.71	2.00	0.00	0.91	0.00
5.52	15.05	2.00	0.00	0.91	0.00	5.60	11.87	2.00	0.00	0.91	0.00
5.67	11.05	2.00	0.00	0.90	0.00	5.72	10.64	2.00	0.00	0.90	0.00
5.80	10.36	2.00	0.00	0.90	0.00	5.87	11.33	2.00	0.00	0.90	0.00
5.93	13.40	2.00	0.00	0.90	0.00	5.99	15.60	2.00	0.00	0.90	0.00
6.05	17.40	2.00	0.00	0.90	0.00	6.12	18.51	2.00	0.00	0.90	0.00
6.18	22.09	2.00	0.00	0.90	0.00	6.26	92.18	0.37	3.12	0.89	0.03
6.32	98.41	0.39	2.92	0.89	0.02	6.39	101.71	0.40	2.82	0.89	0.02
6.45	103.71	0.41	2.76	0.89	0.02	6.52	106.32	0.42	2.68	0.89	0.02
6.57	109.52	0.43	2.60	0.89	0.02	6.63	112.20	0.44	2.53	0.89	0.02
6.70	111.35	0.43	2.55	0.89	0.02	6.78	103.76	0.40	2.74	0.89	0.03
6.85	96.09	0.37	2.96	0.88	0.02	6.91	29.27	2.00	0.00	0.88	0.00
6.97	24.31	2.00	0.00	0.88	0.00	7.03	20.29	2.00	0.00	0.88	0.00
7.09	18.36	2.00	0.00	0.88	0.00	7.18	15.33	2.00	0.00	0.88	0.00
7.24	14.22	2.00	0.00	0.88	0.00	7.30	12.98	2.00	0.00	0.88	0.00
7.37	12.02	2.00	0.00	0.88	0.00	7.42	11.05	2.00	0.00	0.87	0.00
7.48	10.49	2.00	0.00	0.87	0.00	7.57	9.95	2.00	0.00	0.87	0.00
7.63	9.67	2.00	0.00	0.87	0.00	7.70	9.80	2.00	0.00	0.87	0.00
7.76	9.67	2.00	0.00	0.87	0.00	7.82	9.53	2.00	0.00	0.87	0.00
7.90	9.53	2.00	0.00	0.87	0.00	7.96	9.53	2.00	0.00	0.87	0.00
8.01	8.98	2.00	0.00	0.86	0.00	8.09	10.22	2.00	0.00	0.86	0.00
8.15	10.22	2.00	0.00	0.86	0.00	8.21	10.07	2.00	0.00	0.86	0.00
8.30	9.95	2.00	0.00	0.86	0.00	8.36	9.95	2.00	0.00	0.86	0.00
8.42	10.64	2.00	0.00	0.86	0.00	8.49	12.71	2.00	0.00	0.86	0.00
8.54	16.02	2.00	0.00	0.86	0.00	8.60	18.09	2.00	0.00	0.85	0.00
8.69	20.16	2.00	0.00	0.85	0.00	8.76	20.98	2.00	0.00	0.85	0.00
8.81	21.55	2.00	0.00	0.85	0.00	8.87	20.44	2.00	0.00	0.85	0.00
8.93	18.78	2.00	0.00	0.85	0.00	9.02	15.05	2.00	0.00	0.85	0.00
9.06	14.22	2.00	0.00	0.85	0.00	9.15	11.46	2.00	0.00	0.84	0.00
9.21	10.49	2.00	0.00	0.84	0.00	9.26	9.53	2.00	0.00	0.84	0.00
9.33	8.56	2.00	0.00	0.84	0.00	9.42	8.02	2.00	0.00	0.84	0.00
9.48	8.02	2.00	0.00	0.84	0.00	9.54	7.87	2.00	0.00	0.84	0.00
9.60	7.73	2.00	0.00	0.84	0.00	9.66	7.33	2.00	0.00	0.84	0.00
9.74	7.33	2.00	0.00	0.83	0.00	9.80	7.33	2.00	0.00	0.83	0.00
9.86	7.45	2.00	0.00	0.83	0.00	9.92	8.15	2.00	0.00	0.83	0.00
9.98	8.71	2.00	0.00	0.83	0.00	10.07	9.80	2.00	0.00	0.83	0.00
10.13	9.95	2.00	0.00	0.83	0.00	10.19	10.49	2.00	0.00	0.83	0.00
10.25	11.33	2.00	0.00	0.83	0.00	10.31	12.56	2.00	0.00	0.83	0.00
10.40	15.96	2.00	0.00	0.82	0.00	10.45	17.34	2.00	0.00	0.82	0.00
10.52	20.01	2.00	0.00	0.82	0.00	10.57	23.26	2.00	0.00	0.82	0.00
10.64	93.81	0.30	2.81	0.82	0.02	10.70	100.87	0.32	2.61	0.82	0.02
10.79	106.42	0.34	2.46	0.82	0.03	10.84	107.84	0.34	2.43	0.82	0.01
10.91	107.86	0.34	2.42	0.82	0.02	10.97	107.62	0.34	2.42	0.81	0.02
11.04	109.01	0.35	2.39	0.81	0.02	11.10	111.26	0.35	2.34	0.81	0.02
11.16	112.33	0.36	2.31	0.81	0.02	11.23	107.64	0.34	2.41	0.81	0.02

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)
11.30	108.92	0.34	2.38	0.81	0.02	11.36	111.77	0.35	2.31	0.81	0.02
11.42	113.98	0.36	2.26	0.81	0.02	11.50	117.12	0.38	2.19	0.81	0.02
11.58	119.30	0.39	2.15	0.80	0.02	11.62	120.38	0.39	2.12	0.80	0.01
11.68	121.25	0.40	2.11	0.80	0.01	11.75	122.38	0.40	2.08	0.80	0.02
11.85	123.67	0.41	2.05	0.80	0.02	11.91	124.47	0.41	2.04	0.80	0.02
11.99	125.44	0.42	2.02	0.80	0.02	12.03	125.87	0.42	2.01	0.80	0.01
12.08	126.46	0.42	2.00	0.80	0.01	12.15	127.30	0.43	1.98	0.79	0.02
12.24	128.18	0.43	1.96	0.79	0.02	12.30	128.77	0.44	1.95	0.79	0.01
12.36	129.29	0.44	1.94	0.79	0.01	12.42	129.74	0.44	1.93	0.79	0.01
12.47	130.13	0.44	1.92	0.79	0.01	12.57	130.93	0.45	1.90	0.79	0.02
12.63	131.31	0.45	1.89	0.79	0.01	12.69	131.67	0.45	1.88	0.78	0.01
12.75	132.02	0.46	1.88	0.78	0.01	12.82	132.47	0.46	1.87	0.78	0.01
12.88	133.04	0.46	1.86	0.78	0.02	12.93	133.48	0.47	1.85	0.78	0.01
13.02	134.17	0.47	1.83	0.78	0.02	13.09	134.26	0.47	1.83	0.78	0.01
13.14	134.03	0.47	1.83	0.78	0.01	13.20	133.52	0.46	1.84	0.78	0.01
13.28	132.18	0.45	1.85	0.77	0.02	13.35	131.16	0.44	1.87	0.77	0.01
13.40	130.49	0.44	1.87	0.77	0.01	13.47	129.81	0.43	1.88	0.77	0.02
13.55	128.68	0.42	1.90	0.77	0.02	13.61	127.77	0.42	1.91	0.77	0.01
13.67	125.94	0.40	1.94	0.77	0.01	13.73	123.01	0.39	1.98	0.77	0.01
13.79	119.07	0.36	2.05	0.77	0.02	13.85	113.91	0.34	2.15	0.77	0.01
13.94	104.03	0.30	2.36	0.76	0.02	14.00	97.01	0.28	2.53	0.76	0.02
14.06	89.72	0.26	2.73	0.76	0.02	14.11	24.43	2.00	0.00	0.76	0.00
14.20	17.97	2.00	0.00	0.76	0.00	14.27	10.23	2.00	0.00	0.76	0.00
14.32	9.39	2.00	0.00	0.76	0.00	14.38	9.01	2.00	0.00	0.76	0.00
14.44	9.00	2.00	0.00	0.76	0.00	14.53	9.00	2.00	0.00	0.75	0.00
14.59	8.98	2.00	0.00	0.75	0.00	14.65	8.85	2.00	0.00	0.75	0.00
14.70	8.49	2.00	0.00	0.75	0.00	14.79	8.59	2.00	0.00	0.75	0.00
14.86	8.47	2.00	0.00	0.75	0.00	14.91	8.21	2.00	0.00	0.75	0.00
14.97	7.86	2.00	0.00	0.75	0.00	15.06	7.85	2.00	0.00	0.74	0.00
15.12	7.95	2.00	0.00	0.74	0.00	15.18	7.94	2.00	0.00	0.74	0.00
15.24	8.05	2.00	0.00	0.74	0.00	15.29	8.40	2.00	0.00	0.74	0.00
15.38	8.97	2.00	0.00	0.74	0.00	15.45	9.77	2.00	0.00	0.74	0.00
15.51	10.92	2.00	0.00	0.74	0.00	15.56	11.94	2.00	0.00	0.74	0.00
15.65	12.48	2.00	0.00	0.73	0.00	15.71	13.48	2.00	0.00	0.73	0.00
15.77	14.03	2.00	0.00	0.73	0.00	15.84	14.57	2.00	0.00	0.73	0.00
15.90	15.35	2.00	0.00	0.73	0.00	15.97	16.77	2.00	0.00	0.73	0.00
16.03	17.86	2.00	0.00	0.73	0.00	16.09	19.95	2.00	0.00	0.73	0.00
16.16	21.01	2.00	0.00	0.73	0.00	16.23	21.97	2.00	0.00	0.73	0.00
16.29	23.91	2.00	0.00	0.72	0.00	16.35	26.15	2.00	0.00	0.72	0.00
16.42	27.84	2.00	0.00	0.72	0.00	16.48	28.64	2.00	0.00	0.72	0.00
16.54	28.91	2.00	0.00	0.72	0.00	16.62	93.60	0.26	2.47	0.72	0.02
16.68	96.69	0.26	2.39	0.72	0.02	16.74	99.02	0.27	2.32	0.72	0.02
16.81	101.25	0.28	2.27	0.72	0.02	16.89	104.08	0.28	2.20	0.71	0.02
16.93	104.86	0.29	2.18	0.71	0.01	17.03	107.19	0.29	2.13	0.71	0.03
17.09	109.03	0.30	2.09	0.71	0.01	17.16	109.01	0.30	2.08	0.71	0.02
17.22	109.03	0.30	2.08	0.71	0.02	17.28	109.93	0.30	2.06	0.71	0.01
17.35	110.30	0.30	2.05	0.71	0.02	17.41	109.29	0.30	2.07	0.70	0.02
17.46	106.08	0.29	2.13	0.70	0.01	17.53	105.45	0.29	2.14	0.70	0.02

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)
17.59	103.85	0.28	2.17	0.70	0.02	17.65	102.32	0.28	2.20	0.70	0.02
17.72	100.54	0.27	2.24	0.70	0.02	17.81	93.87	0.25	2.39	0.70	0.02
17.88	93.80	0.25	2.39	0.70	0.02	17.93	93.75	0.25	2.39	0.70	0.02
18.00	93.61	0.25	2.39	0.69	0.02	18.07	109.25	0.30	2.03	0.69	0.02
18.13	122.72	0.35	1.80	0.69	0.01	18.19	128.63	0.39	1.70	0.69	0.01
18.26	132.24	0.41	1.65	0.69	0.01	18.32	137.68	0.45	1.58	0.69	0.01
18.39	144.34	0.52	1.49	0.69	0.01	18.45	150.08	0.59	1.43	0.69	0.01
18.52	155.57	0.68	1.29	0.69	0.01	18.58	158.76	0.74	1.04	0.69	0.01
18.65	160.10	0.77	0.95	0.68	0.01	18.71	159.23	0.75	1.01	0.68	0.01
18.78	156.29	0.69	1.23	0.68	0.01	18.84	151.34	0.61	1.40	0.68	0.01
18.91	145.29	0.53	1.46	0.68	0.01	18.97	139.35	0.46	1.53	0.68	0.01
19.04	133.04	0.41	1.61	0.68	0.01	19.10	126.04	0.37	1.70	0.68	0.01
19.19	114.43	0.31	1.88	0.67	0.02	19.25	106.06	0.28	2.04	0.67	0.01
19.31	98.70	0.26	2.19	0.67	0.02	19.37	31.06	2.00	0.00	0.67	0.00
19.44	25.28	2.00	0.00	0.67	0.00	19.50	20.98	2.00	0.00	0.67	0.00
19.57	18.30	2.00	0.00	0.67	0.00	19.63	17.26	2.00	0.00	0.67	0.00
19.70	16.30	2.00	0.00	0.67	0.00	19.75	15.16	2.00	0.00	0.67	0.00
19.82	13.91	2.00	0.00	0.66	0.00	19.89	12.55	2.00	0.00	0.66	0.00
19.95	11.60	2.00	0.00	0.66	0.00	20.01	10.77	2.00	0.00	0.66	0.00
20.08	9.81	2.00	0.00	0.66	0.00	20.15	9.28	2.00	0.00	0.66	0.00
20.21	9.17	2.00	0.00	0.66	0.00	20.28	9.05	2.00	0.00	0.66	0.00
20.35	9.04	2.00	0.00	0.66	0.00	20.41	9.03	2.00	0.00	0.65	0.00
20.50	8.61	2.00	0.00	0.65	0.00	20.57	8.49	2.00	0.00	0.65	0.00
20.64	8.27	2.00	0.00	0.65	0.00	20.70	8.26	2.00	0.00	0.65	0.00
20.76	8.36	2.00	0.00	0.65	0.00	20.83	8.87	2.00	0.00	0.65	0.00
20.89	9.37	2.00	0.00	0.65	0.00	20.95	9.76	2.00	0.00	0.64	0.00
21.01	9.95	2.00	0.00	0.64	0.00	21.07	9.74	2.00	0.00	0.64	0.00
21.13	9.73	2.00	0.00	0.64	0.00	21.20	9.72	2.00	0.00	0.64	0.00
21.26	9.71	2.00	0.00	0.64	0.00	21.36	9.58	2.00	0.00	0.64	0.00
21.39	9.48	2.00	0.00	0.64	0.00	21.49	9.16	2.00	0.00	0.64	0.00
21.55	8.95	2.00	0.00	0.63	0.00	21.62	8.94	2.00	0.00	0.63	0.00
21.68	9.33	2.00	0.00	0.63	0.00	21.74	10.22	2.00	0.00	0.63	0.00
21.80	11.52	2.00	0.00	0.63	0.00	21.85	13.52	2.00	0.00	0.63	0.00
21.92	17.20	2.00	0.00	0.63	0.00	22.01	82.84	0.22	2.43	0.63	0.03
22.08	87.34	0.23	2.30	0.63	0.02	22.15	87.81	0.23	2.29	0.62	0.02
22.19	23.68	2.00	0.00	0.62	0.00	22.26	22.47	2.00	0.00	0.62	0.00
22.33	18.32	2.00	0.00	0.62	0.00	22.39	15.84	2.00	0.00	0.62	0.00
22.45	14.15	2.00	0.00	0.62	0.00	22.52	12.65	2.00	0.00	0.62	0.00
22.58	12.83	2.00	0.00	0.62	0.00	22.65	12.32	2.00	0.00	0.62	0.00
22.73	12.31	2.00	0.00	0.61	0.00	22.80	11.80	2.00	0.00	0.61	0.00
22.86	12.28	2.00	0.00	0.61	0.00	22.92	12.67	2.00	0.00	0.61	0.00
22.98	12.26	2.00	0.00	0.61	0.00	23.05	12.05	2.00	0.00	0.61	0.00
23.11	12.14	2.00	0.00	0.61	0.00	23.18	12.12	2.00	0.00	0.61	0.00
23.24	12.40	2.00	0.00	0.61	0.00	23.30	12.87	2.00	0.00	0.61	0.00
23.39	13.34	2.00	0.00	0.60	0.00	23.45	13.04	2.00	0.00	0.60	0.00
23.51	13.03	2.00	0.00	0.60	0.00	23.57	13.50	2.00	0.00	0.60	0.00
23.63	13.09	2.00	0.00	0.60	0.00	23.70	13.95	2.00	0.00	0.60	0.00
23.76	14.14	2.00	0.00	0.60	0.00	23.82	14.79	2.00	0.00	0.60	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)
23.89	15.16	2.00	0.00	0.60	0.00	23.98	15.72	2.00	0.00	0.59	0.00
24.05	15.89	2.00	0.00	0.59	0.00	24.11	15.97	2.00	0.00	0.59	0.00
24.17	15.95	2.00	0.00	0.59	0.00	24.23	16.02	2.00	0.00	0.59	0.00
24.29	15.91	2.00	0.00	0.59	0.00	24.35	15.70	2.00	0.00	0.59	0.00
24.41	15.40	2.00	0.00	0.59	0.00	24.48	15.10	2.00	0.00	0.59	0.00
24.57	14.12	2.00	0.00	0.58	0.00	24.63	13.25	2.00	0.00	0.58	0.00
24.69	13.24	2.00	0.00	0.58	0.00	24.76	13.22	2.00	0.00	0.58	0.00
24.82	12.26	2.00	0.00	0.58	0.00	24.88	11.38	2.00	0.00	0.58	0.00
24.97	10.80	2.00	0.00	0.58	0.00	25.03	10.79	2.00	0.00	0.58	0.00
25.10	10.39	2.00	0.00	0.57	0.00	25.16	9.90	2.00	0.00	0.57	0.00
25.22	9.89	2.00	0.00	0.57	0.00	25.28	9.98	2.00	0.00	0.57	0.00
25.34	10.06	2.00	0.00	0.57	0.00	25.40	10.34	2.00	0.00	0.57	0.00
25.49	10.04	2.00	0.00	0.57	0.00	25.55	9.94	2.00	0.00	0.57	0.00
25.62	9.74	2.00	0.00	0.57	0.00	25.68	9.63	2.00	0.00	0.56	0.00
25.75	9.44	2.00	0.00	0.56	0.00	25.79	9.24	2.00	0.00	0.56	0.00
25.89	9.13	2.00	0.00	0.56	0.00	25.95	9.12	2.00	0.00	0.56	0.00
26.01	9.30	2.00	0.00	0.56	0.00	26.07	9.48	2.00	0.00	0.56	0.00
26.14	9.56	2.00	0.00	0.56	0.00	26.20	9.46	2.00	0.00	0.56	0.00
26.26	9.36	2.00	0.00	0.55	0.00	26.35	9.63	2.00	0.00	0.55	0.00
26.39	9.34	2.00	0.00	0.55	0.00	26.45	10.92	2.00	0.00	0.55	0.00
26.54	11.83	2.00	0.00	0.55	0.00	26.59	12.66	2.00	0.00	0.55	0.00
26.67	13.85	2.00	0.00	0.55	0.00	26.72	13.56	2.00	0.00	0.55	0.00
26.79	12.90	2.00	0.00	0.55	0.00	26.85	11.87	2.00	0.00	0.54	0.00
26.91	11.58	2.00	0.00	0.54	0.00	26.97	10.55	2.00	0.00	0.54	0.00
27.03	10.72	2.00	0.00	0.54	0.00	27.11	12.28	2.00	0.00	0.54	0.00
27.18	16.12	2.00	0.00	0.54	0.00	27.24	23.58	2.00	0.00	0.54	0.00
27.31	90.71	0.23	1.90	0.54	0.02	27.37	98.19	0.24	1.75	0.54	0.01
27.44	100.57	0.25	1.71	0.53	0.01	27.50	101.00	0.25	1.70	0.53	0.01
27.60	100.57	0.25	1.70	0.53	0.02	27.63	100.09	0.25	1.71	0.53	0.01
27.71	99.12	0.24	1.72	0.53	0.02	27.78	98.15	0.24	1.73	0.53	0.01
27.83	96.78	0.24	1.75	0.53	0.01	27.90	94.81	0.23	1.79	0.53	0.01
27.96	30.43	2.00	0.00	0.53	0.00	28.03	25.40	2.00	0.00	0.53	0.00
28.09	21.51	2.00	0.00	0.52	0.00	28.18	18.71	2.00	0.00	0.52	0.00
28.23	17.43	2.00	0.00	0.52	0.00	28.30	19.12	2.00	0.00	0.52	0.00
28.36	23.73	2.00	0.00	0.52	0.00	28.42	30.02	2.00	0.00	0.52	0.00
28.48	98.06	0.24	1.70	0.52	0.01	28.54	104.02	0.26	1.59	0.52	0.01
28.63	111.47	0.28	1.48	0.51	0.02	28.72	114.68	0.29	1.43	0.51	0.02
28.75	115.71	0.29	1.41	0.51	0.01	28.82	117.48	0.30	1.39	0.51	0.01
28.88	118.21	0.30	1.38	0.51	0.01	28.95	118.73	0.30	1.37	0.51	0.01
29.01	119.40	0.31	1.36	0.51	0.01	29.08	119.97	0.31	1.35	0.51	0.01
29.14	121.81	0.32	1.32	0.51	0.01	29.20	122.85	0.32	1.31	0.51	0.01
29.27	122.77	0.32	1.31	0.50	0.01	29.37	120.71	0.31	1.33	0.50	0.02
29.43	116.84	0.30	1.37	0.50	0.01	29.50	112.82	0.28	1.42	0.50	0.01
29.56	108.74	0.27	1.47	0.50	0.01	29.62	38.50	2.00	0.00	0.50	0.00
29.69	32.75	2.00	0.00	0.50	0.00	29.75	27.16	2.00	0.00	0.50	0.00
29.81	22.96	2.00	0.00	0.49	0.00	29.87	20.07	2.00	0.00	0.49	0.00
29.93	18.31	2.00	0.00	0.49	0.00	29.99	16.81	2.00	0.00	0.49	0.00
30.08	14.17	2.00	0.00	0.49	0.00	30.15	12.48	2.00	0.00	0.49	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)
30.21	11.86	2.00	0.00	0.49	0.00	30.28	10.63	2.00	0.00	0.49	0.00
30.34	9.92	2.00	0.00	0.49	0.00	30.40	9.74	2.00	0.00	0.48	0.00
30.46	9.64	2.00	0.00	0.48	0.00	30.52	9.55	2.00	0.00	0.48	0.00
30.61	9.27	2.00	0.00	0.48	0.00	30.67	9.00	2.00	0.00	0.48	0.00
30.74	8.99	2.00	0.00	0.48	0.00	30.80	8.99	2.00	0.00	0.48	0.00
30.86	9.24	2.00	0.00	0.48	0.00	30.91	9.76	2.00	0.00	0.48	0.00
30.98	9.92	2.00	0.00	0.47	0.00	31.07	11.55	2.00	0.00	0.47	0.00
31.13	11.70	2.00	0.00	0.47	0.00	31.20	12.04	2.00	0.00	0.47	0.00
31.26	12.28	2.00	0.00	0.47	0.00	31.32	12.79	2.00	0.00	0.47	0.00
31.39	13.98	2.00	0.00	0.47	0.00	31.45	14.91	2.00	0.00	0.47	0.00
31.50	15.24	2.00	0.00	0.47	0.00	31.58	17.10	2.00	0.00	0.46	0.00
31.65	17.26	2.00	0.00	0.46	0.00	31.71	17.49	2.00	0.00	0.46	0.00
31.77	17.90	2.00	0.00	0.46	0.00	31.84	17.97	2.00	0.00	0.46	0.00
31.89	17.69	2.00	0.00	0.46	0.00	31.98	19.37	2.00	0.00	0.46	0.00
32.03	25.11	2.00	0.00	0.46	0.00	32.10	34.03	2.00	0.00	0.46	0.00
32.16	103.90	0.25	1.41	0.45	0.01	32.23	106.57	0.26	1.37	0.45	0.01
32.29	107.53	0.26	1.35	0.45	0.01	32.35	108.15	0.26	1.34	0.45	0.01
32.42	109.21	0.27	1.32	0.45	0.01	32.50	109.42	0.27	1.31	0.45	0.01
32.58	109.64	0.27	1.31	0.45	0.01	32.63	112.04	0.28	1.28	0.45	0.01
32.69	114.61	0.28	1.24	0.45	0.01	32.75	115.54	0.29	1.23	0.44	0.01
32.81	114.84	0.29	1.24	0.44	0.01	32.88	114.29	0.28	1.24	0.44	0.01
32.97	112.44	0.28	1.26	0.44	0.01	33.03	111.23	0.27	1.27	0.44	0.01
33.10	110.62	0.27	1.27	0.44	0.01	33.16	109.63	0.27	1.28	0.44	0.01
33.22	108.74	0.27	1.29	0.44	0.01	33.28	108.06	0.26	1.29	0.44	0.01
33.35	108.09	0.26	1.29	0.43	0.01	33.42	108.57	0.27	1.28	0.43	0.01
33.49	110.41	0.27	1.25	0.43	0.01	33.55	112.16	0.28	1.23	0.43	0.01
33.62	112.82	0.28	1.22	0.43	0.01	33.69	114.03	0.28	1.20	0.43	0.01
33.75	115.90	0.29	1.18	0.43	0.01	33.80	118.14	0.30	1.15	0.43	0.01
33.87	119.75	0.30	1.13	0.43	0.01	33.95	121.79	0.31	1.11	0.42	0.01
34.01	122.49	0.32	1.10	0.42	0.01	34.08	122.76	0.32	1.09	0.42	0.01
34.14	126.97	0.34	1.05	0.42	0.01	34.20	132.46	0.37	1.00	0.42	0.01
34.26	138.37	0.41	0.95	0.42	0.01	34.32	142.83	0.45	0.92	0.42	0.01
34.41	148.59	0.51	0.87	0.42	0.01	34.47	151.49	0.54	0.85	0.42	0.01
34.53	153.41	0.57	0.84	0.41	0.01	34.60	154.81	0.59	0.83	0.41	0.01
34.65	156.32	0.61	0.81	0.41	0.01	34.72	157.34	0.63	0.78	0.41	0.01
34.80	159.21	0.66	0.73	0.41	0.01	34.85	159.85	0.68	0.71	0.41	0.00
34.91	160.77	0.69	0.68	0.41	0.01	35.03	160.33	0.69	0.69	0.41	0.01
35.06	160.47	0.69	0.69	0.41	0.00	35.13	160.86	0.70	0.67	0.40	0.01
35.19	160.97	0.70	0.66	0.40	0.01	35.24	153.75	0.57	0.81	0.40	0.01
35.31	160.74	0.69	0.67	0.40	0.01	35.40	162.38	0.73	0.60	0.40	0.01
35.47	162.62	0.73	0.59	0.40	0.00	35.53	163.57	0.75	0.55	0.40	0.00
35.57	164.00	0.76	0.54	0.40	0.00	35.66	164.72	0.78	0.51	0.40	0.01
35.72	165.75	0.81	0.48	0.39	0.00	35.78	166.71	0.83	0.45	0.39	0.00
35.85	167.09	0.84	0.43	0.39	0.00	35.91	167.42	0.85	0.42	0.39	0.00
35.97	168.26	0.88	0.40	0.39	0.00	36.03	168.47	0.88	0.39	0.39	0.00
36.13	168.55	0.88	0.39	0.39	0.00	36.19	168.71	0.89	0.38	0.39	0.00
36.25	168.19	0.87	0.40	0.39	0.00	36.32	166.74	0.83	0.44	0.38	0.00
36.38	164.05	0.76	0.52	0.38	0.00	36.44	159.10	0.66	0.68	0.38	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)
36.51	152.18	0.55	0.78	0.38	0.01	36.57	142.28	0.44	0.84	0.38	0.01
36.64	130.08	0.35	0.92	0.38	0.01	36.70	50.74	2.00	0.00	0.38	0.00
36.76	40.82	2.00	0.00	0.38	0.00	36.82	34.20	2.00	0.00	0.38	0.00
36.89	30.76	2.00	0.00	0.37	0.00	36.95	28.44	2.00	0.00	0.37	0.00
37.04	31.08	2.00	0.00	0.37	0.00	37.10	41.27	2.00	0.00	0.37	0.00
37.17	118.22	0.30	1.00	0.37	0.01	37.22	124.92	0.33	0.94	0.37	0.01
37.29	130.42	0.36	0.89	0.37	0.01	37.35	134.99	0.39	0.86	0.37	0.01
37.41	143.38	0.45	0.80	0.37	0.01	37.50	156.74	0.62	0.70	0.36	0.01
37.56	163.70	0.76	0.50	0.36	0.00	37.63	173.40	1.04	0.25	0.36	0.00
37.69	180.17	1.36	0.13	0.36	0.00	37.75	189.30	2.00	0.00	0.36	0.00
37.82	200.37	2.00	0.00	0.36	0.00	37.89	208.31	2.00	0.00	0.36	0.00
37.95	218.02	2.00	0.00	0.36	0.00	38.01	226.04	2.00	0.00	0.36	0.00
38.07	227.75	2.00	0.00	0.35	0.00	38.13	234.58	2.00	0.00	0.35	0.00
38.20	236.35	2.00	0.00	0.35	0.00	38.26	240.02	2.00	0.00	0.35	0.00
38.33	245.73	2.00	0.00	0.35	0.00	38.39	250.26	2.00	0.00	0.35	0.00
38.48	253.19	2.00	0.00	0.35	0.00	38.53	253.55	2.00	0.00	0.35	0.00
38.60	254.00	2.00	0.00	0.35	0.00	38.67	254.00	2.00	0.00	0.34	0.00
38.73	249.35	2.00	0.00	0.34	0.00	38.79	241.68	2.00	0.00	0.34	0.00
38.86	240.55	2.00	0.00	0.34	0.00	38.92	238.32	2.00	0.00	0.34	0.00
38.98	234.47	2.00	0.00	0.34	0.00	39.05	220.61	2.00	0.00	0.34	0.00
39.12	216.57	2.00	0.00	0.34	0.00	39.19	206.31	2.00	0.00	0.34	0.00
39.26	192.80	2.00	0.00	0.33	0.00	39.32	177.31	1.21	0.17	0.33	0.00
39.39	160.08	0.68	0.57	0.33	0.00	39.45	143.50	0.45	0.72	0.33	0.01
39.51	129.65	0.35	0.81	0.33	0.01	39.57	53.51	2.00	0.00	0.33	0.00
39.64	48.35	2.00	0.00	0.33	0.00	39.73	43.59	2.00	0.00	0.33	0.00
39.78	41.47	2.00	0.00	0.33	0.00	39.85	38.82	2.00	0.00	0.32	0.00
39.91	34.43	2.00	0.00	0.32	0.00	39.97	29.28	2.00	0.00	0.32	0.00
40.03	24.93	2.00	0.00	0.32	0.00	40.10	21.65	2.00	0.00	0.32	0.00
40.17	20.35	2.00	0.00	0.32	0.00	40.25	18.36	2.00	0.00	0.32	0.00
40.31	16.69	2.00	0.00	0.32	0.00	40.38	16.61	2.00	0.00	0.32	0.00
40.43	17.35	2.00	0.00	0.31	0.00	40.49	19.89	2.00	0.00	0.31	0.00
40.55	30.36	2.00	0.00	0.31	0.00	40.62	116.35	0.29	0.85	0.31	0.01
40.71	151.00	0.54	0.64	0.31	0.01	40.77	159.16	0.66	0.55	0.31	0.00
40.83	165.22	0.79	0.39	0.31	0.00	40.89	172.76	1.02	0.23	0.31	0.00
40.95	179.06	1.29	0.13	0.31	0.00	41.02	182.51	1.49	0.08	0.30	0.00
41.08	179.61	1.32	0.12	0.30	0.00	41.14	171.98	0.99	0.24	0.30	0.00
41.21	162.16	0.72	0.46	0.30	0.00	41.29	142.44	0.45	0.66	0.30	0.01
41.35	129.22	0.35	0.73	0.30	0.01	41.41	51.99	2.00	0.00	0.30	0.00
41.48	128.54	0.35	0.73	0.30	0.01	41.54	49.76	2.00	0.00	0.30	0.00
41.61	128.25	0.35	0.73	0.29	0.01	41.67	152.92	0.56	0.60	0.29	0.00
41.74	177.67	1.22	0.14	0.29	0.00	41.83	200.13	2.00	0.00	0.29	0.00
41.88	208.79	2.00	0.00	0.29	0.00	41.94	213.92	2.00	0.00	0.29	0.00
42.01	217.01	2.00	0.00	0.29	0.00	42.07	218.98	2.00	0.00	0.29	0.00
42.14	222.66	2.00	0.00	0.29	0.00	42.20	224.39	2.00	0.00	0.28	0.00
42.26	225.81	2.00	0.00	0.28	0.00	42.35	227.98	2.00	0.00	0.28	0.00
42.42	229.25	2.00	0.00	0.28	0.00	42.47	230.30	2.00	0.00	0.28	0.00
42.53	231.44	2.00	0.00	0.28	0.00	42.59	232.33	2.00	0.00	0.28	0.00
42.66	233.18	2.00	0.00	0.28	0.00	42.72	233.59	2.00	0.00	0.28	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)
42.82	233.11	2.00	0.00	0.27	0.00	42.88	231.84	2.00	0.00	0.27	0.00
42.94	230.03	2.00	0.00	0.27	0.00	42.99	228.57	2.00	0.00	0.27	0.00
43.05	227.28	2.00	0.00	0.27	0.00	43.12	226.41	2.00	0.00	0.27	0.00
43.18	225.47	2.00	0.00	0.27	0.00	43.24	224.72	2.00	0.00	0.27	0.00
43.33	223.13	2.00	0.00	0.27	0.00	43.39	221.90	2.00	0.00	0.26	0.00
43.45	220.54	2.00	0.00	0.26	0.00	43.51	218.55	2.00	0.00	0.26	0.00
43.57	216.28	2.00	0.00	0.26	0.00	43.64	214.59	2.00	0.00	0.26	0.00
43.73	209.55	2.00	0.00	0.26	0.00	43.77	207.96	2.00	0.00	0.26	0.00
43.84	207.43	2.00	0.00	0.26	0.00	43.90	207.40	2.00	0.00	0.26	0.00
43.97	207.34	2.00	0.00	0.25	0.00	44.03	207.35	2.00	0.00	0.25	0.00
44.11	206.50	2.00	0.00	0.25	0.00	44.17	206.37	2.00	0.00	0.25	0.00
44.24	206.37	2.00	0.00	0.25	0.00	44.30	205.44	2.00	0.00	0.25	0.00
44.38	202.80	2.00	0.00	0.25	0.00	44.45	199.10	2.00	0.00	0.25	0.00
44.50	194.82	2.00	0.00	0.25	0.00	44.57	189.72	2.00	0.00	0.24	0.00
44.63	183.83	1.58	0.05	0.24	0.00	44.69	178.59	1.27	0.11	0.24	0.00
44.76	173.83	1.06	0.16	0.24	0.00	44.84	170.07	0.93	0.22	0.24	0.00
44.90	171.52	0.98	0.19	0.24	0.00	44.96	172.45	1.01	0.18	0.24	0.00
45.02	169.73	0.92	0.22	0.24	0.00	45.08	153.25	0.57	0.48	0.24	0.00
45.16	145.41	0.48	0.50	0.23	0.00	45.22	132.51	0.37	0.56	0.23	0.00
45.28	122.30	0.32	0.60	0.23	0.00	45.35	50.18	2.00	0.00	0.23	0.00
45.41	49.83	2.00	0.00	0.23	0.00	45.48	117.33	0.30	0.62	0.23	0.00
45.57	115.48	0.29	0.63	0.23	0.01	45.62	44.37	2.00	0.00	0.23	0.00
45.68	37.23	2.00	0.00	0.23	0.00	45.74	34.04	2.00	0.00	0.22	0.00
45.81	38.33	2.00	0.00	0.22	0.00	45.87	113.66	0.29	0.63	0.22	0.00
45.95	134.42	0.39	0.52	0.22	0.01	46.00	143.57	0.46	0.48	0.22	0.00
46.07	150.34	0.53	0.45	0.22	0.00	46.13	157.18	0.63	0.41	0.22	0.00
46.23	165.16	0.79	0.27	0.22	0.00	46.28	169.87	0.92	0.20	0.22	0.00
46.34	175.11	1.11	0.13	0.21	0.00	46.40	179.63	1.32	0.08	0.21	0.00
46.46	179.70	1.33	0.08	0.21	0.00	46.52	173.73	1.06	0.14	0.21	0.00
46.62	175.83	1.14	0.12	0.21	0.00	46.68	177.76	1.23	0.10	0.21	0.00
46.73	179.20	1.30	0.08	0.21	0.00	46.80	179.17	1.30	0.08	0.21	0.00
46.86	171.69	0.98	0.16	0.21	0.00	46.92	179.62	1.32	0.08	0.20	0.00
47.01	177.93	1.24	0.10	0.20	0.00	47.07	180.17	1.35	0.07	0.20	0.00
47.12	183.58	1.56	0.04	0.20	0.00	47.19	187.81	1.88	0.01	0.20	0.00
47.25	192.66	2.00	0.00	0.20	0.00	47.31	197.33	2.00	0.00	0.20	0.00
47.40	203.15	2.00	0.00	0.20	0.00	47.46	206.25	2.00	0.00	0.20	0.00
47.52	208.72	2.00	0.00	0.19	0.00	47.58	210.56	2.00	0.00	0.19	0.00
47.67	211.40	2.00	0.00	0.19	0.00	47.73	203.17	2.00	0.00	0.19	0.00
47.79	194.25	2.00	0.00	0.19	0.00	47.84	190.69	2.00	0.00	0.19	0.00
47.91	184.63	1.63	0.03	0.19	0.00	47.97	177.39	1.21	0.09	0.19	0.00
48.05	178.33	1.26	0.08	0.19	0.00	48.10	188.15	1.91	0.01	0.18	0.00
48.19	199.75	2.00	0.00	0.18	0.00	48.25	204.24	2.00	0.00	0.18	0.00
48.32	206.79	2.00	0.00	0.18	0.00	48.38	210.50	2.00	0.00	0.18	0.00
48.44	216.30	2.00	0.00	0.18	0.00	48.50	222.61	2.00	0.00	0.18	0.00
48.59	232.38	2.00	0.00	0.18	0.00	48.65	237.90	2.00	0.00	0.18	0.00
48.71	243.19	2.00	0.00	0.17	0.00	48.77	246.47	2.00	0.00	0.17	0.00
48.83	249.09	2.00	0.00	0.17	0.00	48.89	251.00	2.00	0.00	0.17	0.00
48.99	252.71	2.00	0.00	0.17	0.00	49.04	252.82	2.00	0.00	0.17	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)
49.10	250.65	2.00	0.00	0.17	0.00	49.17	247.20	2.00	0.00	0.17	0.00
49.23	247.26	2.00	0.00	0.17	0.00	49.28	254.00	2.00	0.00	0.16	0.00
49.37	254.00	2.00	0.00	0.16	0.00	49.43	254.00	2.00	0.00	0.16	0.00
49.50	254.00	2.00	0.00	0.16	0.00	49.56	254.00	2.00	0.00	0.16	0.00
49.61	254.00	2.00	0.00	0.16	0.00	49.69	254.00	2.00	0.00	0.16	0.00
49.76	254.00	2.00	0.00	0.16	0.00	49.82	254.00	2.00	0.00	0.16	0.00
49.88	254.00	2.00	0.00	0.15	0.00	49.94	254.00	2.00	0.00	0.15	0.00
50.02	254.00	2.00	0.00	0.15	0.00	50.08	254.00	2.00	0.00	0.15	0.00
50.14	245.36	2.00	0.00	0.15	0.00	50.22	254.00	2.00	0.00	0.15	0.00
50.28	254.00	2.00	0.00	0.15	0.00	50.36	253.95	2.00	0.00	0.15	0.00
50.41	252.04	2.00	0.00	0.15	0.00	50.48	247.01	2.00	0.00	0.14	0.00
50.53	247.00	2.00	0.00	0.14	0.00	50.62	239.49	2.00	0.00	0.14	0.00
50.68	234.81	2.00	0.00	0.14	0.00	50.76	228.41	2.00	0.00	0.14	0.00
50.79	226.90	2.00	0.00	0.14	0.00	50.87	219.56	2.00	0.00	0.14	0.00
50.94	214.38	2.00	0.00	0.14	0.00	50.99	206.80	2.00	0.00	0.14	0.00
51.05	198.43	2.00	0.00	0.13	0.00	51.12	189.81	2.00	0.00	0.13	0.00
51.21	184.97	2.00	0.00	0.13	0.00	51.26	187.81	2.00	0.00	0.13	0.00
51.33	189.69	2.00	0.00	0.13	0.00	51.39	186.08	2.00	0.00	0.13	0.00
51.45	173.94	2.00	0.00	0.13	0.00	51.51	155.45	2.00	0.00	0.13	0.00
51.58	135.14	2.00	0.00	0.13	0.00	51.69	38.35	2.00	0.00	0.12	0.00
51.72	34.03	2.00	0.00	0.12	0.00	51.78	28.12	2.00	0.00	0.12	0.00
51.84	22.41	2.00	0.00	0.12	0.00	51.91	19.03	2.00	0.00	0.12	0.00
51.98	21.98	2.00	0.00	0.12	0.00	52.05	19.26	2.00	0.00	0.12	0.00
52.11	21.56	2.00	0.00	0.12	0.00	52.17	24.57	2.00	0.00	0.12	0.00
52.24	105.89	2.00	0.00	0.11	0.00	52.30	118.69	2.00	0.00	0.11	0.00
52.37	123.86	2.00	0.00	0.11	0.00	52.45	121.96	2.00	0.00	0.11	0.00
52.51	50.65	2.00	0.00	0.11	0.00	52.57	44.17	2.00	0.00	0.11	0.00
52.64	114.76	2.00	0.00	0.11	0.00	52.72	42.87	2.00	0.00	0.11	0.00
52.78	113.68	2.00	0.00	0.11	0.00	52.84	126.00	2.00	0.00	0.10	0.00
52.90	140.83	2.00	0.00	0.10	0.00	52.96	152.18	2.00	0.00	0.10	0.00
53.02	161.08	2.00	0.00	0.10	0.00	53.11	170.83	2.00	0.00	0.10	0.00
53.17	175.38	2.00	0.00	0.10	0.00	53.23	177.87	2.00	0.00	0.10	0.00
53.32	179.54	2.00	0.00	0.10	0.00	53.35	179.94	2.00	0.00	0.10	0.00
53.47	184.50	2.00	0.00	0.09	0.00	53.49	186.26	2.00	0.00	0.09	0.00
53.55	189.70	2.00	0.00	0.09	0.00	53.61	192.61	2.00	0.00	0.09	0.00
53.68	194.19	2.00	0.00	0.09	0.00	53.75	195.75	2.00	0.00	0.09	0.00
53.82	195.26	2.00	0.00	0.09	0.00	53.88	193.88	2.00	0.00	0.09	0.00
53.94	190.62	2.00	0.00	0.09	0.00	54.02	183.54	2.00	0.00	0.08	0.00
54.08	180.41	2.00	0.00	0.08	0.00	54.14	178.39	2.00	0.00	0.08	0.00
54.20	178.22	2.00	0.00	0.08	0.00	54.27	179.99	2.00	0.00	0.08	0.00
54.35	184.53	2.00	0.00	0.08	0.00	54.40	186.10	2.00	0.00	0.08	0.00
54.47	186.67	2.00	0.00	0.08	0.00	54.56	184.39	2.00	0.00	0.08	0.00
54.60	183.82	2.00	0.00	0.07	0.00	54.68	183.67	2.00	0.00	0.07	0.00
54.73	187.84	2.00	0.00	0.07	0.00	54.80	193.65	2.00	0.00	0.07	0.00
54.89	200.03	2.00	0.00	0.07	0.00	54.92	201.54	2.00	0.00	0.07	0.00
55.01	206.08	2.00	0.00	0.07	0.00	55.07	206.47	2.00	0.00	0.07	0.00
55.12	204.11	2.00	0.00	0.07	0.00	55.22	196.03	2.00	0.00	0.06	0.00
55.25	192.71	2.00	0.00	0.06	0.00	55.34	182.97	2.00	0.00	0.06	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)
55.39	176.08	2.00	0.00	0.06	0.00	55.46	168.96	2.00	0.00	0.06	0.00
55.54	161.26	2.00	0.00	0.06	0.00	55.59	157.77	2.00	0.00	0.06	0.00
55.65	153.83	2.00	0.00	0.06	0.00	55.74	145.09	2.00	0.00	0.06	0.00
55.80	135.88	2.00	0.00	0.05	0.00	55.86	124.05	2.00	0.00	0.05	0.00
55.91	45.54	2.00	0.00	0.05	0.00	55.97	36.12	2.00	0.00	0.05	0.00
56.07	27.00	2.00	0.00	0.05	0.00	56.13	23.05	2.00	0.00	0.05	0.00
56.17	22.27	2.00	0.00	0.05	0.00	56.25	19.65	2.00	0.00	0.05	0.00
56.31	17.81	2.00	0.00	0.05	0.00	56.39	15.59	2.00	0.00	0.04	0.00
56.45	14.90	2.00	0.00	0.04	0.00	56.52	14.02	2.00	0.00	0.04	0.00
56.58	13.51	2.00	0.00	0.04	0.00	56.66	13.19	2.00	0.00	0.04	0.00
56.72	13.01	2.00	0.00	0.04	0.00	56.79	12.69	2.00	0.00	0.04	0.00
56.84	12.43	2.00	0.00	0.04	0.00	56.89	12.49	2.00	0.00	0.04	0.00
56.99	12.42	2.00	0.00	0.03	0.00	57.05	12.17	2.00	0.00	0.03	0.00
57.10	12.16	2.00	0.00	0.03	0.00	57.15	12.16	2.00	0.00	0.03	0.00
57.22	11.97	2.00	0.00	0.03	0.00	57.32	12.33	2.00	0.00	0.03	0.00
57.38	12.01	2.00	0.00	0.03	0.00	57.43	12.01	2.00	0.00	0.03	0.00
57.48	12.00	2.00	0.00	0.03	0.00	57.55	12.24	2.00	0.00	0.02	0.00
57.64	12.96	2.00	0.00	0.02	0.00	57.70	15.35	2.00	0.00	0.02	0.00
57.76	23.50	2.00	0.00	0.02	0.00	57.81	35.81	2.00	0.00	0.02	0.00
57.90	118.86	2.00	0.00	0.02	0.00	57.97	130.66	2.00	0.00	0.02	0.00
58.02	141.25	2.00	0.00	0.02	0.00	58.08	149.32	2.00	0.00	0.02	0.00
58.17	156.15	2.00	0.00	0.01	0.00	58.23	158.27	2.00	0.00	0.01	0.00
58.29	159.45	2.00	0.00	0.01	0.00	58.35	160.12	2.00	0.00	0.01	0.00
58.43	161.08	2.00	0.00	0.01	0.00	58.49	161.56	2.00	0.00	0.01	0.00
58.55	164.29	2.00	0.00	0.01	0.00	58.61	169.00	2.00	0.00	0.01	0.00
58.66	171.72	2.00	0.00	0.01	0.00	58.75	161.64	2.00	0.00	0.00	0.00
58.82	153.57	2.00	0.00	0.00	0.00	58.88	148.17	2.00	0.00	0.00	0.00
58.93	151.12	2.00	0.00	0.00	0.00	59.02	149.79	2.00	0.00	0.00	0.00
59.08	160.18	2.00	0.00	0.00	0.00	59.13	163.15	2.00	0.00	0.00	0.00
59.19	164.72	2.00	0.00	0.00	0.00	59.28	164.75	2.00	0.00	0.00	0.00
59.34	165.19	2.00	0.00	0.00	0.00	59.41	167.10	2.00	0.00	0.00	0.00
59.46	168.03	2.00	0.00	0.00	0.00	59.54	167.09	2.00	0.00	0.00	0.00
59.59	163.02	2.00	0.00	0.00	0.00	59.65	167.25	2.00	0.00	0.00	0.00
59.73	166.05	2.00	0.00	0.00	0.00	59.79	166.14	2.00	0.00	0.00	0.00
59.86	166.70	2.00	0.00	0.00	0.00	59.91	167.50	2.00	0.00	0.00	0.00
60.00	168.95	2.00	0.00	0.00	0.00	60.06	170.16	2.00	0.00	0.00	0.00
60.13	172.40	2.00	0.00	0.00	0.00	60.17	175.98	2.00	0.00	0.00	0.00
60.26	181.49	2.00	0.00	0.00	0.00	60.31	175.78	2.00	0.00	0.00	0.00
60.37	188.13	2.00	0.00	0.00	0.00	60.46	195.61	2.00	0.00	0.00	0.00
60.52	199.94	2.00	0.00	0.00	0.00	60.58	204.04	2.00	0.00	0.00	0.00
60.64	207.57	2.00	0.00	0.00	0.00	60.70	210.53	2.00	0.00	0.00	0.00
60.78	213.49	2.00	0.00	0.00	0.00	60.85	214.90	2.00	0.00	0.00	0.00
60.91	216.41	2.00	0.00	0.00	0.00	60.98	217.93	2.00	0.00	0.00	0.00
61.03	219.24	2.00	0.00	0.00	0.00	61.11	222.13	2.00	0.00	0.00	0.00
61.17	223.75	2.00	0.00	0.00	0.00	61.24	225.00	2.00	0.00	0.00	0.00
61.32	224.88	2.00	0.00	0.00	0.00	61.36	224.50	2.00	0.00	0.00	0.00
61.44	222.91	2.00	0.00	0.00	0.00	61.50	221.56	2.00	0.00	0.00	0.00
61.56	220.49	2.00	0.00	0.00	0.00	61.62	219.92	2.00	0.00	0.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)
61.71	219.08	2.00	0.00	0.00	0.00	61.77	214.78	2.00	0.00	0.00	0.00
61.83	213.05	2.00	0.00	0.00	0.00	61.88	213.88	2.00	0.00	0.00	0.00
61.97	211.83	2.00	0.00	0.00	0.00	62.03	209.92	2.00	0.00	0.00	0.00
62.09	207.27	2.00	0.00	0.00	0.00	62.14	181.60	2.00	0.00	0.00	0.00
62.22	199.67	2.00	0.00	0.00	0.00	62.29	196.45	2.00	0.00	0.00	0.00
62.34	193.67	2.00	0.00	0.00	0.00	62.41	191.68	2.00	0.00	0.00	0.00
62.49	188.49	2.00	0.00	0.00	0.00	62.55	185.50	2.00	0.00	0.00	0.00
62.62	181.63	2.00	0.00	0.00	0.00	62.67	175.79	2.00	0.00	0.00	0.00
62.74	166.49	2.00	0.00	0.00	0.00	62.82	149.70	2.00	0.00	0.00	0.00
62.88	140.81	2.00	0.00	0.00	0.00	62.94	147.32	2.00	0.00	0.00	0.00
63.03	138.56	2.00	0.00	0.00	0.00	63.08	143.56	2.00	0.00	0.00	0.00
63.14	146.43	2.00	0.00	0.00	0.00	63.21	147.40	2.00	0.00	0.00	0.00
63.28	144.10	2.00	0.00	0.00	0.00	63.33	141.18	2.00	0.00	0.00	0.00
63.39	134.92	2.00	0.00	0.00	0.00	63.46	125.07	2.00	0.00	0.00	0.00
63.52	49.56	2.00	0.00	0.00	0.00	63.61	44.50	2.00	0.00	0.00	0.00
63.67	43.25	2.00	0.00	0.00	0.00	63.73	41.69	2.00	0.00	0.00	0.00
63.79	41.58	2.00	0.00	0.00	0.00	63.85	41.54	2.00	0.00	0.00	0.00
63.93	41.49	2.00	0.00	0.00	0.00	63.99	41.83	2.00	0.00	0.00	0.00
64.05	41.52	2.00	0.00	0.00	0.00	64.11	103.53	2.00	0.00	0.00	0.00
64.20	101.40	2.00	0.00	0.00	0.00	64.26	100.82	2.00	0.00	0.00	0.00
64.31	100.68	2.00	0.00	0.00	0.00	64.38	38.39	2.00	0.00	0.00	0.00
64.44	37.46	2.00	0.00	0.00	0.00	64.52	37.13	2.00	0.00	0.00	0.00
64.58	38.92	2.00	0.00	0.00	0.00	64.64	42.30	2.00	0.00	0.00	0.00
64.70	111.56	2.00	0.00	0.00	0.00	64.78	119.68	2.00	0.00	0.00	0.00
64.84	123.77	2.00	0.00	0.00	0.00	64.90	127.04	2.00	0.00	0.00	0.00
64.98	64.18	2.00	0.00	0.00	0.00	65.04	65.53	2.00	0.00	0.00	0.00
65.10	66.06	2.00	0.00	0.00	0.00	65.16	66.46	2.00	0.00	0.00	0.00
65.23	65.83	2.00	0.00	0.00	0.00	65.30	59.81	2.00	0.00	0.00	0.00

Total estimated settlement: 2.90

Abbreviations

$Q_{tn,cs}$:	Equivalent clean sand normalized cone resistance
FS:	Factor of safety against liquefaction
e_v (%):	Post-liquefaction volumentric strain
DF:	e_v depth weighting factor
Settlement:	Calculated settlement

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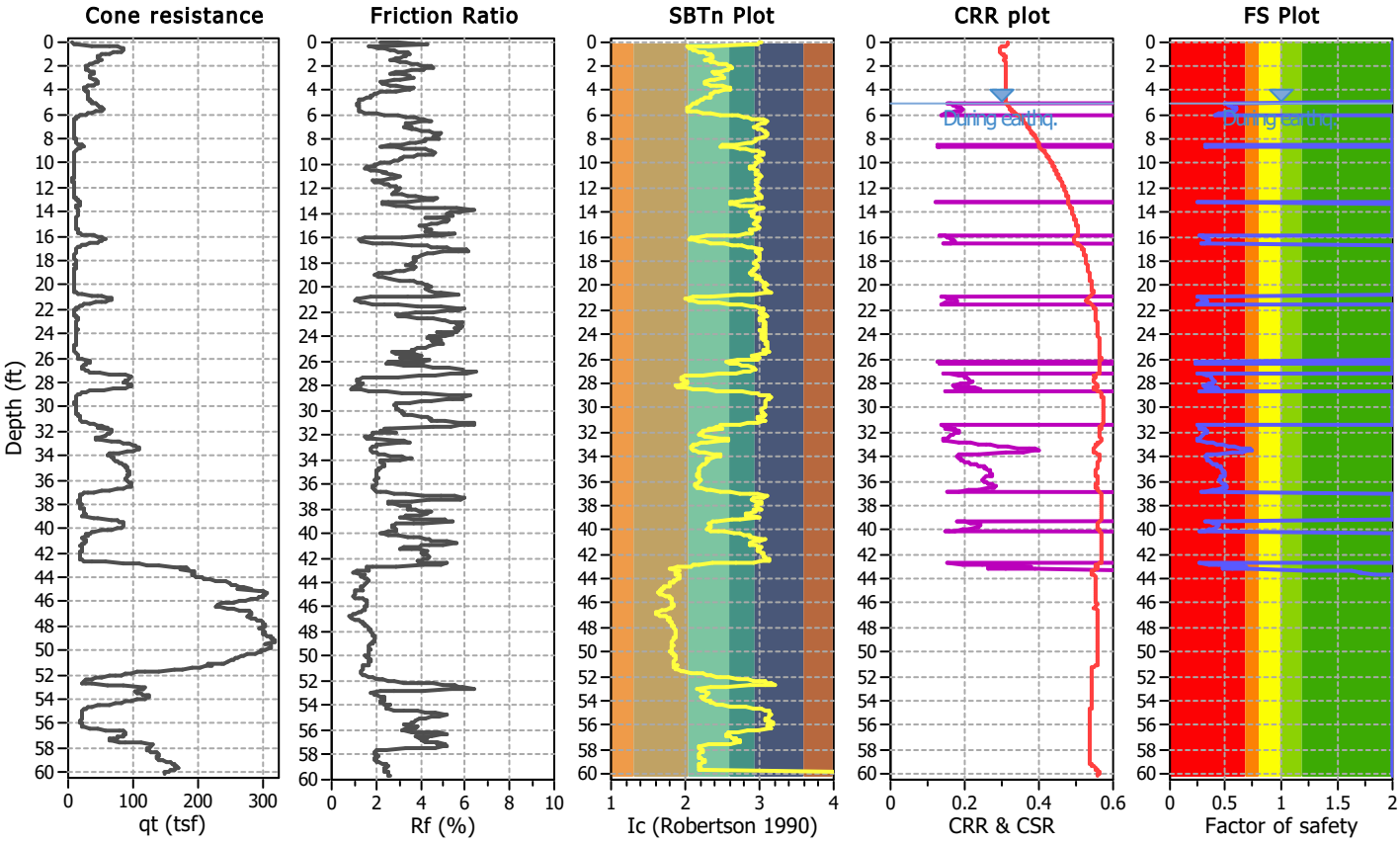
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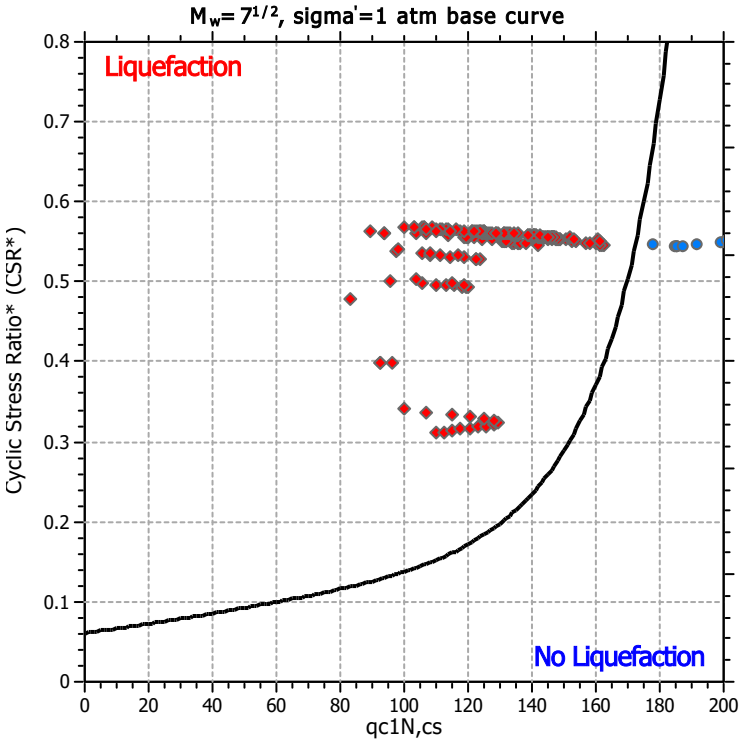
Project title : Proposed Commercial/Industrial Development **Location : Cypress, CA**

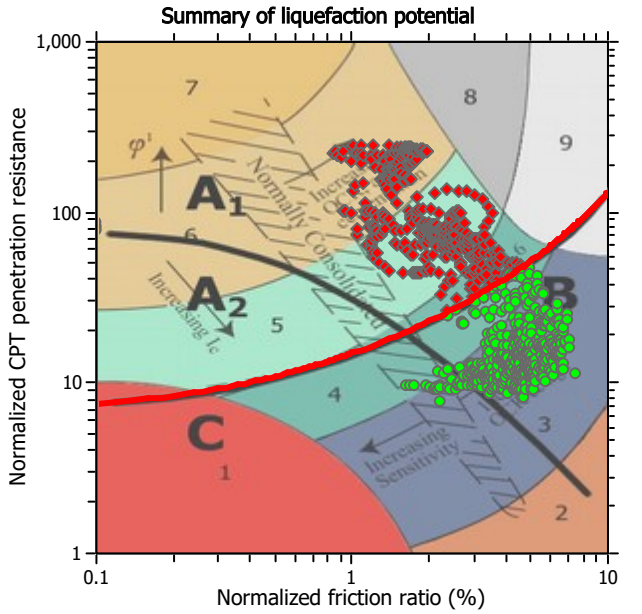
CPT file : CPT-4

Input parameters and analysis data

Analysis method:	**B&I (2014)**	**G.W.T. (in-situ):**	**5.00 ft**	**Use fill:**	**No**	**Clay like behavior applied:**	**Sands only**
Fines correction method:	**B&I (2014)**	**G.W.T. (earthq.):**	**5.00 ft**	**Fill height:**	**N/A**	**Limit depth applie**	**Yes**
Points to test:	**Based on Ic value**	**Average results interva**	**1**	**Fill weight:**	**N/A**	**Limit depth:**	**50.00 ft**
Earthquake magnitude M_w:	**7.30**	**Ic cut-off value:**	**2.60**	**Trans. detect. applied:**	**No**	**MSF method:**	**Method base**
Peak ground acceleration:	**0.54**	**Unit weight calculation**	**Based on SBT**	**K_σ applied:**	**Yes**		

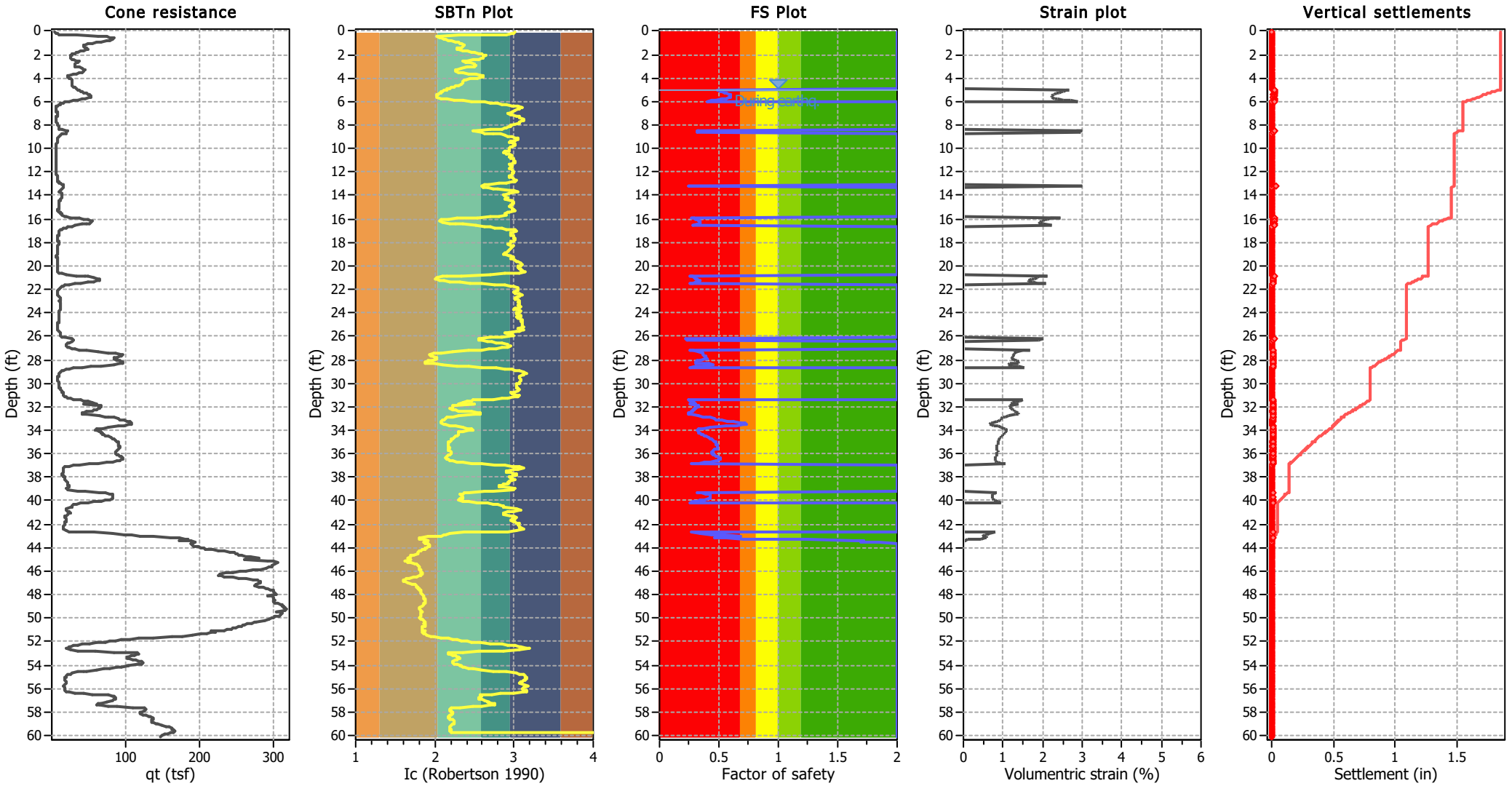






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

:: Post-earthquake settlement due to soil liquefaction ::

Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)
5.01	109.93	0.49	2.67	0.92	0.02	5.07	112.74	0.50	2.59	0.91	0.02
5.14	115.18	0.51	2.53	0.91	0.02	5.20	117.72	0.53	2.47	0.91	0.02
5.26	120.52	0.54	2.41	0.91	0.02	5.33	123.31	0.56	2.35	0.91	0.02
5.39	125.79	0.58	2.29	0.91	0.02	5.46	127.82	0.59	2.25	0.91	0.02
5.52	129.01	0.60	2.23	0.91	0.02	5.59	129.09	0.60	2.22	0.91	0.02
5.65	127.91	0.59	2.24	0.90	0.02	5.72	124.95	0.56	2.30	0.90	0.02
5.79	120.75	0.52	2.38	0.90	0.02	5.85	114.69	0.48	2.51	0.90	0.02
5.92	107.10	0.44	2.69	0.90	0.02	5.98	99.83	0.40	2.89	0.90	0.02
6.06	30.51	2.00	0.00	0.90	0.00	6.10	26.64	2.00	0.00	0.90	0.00
6.18	21.67	2.00	0.00	0.90	0.00	6.24	19.33	2.00	0.00	0.89	0.00
6.31	16.84	2.00	0.00	0.89	0.00	6.37	14.49	2.00	0.00	0.89	0.00
6.44	12.42	2.00	0.00	0.89	0.00	6.50	10.91	2.00	0.00	0.89	0.00
6.57	10.49	2.00	0.00	0.89	0.00	6.63	10.35	2.00	0.00	0.89	0.00
6.70	10.64	2.00	0.00	0.89	0.00	6.76	11.33	2.00	0.00	0.89	0.00
6.83	12.29	2.00	0.00	0.88	0.00	6.90	13.25	2.00	0.00	0.88	0.00
6.97	14.36	2.00	0.00	0.88	0.00	7.03	14.36	2.00	0.00	0.88	0.00
7.09	14.07	2.00	0.00	0.88	0.00	7.18	13.38	2.00	0.00	0.88	0.00
7.22	12.71	2.00	0.00	0.88	0.00	7.31	12.15	2.00	0.00	0.88	0.00
7.35	12.08	2.00	0.00	0.88	0.00	7.43	12.02	2.00	0.00	0.87	0.00
7.49	11.33	2.00	0.00	0.87	0.00	7.55	11.33	2.00	0.00	0.87	0.00
7.63	11.33	2.00	0.00	0.87	0.00	7.68	11.46	2.00	0.00	0.87	0.00
7.76	12.29	2.00	0.00	0.87	0.00	7.81	12.71	2.00	0.00	0.87	0.00
7.90	13.25	2.00	0.00	0.87	0.00	7.95	14.91	2.00	0.00	0.87	0.00
8.03	15.46	2.00	0.00	0.86	0.00	8.09	16.02	2.00	0.00	0.86	0.00
8.15	16.56	2.00	0.00	0.86	0.00	8.23	17.13	2.00	0.00	0.86	0.00
8.28	17.13	2.00	0.00	0.86	0.00	8.36	17.67	2.00	0.00	0.86	0.00
8.42	22.64	2.00	0.00	0.86	0.00	8.49	92.28	0.32	2.98	0.86	0.03
8.55	96.38	0.33	2.85	0.86	0.02	8.60	92.47	0.32	2.97	0.85	0.02
8.69	31.40	2.00	0.00	0.85	0.00	8.75	26.51	2.00	0.00	0.85	0.00
8.80	22.78	2.00	0.00	0.85	0.00	8.88	19.87	2.00	0.00	0.85	0.00
8.94	18.09	2.00	0.00	0.85	0.00	9.00	16.02	2.00	0.00	0.85	0.00
9.07	14.36	2.00	0.00	0.85	0.00	9.14	13.25	2.00	0.00	0.85	0.00
9.22	12.71	2.00	0.00	0.84	0.00	9.27	12.71	2.00	0.00	0.84	0.00
9.32	12.71	2.00	0.00	0.84	0.00	9.41	13.11	2.00	0.00	0.84	0.00
9.47	13.25	2.00	0.00	0.84	0.00	9.53	12.71	2.00	0.00	0.84	0.00
9.60	11.60	2.00	0.00	0.84	0.00	9.66	11.18	2.00	0.00	0.84	0.00
9.74	10.49	2.00	0.00	0.83	0.00	9.79	10.49	2.00	0.00	0.83	0.00
9.85	10.49	2.00	0.00	0.83	0.00	9.91	10.35	2.00	0.00	0.83	0.00
9.99	10.35	2.00	0.00	0.83	0.00	10.05	10.35	2.00	0.00	0.83	0.00
10.12	10.22	2.00	0.00	0.83	0.00	10.18	10.22	2.00	0.00	0.83	0.00
10.25	10.49	2.00	0.00	0.83	0.00	10.31	10.64	2.00	0.00	0.83	0.00
10.37	10.64	2.00	0.00	0.82	0.00	10.44	10.64	2.00	0.00	0.82	0.00
10.51	10.64	2.00	0.00	0.82	0.00	10.58	10.64	2.00	0.00	0.82	0.00
10.64	10.62	2.00	0.00	0.82	0.00	10.71	11.39	2.00	0.00	0.82	0.00
10.77	11.77	2.00	0.00	0.82	0.00	10.83	12.01	2.00	0.00	0.82	0.00
10.90	11.86	2.00	0.00	0.82	0.00	10.96	11.71	2.00	0.00	0.81	0.00
11.03	11.17	2.00	0.00	0.81	0.00	11.11	11.01	2.00	0.00	0.81	0.00
11.18	10.47	2.00	0.00	0.81	0.00	11.25	9.92	2.00	0.00	0.81	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)
11.31	9.90	2.00	0.00	0.81	0.00	11.37	9.89	2.00	0.00	0.81	0.00
11.43	9.88	2.00	0.00	0.81	0.00	11.50	9.86	2.00	0.00	0.81	0.00
11.56	10.50	2.00	0.00	0.80	0.00	11.64	11.26	2.00	0.00	0.80	0.00
11.70	11.63	2.00	0.00	0.80	0.00	11.75	11.74	2.00	0.00	0.80	0.00
11.83	11.71	2.00	0.00	0.80	0.00	11.89	11.69	2.00	0.00	0.80	0.00
11.96	11.55	2.00	0.00	0.80	0.00	12.02	11.53	2.00	0.00	0.80	0.00
12.08	11.77	2.00	0.00	0.80	0.00	12.16	11.75	2.00	0.00	0.79	0.00
12.22	11.73	2.00	0.00	0.79	0.00	12.29	11.96	2.00	0.00	0.79	0.00
12.35	12.08	2.00	0.00	0.79	0.00	12.41	12.18	2.00	0.00	0.79	0.00
12.49	12.15	2.00	0.00	0.79	0.00	12.54	12.38	2.00	0.00	0.79	0.00
12.62	12.73	2.00	0.00	0.79	0.00	12.68	13.09	2.00	0.00	0.79	0.00
12.76	13.68	2.00	0.00	0.78	0.00	12.81	14.39	2.00	0.00	0.78	0.00
12.87	15.49	2.00	0.00	0.78	0.00	12.94	16.93	2.00	0.00	0.78	0.00
13.00	18.98	2.00	0.00	0.78	0.00	13.08	21.62	2.00	0.00	0.78	0.00
13.13	23.27	2.00	0.00	0.78	0.00	13.22	82.97	0.25	3.00	0.78	0.03
13.26	25.18	2.00	0.00	0.78	0.00	13.32	24.53	2.00	0.00	0.77	0.00
13.41	22.35	2.00	0.00	0.77	0.00	13.46	20.53	2.00	0.00	0.77	0.00
13.55	17.71	2.00	0.00	0.77	0.00	13.60	17.21	2.00	0.00	0.77	0.00
13.65	16.10	2.00	0.00	0.77	0.00	13.72	16.67	2.00	0.00	0.77	0.00
13.81	19.47	2.00	0.00	0.77	0.00	13.86	19.79	2.00	0.00	0.77	0.00
13.94	21.28	2.00	0.00	0.76	0.00	14.00	21.60	2.00	0.00	0.76	0.00
14.07	21.20	2.00	0.00	0.76	0.00	14.13	20.58	2.00	0.00	0.76	0.00
14.19	19.97	2.00	0.00	0.76	0.00	14.27	18.31	2.00	0.00	0.76	0.00
14.33	17.93	2.00	0.00	0.76	0.00	14.40	16.95	2.00	0.00	0.76	0.00
14.46	16.33	2.00	0.00	0.75	0.00	14.51	15.73	2.00	0.00	0.75	0.00
14.59	15.46	2.00	0.00	0.75	0.00	14.65	15.62	2.00	0.00	0.75	0.00
14.72	15.53	2.00	0.00	0.75	0.00	14.78	15.39	2.00	0.00	0.75	0.00
14.83	15.37	2.00	0.00	0.75	0.00	14.91	14.65	2.00	0.00	0.75	0.00
14.97	14.98	2.00	0.00	0.75	0.00	15.05	14.01	2.00	0.00	0.74	0.00
15.11	13.99	2.00	0.00	0.74	0.00	15.16	13.97	2.00	0.00	0.74	0.00
15.24	13.25	2.00	0.00	0.74	0.00	15.30	13.46	2.00	0.00	0.74	0.00
15.38	15.06	2.00	0.00	0.74	0.00	15.43	16.19	2.00	0.00	0.74	0.00
15.49	17.65	2.00	0.00	0.74	0.00	15.57	18.97	2.00	0.00	0.74	0.00
15.63	19.40	2.00	0.00	0.74	0.00	15.68	20.37	2.00	0.00	0.73	0.00
15.76	24.03	2.00	0.00	0.73	0.00	15.82	28.40	2.00	0.00	0.73	0.00
15.88	95.49	0.26	2.46	0.73	0.02	15.95	105.86	0.29	2.21	0.73	0.02
16.01	109.90	0.31	2.12	0.73	0.01	16.09	112.88	0.32	2.06	0.73	0.02
16.17	115.79	0.33	2.00	0.73	0.02	16.23	117.97	0.34	1.96	0.72	0.01
16.27	119.50	0.34	1.93	0.72	0.01	16.37	120.15	0.35	1.92	0.72	0.02
16.43	118.69	0.34	1.94	0.72	0.01	16.47	115.05	0.32	2.00	0.72	0.01
16.56	103.79	0.28	2.22	0.72	0.02	16.62	35.40	2.00	0.00	0.72	0.00
16.69	29.71	2.00	0.00	0.72	0.00	16.76	25.59	2.00	0.00	0.72	0.00
16.80	22.41	2.00	0.00	0.72	0.00	16.87	19.76	2.00	0.00	0.71	0.00
16.96	15.98	2.00	0.00	0.71	0.00	17.02	15.07	2.00	0.00	0.71	0.00
17.06	14.89	2.00	0.00	0.71	0.00	17.14	15.03	2.00	0.00	0.71	0.00
17.20	15.01	2.00	0.00	0.71	0.00	17.29	13.99	2.00	0.00	0.71	0.00
17.36	13.53	2.00	0.00	0.71	0.00	17.42	12.51	2.00	0.00	0.70	0.00
17.48	12.16	2.00	0.00	0.70	0.00	17.55	11.82	2.00	0.00	0.70	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)
17.61	11.57	2.00	0.00	0.70	0.00	17.67	11.56	2.00	0.00	0.70	0.00
17.73	11.54	2.00	0.00	0.70	0.00	17.79	11.53	2.00	0.00	0.70	0.00
17.85	11.96	2.00	0.00	0.70	0.00	17.94	12.82	2.00	0.00	0.70	0.00
18.01	12.90	2.00	0.00	0.69	0.00	18.07	12.89	2.00	0.00	0.69	0.00
18.14	12.87	2.00	0.00	0.69	0.00	18.20	12.86	2.00	0.00	0.69	0.00
18.26	12.29	2.00	0.00	0.69	0.00	18.32	12.06	2.00	0.00	0.69	0.00
18.38	12.26	2.00	0.00	0.69	0.00	18.45	12.14	2.00	0.00	0.69	0.00
18.53	12.22	2.00	0.00	0.69	0.00	18.60	12.32	2.00	0.00	0.68	0.00
18.67	11.98	2.00	0.00	0.68	0.00	18.73	11.64	2.00	0.00	0.68	0.00
18.77	11.41	2.00	0.00	0.68	0.00	18.84	11.07	2.00	0.00	0.68	0.00
18.91	10.85	2.00	0.00	0.68	0.00	18.98	10.83	2.00	0.00	0.68	0.00
19.06	10.39	2.00	0.00	0.68	0.00	19.13	9.72	2.00	0.00	0.68	0.00
19.20	9.60	2.00	0.00	0.67	0.00	19.24	9.48	2.00	0.00	0.67	0.00
19.30	10.01	2.00	0.00	0.67	0.00	19.37	10.53	2.00	0.00	0.67	0.00
19.45	10.84	2.00	0.00	0.67	0.00	19.52	11.04	2.00	0.00	0.67	0.00
19.55	11.13	2.00	0.00	0.67	0.00	19.62	11.02	2.00	0.00	0.67	0.00
19.69	10.84	2.00	0.00	0.67	0.00	19.77	10.55	2.00	0.00	0.66	0.00
19.83	10.65	2.00	0.00	0.66	0.00	19.91	10.52	2.00	0.00	0.66	0.00
19.98	10.83	2.00	0.00	0.66	0.00	20.05	11.24	2.00	0.00	0.66	0.00
20.11	11.54	2.00	0.00	0.66	0.00	20.15	11.53	2.00	0.00	0.66	0.00
20.21	11.09	2.00	0.00	0.66	0.00	20.28	10.97	2.00	0.00	0.66	0.00
20.35	10.86	2.00	0.00	0.66	0.00	20.43	10.73	2.00	0.00	0.65	0.00
20.49	10.71	2.00	0.00	0.65	0.00	20.56	11.13	2.00	0.00	0.65	0.00
20.63	13.20	2.00	0.00	0.65	0.00	20.68	17.73	2.00	0.00	0.65	0.00
20.74	23.94	2.00	0.00	0.65	0.00	20.83	97.70	0.25	2.13	0.65	0.02
20.90	105.54	0.27	1.96	0.65	0.02	20.93	108.01	0.28	1.91	0.65	0.01
21.00	111.18	0.29	1.85	0.64	0.01	21.07	114.43	0.30	1.80	0.64	0.01
21.14	119.00	0.32	1.72	0.64	0.01	21.20	122.53	0.34	1.66	0.64	0.01
21.26	123.93	0.34	1.64	0.64	0.01	21.33	122.48	0.33	1.66	0.64	0.01
21.40	116.99	0.31	1.74	0.64	0.01	21.46	108.24	0.28	1.88	0.64	0.01
21.53	98.34	0.25	2.08	0.64	0.02	21.59	28.14	2.00	0.00	0.63	0.00
21.66	22.24	2.00	0.00	0.63	0.00	21.72	19.22	2.00	0.00	0.63	0.00
21.79	16.88	2.00	0.00	0.63	0.00	21.86	14.65	2.00	0.00	0.63	0.00
21.93	13.42	2.00	0.00	0.63	0.00	21.99	12.29	2.00	0.00	0.63	0.00
22.06	11.26	2.00	0.00	0.63	0.00	22.13	10.53	2.00	0.00	0.62	0.00
22.19	10.52	2.00	0.00	0.62	0.00	22.26	10.31	2.00	0.00	0.62	0.00
22.32	10.20	2.00	0.00	0.62	0.00	22.39	9.88	2.00	0.00	0.62	0.00
22.45	9.96	2.00	0.00	0.62	0.00	22.52	10.76	2.00	0.00	0.62	0.00
22.59	12.06	2.00	0.00	0.62	0.00	22.65	13.05	2.00	0.00	0.62	0.00
22.72	14.82	2.00	0.00	0.61	0.00	22.79	15.30	2.00	0.00	0.61	0.00
22.85	15.87	2.00	0.00	0.61	0.00	22.91	14.77	2.00	0.00	0.61	0.00
22.99	14.04	2.00	0.00	0.61	0.00	23.04	13.64	2.00	0.00	0.61	0.00
23.11	14.41	2.00	0.00	0.61	0.00	23.17	14.29	2.00	0.00	0.61	0.00
23.24	14.08	2.00	0.00	0.61	0.00	23.30	13.96	2.00	0.00	0.61	0.00
23.39	14.43	2.00	0.00	0.60	0.00	23.45	13.92	2.00	0.00	0.60	0.00
23.52	13.61	2.00	0.00	0.60	0.00	23.58	13.88	2.00	0.00	0.60	0.00
23.65	14.56	2.00	0.00	0.60	0.00	23.71	14.63	2.00	0.00	0.60	0.00
23.77	13.74	2.00	0.00	0.60	0.00	23.83	13.13	2.00	0.00	0.60	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)
23.91	12.92	2.00	0.00	0.59	0.00	23.96	13.20	2.00	0.00	0.59	0.00
24.03	12.89	2.00	0.00	0.59	0.00	24.10	12.68	2.00	0.00	0.59	0.00
24.16	12.18	2.00	0.00	0.59	0.00	24.23	12.17	2.00	0.00	0.59	0.00
24.29	12.15	2.00	0.00	0.59	0.00	24.36	13.01	2.00	0.00	0.59	0.00
24.42	12.90	2.00	0.00	0.59	0.00	24.49	12.68	2.00	0.00	0.58	0.00
24.55	12.67	2.00	0.00	0.58	0.00	24.61	12.18	2.00	0.00	0.58	0.00
24.68	11.77	2.00	0.00	0.58	0.00	24.74	11.67	2.00	0.00	0.58	0.00
24.81	11.17	2.00	0.00	0.58	0.00	24.87	10.77	2.00	0.00	0.58	0.00
24.94	10.46	2.00	0.00	0.58	0.00	25.00	10.36	2.00	0.00	0.58	0.00
25.07	10.25	2.00	0.00	0.58	0.00	25.16	10.04	2.00	0.00	0.57	0.00
25.20	9.75	2.00	0.00	0.57	0.00	25.29	9.73	2.00	0.00	0.57	0.00
25.36	9.72	2.00	0.00	0.57	0.00	25.42	9.71	2.00	0.00	0.57	0.00
25.49	10.47	2.00	0.00	0.57	0.00	25.54	11.23	2.00	0.00	0.57	0.00
25.61	11.88	2.00	0.00	0.57	0.00	25.67	14.34	2.00	0.00	0.56	0.00
25.73	14.80	2.00	0.00	0.56	0.00	25.79	14.40	2.00	0.00	0.56	0.00
25.86	14.39	2.00	0.00	0.56	0.00	25.92	14.37	2.00	0.00	0.56	0.00
25.99	14.35	2.00	0.00	0.56	0.00	26.05	16.79	2.00	0.00	0.56	0.00
26.12	21.17	2.00	0.00	0.56	0.00	26.22	89.27	0.22	2.00	0.56	0.02
26.28	93.54	0.23	1.91	0.55	0.01	26.34	93.96	0.23	1.89	0.55	0.01
26.41	31.37	2.00	0.00	0.55	0.00	26.44	29.69	2.00	0.00	0.55	0.00
26.51	26.90	2.00	0.00	0.55	0.00	26.60	24.37	2.00	0.00	0.55	0.00
26.66	22.13	2.00	0.00	0.55	0.00	26.73	22.15	2.00	0.00	0.55	0.00
26.78	22.13	2.00	0.00	0.55	0.00	26.85	22.14	2.00	0.00	0.54	0.00
26.92	23.94	2.00	0.00	0.54	0.00	26.99	27.20	2.00	0.00	0.54	0.00
27.05	30.80	2.00	0.00	0.54	0.00	27.12	35.19	2.00	0.00	0.54	0.00
27.19	103.45	0.25	1.67	0.54	0.01	27.25	113.53	0.28	1.52	0.54	0.01
27.32	124.63	0.33	1.37	0.54	0.01	27.38	130.64	0.36	1.30	0.54	0.01
27.43	131.54	0.37	1.29	0.54	0.01	27.52	131.07	0.37	1.29	0.53	0.01
27.59	131.94	0.37	1.28	0.53	0.01	27.65	133.58	0.38	1.26	0.53	0.01
27.69	134.53	0.39	1.24	0.53	0.01	27.76	135.53	0.39	1.23	0.53	0.01
27.83	135.73	0.40	1.23	0.53	0.01	27.89	136.18	0.40	1.22	0.53	0.01
27.96	133.35	0.38	1.25	0.53	0.01	28.03	127.74	0.35	1.30	0.52	0.01
28.09	122.01	0.32	1.37	0.52	0.01	28.16	119.89	0.31	1.39	0.52	0.01
28.23	118.75	0.30	1.40	0.52	0.01	28.29	119.84	0.31	1.38	0.52	0.01
28.35	138.09	0.41	1.18	0.52	0.01	28.41	142.02	0.45	1.14	0.52	0.01
28.52	132.10	0.37	1.24	0.52	0.02	28.57	119.66	0.31	1.37	0.52	0.01
28.64	106.64	0.26	1.55	0.51	0.01	28.70	32.56	2.00	0.00	0.51	0.00
28.76	25.72	2.00	0.00	0.51	0.00	28.83	20.98	2.00	0.00	0.51	0.00
28.89	18.21	2.00	0.00	0.51	0.00	28.95	15.87	2.00	0.00	0.51	0.00
29.01	13.71	2.00	0.00	0.51	0.00	29.08	12.98	2.00	0.00	0.51	0.00
29.15	11.81	2.00	0.00	0.51	0.00	29.20	11.61	2.00	0.00	0.51	0.00
29.27	10.80	2.00	0.00	0.50	0.00	29.34	10.61	2.00	0.00	0.50	0.00
29.42	10.51	2.00	0.00	0.50	0.00	29.48	10.15	2.00	0.00	0.50	0.00
29.54	9.96	2.00	0.00	0.50	0.00	29.61	9.77	2.00	0.00	0.50	0.00
29.68	9.77	2.00	0.00	0.50	0.00	29.74	9.76	2.00	0.00	0.50	0.00
29.80	9.92	2.00	0.00	0.49	0.00	29.87	10.18	2.00	0.00	0.49	0.00
29.93	10.35	2.00	0.00	0.49	0.00	30.00	10.61	2.00	0.00	0.49	0.00
30.06	11.39	2.00	0.00	0.49	0.00	30.13	11.55	2.00	0.00	0.49	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)
30.19	11.72	2.00	0.00	0.49	0.00	30.26	11.97	2.00	0.00	0.49	0.00
30.32	11.96	2.00	0.00	0.49	0.00	30.39	11.86	2.00	0.00	0.48	0.00
30.45	12.47	2.00	0.00	0.48	0.00	30.51	12.27	2.00	0.00	0.48	0.00
30.58	12.79	2.00	0.00	0.48	0.00	30.68	14.08	2.00	0.00	0.48	0.00
30.74	15.63	2.00	0.00	0.48	0.00	30.81	17.02	2.00	0.00	0.48	0.00
30.87	17.17	2.00	0.00	0.48	0.00	30.92	17.15	2.00	0.00	0.48	0.00
30.99	17.06	2.00	0.00	0.47	0.00	31.05	16.95	2.00	0.00	0.47	0.00
31.11	18.31	2.00	0.00	0.47	0.00	31.17	20.45	2.00	0.00	0.47	0.00
31.24	23.19	2.00	0.00	0.47	0.00	31.30	27.03	2.00	0.00	0.47	0.00
31.37	31.21	2.00	0.00	0.47	0.00	31.46	99.81	0.24	1.50	0.47	0.02
31.52	105.73	0.26	1.41	0.47	0.01	31.59	112.19	0.28	1.33	0.46	0.01
31.65	117.44	0.29	1.26	0.46	0.01	31.71	120.94	0.31	1.22	0.46	0.01
31.76	106.12	0.26	1.40	0.46	0.01	31.84	124.55	0.32	1.17	0.46	0.01
31.90	124.94	0.33	1.17	0.46	0.01	31.97	124.61	0.32	1.17	0.46	0.01
32.03	123.47	0.32	1.18	0.46	0.01	32.10	121.38	0.31	1.20	0.46	0.01
32.15	118.57	0.30	1.22	0.46	0.01	32.25	116.52	0.29	1.24	0.45	0.01
32.32	113.86	0.28	1.27	0.45	0.01	32.35	113.40	0.28	1.27	0.45	0.01
32.44	109.95	0.27	1.31	0.45	0.01	32.50	106.13	0.26	1.36	0.45	0.01
32.57	103.33	0.25	1.39	0.45	0.01	32.62	103.42	0.25	1.39	0.45	0.01
32.69	108.53	0.26	1.32	0.45	0.01	32.77	124.99	0.33	1.13	0.44	0.01
32.83	131.67	0.36	1.06	0.44	0.01	32.88	135.45	0.39	1.03	0.44	0.01
32.94	140.79	0.43	0.98	0.44	0.01	33.04	144.91	0.47	0.95	0.44	0.01
33.07	146.23	0.48	0.94	0.44	0.00	33.17	150.35	0.53	0.91	0.44	0.01
33.22	153.52	0.57	0.88	0.44	0.01	33.28	156.99	0.62	0.83	0.44	0.01
33.35	160.04	0.68	0.75	0.43	0.01	33.41	161.75	0.71	0.68	0.43	0.00
33.48	162.55	0.73	0.64	0.43	0.01	33.53	161.41	0.71	0.69	0.43	0.00
33.60	158.36	0.65	0.79	0.43	0.01	33.66	152.81	0.56	0.87	0.43	0.01
33.76	140.71	0.43	0.95	0.43	0.01	33.82	132.38	0.37	1.02	0.43	0.01
33.89	125.70	0.33	1.07	0.43	0.01	33.95	122.65	0.32	1.10	0.42	0.01
34.01	123.40	0.32	1.09	0.42	0.01	34.07	125.18	0.33	1.07	0.42	0.01
34.13	126.37	0.33	1.06	0.42	0.01	34.19	126.73	0.33	1.05	0.42	0.01
34.26	127.59	0.34	1.04	0.42	0.01	34.32	129.38	0.35	1.02	0.42	0.01
34.41	131.53	0.36	1.00	0.42	0.01	34.47	133.27	0.37	0.98	0.42	0.01
34.54	135.81	0.39	0.96	0.41	0.01	34.61	138.62	0.41	0.94	0.41	0.01
34.66	139.43	0.42	0.93	0.41	0.01	34.72	140.85	0.43	0.92	0.41	0.01
34.78	141.82	0.44	0.91	0.41	0.01	34.84	143.29	0.45	0.89	0.41	0.01
34.93	144.71	0.46	0.88	0.41	0.01	34.99	144.14	0.46	0.88	0.41	0.01
35.05	145.94	0.48	0.87	0.41	0.01	35.12	146.02	0.48	0.87	0.40	0.01
35.18	146.29	0.48	0.86	0.40	0.01	35.25	146.49	0.48	0.86	0.40	0.01
35.30	146.76	0.48	0.85	0.40	0.01	35.40	146.98	0.49	0.85	0.40	0.01
35.46	147.25	0.49	0.85	0.40	0.01	35.52	147.58	0.49	0.84	0.40	0.01
35.59	146.67	0.48	0.84	0.40	0.01	35.65	144.78	0.46	0.86	0.40	0.01
35.71	143.76	0.45	0.86	0.39	0.01	35.77	143.31	0.45	0.86	0.39	0.01
35.84	142.81	0.45	0.86	0.39	0.01	35.91	142.76	0.44	0.86	0.39	0.01
35.99	142.52	0.44	0.86	0.39	0.01	36.05	143.44	0.45	0.85	0.39	0.01
36.11	144.30	0.46	0.84	0.39	0.01	36.18	145.44	0.47	0.83	0.39	0.01
36.24	146.57	0.48	0.82	0.39	0.01	36.31	147.96	0.50	0.81	0.38	0.01
36.37	148.72	0.51	0.80	0.38	0.01	36.43	148.94	0.51	0.80	0.38	0.01

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)
36.49	148.38	0.50	0.80	0.38	0.01	36.55	147.30	0.49	0.81	0.38	0.01
36.62	145.44	0.47	0.82	0.38	0.01	36.71	140.57	0.43	0.84	0.38	0.01
36.77	134.28	0.38	0.89	0.38	0.01	36.84	124.49	0.32	0.96	0.38	0.01
36.90	111.54	0.27	1.08	0.37	0.01	36.96	35.74	2.00	0.00	0.37	0.00
37.02	27.37	2.00	0.00	0.37	0.00	37.09	21.95	2.00	0.00	0.37	0.00
37.15	17.73	2.00	0.00	0.37	0.00	37.21	15.27	2.00	0.00	0.37	0.00
37.30	15.22	2.00	0.00	0.37	0.00	37.35	15.21	2.00	0.00	0.37	0.00
37.43	15.15	2.00	0.00	0.37	0.00	37.48	15.38	2.00	0.00	0.36	0.00
37.55	15.21	2.00	0.00	0.36	0.00	37.61	14.33	2.00	0.00	0.36	0.00
37.68	13.70	2.00	0.00	0.36	0.00	37.75	13.36	2.00	0.00	0.36	0.00
37.80	13.75	2.00	0.00	0.36	0.00	37.89	14.84	2.00	0.00	0.36	0.00
37.94	15.92	2.00	0.00	0.36	0.00	38.01	16.84	2.00	0.00	0.36	0.00
38.07	16.44	2.00	0.00	0.35	0.00	38.13	16.04	2.00	0.00	0.35	0.00
38.19	16.38	2.00	0.00	0.35	0.00	38.26	16.32	2.00	0.00	0.35	0.00
38.33	19.19	2.00	0.00	0.35	0.00	38.40	19.73	2.00	0.00	0.35	0.00
38.46	19.67	2.00	0.00	0.35	0.00	38.52	19.65	2.00	0.00	0.35	0.00
38.62	19.59	2.00	0.00	0.35	0.00	38.67	20.27	2.00	0.00	0.34	0.00
38.73	21.81	2.00	0.00	0.34	0.00	38.79	22.27	2.00	0.00	0.34	0.00
38.85	21.55	2.00	0.00	0.34	0.00	38.94	18.50	2.00	0.00	0.34	0.00
38.99	19.73	2.00	0.00	0.34	0.00	39.05	20.80	2.00	0.00	0.34	0.00
39.14	33.27	2.00	0.00	0.34	0.00	39.18	40.51	2.00	0.00	0.34	0.00
39.27	123.73	0.32	0.86	0.33	0.01	39.33	131.09	0.36	0.80	0.33	0.01
39.39	135.62	0.39	0.77	0.33	0.01	39.45	139.22	0.41	0.75	0.33	0.01
39.51	141.18	0.43	0.73	0.33	0.01	39.57	141.26	0.43	0.73	0.33	0.01
39.66	140.75	0.43	0.73	0.33	0.01	39.72	140.69	0.43	0.73	0.33	0.00
39.79	140.39	0.42	0.73	0.33	0.01	39.85	139.04	0.41	0.73	0.32	0.01
39.92	134.57	0.38	0.76	0.32	0.01	39.98	128.72	0.35	0.79	0.32	0.01
40.03	121.83	0.31	0.84	0.32	0.01	40.10	114.46	0.28	0.89	0.32	0.01
40.16	106.72	0.26	0.96	0.32	0.01	40.25	35.23	2.00	0.00	0.32	0.00
40.31	30.98	2.00	0.00	0.32	0.00	40.38	27.36	2.00	0.00	0.32	0.00
40.44	25.27	2.00	0.00	0.31	0.00	40.50	24.34	2.00	0.00	0.31	0.00
40.56	24.70	2.00	0.00	0.31	0.00	40.62	23.54	2.00	0.00	0.31	0.00
40.70	18.80	2.00	0.00	0.31	0.00	40.76	17.35	2.00	0.00	0.31	0.00
40.83	17.63	2.00	0.00	0.31	0.00	40.89	19.51	2.00	0.00	0.31	0.00
40.96	21.85	2.00	0.00	0.31	0.00	41.02	22.89	2.00	0.00	0.30	0.00
41.11	21.65	2.00	0.00	0.30	0.00	41.17	20.05	2.00	0.00	0.30	0.00
41.23	18.82	2.00	0.00	0.30	0.00	41.29	17.53	2.00	0.00	0.30	0.00
41.35	16.47	2.00	0.00	0.30	0.00	41.41	16.00	2.00	0.00	0.30	0.00
41.47	16.15	2.00	0.00	0.30	0.00	41.56	17.03	2.00	0.00	0.30	0.00
41.61	18.15	2.00	0.00	0.29	0.00	41.67	18.13	2.00	0.00	0.29	0.00
41.76	17.36	2.00	0.00	0.29	0.00	41.82	16.75	2.00	0.00	0.29	0.00
41.88	16.21	2.00	0.00	0.29	0.00	41.95	15.52	2.00	0.00	0.29	0.00
42.00	15.37	2.00	0.00	0.29	0.00	42.06	15.29	2.00	0.00	0.29	0.00
42.15	14.75	2.00	0.00	0.29	0.00	42.21	14.29	2.00	0.00	0.28	0.00
42.28	14.05	2.00	0.00	0.28	0.00	42.33	13.98	2.00	0.00	0.28	0.00
42.40	13.74	2.00	0.00	0.28	0.00	42.46	14.76	2.00	0.00	0.28	0.00
42.55	17.87	2.00	0.00	0.28	0.00	42.61	20.83	2.00	0.00	0.28	0.00
42.67	29.62	2.00	0.00	0.28	0.00	42.73	110.05	0.27	0.80	0.28	0.01

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)
42.80	128.99	0.35	0.67	0.27	0.01	42.86	142.60	0.44	0.60	0.27	0.00
42.92	151.87	0.54	0.56	0.27	0.00	42.99	160.71	0.69	0.46	0.27	0.00
43.05	146.17	0.48	0.58	0.27	0.00	43.14	145.31	0.47	0.58	0.27	0.01
43.20	152.86	0.56	0.54	0.27	0.00	43.25	161.52	0.70	0.43	0.27	0.00
43.34	177.99	1.23	0.13	0.27	0.00	43.39	184.76	1.63	0.05	0.26	0.00
43.45	185.92	1.71	0.03	0.26	0.00	43.52	185.66	1.69	0.04	0.26	0.00
43.59	187.50	1.84	0.02	0.26	0.00	43.65	191.97	2.00	0.00	0.26	0.00
43.72	200.03	2.00	0.00	0.26	0.00	43.78	205.17	2.00	0.00	0.26	0.00
43.85	208.23	2.00	0.00	0.26	0.00	43.91	208.92	2.00	0.00	0.26	0.00
43.98	207.84	2.00	0.00	0.25	0.00	44.03	205.91	2.00	0.00	0.25	0.00
44.10	205.57	2.00	0.00	0.25	0.00	44.18	204.44	2.00	0.00	0.25	0.00
44.25	205.95	2.00	0.00	0.25	0.00	44.31	208.77	2.00	0.00	0.25	0.00
44.38	213.89	2.00	0.00	0.25	0.00	44.44	217.47	2.00	0.00	0.25	0.00
44.51	219.65	2.00	0.00	0.25	0.00	44.59	222.13	2.00	0.00	0.24	0.00
44.65	222.02	2.00	0.00	0.24	0.00	44.71	225.63	2.00	0.00	0.24	0.00
44.77	231.03	2.00	0.00	0.24	0.00	44.83	237.65	2.00	0.00	0.24	0.00
44.89	248.05	2.00	0.00	0.24	0.00	44.96	241.65	2.00	0.00	0.24	0.00
45.02	228.70	2.00	0.00	0.24	0.00	45.09	254.00	2.00	0.00	0.24	0.00
45.15	254.00	2.00	0.00	0.23	0.00	45.21	254.00	2.00	0.00	0.23	0.00
45.28	254.00	2.00	0.00	0.23	0.00	45.37	254.00	2.00	0.00	0.23	0.00
45.43	254.00	2.00	0.00	0.23	0.00	45.49	254.00	2.00	0.00	0.23	0.00
45.56	254.00	2.00	0.00	0.23	0.00	45.62	254.00	2.00	0.00	0.23	0.00
45.67	254.00	2.00	0.00	0.23	0.00	45.74	254.00	2.00	0.00	0.22	0.00
45.83	252.71	2.00	0.00	0.22	0.00	45.89	245.14	2.00	0.00	0.22	0.00
45.95	236.39	2.00	0.00	0.22	0.00	46.01	228.58	2.00	0.00	0.22	0.00
46.07	221.35	2.00	0.00	0.22	0.00	46.13	215.81	2.00	0.00	0.22	0.00
46.20	210.10	2.00	0.00	0.22	0.00	46.27	204.71	2.00	0.00	0.22	0.00
46.34	201.29	2.00	0.00	0.21	0.00	46.40	199.57	2.00	0.00	0.21	0.00
46.46	201.43	2.00	0.00	0.21	0.00	46.54	211.25	2.00	0.00	0.21	0.00
46.60	219.29	2.00	0.00	0.21	0.00	46.66	228.07	2.00	0.00	0.21	0.00
46.73	236.97	2.00	0.00	0.21	0.00	46.80	243.20	2.00	0.00	0.21	0.00
46.87	244.72	2.00	0.00	0.21	0.00	46.92	246.18	2.00	0.00	0.20	0.00
46.98	245.82	2.00	0.00	0.20	0.00	47.07	240.60	2.00	0.00	0.20	0.00
47.12	240.35	2.00	0.00	0.20	0.00	47.18	239.31	2.00	0.00	0.20	0.00
47.26	238.54	2.00	0.00	0.20	0.00	47.31	243.65	2.00	0.00	0.20	0.00
47.39	250.19	2.00	0.00	0.20	0.00	47.46	254.00	2.00	0.00	0.20	0.00
47.51	254.00	2.00	0.00	0.19	0.00	47.59	254.00	2.00	0.00	0.19	0.00
47.65	254.00	2.00	0.00	0.19	0.00	47.73	254.00	2.00	0.00	0.19	0.00
47.78	254.00	2.00	0.00	0.19	0.00	47.85	254.00	2.00	0.00	0.19	0.00
47.91	254.00	2.00	0.00	0.19	0.00	47.98	254.00	2.00	0.00	0.19	0.00
48.05	254.00	2.00	0.00	0.19	0.00	48.11	254.00	2.00	0.00	0.18	0.00
48.16	254.00	2.00	0.00	0.18	0.00	48.23	254.00	2.00	0.00	0.18	0.00
48.30	254.00	2.00	0.00	0.18	0.00	48.37	254.00	2.00	0.00	0.18	0.00
48.43	254.00	2.00	0.00	0.18	0.00	48.50	254.00	2.00	0.00	0.18	0.00
48.56	254.00	2.00	0.00	0.18	0.00	48.63	254.00	2.00	0.00	0.18	0.00
48.69	254.00	2.00	0.00	0.17	0.00	48.76	254.00	2.00	0.00	0.17	0.00
48.82	254.00	2.00	0.00	0.17	0.00	48.89	254.00	2.00	0.00	0.17	0.00
48.96	254.00	2.00	0.00	0.17	0.00	49.02	254.00	2.00	0.00	0.17	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)
49.09	254.00	2.00	0.00	0.17	0.00	49.16	254.00	2.00	0.00	0.17	0.00
49.22	254.00	2.00	0.00	0.17	0.00	49.28	254.00	2.00	0.00	0.16	0.00
49.35	254.00	2.00	0.00	0.16	0.00	49.42	254.00	2.00	0.00	0.16	0.00
49.49	254.00	2.00	0.00	0.16	0.00	49.54	254.00	2.00	0.00	0.16	0.00
49.61	254.00	2.00	0.00	0.16	0.00	49.68	254.00	2.00	0.00	0.16	0.00
49.75	254.00	2.00	0.00	0.16	0.00	49.81	254.00	2.00	0.00	0.16	0.00
49.88	254.00	2.00	0.00	0.15	0.00	49.94	254.00	2.00	0.00	0.15	0.00
50.02	254.00	2.00	0.00	0.15	0.00	50.08	254.00	2.00	0.00	0.15	0.00
50.14	254.00	2.00	0.00	0.15	0.00	50.21	254.00	2.00	0.00	0.15	0.00
50.29	254.00	2.00	0.00	0.15	0.00	50.34	254.00	2.00	0.00	0.15	0.00
50.41	252.90	2.00	0.00	0.15	0.00	50.46	249.18	2.00	0.00	0.14	0.00
50.55	246.22	2.00	0.00	0.14	0.00	50.60	244.30	2.00	0.00	0.14	0.00
50.66	241.69	2.00	0.00	0.14	0.00	50.74	228.79	2.00	0.00	0.14	0.00
50.81	219.15	2.00	0.00	0.14	0.00	50.87	217.43	2.00	0.00	0.14	0.00
50.92	216.55	2.00	0.00	0.14	0.00	51.01	211.81	2.00	0.00	0.14	0.00
51.05	207.78	2.00	0.00	0.13	0.00	51.12	202.46	2.00	0.00	0.13	0.00
51.19	195.21	2.00	0.00	0.13	0.00	51.26	190.25	2.00	0.00	0.13	0.00
51.31	188.17	2.00	0.00	0.13	0.00	51.38	187.22	2.00	0.00	0.13	0.00
51.46	185.73	2.00	0.00	0.13	0.00	51.52	182.51	2.00	0.00	0.13	0.00
51.58	178.11	2.00	0.00	0.13	0.00	51.66	168.10	2.00	0.00	0.12	0.00
51.72	156.87	2.00	0.00	0.12	0.00	51.78	148.05	2.00	0.00	0.12	0.00
51.85	138.60	2.00	0.00	0.12	0.00	51.91	132.52	2.00	0.00	0.12	0.00
51.98	127.18	2.00	0.00	0.12	0.00	52.05	121.32	2.00	0.00	0.12	0.00
52.11	113.00	2.00	0.00	0.12	0.00	52.17	39.31	2.00	0.00	0.12	0.00
52.24	31.22	2.00	0.00	0.11	0.00	52.30	26.67	2.00	0.00	0.11	0.00
52.37	22.55	2.00	0.00	0.11	0.00	52.44	19.88	2.00	0.00	0.11	0.00
52.50	18.27	2.00	0.00	0.11	0.00	52.57	16.68	2.00	0.00	0.11	0.00
52.63	15.75	2.00	0.00	0.11	0.00	52.71	18.89	2.00	0.00	0.11	0.00
52.76	27.14	2.00	0.00	0.11	0.00	52.83	108.21	2.00	0.00	0.10	0.00
52.89	130.32	2.00	0.00	0.10	0.00	52.96	152.74	2.00	0.00	0.10	0.00
53.03	155.29	2.00	0.00	0.10	0.00	53.10	155.52	2.00	0.00	0.10	0.00
53.16	153.99	2.00	0.00	0.10	0.00	53.23	150.83	2.00	0.00	0.10	0.00
53.28	148.43	2.00	0.00	0.10	0.00	53.36	146.32	2.00	0.00	0.10	0.00
53.42	146.31	2.00	0.00	0.09	0.00	53.49	149.54	2.00	0.00	0.09	0.00
53.56	153.99	2.00	0.00	0.09	0.00	53.62	157.32	2.00	0.00	0.09	0.00
53.68	160.27	2.00	0.00	0.09	0.00	53.75	163.81	2.00	0.00	0.09	0.00
53.82	165.19	2.00	0.00	0.09	0.00	53.88	163.54	2.00	0.00	0.09	0.00
53.94	159.41	2.00	0.00	0.09	0.00	54.02	148.95	2.00	0.00	0.08	0.00
54.07	148.10	2.00	0.00	0.08	0.00	54.14	139.67	2.00	0.00	0.08	0.00
54.20	133.77	2.00	0.00	0.08	0.00	54.29	126.20	2.00	0.00	0.08	0.00
54.35	119.90	2.00	0.00	0.08	0.00	54.41	111.16	2.00	0.00	0.08	0.00
54.49	36.46	2.00	0.00	0.08	0.00	54.53	32.29	2.00	0.00	0.08	0.00
54.60	26.69	2.00	0.00	0.07	0.00	54.67	21.29	2.00	0.00	0.07	0.00
54.74	19.06	2.00	0.00	0.07	0.00	54.81	16.79	2.00	0.00	0.07	0.00
54.88	15.49	2.00	0.00	0.07	0.00	54.95	14.77	2.00	0.00	0.07	0.00
54.99	14.32	2.00	0.00	0.07	0.00	55.06	13.49	2.00	0.00	0.07	0.00
55.13	13.48	2.00	0.00	0.07	0.00	55.20	13.47	2.00	0.00	0.06	0.00
55.27	13.46	2.00	0.00	0.06	0.00	55.34	13.83	2.00	0.00	0.06	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$q_{c1N,cs}$	FS	e_v (%)	DF	Settlement (in)
55.40	14.21	2.00	0.00	0.06	0.00	55.47	14.70	2.00	0.00	0.06	0.00
55.52	14.69	2.00	0.00	0.06	0.00	55.60	14.18	2.00	0.00	0.06	0.00
55.66	13.41	2.00	0.00	0.06	0.00	55.74	12.58	2.00	0.00	0.06	0.00
55.79	12.38	2.00	0.00	0.05	0.00	55.85	12.32	2.00	0.00	0.05	0.00
55.92	13.07	2.00	0.00	0.05	0.00	55.98	13.50	2.00	0.00	0.05	0.00
56.04	13.69	2.00	0.00	0.05	0.00	56.11	13.61	2.00	0.00	0.05	0.00
56.17	13.73	2.00	0.00	0.05	0.00	56.25	14.79	2.00	0.00	0.05	0.00
56.30	17.08	2.00	0.00	0.05	0.00	56.37	23.10	2.00	0.00	0.04	0.00
56.46	32.77	2.00	0.00	0.04	0.00	56.50	41.97	2.00	0.00	0.04	0.00
56.58	125.20	2.00	0.00	0.04	0.00	56.63	130.99	2.00	0.00	0.04	0.00
56.70	134.57	2.00	0.00	0.04	0.00	56.79	135.33	2.00	0.00	0.04	0.00
56.86	136.29	2.00	0.00	0.04	0.00	56.91	136.23	2.00	0.00	0.04	0.00
56.96	134.44	2.00	0.00	0.03	0.00	57.02	62.52	2.00	0.00	0.03	0.00
57.10	56.99	2.00	0.00	0.03	0.00	57.16	57.42	2.00	0.00	0.03	0.00
57.23	50.99	2.00	0.00	0.03	0.00	57.29	47.42	2.00	0.00	0.03	0.00
57.36	46.09	2.00	0.00	0.03	0.00	57.42	48.57	2.00	0.00	0.03	0.00
57.49	57.27	2.00	0.00	0.03	0.00	57.55	134.78	2.00	0.00	0.02	0.00
57.62	152.91	2.00	0.00	0.02	0.00	57.71	162.82	2.00	0.00	0.02	0.00
57.75	163.40	2.00	0.00	0.02	0.00	57.84	162.16	2.00	0.00	0.02	0.00
57.88	161.00	2.00	0.00	0.02	0.00	57.96	158.81	2.00	0.00	0.02	0.00
58.01	157.53	2.00	0.00	0.02	0.00	58.09	157.85	2.00	0.00	0.02	0.00
58.14	157.95	2.00	0.00	0.01	0.00	58.22	160.39	2.00	0.00	0.01	0.00
58.28	162.83	2.00	0.00	0.01	0.00	58.35	166.13	2.00	0.00	0.01	0.00
58.40	168.57	2.00	0.00	0.01	0.00	58.47	171.44	2.00	0.00	0.01	0.00
58.56	173.44	2.00	0.00	0.01	0.00	58.60	173.70	2.00	0.00	0.01	0.00
58.68	173.36	2.00	0.00	0.01	0.00	58.76	173.56	2.00	0.00	0.00	0.00
58.80	174.08	2.00	0.00	0.00	0.00	58.88	175.95	2.00	0.00	0.00	0.00
58.93	177.49	2.00	0.00	0.00	0.00	59.01	180.28	2.00	0.00	0.00	0.00
59.07	182.65	2.00	0.00	0.00	0.00	59.14	186.75	2.00	0.00	0.00	0.00
59.21	191.62	2.00	0.00	0.00	0.00	59.26	194.70	2.00	0.00	0.00	0.00
59.34	199.07	2.00	0.00	0.00	0.00	59.40	200.10	2.00	0.00	0.00	0.00
59.47	200.84	2.00	0.00	0.00	0.00	59.52	203.20	2.00	0.00	0.00	0.00
59.59	204.88	2.00	0.00	0.00	0.00	59.67	204.59	2.00	0.00	0.00	0.00
59.72	203.54	2.00	0.00	0.00	0.00	59.80	129.27	2.00	0.00	0.00	0.00
59.87	125.14	2.00	0.00	0.00	0.00	59.92	122.51	2.00	0.00	0.00	0.00
60.00	118.95	2.00	0.00	0.00	0.00	60.04	117.33	2.00	0.00	0.00	0.00
60.13	116.31	2.00	0.00	0.00	0.00						

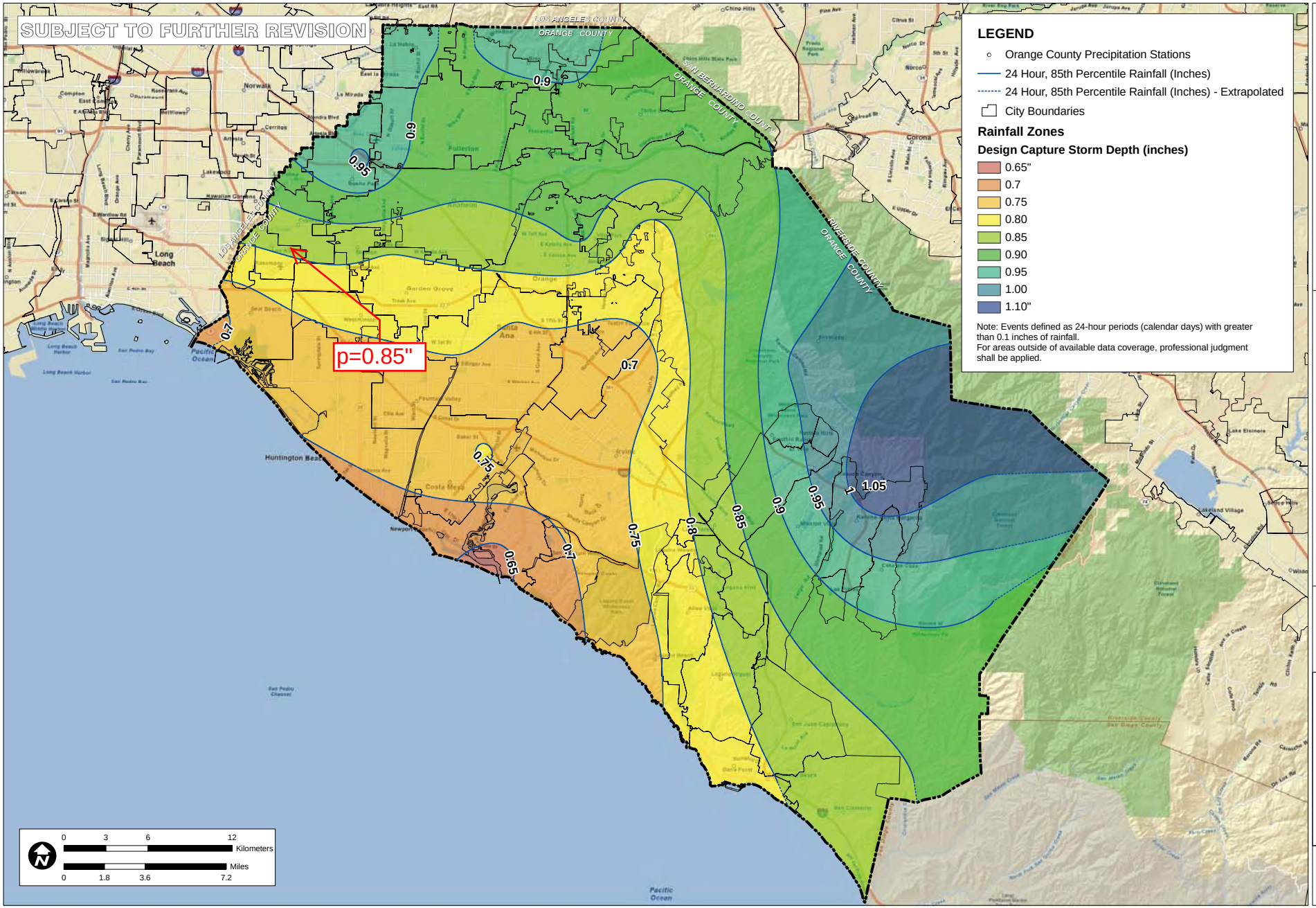
Total estimated settlement: 1.85

Abbreviations

$Q_{tn,cs}$:	Equivalent clean sand normalized cone resistance
FS:	Factor of safety against liquefaction
e_v (%):	Post-liquefaction volumentric strain
DF:	e_v depth weighting factor
Settlement:	Calculated settlement

Attachment F

2-YR Hydrology and BMP Calculations



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

TITLE: RAINFALL ZONES

JOB: ORANGE COUNTY TECHNICAL GUIDANCE DOCUMENT

ORANGE CO. CA

SCALE	1" = 1.6 miles
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	04/23/10
JOB NO.	9526-E

PACE Advanced Water Engineering

FIGURE XVI-1

Worksheet B: Simple Design Capture Volume Sizing Method

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter design capture storm depth from Figure III.1, *d* (inches)	d=	0.85	inches
2	Enter the effect of provided HSCs, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0.0	inches
3	Calculate the remainder of the design capture storm depth, $d_{remainder}$ (inches) (Line 1 – Line 2)	$d_{remainder}$=	0.85	inches
Step 2: Calculate the DCV				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	9.46	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	.77	
3	Calculate runoff coefficient, *C= (0.75 x imp) + 0.15*	C=	0.73	
4	Calculate runoff volume, V_{design}= *(C x* $d_{remainder}$ *x A x 43560 x (1/12))*	V_{design}=	21,308	cu-ft
Step 3: Design BMPs to ensure full retention of the DCV				
Step 3a: Determine design infiltration rate				
1	Enter measured infiltration rate, $K_{observed}$[1] (in/hr) (**Appendix VII**)	$K_{observed}$=		In/hr
2	Enter combined safety factor from Worksheet H, S_{total} (unitless)	S_{total}=		not feasible, groundwater
3	Calculate design infiltration rate, $K_{design} = K_{observed} / S_{total}$	K_{design}=		In/hr
Step 3b: Determine minimum BMP footprint				
4	Enter drawdown time, *T* (max 48 hours)	T=		Hours
5	Calculate max retention depth that can be drawn down within the drawdown time (feet), $D_{max} = K_{design} \times T \times (1/12)$	D_{max}=		feet
6	Calculate minimum area required for BMP (sq-ft), $A_{min} = V_{design} / d_{max}$	A_{min}=		sq-ft

[1] $K_{observed}$ is the vertical infiltration measured in the field, before applying a factor of safety. If field testing measures a rate that is different than the vertical infiltration rate (for example, three-dimensional borehole percolation rate), then this rate must be adjusted by an acceptable method (for example, Porchet method) to yield the field estimate of vertical infiltration rate, $K_{observed}$. See Appendix VII.

Worksheet B: Simple Design Capture Volume Sizing Method

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter design capture storm depth from Figure III.1, *d* (inches)	d=	0.85	inches
2	Enter the effect of provided HSCs, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0.0	inches
3	Calculate the remainder of the design capture storm depth, $d_{remainder}$ (inches) (Line 1 – Line 2)	$d_{remainder}$=	0.85	inches
Step 2: Calculate the DCV				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	4.18	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	.70	
3	Calculate runoff coefficient, *C= (0.75 x imp) + 0.15*	C=	0.68	
4	Calculate runoff volume, V_{design}= *(C x* $d_{remainder}$ *x A x 43560 x (1/12))*	V_{design}=	8,770	cu-ft
Step 3: Design BMPs to ensure full retention of the DCV				
Step 3a: Determine design infiltration rate				
1	Enter measured infiltration rate, $K_{observed}$[1] (in/hr) (**Appendix VII**)	$K_{observed}$=	100	In/hr
2	Enter combined safety factor from Worksheet H, S_{total} (unitless)	S_{total}=	20	
3	Calculate design infiltration rate, $K_{design} = K_{observed} / S_{total}$	K_{design}=	5	In/hr
Step 3b: Determine minimum BMP footprint				
4	Enter drawdown time, *T* (max 48 hours)	T=	48	Hours
5	Calculate max retention depth that can be drawn down within the drawdown time (feet), $D_{max} = K_{design} \times T \times (1/12)$	D_{max}=	20	feet
6	Calculate minimum area required for BMP (sq-ft), $A_{min} = V_{design} / d_{max}$	A_{min}=	685	sq-ft

[1] $K_{observed}$ is the vertical infiltration measured in the field, before applying a factor of safety. If field testing measures a rate that is different than the vertical infiltration rate (for example, three-dimensional borehole percolation rate), then this rate must be adjusted by an acceptable method (for example, Porchet method) to yield the field estimate of vertical infiltration rate, $K_{observed}$. See Appendix VII.

Three (3) 8x6 Filterra Bioscape Vaults are proposed which provide 144 sq-ft of storage (21% Required). Each unit will have an additional 200' of 48" diameter storm drain which provides the additional 6,930 cu-ft of storage.

Worksheet B: Simple Design Capture Volume Sizing Method

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter design capture storm depth from Figure III.1, *d* (inches)	d=	0.85	inches
2	Enter the effect of provided HSCs, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0.0	inches
3	Calculate the remainder of the design capture storm depth, $d_{remainder}$ (inches) (Line 1 – Line 2)	$d_{remainder}$=	0.85	inches
Step 2: Calculate the DCV				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	0.55	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.55	
3	Calculate runoff coefficient, *C= (0.75 x imp) + 0.15*	C=	0.56	
4	Calculate runoff volume, V_{design}= *(C x* $d_{remainder}$ *x A x 43560 x (1/12))*	V_{design}=	950	cu-ft
Step 3: Design BMPs to ensure full retention of the DCV				
Step 3a: Determine design infiltration rate				
1	Enter measured infiltration rate, $K_{observed}$[1] (in/hr) (**Appendix VII**)	$K_{observed}$=		In/hr
2	Enter combined safety factor from Worksheet H, S_{total} (unitless)	S_{total}=		
3	Calculate design infiltration rate, $K_{design} = K_{observed} / S_{total}$	K_{design}=	2.5	In/hr
Step 3b: Determine minimum BMP footprint				
4	Enter drawdown time, *T* (max 48 hours)	T=	48	Hours
5	Calculate max retention depth that can be drawn down within the drawdown time (feet), $D_{max} = K_{design} x T x (1/12)$	D_{max}=	10	feet
6	Calculate minimum area required for BMP (sq-ft), $A_{min} = V_{design} / d_{max}$	A_{min}=	246	sq-ft

[1] $K_{observed}$ is the vertical infiltration measured in the field, before applying a factor of safety. If field testing measures a rate that is different than the vertical infiltration rate (for example, three-dimensional borehole percolation rate), then this rate must be adjusted by an acceptable method (for example, Porchet method) to yield the field estimate of vertical infiltration rate, $K_{observed}$. See Appendix VII.

Proposed BMP is Biorention with a 4" underdrain. The approximate size is 8'x45' (360 sq-ft). The bottom of the basin is at an elevation of 41.0 with a 6' wide overflow at an elevation of 40.0.

Worksheet B: Simple Design Capture Volume Sizing Method

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter design capture storm depth from Figure III.1, *d* (inches)	d=	0.85	inches
2	Enter the effect of provided HSCs, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0.0	inches
3	Calculate the remainder of the design capture storm depth, $d_{remainder}$ (inches) (Line 1 – Line 2)	$d_{remainder}$=	0.85	inches
Step 2: Calculate the DCV				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	0.44	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	.73	
3	Calculate runoff coefficient, *C= (0.75 x imp) + 0.15*	C=	0.70	
4	Calculate runoff volume, V_{design}= *(C x* $d_{remainder}$ *x A x 43560 x (1/12))*	V_{design}=	950	cu-ft
Step 3: Design BMPs to ensure full retention of the DCV				
Step 3a: Determine design infiltration rate				
1	Enter measured infiltration rate, $K_{observed}$[1] (in/hr) (**Appendix VII**)	$K_{observed}$=	100	In/hr
2	Enter combined safety factor from Worksheet H, S_{total} (unitless)	S_{total}=	20	
3	Calculate design infiltration rate, $K_{design} = K_{observed} / S_{total}$	K_{design}=	5	In/hr
Step 3b: Determine minimum BMP footprint				
4	Enter drawdown time, *T* (max 48 hours)	T=	48	Hours
5	Calculate max retention depth that can be drawn down within the drawdown time (feet), $D_{max} = K_{design} \times T \times (1/12)$	D_{max}=	20	feet
6	Calculate minimum area required for BMP (sq-ft), $A_{min} = V_{design} / d_{max}$	A_{min}=	48	sq-ft

[1] $K_{observed}$ is the vertical infiltration measured in the field, before applying a factor of safety. If field testing measures a rate that is different than the vertical infiltration rate (for example, three-dimensional borehole percolation rate), then this rate must be adjusted by an acceptable method (for example, Porchet method) to yield the field estimate of vertical infiltration rate, $K_{observed}$. See Appendix VII.

One (1) 8x6 Filterra Tree Pit has been provided which provides 48 sq-ft of storage.

Worksheet B: Simple Design Capture Volume Sizing Method

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter design capture storm depth from Figure III.1, *d* (inches)	d=	0.85	inches
2	Enter the effect of provided HSCs, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0.0	inches
3	Calculate the remainder of the design capture storm depth, $d_{remainder}$ (inches) (Line 1 – Line 2)	$d_{remainder}$=	0.85	inches
Step 2: Calculate the DCV				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	0.27	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	.93	
3	Calculate runoff coefficient, *C= (0.75 x imp) + 0.15*	C=	0.85	
4	Calculate runoff volume, V_{design}= *(C x* $d_{remainder}$ *x A x 43560 x (1/12))*	V_{design}=	708	cu-ft
Step 3: Design BMPs to ensure full retention of the DCV				
Step 3a: Determine design infiltration rate				
1	Enter measured infiltration rate, $K_{observed}$[1] (in/hr) (**Appendix VII**)	$K_{observed}$=	100	In/hr
2	Enter combined safety factor from Worksheet H, S_{total} (unitless)	S_{total}=	20	
3	Calculate design infiltration rate, $K_{design} = K_{observed} / S_{total}$	K_{design}=	5	In/hr
Step 3b: Determine minimum BMP footprint				
4	Enter drawdown time, *T* (max 48 hours)	T=	48	Hours
5	Calculate max retention depth that can be drawn down within the drawdown time (feet), $D_{max} = K_{design} x T x (1/12)$	D_{max}=	20	feet
6	Calculate minimum area required for BMP (sq-ft), $A_{min} = V_{design} / d_{max}$	A_{min}=	35	sq-ft

[1] $K_{observed}$ is the vertical infiltration measured in the field, before applying a factor of safety. If field testing measures a rate that is different than the vertical infiltration rate (for example, three-dimensional borehole percolation rate), then this rate must be adjusted by an acceptable method (for example, Porchet method) to yield the field estimate of vertical infiltration rate, $K_{observed}$. See Appendix VII.

One (1) 6x6 Filterra Tree Pit has been provided which provides 36 sq-ft of storage.

Worksheet B: Simple Design Capture Volume Sizing Method

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter design capture storm depth from Figure III.1, *d* (inches)	d=	0.85	inches
2	Enter the effect of provided HSCs, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0.0	inches
3	Calculate the remainder of the design capture storm depth, $d_{remainder}$ (inches) (Line 1 – Line 2)	$d_{remainder}$=	0.85	inches
Step 2: Calculate the DCV				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	0.42	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	.93	
3	Calculate runoff coefficient, *C= (0.75 x imp) + 0.15*	C=	0.85	
4	Calculate runoff volume, V_{design}= *(C x* $d_{remainder}$ *x A x 43560 x (1/12))*	V_{design}=	1101	cu-ft
Step 3: Design BMPs to ensure full retention of the DCV				
Step 3a: Determine design infiltration rate				
1	Enter measured infiltration rate, $K_{observed}$[1] (in/hr) (**Appendix VII**)	$K_{observed}$=	100	In/hr
2	Enter combined safety factor from Worksheet H, S_{total} (unitless)	S_{total}=	20	
3	Calculate design infiltration rate, $K_{design} = K_{observed} / S_{total}$	K_{design}=	5	In/hr
Step 3b: Determine minimum BMP footprint				
4	Enter drawdown time, *T* (max 48 hours)	T=	48	Hours
5	Calculate max retention depth that can be drawn down within the drawdown time (feet), $D_{max} = K_{design} \times T \times (1/12)$	D_{max}=	20	feet
6	Calculate minimum area required for BMP (sq-ft), $A_{min} = V_{design} / d_{max}$	A_{min}=	55	sq-ft

[1] $K_{observed}$ is the vertical infiltration measured in the field, before applying a factor of safety. If field testing measures a rate that is different than the vertical infiltration rate (for example, three-dimensional borehole percolation rate), then this rate must be adjusted by an acceptable method (for example, Porchet method) to yield the field estimate of vertical infiltration rate, $K_{observed}$. See Appendix VII.

One (1) 10x6 Filterra Tree Pit has been provided which provides 60 sq-ft of storage.

Worksheet B: Simple Design Capture Volume Sizing Method

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter design capture storm depth from Figure III.1, *d* (inches)	d=	0.85	inches
2	Enter the effect of provided HSCs, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0.0	inches
3	Calculate the remainder of the design capture storm depth, $d_{remainder}$ (inches) (Line 1 – Line 2)	$d_{remainder}$=	0.85	inches
Step 2: Calculate the DCV				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	0.30	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	.93	
3	Calculate runoff coefficient, *C= (0.75 x imp) + 0.15*	C=	0.85	
4	Calculate runoff volume, V_{design}= *(C x* $d_{remainder}$ *x A x 43560 x (1/12))*	V_{design}=	786	cu-ft
Step 3: Design BMPs to ensure full retention of the DCV				
Step 3a: Determine design infiltration rate				
1	Enter measured infiltration rate, $K_{observed}$[1] (in/hr) (**Appendix VII**)	$K_{observed}$=	100	In/hr
2	Enter combined safety factor from Worksheet H, S_{total} (unitless)	S_{total}=	20	
3	Calculate design infiltration rate, $K_{design} = K_{observed} / S_{total}$	K_{design}=	5	In/hr
Step 3b: Determine minimum BMP footprint				
4	Enter drawdown time, *T* (max 48 hours)	T=	48	Hours
5	Calculate max retention depth that can be drawn down within the drawdown time (feet), $D_{max} = K_{design} \times T \times (1/12)$	D_{max}=	20	feet
6	Calculate minimum area required for BMP (sq-ft), $A_{min} = V_{design} / d_{max}$	A_{min}=	39	sq-ft

[1] $K_{observed}$ is the vertical infiltration measured in the field, before applying a factor of safety. If field testing measures a rate that is different than the vertical infiltration rate (for example, three-dimensional borehole percolation rate), then this rate must be adjusted by an acceptable method (for example, Porchet method) to yield the field estimate of vertical infiltration rate, $K_{observed}$. See Appendix VII.

One (1) 8x6 Filterra Tree Pit has been provided which provides 48 sq-ft of storage.

Worksheet B: Simple Design Capture Volume Sizing Method

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter design capture storm depth from Figure III.1, *d* (inches)	d=	0.85	inches
2	Enter the effect of provided HSCs, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0.0	inches
3	Calculate the remainder of the design capture storm depth, $d_{remainder}$ (inches) (Line 1 – Line 2)	$d_{remainder}$=	0.85	inches
Step 2: Calculate the DCV				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	0.28	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.46	
3	Calculate runoff coefficient, *C= (0.75 x imp) + 0.15*	C=	0.50	
4	Calculate runoff volume, V_{design}= *(C x* $d_{remainder}$ *x A x 43560 x (1/12))*	V_{design}=	432	cu-ft
Step 3: Design BMPs to ensure full retention of the DCV				
Step 3a: Determine design infiltration rate				
1	Enter measured infiltration rate, $K_{observed}$[1] (in/hr) (**Appendix VII**)	$K_{observed}$=		In/hr
2	Enter combined safety factor from Worksheet H, S_{total} (unitless)	S_{total}=		
3	Calculate design infiltration rate, $K_{design} = K_{observed} / S_{total}$	K_{design}=	2.5	In/hr
Step 3b: Determine minimum BMP footprint				
4	Enter drawdown time, *T* (max 48 hours)	T=	48	Hours
5	Calculate max retention depth that can be drawn down within the drawdown time (feet), $D_{max} = K_{design} \times T \times (1/12)$	D_{max}=	10	feet
6	Calculate minimum area required for BMP (sq-ft), $A_{min} = V_{design} / d_{max}$	A_{min}=	43	sq-ft

[1] $K_{observed}$ is the vertical infiltration measured in the field, before applying a factor of safety. If field testing measures a rate that is different than the vertical infiltration rate (for example, three-dimensional borehole percolation rate), then this rate must be adjusted by an acceptable method (for example, Porchet method) to yield the field estimate of vertical infiltration rate, $K_{observed}$. See Appendix VII.

Proposed BMP is Biorention with a 4" underdrain. The approximate size is 8'x10' (80 sq-ft). The bottom of the basin is at an elevation of 38.0 with a 4' wide overflow at an elevation of 39.0.

Worksheet B: Simple Design Capture Volume Sizing Method

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter design capture storm depth from Figure III.1, *d* (inches)	d=	0.85	inches
2	Enter the effect of provided HSCs, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0.0	inches
3	Calculate the remainder of the design capture storm depth, $d_{remainder}$ (inches) (Line 1 – Line 2)	$d_{remainder}$=	0.85	inches
Step 2: Calculate the DCV				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	2.19	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.82	
3	Calculate runoff coefficient, *C= (0.75 x imp) + 0.15*	C=	0.77	
4	Calculate runoff volume, V_{design}= *(C x* $d_{remainder}$ *x A x 43560 x (1/12))*	V_{design}=	5,203	cu-ft
Step 3: Design BMPs to ensure full retention of the DCV				
Step 3a: Determine design infiltration rate				
1	Enter measured infiltration rate, $K_{observed}$[1] (in/hr) (**Appendix VII**)	$K_{observed}$=		In/hr
2	Enter combined safety factor from Worksheet H, S_{total} (unitless)	S_{total}=		
3	Calculate design infiltration rate, $K_{design} = K_{observed} / S_{total}$	K_{design}=	2.5	In/hr
Step 3b: Determine minimum BMP footprint				
4	Enter drawdown time, *T* (max 48 hours)	T=	48	Hours
5	Calculate max retention depth that can be drawn down within the drawdown time (feet), $D_{max} = K_{design} \times T \times (1/12)$	D_{max}=	10	feet
6	Calculate minimum area required for BMP (sq-ft), $A_{min} = V_{design} / d_{max}$	A_{min}=	663	sq-ft

[1] $K_{observed}$ is the vertical infiltration measured in the field, before applying a factor of safety. If field testing measures a rate that is different than the vertical infiltration rate (for example, three-dimensional borehole percolation rate), then this rate must be adjusted by an acceptable method (for example, Porchet method) to yield the field estimate of vertical infiltration rate, $K_{observed}$. See Appendix VII.

Proposed BMP is Biorention with a 4" underdrain. The approximate size is 80'x10' (800 sq-ft). The bottom of the basin is at an elevation of 38.0 with a 6' wide overflow at an elevation of 39.5.

Worksheet B: Simple Design Capture Volume Sizing Method

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter design capture storm depth from Figure III.1, *d* (inches)	d=	0.85	inches
2	Enter the effect of provided HSCs, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0.0	inches
3	Calculate the remainder of the design capture storm depth, $d_{remainder}$ (inches) (Line 1 – Line 2)	$d_{remainder}$=	0.85	inches
Step 2: Calculate the DCV				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	0.53	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.34	
3	Calculate runoff coefficient, *C= (0.75 x imp) + 0.15*	C=	0.41	
4	Calculate runoff volume, V_{design}= *(C x* $d_{remainder}$ *x A x 43560 x (1/12))*	V_{design}=	670	cu-ft
Step 3: Design BMPs to ensure full retention of the DCV				
Step 3a: Determine design infiltration rate				
1	Enter measured infiltration rate, $K_{observed}$[1] (in/hr) (**Appendix VII**)	$K_{observed}$=		In/hr
2	Enter combined safety factor from Worksheet H, S_{total} (unitless)	S_{total}=		
3	Calculate design infiltration rate, $K_{design} = K_{observed} / S_{total}$	K_{design}=	2.5	In/hr
Step 3b: Determine minimum BMP footprint				
4	Enter drawdown time, *T* (max 48 hours)	T=	48	Hours
5	Calculate max retention depth that can be drawn down within the drawdown time (feet), $D_{max} = K_{design} \times T \times (1/12)$	D_{max}=	10	feet
6	Calculate minimum area required for BMP (sq-ft), $A_{min} = V_{design} / d_{max}$	A_{min}=	226	sq-ft

[1] $K_{observed}$ is the vertical infiltration measured in the field, before applying a factor of safety. If field testing measures a rate that is different than the vertical infiltration rate (for example, three-dimensional borehole percolation rate), then this rate must be adjusted by an acceptable method (for example, Porchet method) to yield the field estimate of vertical infiltration rate, $K_{observed}$. See Appendix VII.

Proposed BMP is Biorention with a 4" underdrain. The approximate size is 4'x75' (300 sq-ft). The bottom of the basin is at an elevation of 40.0 with a 6' wide overflow at an elevation of 41.0.

Worksheet B: Simple Design Capture Volume Sizing Method

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter design capture storm depth from Figure III.1, *d* (inches)	d=	0.85	inches
2	Enter the effect of provided HSCs, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0.0	inches
3	Calculate the remainder of the design capture storm depth, $d_{remainder}$ (inches) (Line 1 – Line 2)	$d_{remainder}$=	0.85	inches
Step 2: Calculate the DCV				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	0.30	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.17	
3	Calculate runoff coefficient, *C= (0.75 x imp) + 0.15*	C=	0.28	
4	Calculate runoff volume, V_{design}= *(C x* $d_{remainder}$ *x A x 43560 x (1/12))*	V_{design}=	260	cu-ft
Step 3: Design BMPs to ensure full retention of the DCV				
Step 3a: Determine design infiltration rate				
1	Enter measured infiltration rate, $K_{observed}$[1] (in/hr) (**Appendix VII**)	$K_{observed}$=		In/hr
2	Enter combined safety factor from Worksheet H, S_{total} (unitless)	S_{total}=		
3	Calculate design infiltration rate, $K_{design} = K_{observed} / S_{total}$	K_{design}=	2.5	In/hr
Step 3b: Determine minimum BMP footprint				
4	Enter drawdown time, *T* (max 48 hours)	T=	48	Hours
5	Calculate max retention depth that can be drawn down within the drawdown time (feet), $D_{max} = K_{design} \times T \times (1/12)$	D_{max}=	10	feet
6	Calculate minimum area required for BMP (sq-ft), $A_{min} = V_{design} / d_{max}$	A_{min}=	83	sq-ft

[1] $K_{observed}$ is the vertical infiltration measured in the field, before applying a factor of safety. If field testing measures a rate that is different than the vertical infiltration rate (for example, three-dimensional borehole percolation rate), then this rate must be adjusted by an acceptable method (for example, Porchet method) to yield the field estimate of vertical infiltration rate, $K_{observed}$. See Appendix VII.

Proposed BMP is Biorention with a 4" underdrain. The approximate size is 12'x12' (144 sq-ft). The bottom of the basin is at an elevation of 40.0 with a 6' wide overflow at an elevation of 41.0.

raSmith

CREATIVITY BEYOND ENGINEERING

Preliminary Hydrology and Hydraulic Report for

Amazon Delivery Station, DLX7

6400 Katella Avenue
City of Cypress, Orange County, California

RASN Project No. 3190323

Date: May 18, 2020
Rev. June 23, 2020
Rev. July 2, 2020
Rev. August 4, 2020

Preliminary

Hydrology and Hydraulic Report

FOR

Amazon Delivery Station, DLX7
6400 Katella Avenue
City of Cypress, Orange County, California

Prepared for:

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Web: rasmith.com

Preparation Date
May 18, 2020
June 23, 2020
July 2, 2020
August 4, 2020

Section I. Table of Contents

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Section IV - Existing Hydrology

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Attachment B – Orange County Drainage Facilities Map

Attachment C – TR-55 Model Output

Attachment C – Existing Conditions Exhibit

Attachment D – Proposed Conditions Exhibit

Section II. Executive Summary

The proposed Amazon Delivery Station project is located on 23.31 acres at 6400 Katella Ave. in the City of Cypress. The project has been designed to be compliant with the City of City of Cypress Municipal Standards and the 2003 Orange County Drainage Area Management Plan. Filterra Bioscape Vaults and Bioretention with underdrains will be used to treat pollutants prior to discharge back into the existing storm drains. The central parking lot will include underground detention (600' of 48" Pipe) tied to the Filterra units for storage purposes. Only a portion of the site, 15.96 acres will be within the limits of construction and this study will only account for those areas.

Section III. Site Description

The existing site has been used as the headquarters and design studio for the Mitsubishi Motor Company since it was constructed in 1988. There are multiple buildings, parking lots, a tennis court, sidewalks, and associated landscaping.

The proposed site will be used as an Amazon Warehouse and Delivery Station. Parking lots and traffic flow will be reconstructed to work more efficiently with this use. Sidewalks and landscaping will be modified as necessary. Additionally, Katella Ave will be widened about 5' to the south to accommodate another turn lane.

Section IV. Existing Hydrology

There is a large 45" diameter existing storm drain located on the west side of the site that flows from south of Katella Ave to the Stanton Channel. As the site is relatively flat, multiple inlet drains are connected to main via storm drain. Runoff sheet flows into the inlets and via underground drains to the Stanton Channel (C02S01). The channel continues to the Bolsa Chica Channel and discharges into the Anaheim Bay.

Section V. Proposed Hydrology

The majority of the mainline storm drain as discussed in Section IV will be preserved. In the proposed condition, runoff will be routed via sheet flow to BMPs (Filterra Bioscape Vaults and Bioretention with underdrain) to treat pollutants prior to being discharged back into the existing storm sewer system via additional underground storm drain. Additionally, the central parking lot will include underground detention (600' of 48" Pipe) tied to the Filterra units for storage purposes. Due to high groundwater infiltration is not expected. See County Groundwater maps in Attachment B.

Section VI. Methodology

The hydrologic analysis was performed in accordance with Tehcnical Release 55 (TR-55) as allowed in the Orange County Technical Guidance Document. Table 1 shows the rainfall depth used for drainage areas below 2,000 ft. per the Orange County Hydrology Manual. Hydrologic analysis included in this report was performed using the HydroCAD hydrologic simulation computer model, version 10.00 by HydroCAD Software Solutions LLC. The discharges were generated using the SCS Dimensionless Unit Hydrograph Method for a 24-hour duration storm. Model parameters include drainage area, SCS runoff curve number, time of concentration and 24-hour precipitation with Type I rainfall distribution curve.

Table 1 – Design Storm Events for City of Cypress, Orange Co.
Per TGD

Frequency (years)	Duration (hours)	Rainfall Depth (inches)
2	24	2.05

The runoff curve number is determined by the soils, vegetation cover, amount of impervious area, and surface storage to convert the mass of rainfall into the mass runoff in the SCS Method. Higher curve numbers mean more potential runoff. Composite curve numbers were determined from the existing and proposed land uses.

The hydraulic length is the distance from the most hydraulically remote point in the watershed to the outlet of that area. This parameter is used in computing the basin lag and the unit hydrograph.

The time of concentration is the time required for water to flow from the most remote part of the drainage area to the point of design. The water moves through the watershed or sub-basin as sheet flow, shallow concentrated flow, open channel flow, gutter flow, storm drain flow, culvert flow or any combination of these aforementioned items.

Table 2 – Design Summary
Per TR-55 Model

DMA (Ac.)	AREA (Ac.)	CN	Tc (Min.)	Peak Flow (cfs)	Runoff Volume (ac-ft)	Runoff Volume (cu-ft)	Capture Volume (cu-ft)	Reduced Runoff Volume(cu-ft)
EXISTING	**14.96**	**82**	**5**	**7.32**	**0.850**	**37,026**	**-**	**-**
1	6.06	86	5	0.39	0.448	19,515	6,112	13,403
2	1.11	85	5	0.18	0.077	3,354	538	2,816
3	0.44	82	5	0.22	0.025	1,089	48	1,041
4	0.27	94	5	0.33	0.032	1,394	36	1,358
5	0.42	94	5	0.51	0.050	2,178	60	2,118
6	0.3	94	5	0.36	0.036	1,568	48	1,520
7	0.28	66	5	0.00	0.004	174	1	173
8	2.72	89	5	0.46	0.242	10,542	2,739	7,803
9	1.11	79	5	0.24	0.051	2,222	140	2,082
10	0.51	69	5	0.02	0.010	436	6	430
11	1.74	86	5	1.21	0.129	5,619	0	5,619
TOTAL	**14.96**	**-**	**-**	**3.92**	**1.104**	**48,090**	**9,728**	**38,362**

Section VII. Summary

With the use of the Filterra Bioscape Vaults, 600’ of 48” Pipe used for Underground Detention and Bioretention with underdrains for water quality and quantity we will be able to meet the City and County requirements for Stormwater Management. Peak flows from the sited are reduced from 7.32 cfs to 3.92 cfs. Additionally, runoff volume increase by 3.6% which is under the allowable 5%.

Attachment A - USGS Soil Survey

Hydrologic Soil Group—Orange County and Part of Riverside County, California
(Amazon DLX7 Soils)



Map Scale: 1:2,210 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 30 60 120 180

Feet
0 100 200 400 600

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 13, Sep 16, 2019

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

Date(s) aerial images were photographed: Apr 13, 2018—Jan 25, 2019

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
158	Hueneme fine sandy loam, drained	A	22.8	100.0%
Totals for Area of Interest			**22.8**	**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.

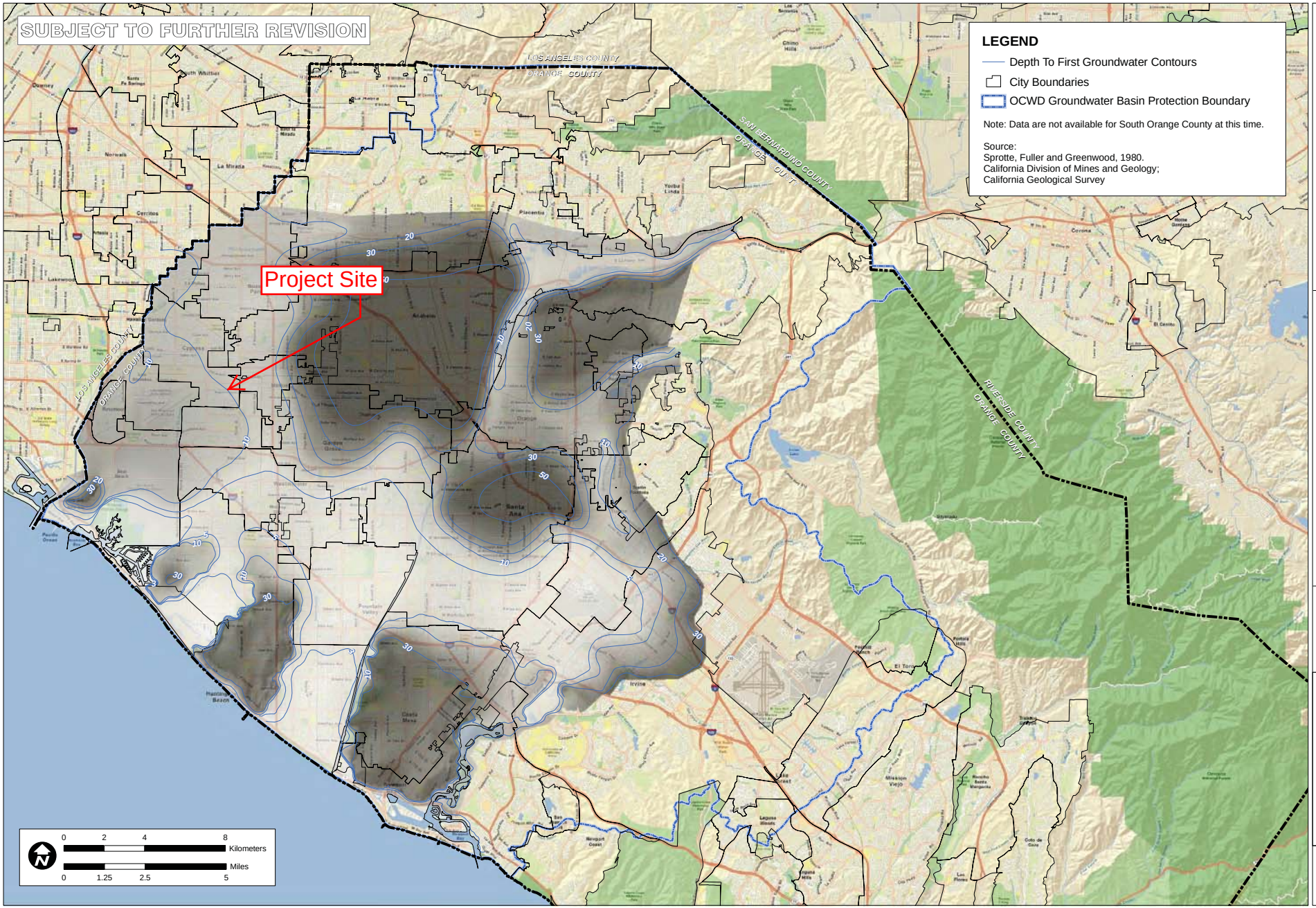
If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher



TITLE
NORTH ORANGE COUNTY
MAPPED DEPTH TO FIRST
GROUNDWATER

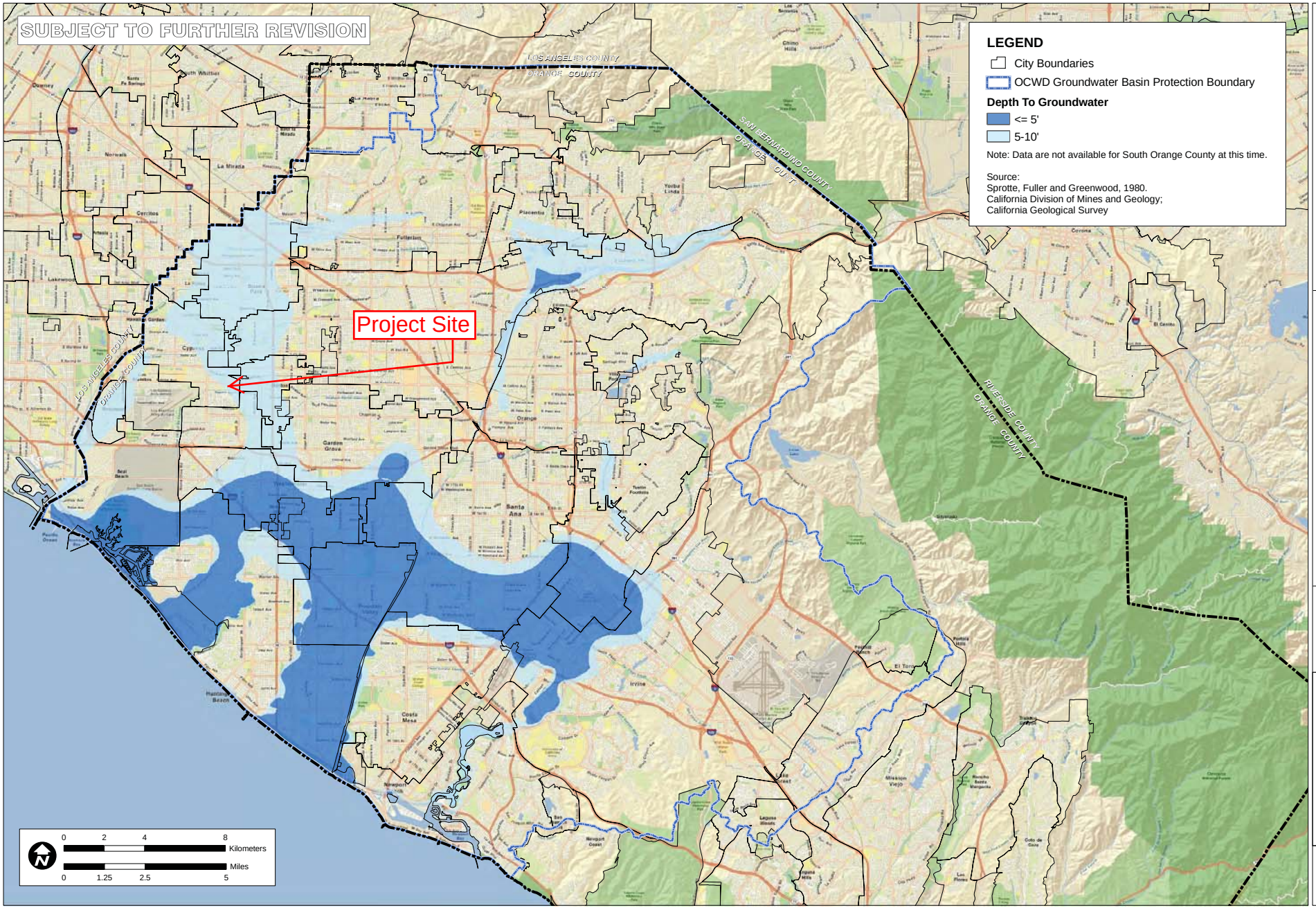
JOB
ORANGE COUNTY
INFILTRATION STUDY
ORANGE CO. CA

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-2d

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P:\9526E\16-GIS\Mxds\Reports\InfiltrationFeasability_20110215\9526E_FigureXVI-2e_DepthToGroundwaterUSH_20110215.mxd

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

Attachment B – Orange County Drainage Facilities Map

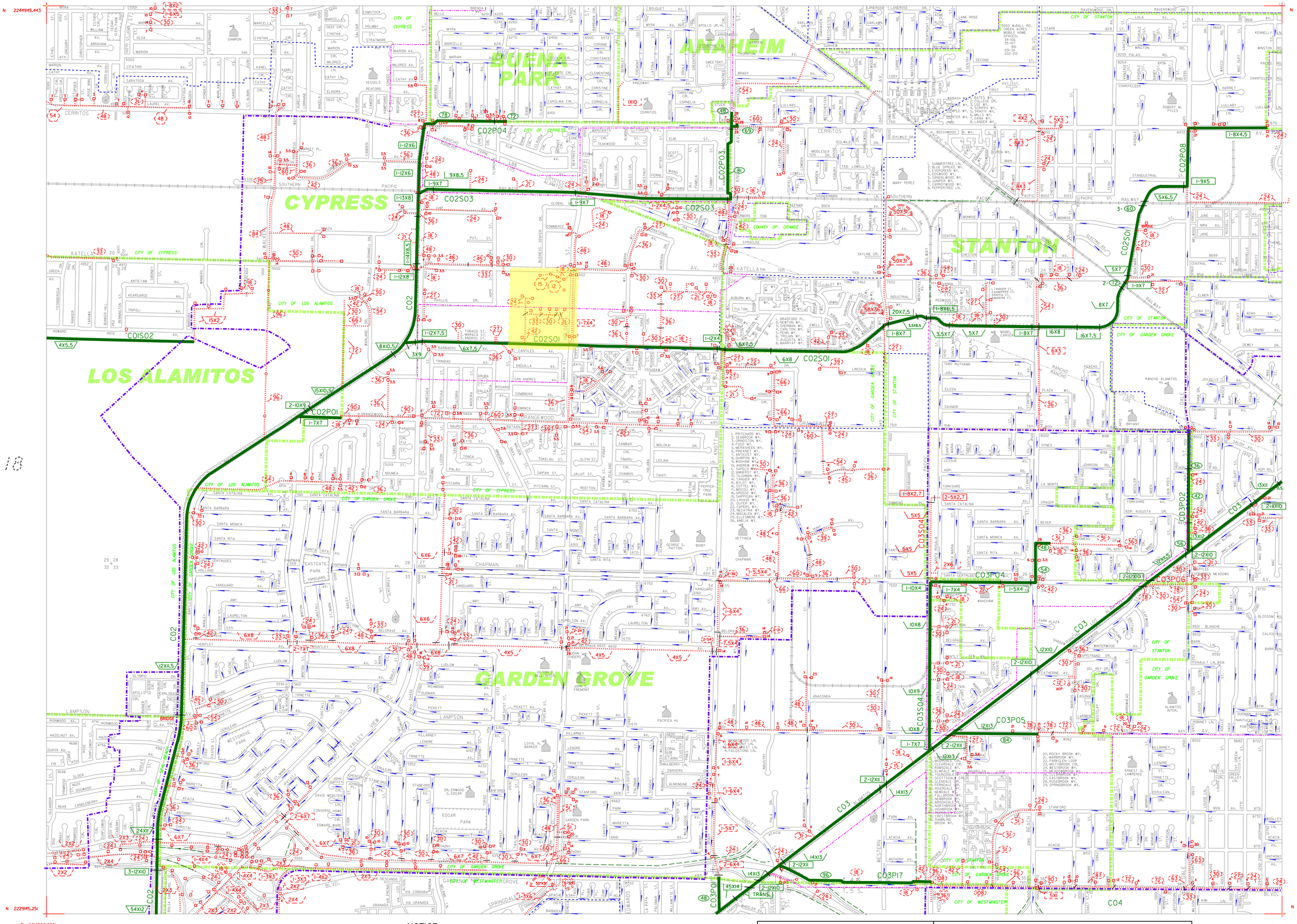
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E 6036406.959
N 2244945.434

12

18

20



19

N 2229145.251
E 6014906.805

N 2229144.956
E 6036407.116

27

NOTICE

The drainage information has been prepared for information purposes only. The location, ownership, facility information and limits have been determined from available information provided by public agencies, but may not be exact, accurate, or up-to-date. The user of this information is responsible for verifying exact location, ownership, accuracy, and the regional versus local character of drainage facilities.

Additional information may be obtained from public plans and recorded deeds. Facility designations included with this information are for convenience only and are not controlling or intended to imply ownership by the County or the Orange County Flood Control District (OCFCD). The information is being provided as a courtesy and neither the County of Orange nor OCFCD assume any liabilities for inaccuracy of the information.

To notify OC Public Works Flood Control Section of additions or corrections, please contact Sal Gutierrez at (714) 647-3992 or by email at sal.gutierrez@ocpw.ocgov.com

N

0 200 400 600 800
FEET

ORANGE COUNTY FLOOD CONTROL DISTRICT

BASE MAP OF DRAINAGE FACILITIES IN ORANGE COUNTY

REVISION	DATE	SHEET NO.	DWG. NO.
S. GUTIERREZ	JAN 23,2012	19	MAPS-113-3

- Channel Drainage Area Boundary
- Major Sub-Area Drainage Boundary
- Minor Sub-Area Drainage Boundary
- Existing O.C.F.C.D. Facility
- Existing Local Facility
- Existing Retarding Basin or Reservoir
- Natural Watercourse
- City Limits
- G G Greenbelt
- P.S. P.S. Pump Station
- Catch Basin (length in feet)
- Drop Inlet or Other Entry
- OCFCD Basins or Reservoirs

Ownership (If other than City or County): Private = P State = S Federal = F

EXISTING FACILITIES

O.C.F.C.D.	LOCAL
	Earth Trapezoidal Channel (base width by height in feet)
	Reinforced Concrete Trapezoidal Channel (base width by height in feet)
	Reinforced Concrete Rectangular Channel (base width by height in feet)
	Reinforced Concrete Box (RCB) (number of barrels-span by height in feet)
	Reinforced Concrete Pipe (RCP) (diameter in inches)
	Metal Sheet Channel (MSC) (Base width by pile height in feet.Sheet pile total length)
	Corrugated Metal Pipe (CMP) (diameter in inches)
	Concrete Pipe (diameter in inches)
	Concrete Oval Pipe (width by height in inches)
	Steel Pipe (diameter in inches)
	Reinforced Concrete Arch (base span by height in inches)
	Corrugated Metal Arch (base span by height in inches)

E 6014906.805
N 2229145.251

E 6036407.186
N 2229144.956

19

26

28

27

36

WESTMINSTER

HUNTINGTON BEACH

CITY OF WESTMINSTER

CITY OF GARDEN GROVE

CITY OF HUNTINGTON BEACH

COUNTY OF ORANGE

CONCRETE CHANNEL

CONCRETE DRAINAGE CHANNEL

C02 C03 C03S01 C03S02 C03S03 C04 C05P06 C05P07 C05P24 C05P27 C05P32 C05S05 C05S06

E 6014906.821
N 2213345.157

E 6036407.139
N 2213344.878

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To notify OC Public Works Flood Control Section of additions or corrections, please contact Sal Gutierrez at (714) 834-5396 or by email at sal.gutierrez@ocpw.ocgov.com

0 200 400 600 800
FEET

ORANGE COUNTY FLOOD CONTROL DISTRICT

BASE MAP OF DRAINAGE FACILITIES IN ORANGE COUNTY

REVISION	DATE	SHEET NO.	DWG. NO.
S. GUTIERREZ	JAN.12/2000	27	MAPS-113-3

- Channel Drainage Area Boundary
- Major Sub-Area Drainage Boundary
- Minor Sub-Area Drainage Boundary
- Existing O.C.F.C.D. Facility
- Existing Local Facility
- Existing Retarding Basin or Reservoir
- Natural Watercourse
- City Limits
- Greenbelt
- Pump Station
- Catch Basin (length in feet)
- Drop Inlet or Other Entry
- OCFCD Basins or Reservoirs

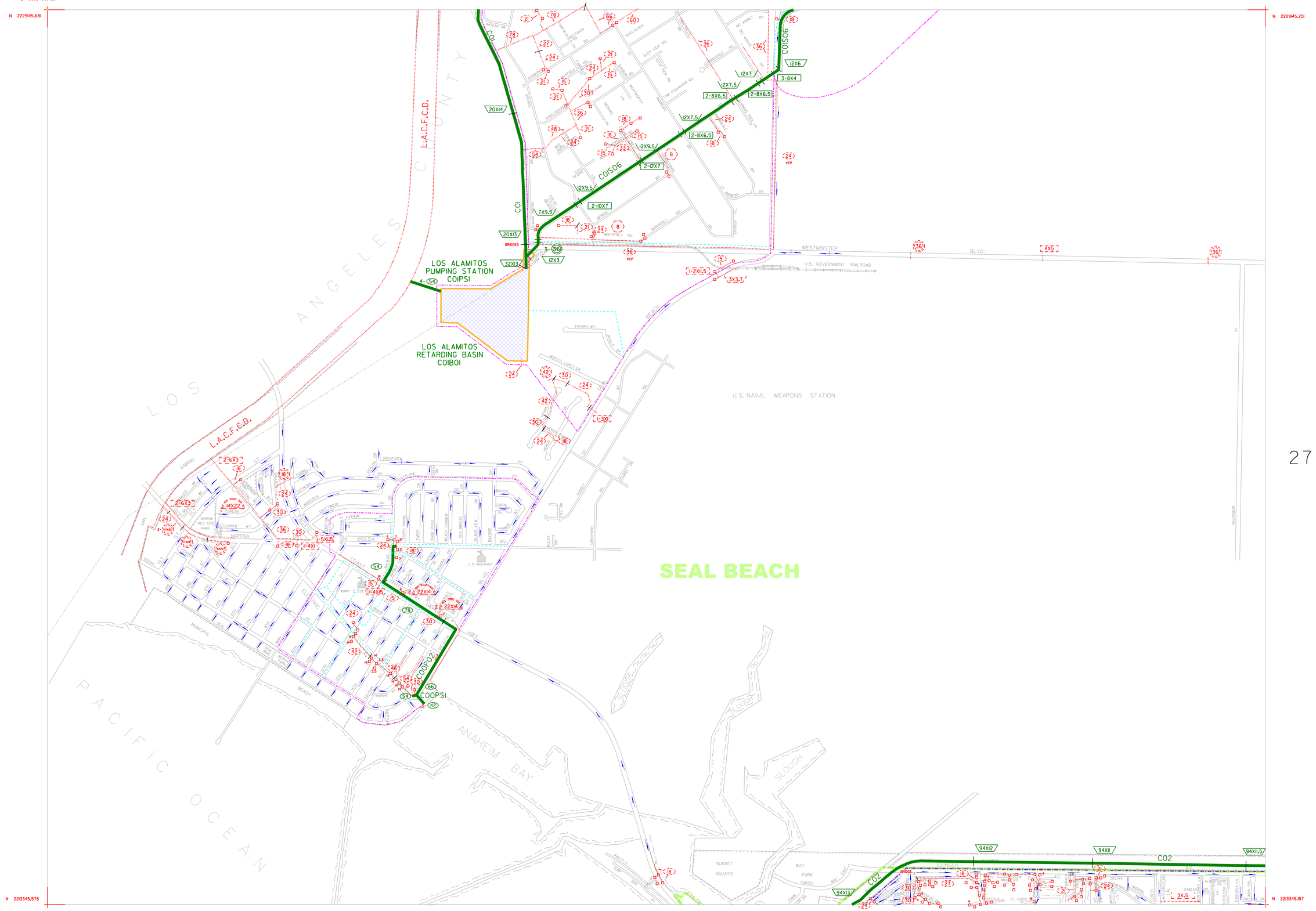
Ownership (If other than City or County): Private = P State = S Federal = F

EXISTING FACILITIES

O.C.F.C.D.	LOCAL	
		Earth Trapezoidal Channel (base width by height in feet)
		Reinforced Concrete Trapezoidal Channel (base width by height in feet)
		Reinforced Concrete Rectangular Channel (base width by height in feet)
		Reinforced Concrete Box (RCB) (number of barrels-span by height in feet)
		Reinforced Concrete Pipe (RCP) (diameter in inches)
		Metal Sheet Channel (MSC) (Base width by pile height in feet./Sheet pile total length)
		Corrugated Metal Pipe (CMP) (diameter in inches)
		Concrete Pipe (diameter in inches)
		Concrete Oval Pipe (width by height in inches)
		Steel Pipe (diameter in inches)
		Reinforced Concrete Arch (base span by height in inches)
		Corrugated Metal Arch (base span by height in inches)

E 5993406.420
N 2229145.681

E 6014906.805
N 2229145.251



N

0 200 400 600 800
FEET

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The drainage information has been prepared for information purposes only. The location, ownership, facility information and limits have been determined from available information provided by public agencies, but may not be exact, accurate, or up-to-date. The user of this information is responsible for verifying exact location, ownership, accuracy, and the regional versus local character of drainage facilities.

Additional information may be obtained from public plans and recorded deeds. Facility designations included with this information are for convenience only and are not controlling or intended to imply ownership by the County or the Orange County Flood Control District (OCFCD). The information is being provided as a courtesy and neither the County of Orange nor OCFCD assume any liabilities for inaccuracy of the information.

To notify the Resources & Development Management Department (RDMD) of additions or corrections, please contact Sal Gutierrez at (714) 834-5396 or by email at sal.gutierrez@rdmd.ocgov.com

ORANGE COUNTY FLOOD CONTROL DISTRICT

BASE MAP
OF DRAINAGE FACILITIES
IN ORANGE COUNTY

REVISION	DATE	SHEET NO.	DWG. NO.
S. GUTIERREZ	MAR. 7, 2007	26	MAPS-113-3

- Channel Drainage Area Boundary
- Major Sub-Area Drainage Boundary
- Minor Sub-Area Drainage Boundary
- Existing O.C.F.C.D. Facility
- Existing Local Facility
- Existing Retarding Basin or Reservoir
- Natural Watercourse
- City Limits
- G G Greenbelt
- P.S. P.S. Pump Station
- Catch Basin (length in feet)
- Drop Inlet or Other Entry
- OCFCD Basins or Reservoirs

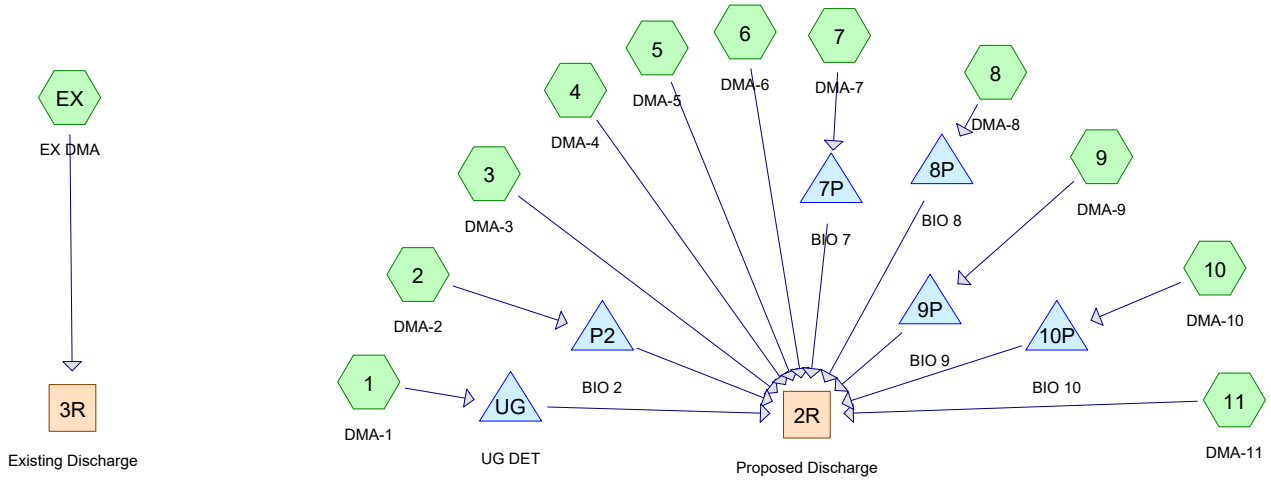
Ownership (If other than City or County): Private = P State = S Federal = F

EXISTING FACILITIES

O.C.F.C.D.	LOCAL	
		Earth Trapezoidal Channel (base width by height in feet)
		Reinforced Concrete Trapezoidal Channel (base width by height in feet)
		Reinforced Concrete Rectangular Channel (base width by height in feet)
		Reinforced Concrete Box (RCB) (number of barrels-span by height in feet)
		Reinforced Concrete Pipe (RCP) (diameter in inches)
		Metal Sheet Channel (MSC) (Base width by pile height in feet /Sheet pile total length)
		Corrugated Metal Pipe (CMP) (diameter in inches)
		Concrete Pipe (diameter in inches)
		Concrete Oval Pipe (width by height in inches)
		Steel Pipe (diameter in inches)
		Reinforced Concrete Arch (base span by height in inches)
		Corrugated Metal Arch (base span by height in inches)

26

Attachment C – TR-55 Model Output



Subcat Reach Pond Link

Routing Diagram for DLX7 - Cypress Amazon Delivery
Prepared by {enter your company name here}, Printed 8/5/2020
HydroCAD® 10.00-22 s/n 02878 © 2018 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
7.290	39	>75% Grass cover, Good, HSG A (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, EX)
22.630	98	Paved parking, HSG A (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, EX)
29.920	**84**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
29.920	HSG A	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, EX
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
29.920		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
7.290	0.000	0.000	0.000	0.000	7.290	>75% Grass cover, Good	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, EX
22.630	0.000	0.000	0.000	0.000	22.630	Paved parking	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, EX
29.920	**0.000**	**0.000**	**0.000**	**0.000**	**29.920**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	7P	37.00	36.90	25.0	0.0040	0.013	8.0	0.0	0.0
2	8P	37.00	36.90	25.0	0.0040	0.013	8.0	0.0	0.0
3	9P	37.00	36.90	25.0	0.0040	0.013	8.0	0.0	0.0
4	10P	37.00	36.90	25.0	0.0040	0.013	8.0	0.0	0.0
5	P2	37.00	36.90	25.0	0.0040	0.013	8.0	0.0	0.0
6	UG	35.70	35.10	28.9	0.0208	0.011	8.0	0.0	0.0

Time span=5.00-30.00 hrs, dt=0.05 hrs, 501 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1: DMA-1 Runoff Area=6.060 ac 79.54% Impervious Runoff Depth=0.89"
Tc=5.0 min CN=86 Runoff=4.21 cfs 0.448 af

Subcatchment2: DMA-2 Runoff Area=1.110 ac 77.48% Impervious Runoff Depth=0.83"
Tc=5.0 min CN=85 Runoff=0.71 cfs 0.077 af

Subcatchment3: DMA-3 Runoff Area=0.440 ac 72.73% Impervious Runoff Depth=0.68"
Tc=5.0 min CN=82 Runoff=0.22 cfs 0.025 af

Subcatchment4: DMA-4 Runoff Area=0.270 ac 92.59% Impervious Runoff Depth>1.44"
Tc=5.0 min CN=94 Runoff=0.33 cfs 0.032 af

Subcatchment5: DMA-5 Runoff Area=0.420 ac 92.86% Impervious Runoff Depth>1.44"
Tc=5.0 min CN=94 Runoff=0.51 cfs 0.050 af

Subcatchment6: DMA-6 Runoff Area=0.300 ac 93.33% Impervious Runoff Depth>1.44"
Tc=5.0 min CN=94 Runoff=0.36 cfs 0.036 af

Subcatchment7: DMA-7 Runoff Area=0.280 ac 46.43% Impervious Runoff Depth=0.17"
Tc=5.0 min CN=66 Runoff=0.00 cfs 0.004 af

Subcatchment8: DMA-8 Runoff Area=2.720 ac 85.29% Impervious Runoff Depth=1.07"
Tc=5.0 min CN=89 Runoff=2.38 cfs 0.242 af

Subcatchment9: DMA-9 Runoff Area=1.110 ac 68.47% Impervious Runoff Depth=0.55"
Tc=5.0 min CN=79 Runoff=0.40 cfs 0.051 af

Subcatchment10: DMA-10 Runoff Area=0.510 ac 50.98% Impervious Runoff Depth=0.23"
Tc=5.0 min CN=69 Runoff=0.02 cfs 0.010 af

Subcatchment11: DMA-11 Runoff Area=1.740 ac 80.46% Impervious Runoff Depth=0.89"
Tc=5.0 min CN=86 Runoff=1.21 cfs 0.129 af

SubcatchmentEX: EX DMA Runoff Area=14.960 ac 72.46% Impervious Runoff Depth=0.68"
Tc=5.0 min CN=82 Runoff=7.32 cfs 0.850 af

Reach 2R: Proposed Discharge Inflow=3.45 cfs 1.104 af
Outflow=3.45 cfs 1.104 af

Reach 3R: Existing Discharge Inflow=7.32 cfs 0.850 af
Outflow=7.32 cfs 0.850 af

Pond 7P: BIO 7 Peak Elev=37.04' Storage=1 cf Inflow=0.00 cfs 0.004 af
Outflow=0.00 cfs 0.004 af

Pond 8P: BIO 8 Peak Elev=42.04' Storage=2,739 cf Inflow=2.38 cfs 0.242 af
Outflow=0.46 cfs 0.242 af

Pond 9P: BIO 9 Peak Elev=38.17' Storage=140 cf Inflow=0.40 cfs 0.051 af
Outflow=0.24 cfs 0.051 af

Pond 10P: BIO 10 Peak Elev=37.10' Storage=6 cf Inflow=0.02 cfs 0.010 af
Outflow=0.02 cfs 0.010 af

Pond P2: BIO 2 Peak Elev=39.99' Storage=538 cf Inflow=0.71 cfs 0.077 af
Outflow=0.18 cfs 0.077 af

Pond UG: UG DET Peak Elev=38.65' Storage=0.137 af Inflow=4.21 cfs 0.448 af
Outflow=0.39 cfs 0.447 af

Total Runoff Area = 29.920 ac Runoff Volume = 1.954 af Average Runoff Depth = 0.78"
24.36% Pervious = 7.290 ac 75.64% Impervious = 22.630 ac

Summary for Subcatchment 1: DMA-1

[49] Hint: Tc<2dt may require smaller dt

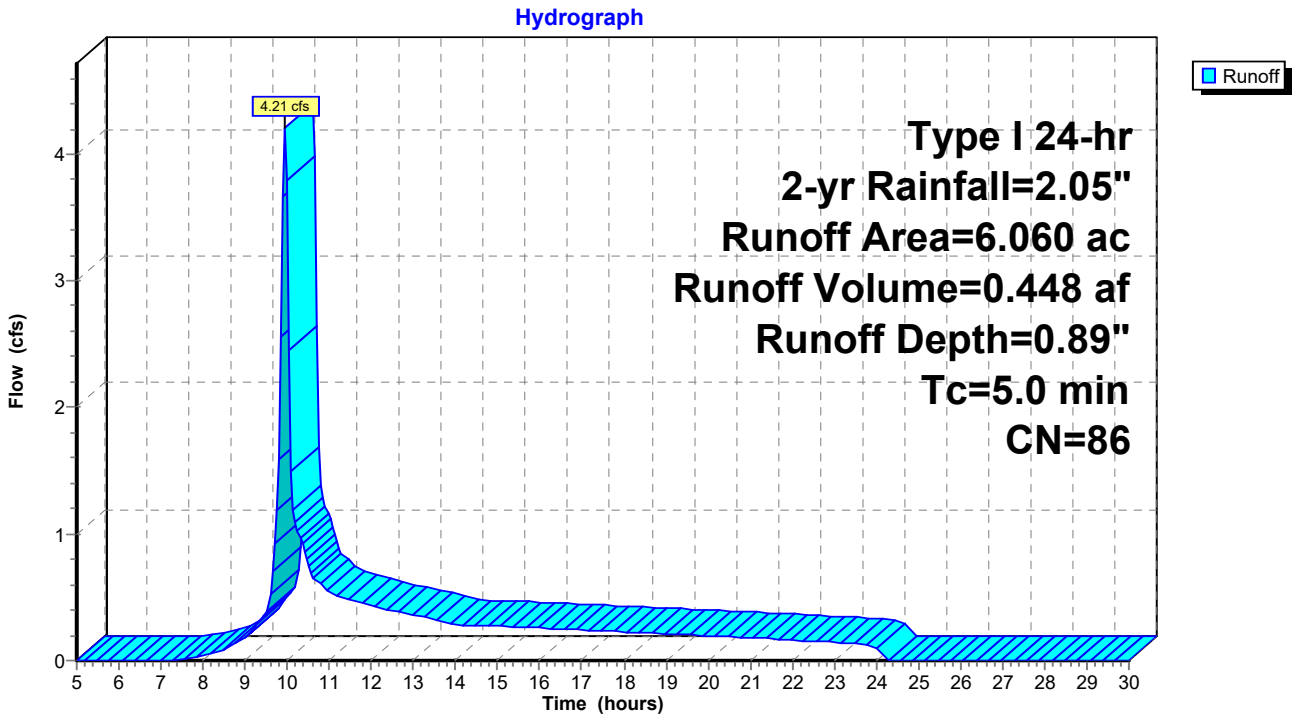
Runoff = 4.21 cfs @ 9.95 hrs, Volume= 0.448 af, Depth= 0.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type I 24-hr 2-yr Rainfall=2.05"

Area (ac)	CN	Description
4.820	98	Paved parking, HSG A
1.240	39	>75% Grass cover, Good, HSG A
6.060	86	Weighted Average
1.240		20.46% Pervious Area
4.820		79.54% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 1: DMA-1



Summary for Subcatchment 2: DMA-2

[49] Hint: Tc<2dt may require smaller dt

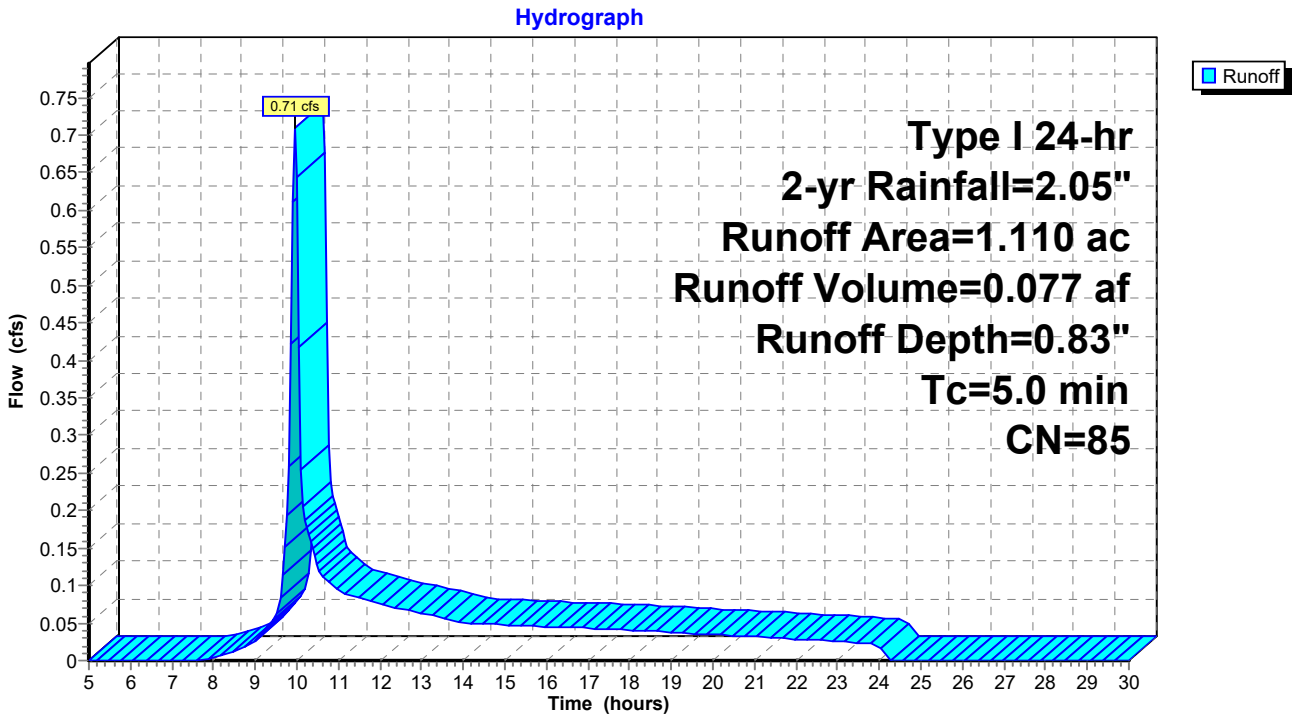
Runoff = 0.71 cfs @ 9.95 hrs, Volume= 0.077 af, Depth= 0.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type I 24-hr 2-yr Rainfall=2.05"

Area (ac)	CN	Description
0.860	98	Paved parking, HSG A
0.250	39	>75% Grass cover, Good, HSG A
1.110	85	Weighted Average
0.250		22.52% Pervious Area
0.860		77.48% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2: DMA-2



Summary for Subcatchment 3: DMA-3

[49] Hint: Tc<2dt may require smaller dt

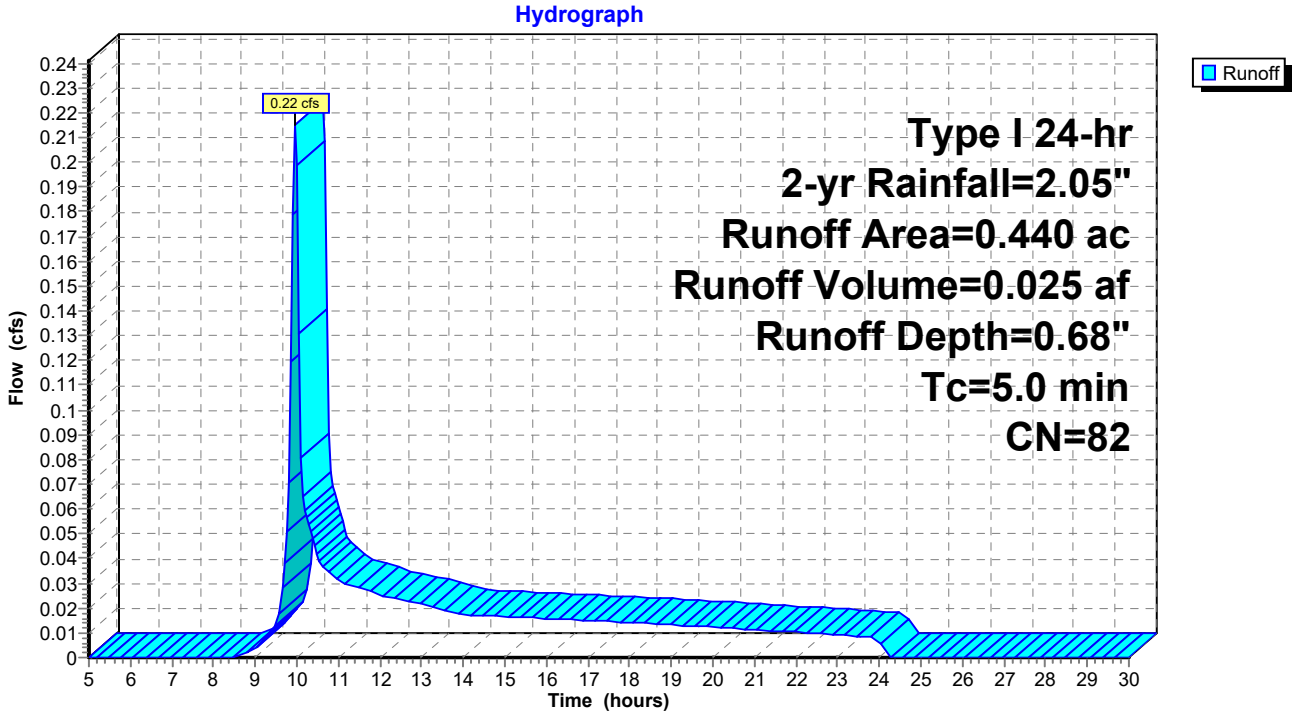
Runoff = 0.22 cfs @ 9.96 hrs, Volume= 0.025 af, Depth= 0.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type I 24-hr 2-yr Rainfall=2.05"

Area (ac)	CN	Description
0.320	98	Paved parking, HSG A
0.120	39	>75% Grass cover, Good, HSG A
0.440	82	Weighted Average
0.120		27.27% Pervious Area
0.320		72.73% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3: DMA-3



Summary for Subcatchment 4: DMA-4

[49] Hint: Tc<2dt may require smaller dt

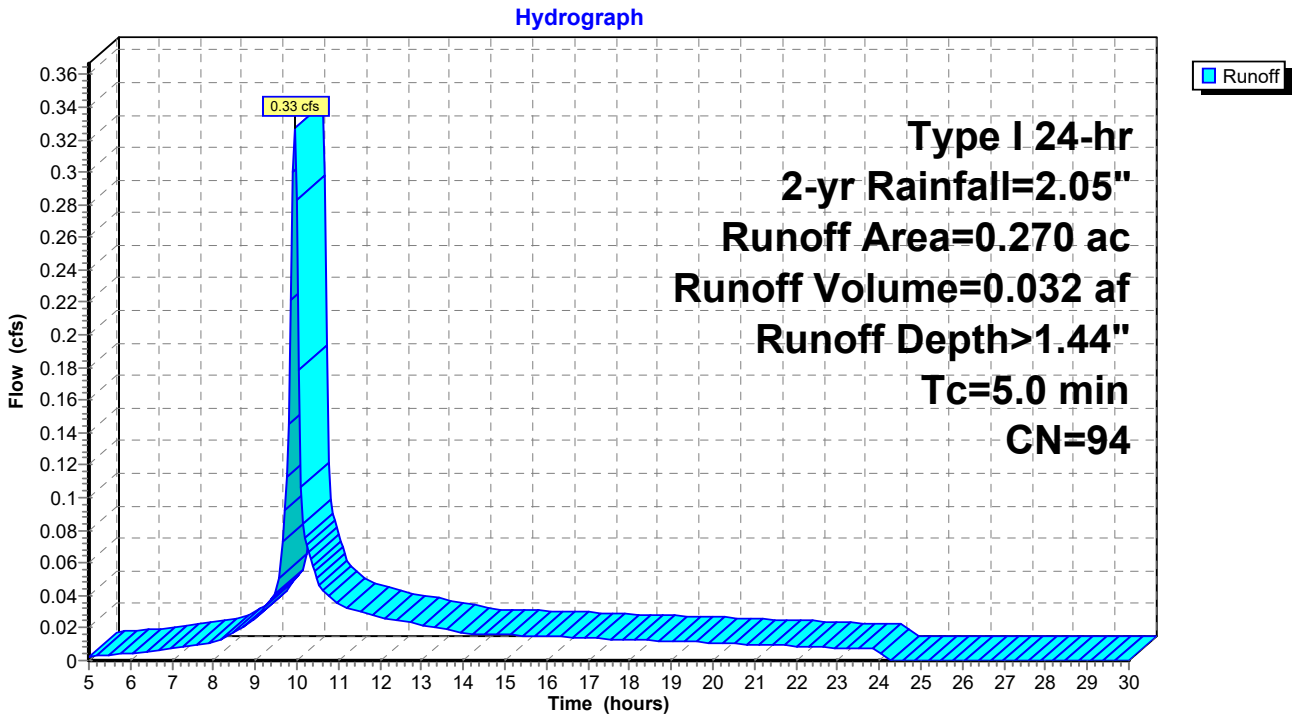
Runoff = 0.33 cfs @ 9.94 hrs, Volume= 0.032 af, Depth> 1.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type I 24-hr 2-yr Rainfall=2.05"

Area (ac)	CN	Description
0.250	98	Paved parking, HSG A
0.020	39	>75% Grass cover, Good, HSG A
0.270	94	Weighted Average
0.020		7.41% Pervious Area
0.250		92.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 4: DMA-4



Summary for Subcatchment 5: DMA-5

[49] Hint: Tc<2dt may require smaller dt

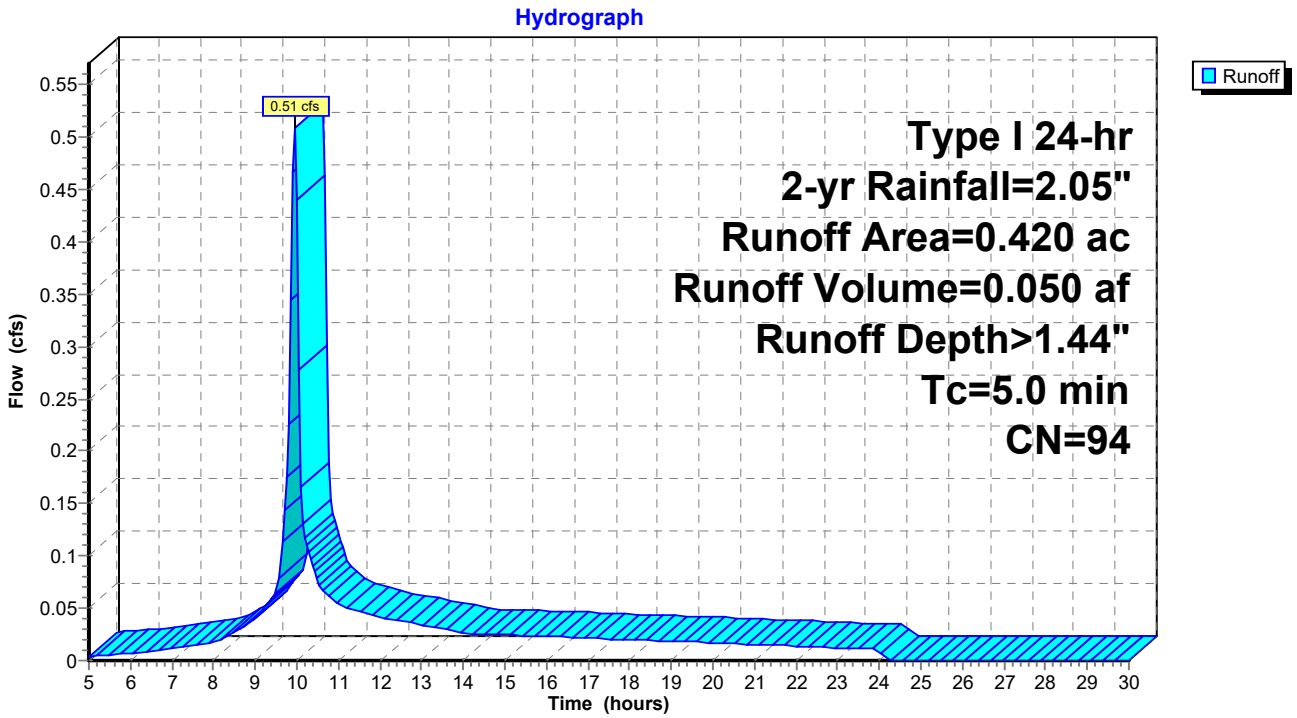
Runoff = 0.51 cfs @ 9.94 hrs, Volume= 0.050 af, Depth> 1.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type I 24-hr 2-yr Rainfall=2.05"

Area (ac)	CN	Description
0.390	98	Paved parking, HSG A
0.030	39	>75% Grass cover, Good, HSG A
0.420	94	Weighted Average
0.030		7.14% Pervious Area
0.390		92.86% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5: DMA-5



Summary for Subcatchment 6: DMA-6

[49] Hint: Tc<2dt may require smaller dt

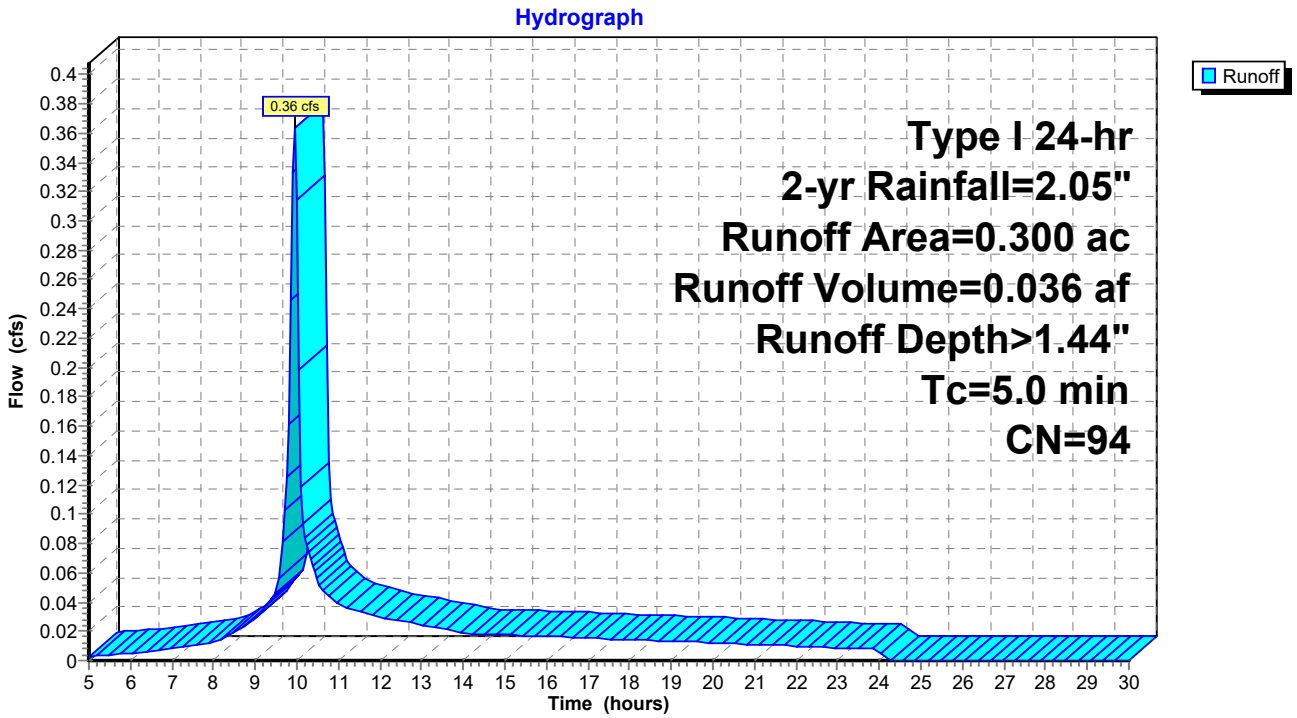
Runoff = 0.36 cfs @ 9.94 hrs, Volume= 0.036 af, Depth> 1.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type I 24-hr 2-yr Rainfall=2.05"

Area (ac)	CN	Description
0.280	98	Paved parking, HSG A
0.020	39	>75% Grass cover, Good, HSG A
0.300	94	Weighted Average
0.020		6.67% Pervious Area
0.280		93.33% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6: DMA-6



Summary for Subcatchment 7: DMA-7

[49] Hint: Tc<2dt may require smaller dt

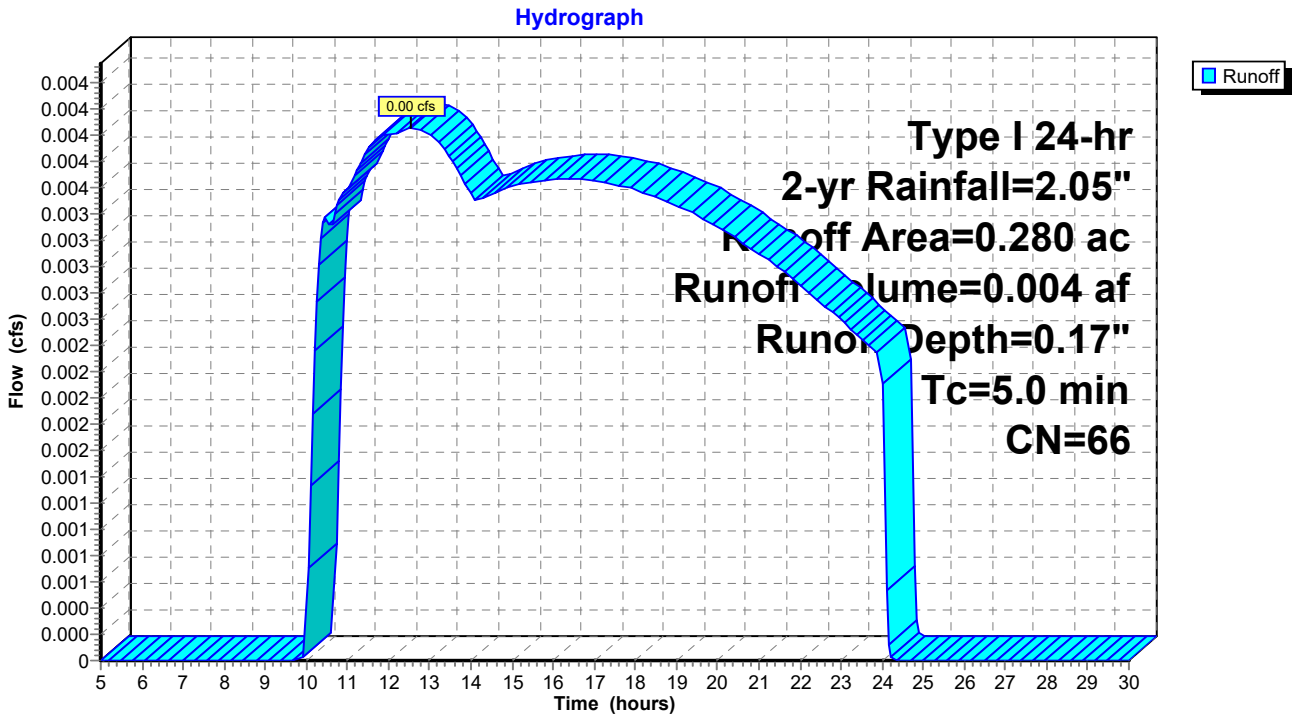
Runoff = 0.00 cfs @ 12.56 hrs, Volume= 0.004 af, Depth= 0.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type I 24-hr 2-yr Rainfall=2.05"

Area (ac)	CN	Description
0.130	98	Paved parking, HSG A
0.150	39	>75% Grass cover, Good, HSG A
0.280	66	Weighted Average
0.150		53.57% Pervious Area
0.130		46.43% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 7: DMA-7



Summary for Subcatchment 8: DMA-8

[49] Hint: Tc<2dt may require smaller dt

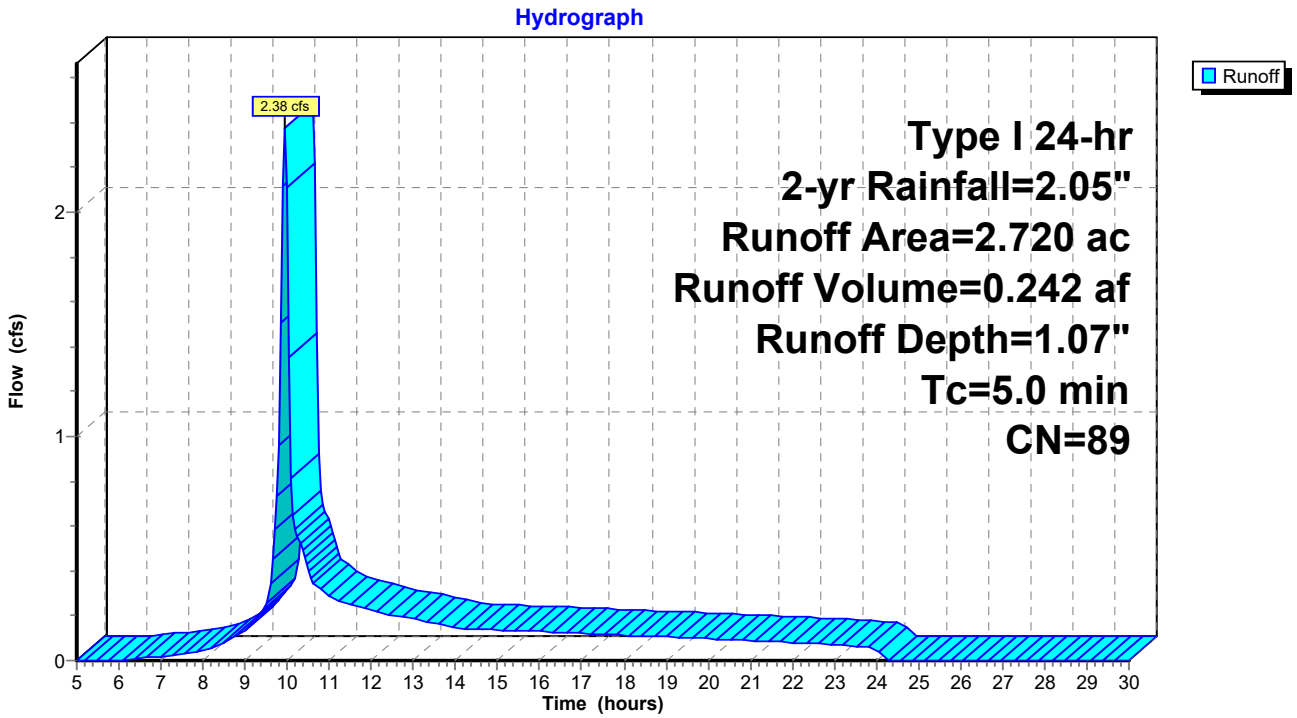
Runoff = 2.38 cfs @ 9.95 hrs, Volume= 0.242 af, Depth= 1.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type I 24-hr 2-yr Rainfall=2.05"

Area (ac)	CN	Description
2.320	98	Paved parking, HSG A
0.400	39	>75% Grass cover, Good, HSG A
2.720	89	Weighted Average
0.400		14.71% Pervious Area
2.320		85.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 8: DMA-8



Summary for Subcatchment 9: DMA-9

[49] Hint: Tc<2dt may require smaller dt

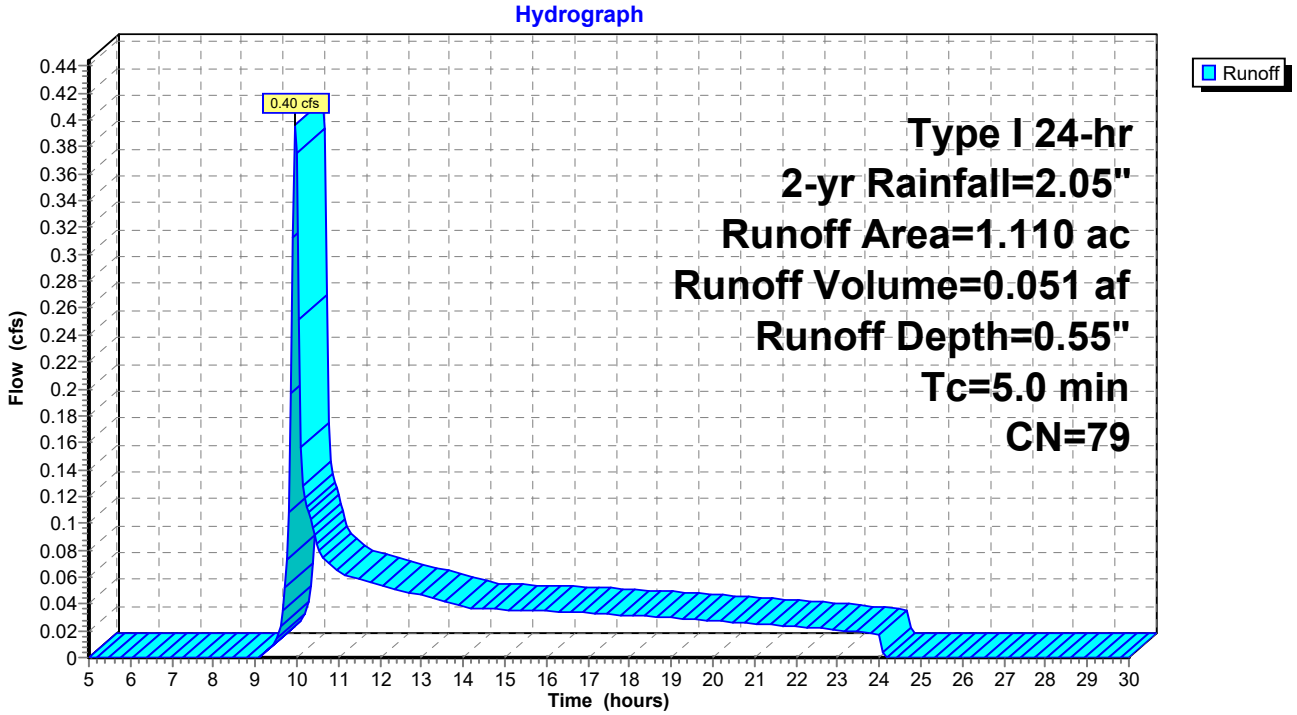
Runoff = 0.40 cfs @ 9.97 hrs, Volume= 0.051 af, Depth= 0.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type I 24-hr 2-yr Rainfall=2.05"

Area (ac)	CN	Description
0.760	98	Paved parking, HSG A
0.350	39	>75% Grass cover, Good, HSG A
1.110	79	Weighted Average
0.350		31.53% Pervious Area
0.760		68.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 9: DMA-9



Summary for Subcatchment 10: DMA-10

[49] Hint: Tc<2dt may require smaller dt

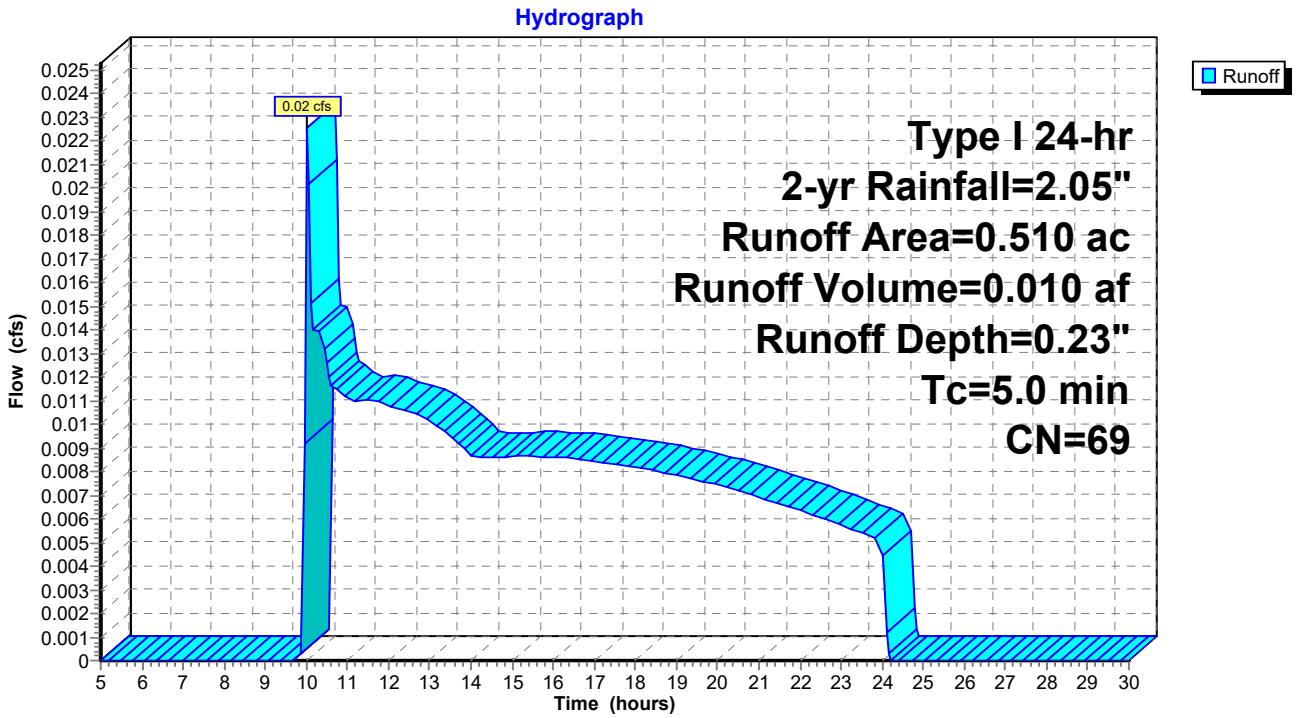
Runoff = 0.02 cfs @ 10.02 hrs, Volume= 0.010 af, Depth= 0.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type I 24-hr 2-yr Rainfall=2.05"

Area (ac)	CN	Description
0.260	98	Paved parking, HSG A
0.250	39	>75% Grass cover, Good, HSG A
0.510	69	Weighted Average
0.250		49.02% Pervious Area
0.260		50.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 10: DMA-10



Summary for Subcatchment 11: DMA-11

[49] Hint: Tc<2dt may require smaller dt

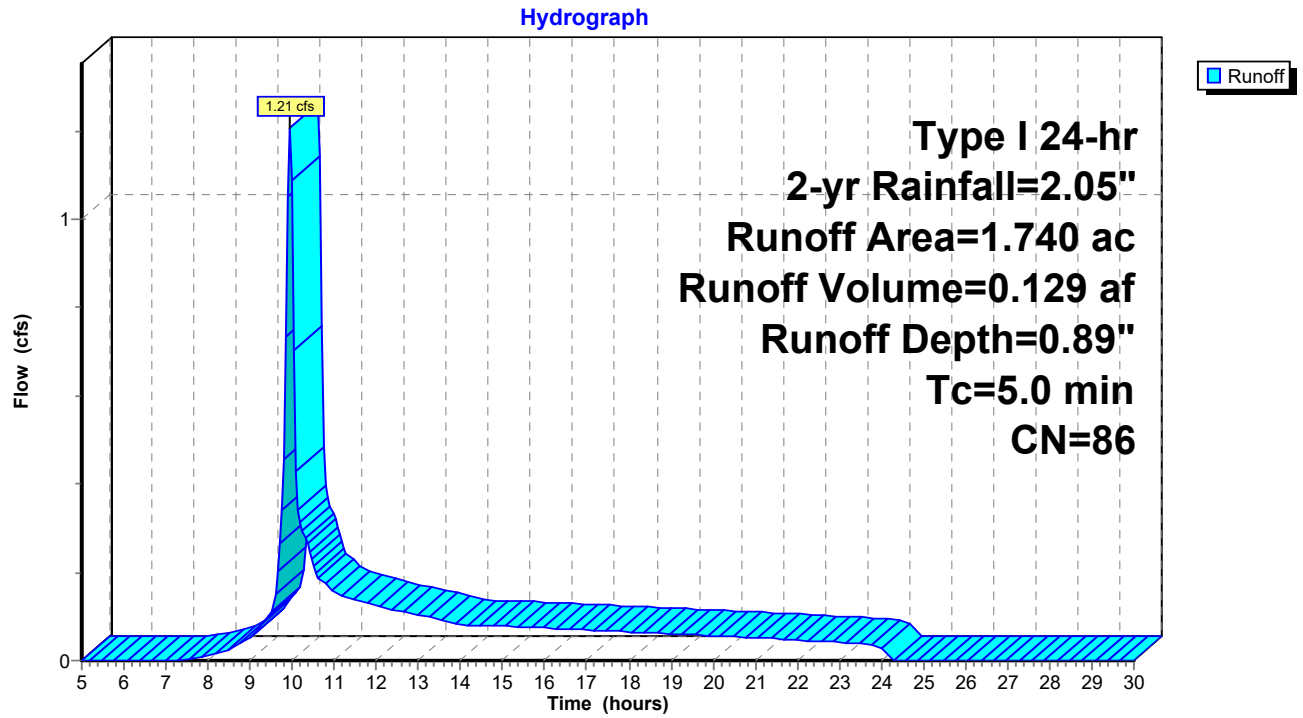
Runoff = 1.21 cfs @ 9.95 hrs, Volume= 0.129 af, Depth= 0.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type I 24-hr 2-yr Rainfall=2.05"

Area (ac)	CN	Description
1.400	98	Paved parking, HSG A
0.340	39	>75% Grass cover, Good, HSG A
1.740	86	Weighted Average
0.340		19.54% Pervious Area
1.400		80.46% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 11: DMA-11



Summary for Subcatchment EX: EX DMA

[49] Hint: Tc<2dt may require smaller dt

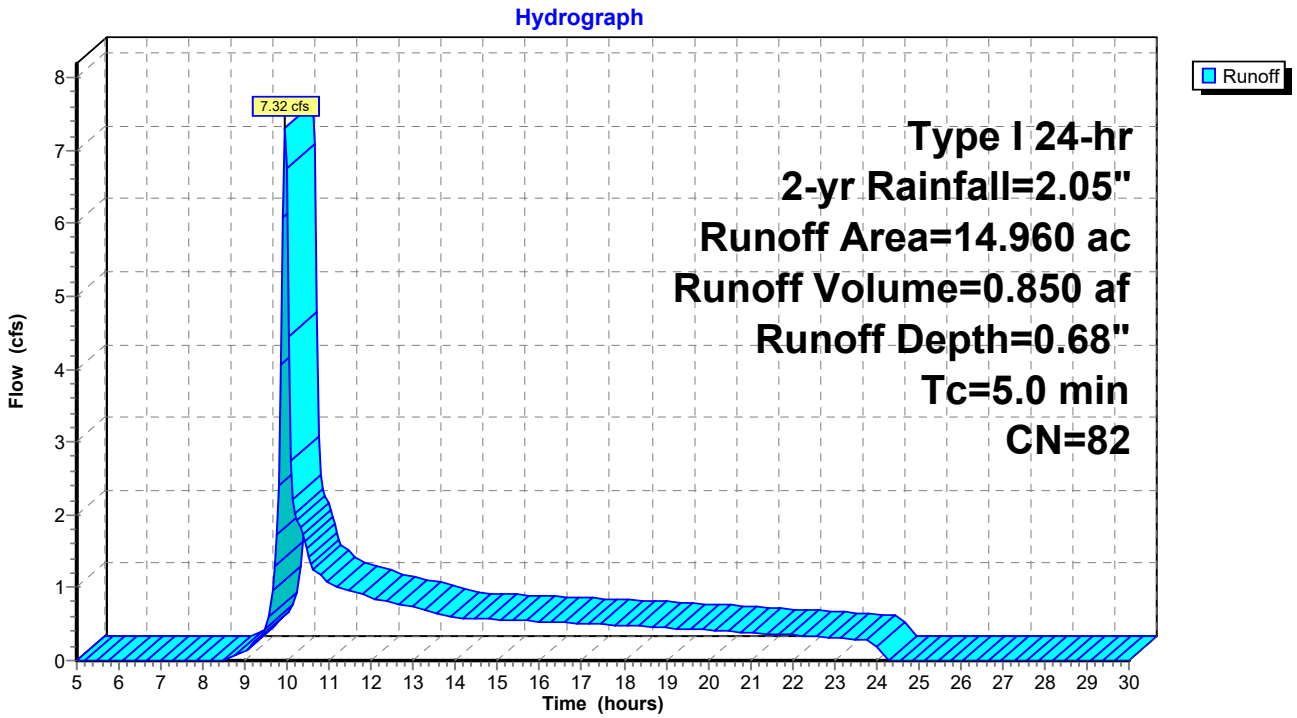
Runoff = 7.32 cfs @ 9.96 hrs, Volume= 0.850 af, Depth= 0.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type I 24-hr 2-yr Rainfall=2.05"

Area (ac)	CN	Description
10.840	98	Paved parking, HSG A
4.120	39	>75% Grass cover, Good, HSG A
14.960	82	Weighted Average
4.120		27.54% Pervious Area
10.840		72.46% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment EX: EX DMA



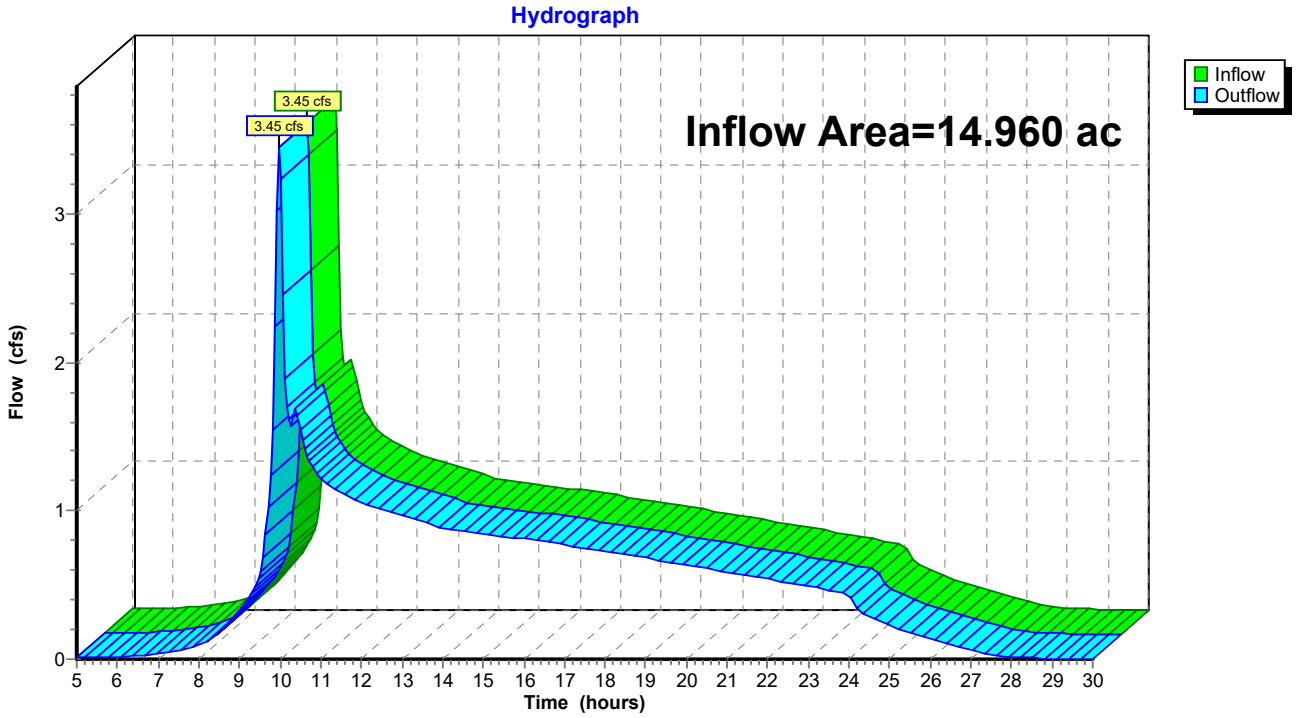
Summary for Reach 2R: Proposed Discharge

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 14.960 ac, 78.81% Impervious, Inflow Depth > 0.89" for 2-yr event
Inflow = 3.45 cfs @ 9.96 hrs, Volume= 1.104 af
Outflow = 3.45 cfs @ 9.96 hrs, Volume= 1.104 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs

Reach 2R: Proposed Discharge



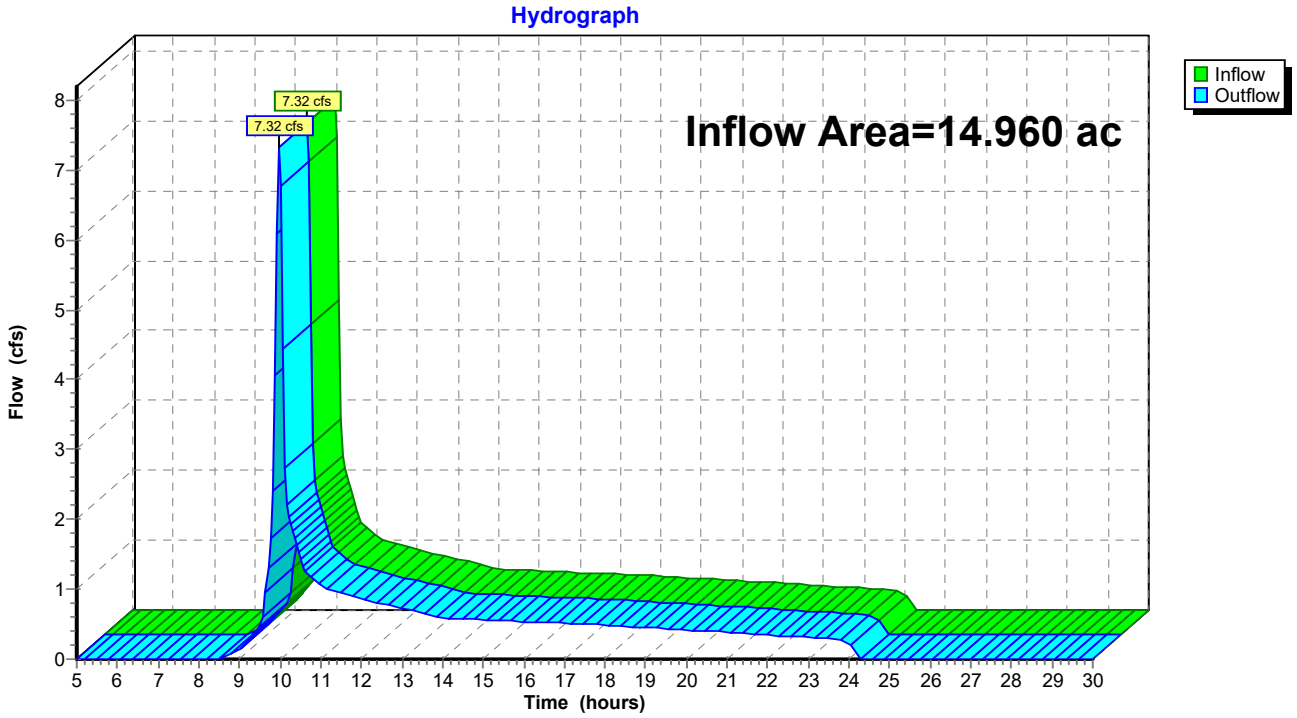
Summary for Reach 3R: Existing Discharge

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 14.960 ac, 72.46% Impervious, Inflow Depth = 0.68" for 2-yr event
Inflow = 7.32 cfs @ 9.96 hrs, Volume= 0.850 af
Outflow = 7.32 cfs @ 9.96 hrs, Volume= 0.850 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs

Reach 3R: Existing Discharge



Summary for Pond 7P: BIO 7

Inflow Area = 0.280 ac, 46.43% Impervious, Inflow Depth = 0.17" for 2-yr event
Inflow = 0.00 cfs @ 12.56 hrs, Volume= 0.004 af
Outflow = 0.00 cfs @ 12.64 hrs, Volume= 0.004 af, Atten= 0%, Lag= 5.0 min
Primary = 0.00 cfs @ 12.64 hrs, Volume= 0.004 af

Routing by Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 37.04' @ 12.64 hrs Surf.Area= 80 sf Storage= 1 cf

Plug-Flow detention time= 4.8 min calculated for 0.004 af (100% of inflow)
Center-of-Mass det. time= 4.8 min (1,005.5 - 1,000.8)

Volume	Invert	Avail.Storage	Storage Description
#1	41.00'	1,068 cf	**Open Storage (Prismatic)** Listed below (Recalc)
#2	38.00'	96 cf	**Soil (Prismatic)** Listed below (Recalc) 240 cf Overall x 40.0% Voids
#3	37.00'	32 cf	**Stone (Prismatic)** Listed below (Recalc) 80 cf Overall x 40.0% Voids
		1,196 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
41.00	80	0	0
42.00	224	152	152
43.00	440	332	484
44.00	728	584	1,068

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
38.00	80	0	0
39.00	80	80	80
40.00	80	80	160
41.00	80	80	240

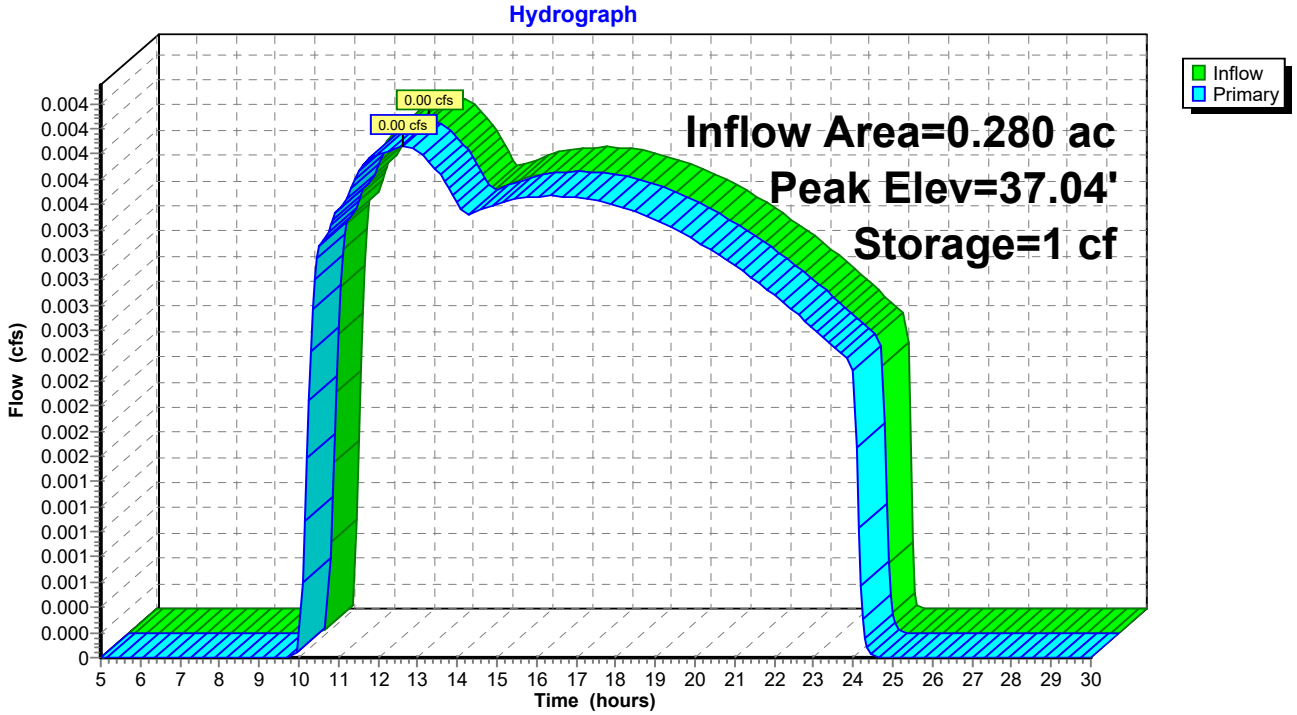
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
37.00	80	0	0
38.00	80	80	80

Device	Routing	Invert	Outlet Devices
#1	Primary	37.00'	**8.0" Round 12" Outlet** L= 25.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 37.00' / 36.90' S= 0.0040 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf
#2	Device 1	37.00'	**2.0" Vert. 4" Drain Tile** C= 0.600
#3	Device 1	42.00'	**36.0" Horiz. Riser** C= 0.600 Limited to weir flow at low heads
#4	Primary	42.50'	**6.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65

2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=0.00 cfs @ 12.64 hrs HW=37.04' (Free Discharge)
- **1=12" Outlet** (Passes 0.00 cfs of 0.00 cfs potential flow)
  - **2=4" Drain Tile** (Orifice Controls 0.00 cfs @ 0.65 fps)
  - **3=Riser** (Controls 0.00 cfs)
- **4=Broad-Crested Rectangular Weir**(Controls 0.00 cfs)

Pond 7P: BIO 7



Summary for Pond 8P: BIO 8

Inflow Area = 2.720 ac, 85.29% Impervious, Inflow Depth = 1.07" for 2-yr event
Inflow = 2.38 cfs @ 9.95 hrs, Volume= 0.242 af
Outflow = 0.46 cfs @ 10.41 hrs, Volume= 0.242 af, Atten= 81%, Lag= 27.8 min
Primary = 0.46 cfs @ 10.41 hrs, Volume= 0.242 af

Routing by Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 42.04' @ 10.41 hrs Surf.Area= 3,000 sf Storage= 2,739 cf

Plug-Flow detention time= 128.2 min calculated for 0.242 af (100% of inflow)
Center-of-Mass det. time= 128.1 min (934.0 - 805.9)

Volume	Invert	Avail.Storage	Storage Description
#1	41.00'	5,172 cf	**Open Storage (Prismatic)** Listed below (Recalc)
#2	38.00'	1,200 cf	**Soil (Prismatic)** Listed below (Recalc) 2,400 cf Overall x 50.0% Voids
#3	37.00'	400 cf	**Stone (Prismatic)** Listed below (Recalc) 800 cf Overall x 50.0% Voids
		6,772 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
41.00	800	0	0
42.00	1,376	1,088	1,088
43.00	2,024	1,700	2,788
44.00	2,744	2,384	5,172

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
38.00	800	0	0
39.00	800	800	800
40.00	800	800	1,600
41.00	800	800	2,400

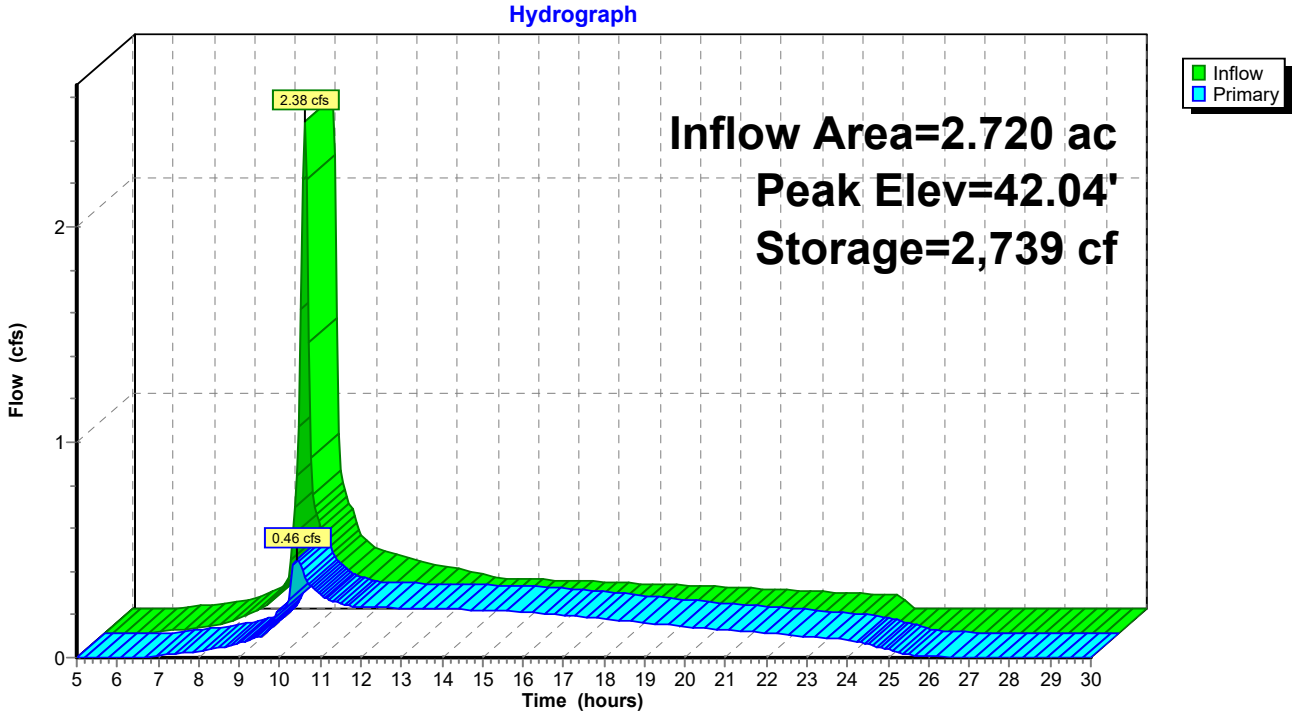
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
37.00	800	0	0
38.00	800	800	800

Device	Routing	Invert	Outlet Devices
#1	Primary	37.00'	**8.0" Round 12" Outlet** L= 25.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 37.00' / 36.90' S= 0.0040 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf
#2	Device 1	37.00'	**2.0" Vert. 4" Drain Tile** C= 0.600
#3	Device 1	42.00'	**36.0" Horiz. Riser** C= 0.600 Limited to weir flow at low heads
#4	Primary	42.50'	**6.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65

2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=0.45 cfs @ 10.41 hrs HW=42.04' (Free Discharge)
- **1=12" Outlet** (Passes 0.45 cfs of 3.51 cfs potential flow)
  - **2=4" Drain Tile** (Orifice Controls 0.23 cfs @ 10.72 fps)
  - **3=Riser** (Weir Controls 0.21 cfs @ 0.62 fps)
- **4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 8P: BIO 8



Summary for Pond 9P: BIO 9

Inflow Area = 1.110 ac, 68.47% Impervious, Inflow Depth = 0.55" for 2-yr event
Inflow = 0.40 cfs @ 9.97 hrs, Volume= 0.051 af
Outflow = 0.24 cfs @ 10.06 hrs, Volume= 0.051 af, Atten= 39%, Lag= 5.6 min
Primary = 0.24 cfs @ 10.06 hrs, Volume= 0.051 af

Routing by Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 38.17' @ 10.06 hrs Surf.Area= 600 sf Storage= 140 cf

Plug-Flow detention time= 8.1 min calculated for 0.051 af (100% of inflow)
Center-of-Mass det. time= 7.8 min (883.7 - 875.8)

Volume	Invert	Avail.Storage	Storage Description
#1	41.00'	3,375 cf	**Open Storage (Prismatic)** Listed below (Recalc)
#2	38.00'	360 cf	**Soil (Prismatic)** Listed below (Recalc) 900 cf Overall x 40.0% Voids
#3	37.00'	120 cf	**Stone (Prismatic)** Listed below (Recalc) 300 cf Overall x 40.0% Voids
		3,855 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
41.00	300	0	0
42.00	810	555	555
43.00	1,392	1,101	1,656
44.00	2,046	1,719	3,375

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
38.00	300	0	0
39.00	300	300	300
40.00	300	300	600
41.00	300	300	900

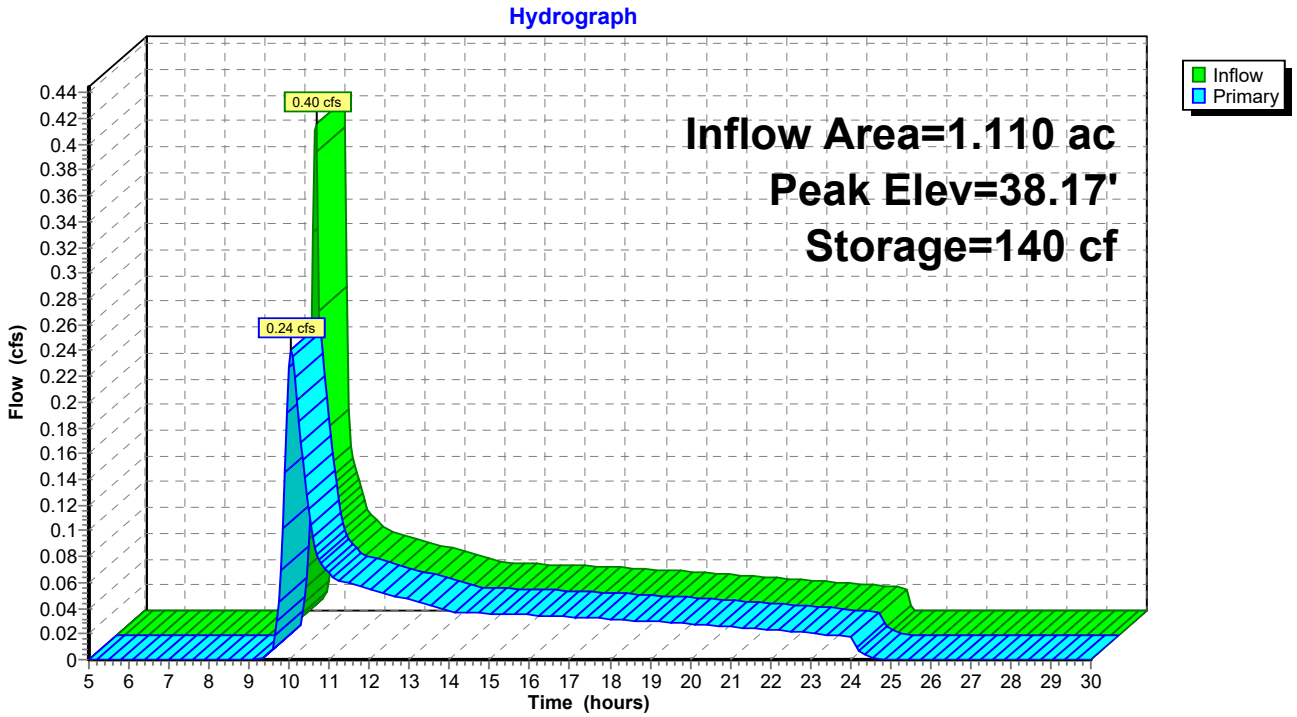
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
37.00	300	0	0
38.00	300	300	300

Device	Routing	Invert	Outlet Devices
#1	Primary	37.00'	**8.0" Round 12" Outlet** L= 25.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 37.00' / 36.90' S= 0.0040 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf
#2	Device 1	37.00'	**3.0" Vert. 4" Drain Tile** C= 0.600
#3	Device 1	42.00'	**36.0" Horiz. Riser** C= 0.600 Limited to weir flow at low heads
#4	Primary	42.50'	**6.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65

2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=0.24 cfs @ 10.06 hrs HW=38.15' (Free Discharge)
- **1=12" Outlet** (Passes 0.24 cfs of 1.27 cfs potential flow)
  - **2=4" Drain Tile** (Orifice Controls 0.24 cfs @ 4.88 fps)
  - **3=Riser** (Controls 0.00 cfs)
- **4=Broad-Crested Rectangular Weir**(Controls 0.00 cfs)

Pond 9P: BIO 9



Summary for Pond 10P: BIO 10

Inflow Area = 0.510 ac, 50.98% Impervious, Inflow Depth = 0.23" for 2-yr event
Inflow = 0.02 cfs @ 10.02 hrs, Volume= 0.010 af
Outflow = 0.02 cfs @ 10.12 hrs, Volume= 0.010 af, Atten= 31%, Lag= 6.0 min
Primary = 0.02 cfs @ 10.12 hrs, Volume= 0.010 af

Routing by Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 37.10' @ 10.12 hrs Surf.Area= 144 sf Storage= 6 cf

Plug-Flow detention time= 8.0 min calculated for 0.010 af (100% of inflow)
Center-of-Mass det. time= 8.0 min (972.1 - 964.1)

Volume	Invert	Avail.Storage	Storage Description
#1	41.00'	1,422 cf	**Open Storage (Prismatic)** Listed below (Recalc)
#2	38.00'	173 cf	**Soil (Prismatic)** Listed below (Recalc) 432 cf Overall x 40.0% Voids
#3	37.00'	58 cf	**Stone (Prismatic)** Listed below (Recalc) 144 cf Overall x 40.0% Voids
		1,652 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
41.00	144	0	0
42.00	324	234	234
43.00	576	450	684
44.00	900	738	1,422

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
38.00	144	0	0
39.00	144	144	144
40.00	144	144	288
41.00	144	144	432

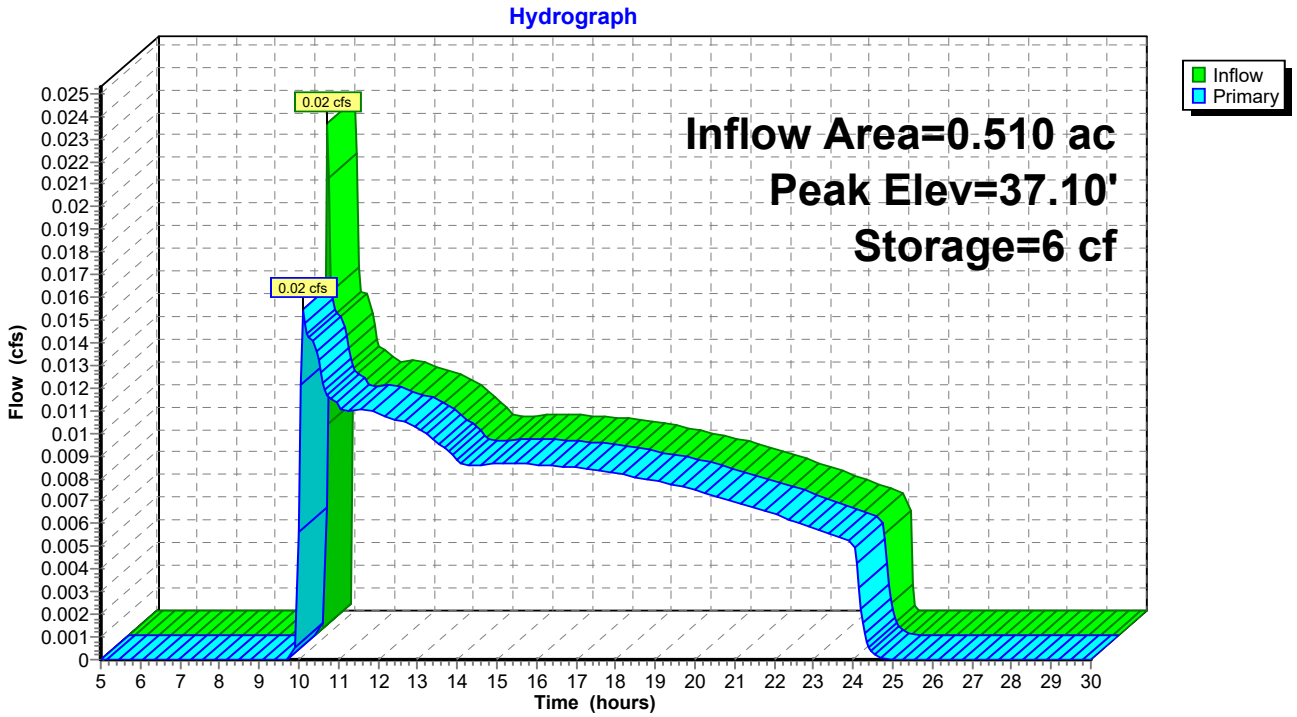
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
37.00	144	0	0
38.00	144	144	144

Device	Routing	Invert	Outlet Devices
#1	Primary	37.00'	**8.0" Round 12" Outlet** L= 25.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 37.00' / 36.90' S= 0.0040 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf
#2	Device 1	37.00'	**2.0" Vert. 4" Drain Tile** C= 0.600
#3	Device 1	42.00'	**36.0" Horiz. Riser** C= 0.600 Limited to weir flow at low heads
#4	Primary	42.50'	**6.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65

2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=0.01 cfs @ 10.12 hrs HW=37.10' (Free Discharge)
- **1=12" Outlet** (Passes 0.01 cfs of 0.02 cfs potential flow)
  - **2=4" Drain Tile** (Orifice Controls 0.01 cfs @ 1.07 fps)
  - **3=Riser** (Controls 0.00 cfs)
- **4=Broad-Crested Rectangular Weir**(Controls 0.00 cfs)

Pond 10P: BIO 10



Summary for Pond P2: BIO 2

Inflow Area = 1.110 ac, 77.48% Impervious, Inflow Depth = 0.83" for 2-yr event
Inflow = 0.71 cfs @ 9.95 hrs, Volume= 0.077 af
Outflow = 0.18 cfs @ 10.24 hrs, Volume= 0.077 af, Atten= 75%, Lag= 16.9 min
Primary = 0.18 cfs @ 10.24 hrs, Volume= 0.077 af

Routing by Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 39.99' @ 10.24 hrs Surf.Area= 720 sf Storage= 538 cf

Plug-Flow detention time= 28.4 min calculated for 0.077 af (100% of inflow)
Center-of-Mass det. time= 28.5 min (862.6 - 834.1)

Volume	Invert	Avail.Storage	Storage Description
#1	41.00'	2,853 cf	**Open Storage (Prismatic)** Listed below (Recalc)
#2	38.00'	540 cf	**Soil (Prismatic)** Listed below (Recalc) 1,080 cf Overall x 50.0% Voids
#3	37.00'	180 cf	**Stone (Prismatic)** Listed below (Recalc) 360 cf Overall x 50.0% Voids
		3,573 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
41.00	360	0	0
42.00	714	537	537
43.00	1,140	927	1,464
44.00	1,638	1,389	2,853

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
38.00	360	0	0
39.00	360	360	360
40.00	360	360	720
41.00	360	360	1,080

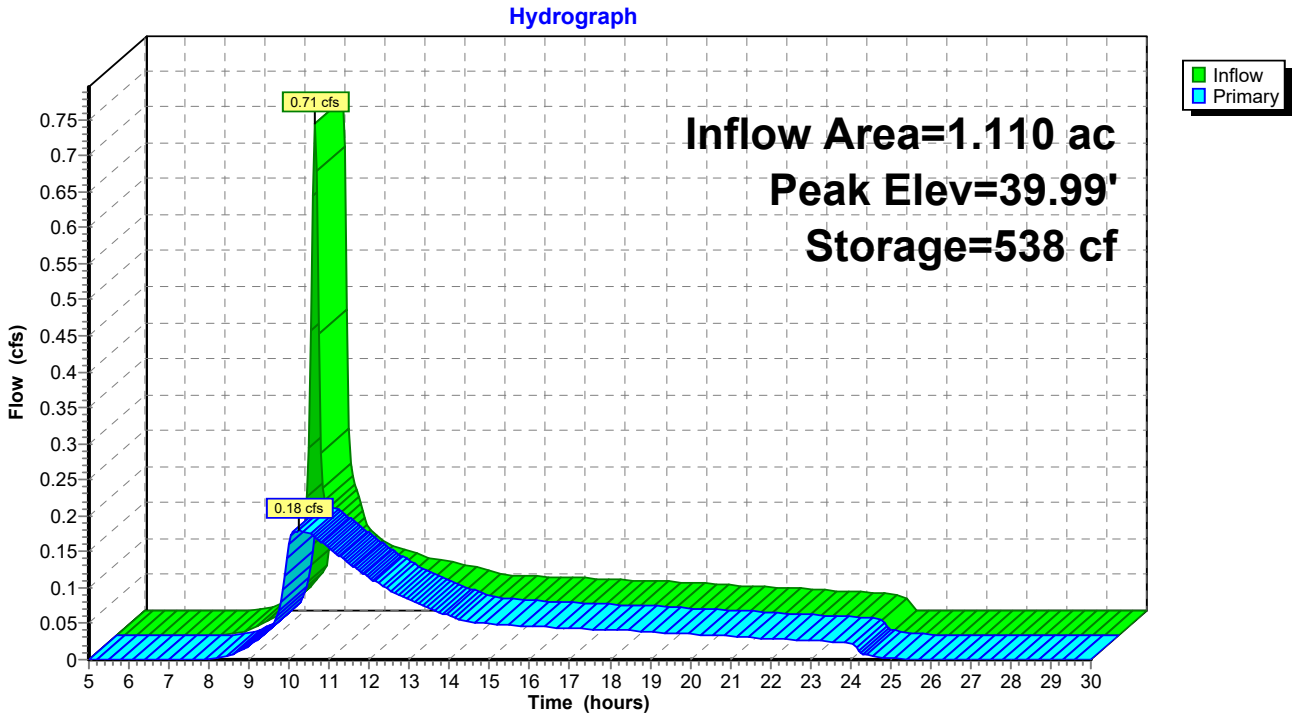
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
37.00	360	0	0
38.00	360	360	360

Device	Routing	Invert	Outlet Devices
#1	Primary	37.00'	**8.0" Round 12" Outlet** L= 25.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 37.00' / 36.90' S= 0.0040 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf
#2	Device 1	37.00'	**2.0" Vert. 4" Drain Tile** C= 0.600
#3	Device 1	42.00'	**36.0" Horiz. Riser** C= 0.600 Limited to weir flow at low heads
#4	Primary	42.50'	**6.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65

2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=0.18 cfs @ 10.24 hrs HW=39.99' (Free Discharge)
- **1=12" Outlet** (Passes 0.18 cfs of 2.58 cfs potential flow)
  - **2=4" Drain Tile** (Orifice Controls 0.18 cfs @ 8.21 fps)
  - **3=Riser** (Controls 0.00 cfs)
- **4=Broad-Crested Rectangular Weir**(Controls 0.00 cfs)

Pond P2: BIO 2



Summary for Pond UG: UG DET

Inflow Area = 6.060 ac, 79.54% Impervious, Inflow Depth = 0.89" for 2-yr event
Inflow = 4.21 cfs @ 9.95 hrs, Volume= 0.448 af
Outflow = 0.39 cfs @ 12.55 hrs, Volume= 0.447 af, Atten= 91%, Lag= 155.6 min
Primary = 0.39 cfs @ 12.55 hrs, Volume= 0.447 af

Routing by Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 38.65' @ 12.55 hrs Surf.Area= 0.049 ac Storage= 0.137 af

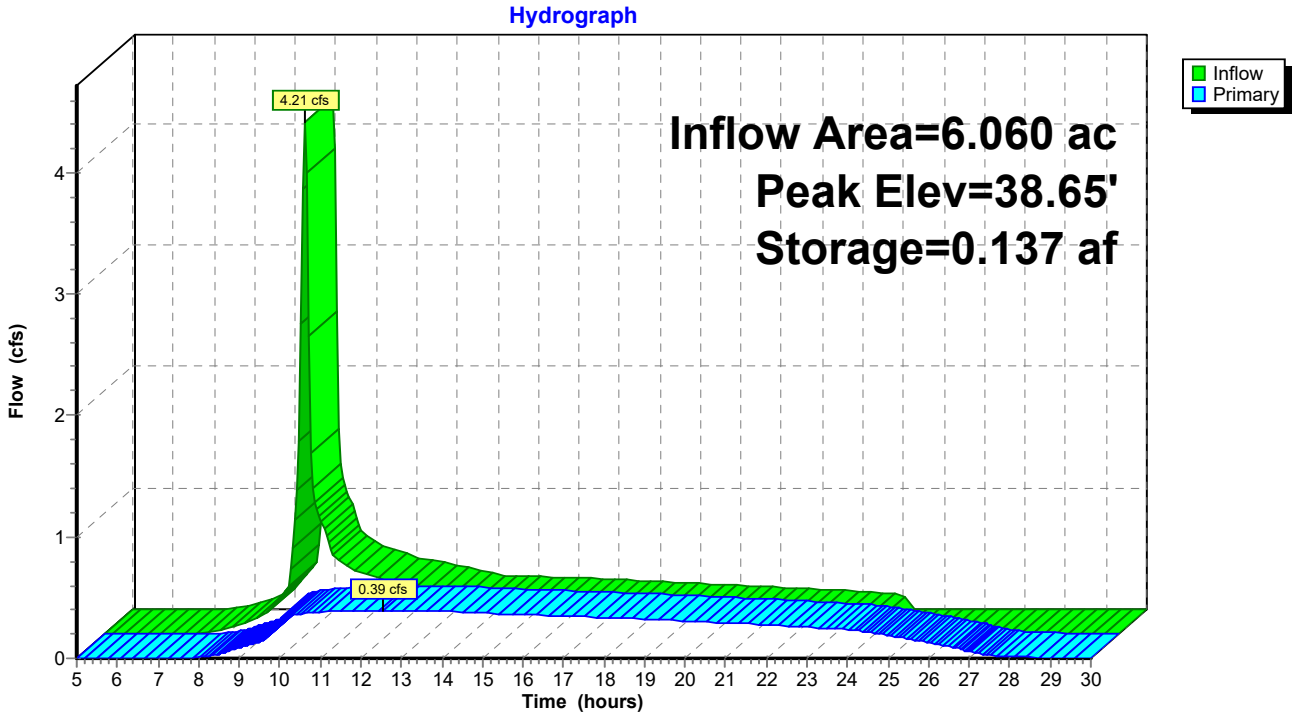
Plug-Flow detention time= 197.5 min calculated for 0.446 af (100% of inflow)
Center-of-Mass det. time= 196.6 min (1,023.8 - 827.2)

Volume	Invert	Avail.Storage	Storage Description
#1	35.70'	0.173 af	**48.0" Round Pipe Storage** L= 600.0'

Device	Routing	Invert	Outlet Devices
#1	Primary	35.70'	**8.0" Round Culvert** L= 28.9' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 35.70' / 35.10' S= 0.0208 '/' Cc= 0.900 n= 0.011, Flow Area= 0.35 sf
#2	Device 1	35.75'	**3.0" Vert. Orifice/Grate** C= 0.600

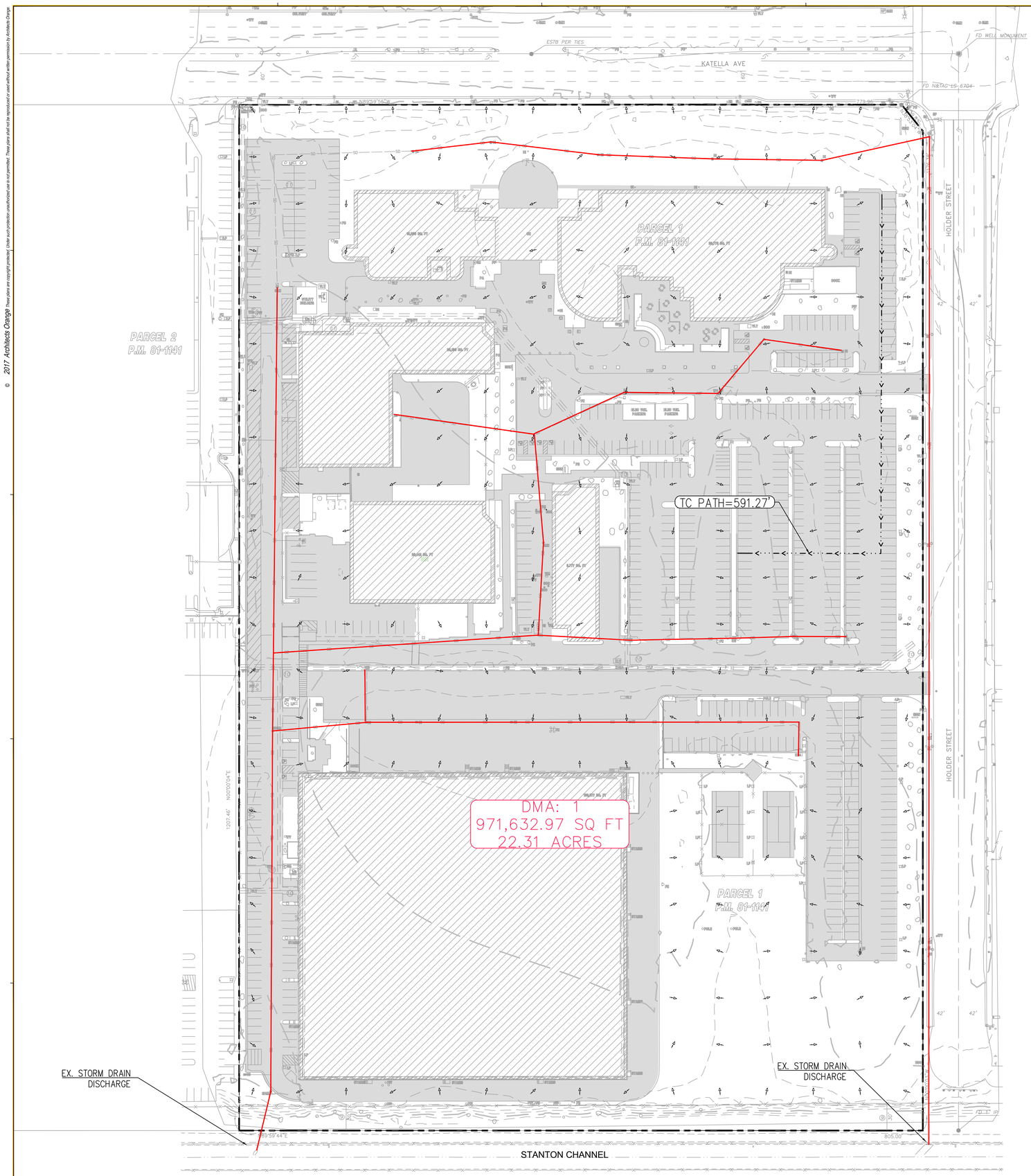
Primary OutFlow Max=0.39 cfs @ 12.55 hrs HW=38.65' (Free Discharge)
↑**1=Culvert** (Passes 0.39 cfs of 2.72 cfs potential flow)
↑**2=Orifice/Grate** (Orifice Controls 0.39 cfs @ 8.02 fps)

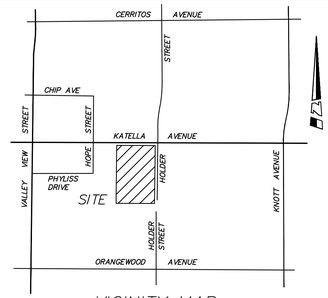
Pond UG: UG DET



Attachment D- Existing Conditions Exhibit

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VICINITY MAP
NOT TO SCALE

LEGEND

- EX PAVING (9.58 AC)
- EX BUILDING (5.91 AC)
- EX LANDSCAPE (6.83 AC)
- EXISTING STORM DRAIN

GRAPHIC SCALE
25 0 12.5 25 50 100
(IN FEET)
1 inch = 50 ft.

811 Know what's below. Call before you dig.

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THE LOCATIONS OF EXISTING UTILITY INSTALLATIONS AS SHOWN ON THIS PLAN ARE APPROXIMATE. THERE MAY BE OTHER UNDERGROUND UTILITY INSTALLATIONS WITHIN THE PROJECT AREA THAT ARE NOT SHOWN.

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DATE: 04/23/20
SCALE: AS SHOWN
JOB NO. 3190323
PROJECT MANAGER: SAMUEL J. JACOBY
DESIGNED BY: EAR
CHECKED BY: SJJ

ARCHITECTS ORANGE
144 North Orange Street • Orange, California 92866 • 714 639-9960

Seal
REGISTERED PROFESSIONAL ENGINEER
SAMUEL J. JACOBY
C74309
EXP.6/30/21
CIVIL
STATE OF CALIFORNIA
DATE 04/23/20

Consultant
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8881 Research Drive
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rasmith.com

DLX7 T.I.
6400 KATELLA AVE
CYPRESS, CALIFORNIA
90630

EXISTING HYDROLOGY EXHIBIT

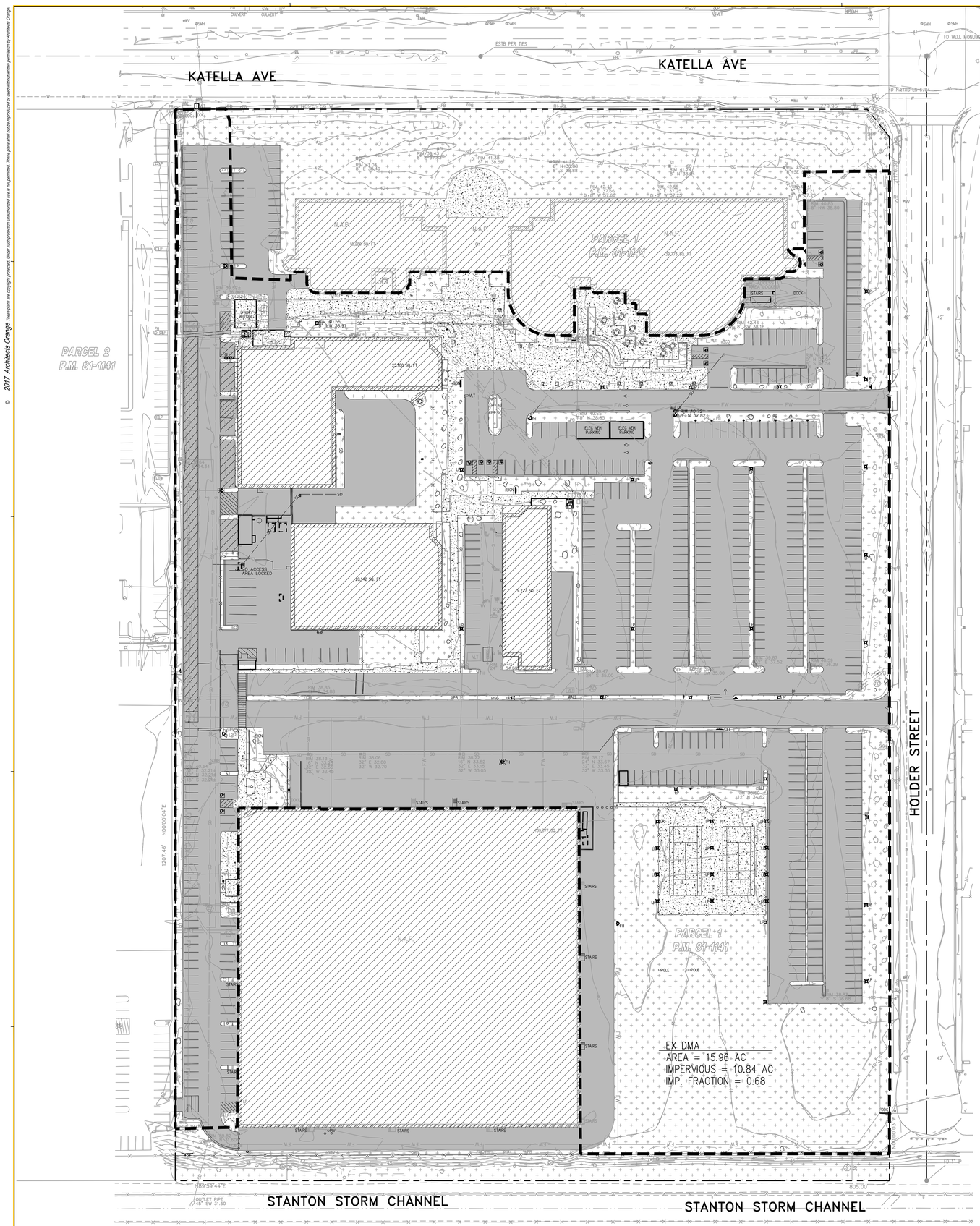
PROJECT: DLX7 CYPRESS CALIFORNIA
ADDRESS: 6400 KATELLA AVE, CA
FOR: GREENLAW PARTNERS
18301 VON KARMAN, STE 250
IRVINE CA 92612

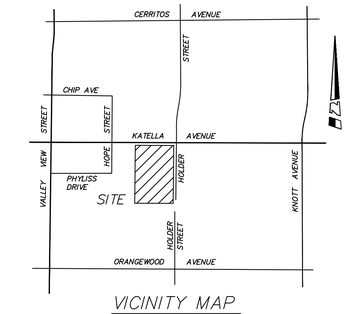
Project Number: 2019-447
Plan Check Number: PC # XXXX-XXX

HX1

SAVED: 5/19/2020 1:33:33 PM By: rjr
O:\3190323\Dwg\Sheets\3190323-HX1.dwg HX1 EXISTING HYDROLOGY EXHIBIT, 5/19/2020 1:33:33 PM, rjr

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VICINITY MAP
NOT TO SCALE

LEGEND:

- PROPERTY LINE
- EXISTING STORM DRAIN
- EXISTING CONTOURS
- EXISTING LANDSCAPING
- EXISTING PAVEMENT
- EXISTING BUILDING
- EXISTING SIDEWALK

File No.: NCS-979526-SA1

The Land referred to herein below is situated in the City of Cypress, County of Orange, State of California, and is described as follows:

PARCEL 1 OF PARCEL MAP NO. 81-1141, IN THE CITY OF CYPRESS, COUNTY OF RANGE, STATE OF CALIFORNIA, AS PER MAP FILED IN BOOK 167, PAGES 34-36 OF PARCEL MAPS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID

ALSO EXCEPT FROM THAT PORTION OF SAID LAND NOT INCLUDED WITHIN THE LINES OF PARCEL 1 SHOWN ON PARCEL MAP FILED IN BOOK 108, PAGES 10 AND 11 OF PARCEL MAPS, ALL COAL, CHEMICAL, PETROLEUM, OIL, GAS, ASPHALTUM AND OTHER HYDROCARBONS, AND ALL MINERALS, METALS AND MINERAL ORES, WHETHER SIMILAR TO THOSE HEREIN SPECIFIED OR NOT, OF EVERY KIND AND CHARACTER NOW KNOWN TO EXIST OR HEREAFTER DISCOVERED UPON, WITHIN OR UNDERLYING SAID LAND, TOGETHER WITH THE EXCLUSIVE AND PERPETUAL RIGHT OF THE GRANTEE, ITS SUCCESSORS AND ASSIGNS, OF INGRESS AND EGRESS BENEATH THE SURFACE OF SAID LAND TO EXPLORE FOR, EXTRACT, MINE, AND REMOVE THE SAME AND TO MAKE SUCH USE OF SAID LAND BENEATH THE SURFACE AS IS NECESSARY OR USEFUL IN CONNECTION THEREWITH, WHICH USE MAY INCLUDE LATERAL OR SLANT DRILLING, DIGGING, BORING OR SINKING OF WELLS, SHAFTS, TUNNELS OR OTHER METHODS, TOGETHER WITH THE FURTHER EXCLUSIVE AND PERPETUAL RIGHT OF THE GRANTEE, ITS SUCCESSORS AND ASSIGNS, TO MAKE SUCH USE OF SAID LAND AS MAY BE NECESSARY TO STORE, KEEP, DEPOSIT, AND/OR REMOVE ALL COAL, CHEMICALS, PETROLEUM, OIL, GAS, ASPHALTUM AND OTHER HYDROCARBONS AND ALL MINERALS, METALS AND MINERAL ORES, WHETHER SIMILAR TO THOSE HEREIN SPECIFIED OR NOT, OF EVERY KIND AND CHARACTER NOW KNOWN TO EXIST OR HEREAFTER DISCOVERED, PROVIDED, HOWEVER, THAT THE GRANTEE, ITS SUCCESSORS OR ASSIGNS, SHALL NOT USE THE SURFACE OF SAID LAND ABOVE A FIVE HUNDRED FOOT DEPTH IN THE EXERCISE OF ANY OF SAID RIGHTS, AS GRANTED TO CONSOLIDATED PACIFIC INVESTMENT COMPANY BY DEED RECORDED JANUARY 29, 1959 IN BOOK 4567, PAGE 496 OF OFFICIAL RECORDS.

For conveyancing purposes only: APN 224-261-04

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R.A. Smith, Inc.

DATE: 04/23/20
SCALE: AS SHOWN
JOB NO. 3190323
PROJECT MANAGER: SAMUEL J. JACOBY
DESIGNED BY: EAR
CHECKED BY: SJJ

N

GRAPHIC SCALE
25 0 12.5 25 50 100
(IN FEET)
1 inch = 50 ft.

811 Know what's below. Call before you dig.

RA SMITH ASSUMES NO RESPONSIBILITY FOR DAMAGES, LIABILITY OR COSTS RESULTING FROM CHANGES OR ALTERATIONS MADE TO THIS PLAN WITHOUT THE EXPRESSED WRITTEN CONSENT OF RA SMITH.

THE LOCATIONS OF EXISTING UTILITY INSTALLATIONS AS SHOWN ON THIS PLAN ARE APPROXIMATE. THERE MAY BE OTHER UNDERGROUND UTILITY INSTALLATIONS WITHIN THE PROJECT AREA THAT ARE NOT SHOWN.

ARCHITECTS ORANGE
144 North Orange Street • Orange, California 92866 • 714 639-9960

Sheet

04/23/20

Consultant

raSmith
CREATIVITY BEYOND ENGINEERING
8881 Research Drive
Irvine, CA 92618-4236
(949) 872-2378
rasmith.com

DLX7 T.I.

6400 KATELLA AVE
CYPRESS, CALIFORNIA
90630

EXISTING WATER QUALITY EXHIBIT

PROJECT: DLX7 CYPRESS CALIFORNIA
ADDRESS: 6400 KATELLA AVE, CA
FOR: GREENLAW PARTNERS 18301 VON KARMAN, STE 250 IRVINE CA 92612

Project Number: 2019-447
Plan Check Number: PC # XXXX/XXX

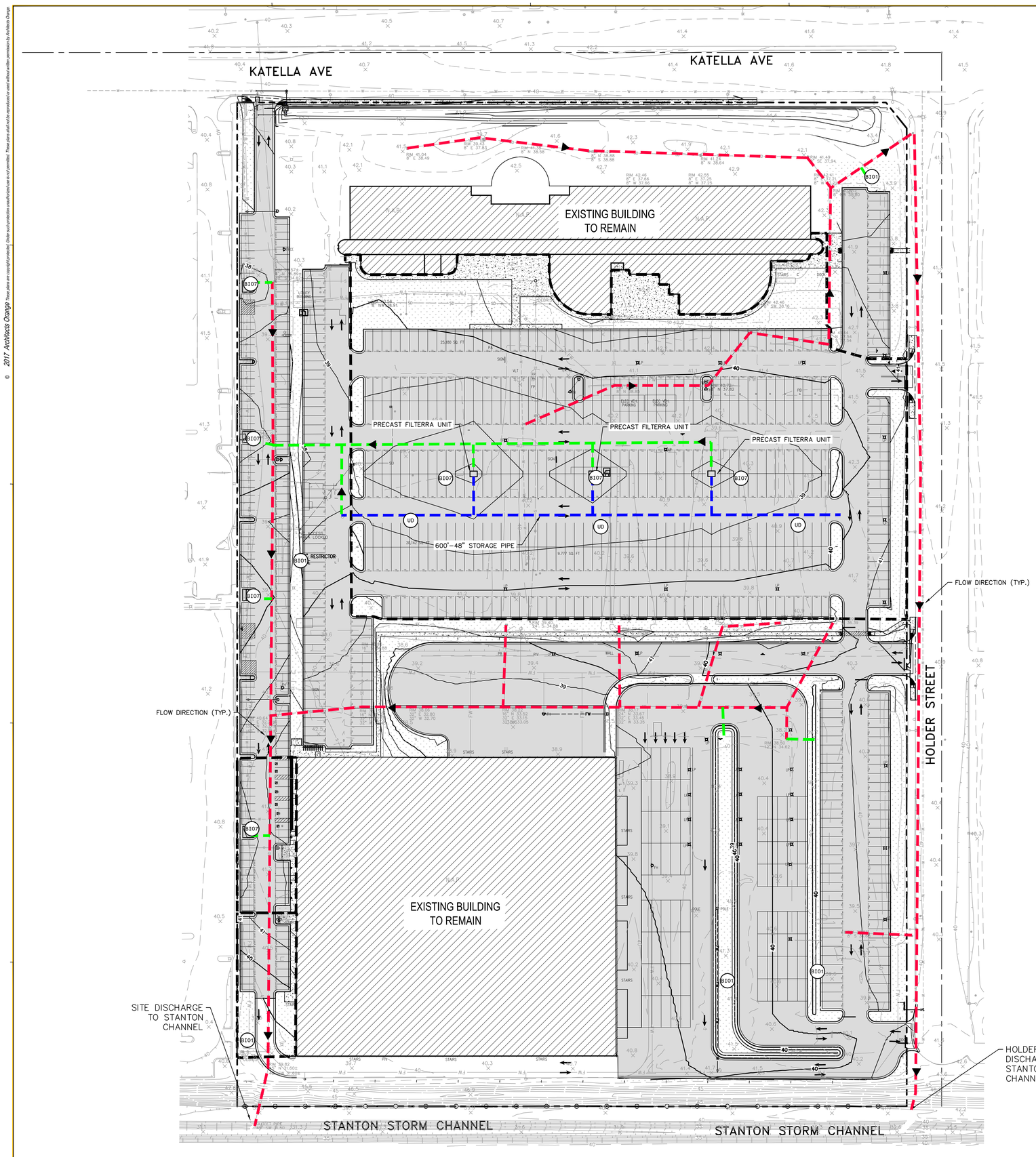
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REV 08/04/2020

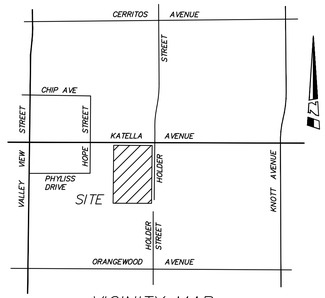
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Attachment E - Proposed Conditions Exhibit

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VICINITY MAP
NOT TO SCALE

File No.: NCS-979526-SA1

The Land referred to herein below is situated in the City of Cypress, County of Orange, State of California, and is described as follows:

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For conveyancing purposes only: APN 224-261-04

LEGEND:

- PROPERTY LINE
- EXISTING STORM DRAIN
- PROPOSED STORM DRAIN
- PROPOSED PIPE STORAGE
- EXISTING CONTOURS
- PROPOSED CONTOURS
- EXISTING BUILDING
- PROPOSED LANDSCAPING
- PROPOSED PAVEMENT
- PROPOSED SIDEWALK
- B101 — BIORETENTION W UNDERDRAIN
- B107 — FILTERRA BIOSCAPE VAULTS
- UD — UNDERGROUND DETENTION

SITE CONDITIONS SUMMARY:

PARCEL AREA =	22.31 ACRES
PROJECT LIMITS =	14.96 ACRES
PAVEMENT MAINTENANCE =	5.50 ACRES
PROJECT AREA=	9.46 ACRES

INFILTRATION IS INFEASIBLE (GROUNDWATER DEPTH IS LESS THAN 10-FT)

EXISTING CONDITIONS AREA SUMMARY

PERVIOUS AREA =	31%
IMPERVIOUS AREA =	69%

PROPOSED CONDITIONS AREA SUMMARY

PERVIOUS AREA =	23%
IMPERVIOUS AREA =	77%

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DATE: 04/23/20
SCALE: AS SHOWN
JOB NO. 3190323
PROJECT MANAGER: SAMUEL J. JACOBY
DESIGNED BY: EAR
CHECKED BY: SJJ

N

GRAPHIC SCALE
25 0 12.5 25 50 100
(IN FEET)
1 inch = 50 ft.

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Irvine, CA 92618-4236
(949) 872-2378
rasmith.com

04/23/20

PROPOSED WATER QUALITY EXHIBIT

DLX7 T.I.
6400 KATELLA AVE
CYPRESS, CALIFORNIA
90630

PROJECT: DLX7 CYPRESS CALIFORNIA
ADDRESS: 6400 KATELLA AVE, CA
FOR: GREENLAW PARTNERS
18301 VON KARMAN, STE 250
IRVINE CA 92612

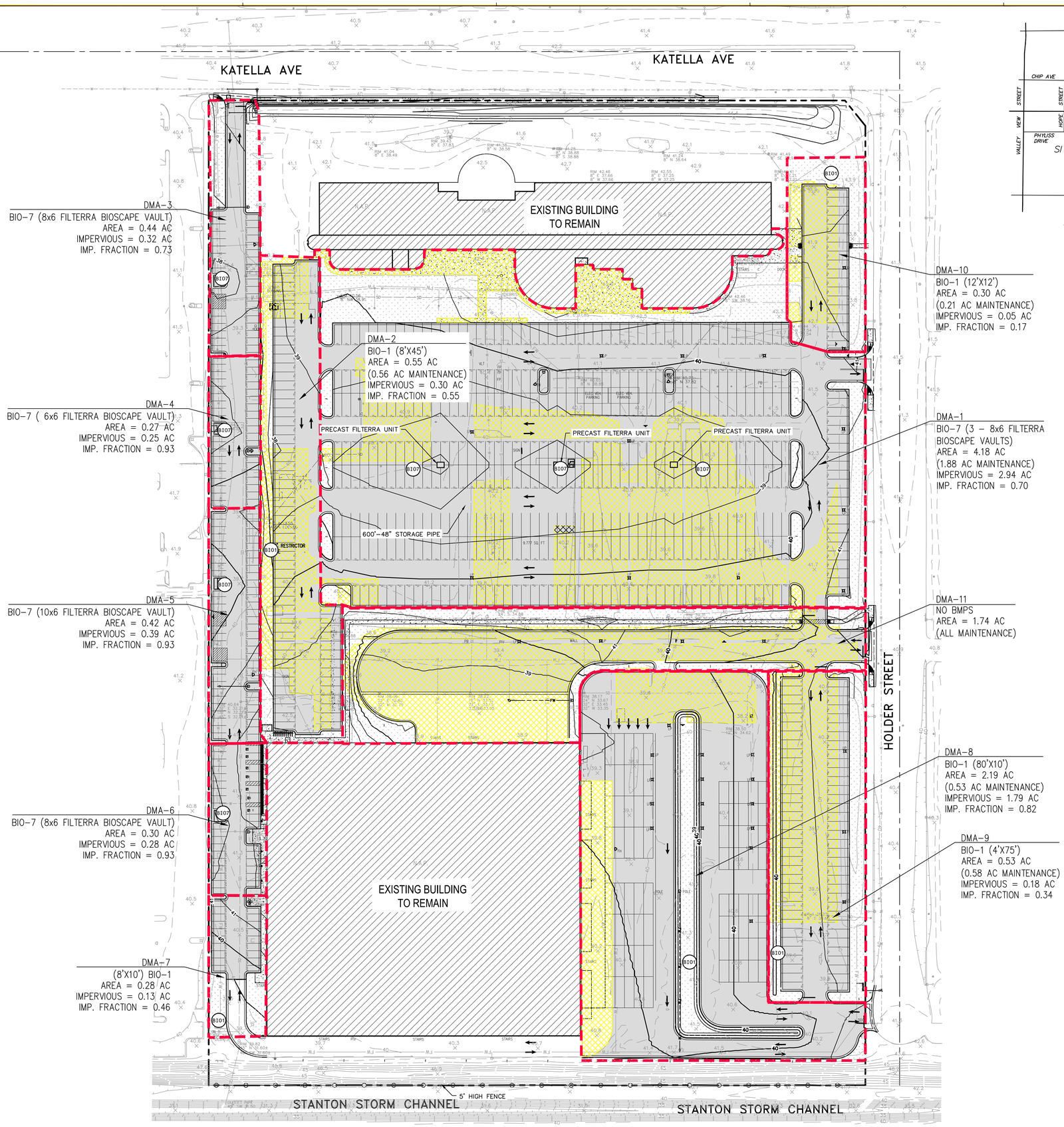
Project Number: 2019-447
Plan Check Number: PC # XXXX-XXX

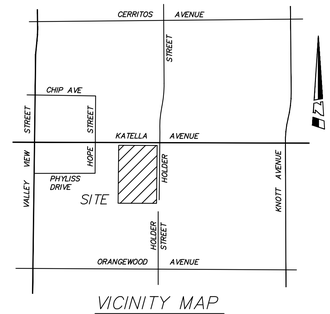
REV 06/23/2020
REV 07/02/2020

HH2

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C:\3190323\Dwg\Sheets\3190323-HH1.dwg, WQ2 PROPOSED WATER QUALITY EXHIBIT, 8/5/2020 2:18:54 PM, rjy

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For conveyancing purposes only: APN 224-261-04

LEGEND:

- PROPERTY LINE
- DRAINAGE AREA BOUNDARY
- PROPOSED 6" PVC PIPE
- PR. DRAINAGE PATH
- EXISTING CONTOURS
- PROPOSED CONTOURS
- EXISTING BUILDING
- PROPOSED LANDSCAPING
- PROPOSED PAVEMENT
- PROPOSED SIDEWALK
- PAVEMENT MAINTENANCE AREA - NO SOIL DISTURBANCE
- (B101) BIORETENTION W UNDERDRAIN
- (B107) FILTERRA BIOSCAPE VAULT

SITE CONDITIONS SUMMARY:

PARCEL AREA =	22.31 ACRES
PROJECT LIMITS =	14.96 ACRES
PAVEMENT MAINTENANCE =	5.50 ACRES
PROJECT AREA=	9.46 ACRES

INFILTRATION IS INFEASIBLE (GROUNDWATER DEPTH IS LESS THAN 10-FT)

PROPOSED CONDITIONS AREA SUMMARY

END-PROJECT CONDITION	
PERVIOUS AREA =	23%
IMPERVIOUS AREA =	77%
DMA (WATER QUALITY CALC)	
AREA=	9.46 ACRES
IMPERVIOUS AREA =	7.28 ACRES
85% RAINFALL DEPTH=	0.85 INCH
DCV	21,308 CF
SWQDV (DMA-1)=	9,340 CF
SWQDV (DMA-2)=	1,390 CF
SWQDV (DMA-3)=	950 CF
SWQDV (DMA-4)=	708 CF
SWQDV (DMA-5)=	1,101 CF
SWQDV (DMA-6)=	786 CF
SWQDV (DMA-7)=	432 CF
SWQDV (DMA-8)=	6,275 CF
SWQDV (DMA-9)=	890 CF
SWQDV (DMA-10)=	450 CF
SWQDV (TOTAL)=	22,322 CF

N

GRAPHIC SCALE
25 0 12.5 25 50 100
(IN FEET)
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6400 KATELLA AVE
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PROJECT: DLX7 CYPRESS CALIFORNIA
ADDRESS: 6400 KATELLA AVE, CA
FOR: GREENLAW PARTNERS 18301 VON KARMAN, STE 250 IRVINE CA 92612

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Project Number: 2019-447
Plan Check Number: PC # XXXX-XXX

DATE: 04/23/20
SCALE: AS SHOWN
JOB NO. 3190323
PROJECT MANAGER: SAMUEL J. JACOBY
DESIGNED BY: EAR
CHECKED BY: SJJ

REV 06/23/2020
REV 07/02/2020
REV 08/04/2020

WQ2

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