BYER GEOTECHNICAL, INC.

February 10, 2017
BG 22590

5297 Marina Island, LLC
℅ AHN & Associates, LLC
4924 Balboa Boulevard, Suite 518
Encino, California 91316

Attention: Ms. Athena Novak

Subject

Transmittal of Geotechnical Engineering Exploration
Proposed Five-Story Residential Development over Subterranean Parking Level
The Del Rey Pointe
Assessor's Parcel Nos. 4211-007-034 and -035
Arbs. 1 and 2, Fraction of Lot 1, Tract 1100, Arbs. 301 and 432, Fraction of Jacinto Talamantes 17 Acres Lot, Rancho La Ballona Tract, and Arb. 4, Record of Survey Tract
5000 South Beethoven Street
Del Rey, California

Gentlepersons:

Byer Geotechnical has completed our report dated February 10, 2017, which describes the geotechnical engineering conditions with respect to the proposed project. The reviewing agency for this document is the City of Los Angeles, Department of Building and Safety (LADBS). The reviewing agency requires two unbound copies, one with a wet signature, a CD (PDF format), an application form, and a filing fee. Copies of the report have been distributed as follows:

(4) Addressee (E-mail and Mail)
(1) The Albert Group Architects, Attention: Steve Albert (E-mail and Mail)
(1) Ophir, Attention: Ilan Isrealy (E-mail)

It is our understanding that AHN & Associates, LLC, will file the report and CD with the LADBS. Please review the report carefully prior to submittal to the governmental agency. Questions concerning the report should be directed to the undersigned. Byer Geotechnical appreciates the opportunity to offer our consultation and advice on this project.

Very truly yours,
BYER GEOTECHNICAL, INC.

Raffi S. Babayan
Senior Project Engineer

BYER GEOTECHNICAL, INC.

GEOTECHNICAL ENGINEERING EXPLORATION
PROPOSED FIVE-STORY RESIDENTIAL DEVELOPMENT OVER
SUBTERRANEAN PARKING LEVEL
THE DEL REY POINTE
ASSESSOR'S PARCEL NOS. 4211-007-034 AND -035
ARBS. 1 AND 2, FRACTION OF LOT 1, TRACT 1100, ARBS. 301 AND 432, FRACTION OF
JACINTO TALAMANTES 17 ACRES LOTS, RANCHO LA BALLONA TRACT, AND
ARB. 4, RECORD OF SURVEY TRACT
5000 SOUTH BEETHOVEN STREET
DEL REY, CALIFORNIA
FOR 5297 MARINA ISLAND, LLC
BYER GEOTECHNICAL, INC., PROJECT NUMBER BG 22590
FEBRUARY 10, 2017

1461 East Chevy Chase Drive, Suite 200 • Glendale, California 91206 • tel 818.549.9959 • fax 818.543.3747 • www.byergeo.com

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INTRODUCTION

This report has been prepared per our signed Agreement and summarizes findings of Byer Geotechnical, Inc., geotechnical engineering exploration performed on the subject site. The purpose of this study is to evaluate the nature, distribution, engineering properties, and geologic hazards of the earth materials underlying the site with respect to construction of a five-story residential development over a subterranean parking level. This report is intended to assist in the design and completion of the proposed project and to reduce geotechnical risks that may affect the project. The professional opinions and advice presented in this report are based upon commonly accepted exploration standards and are subject to the AGREEMENT with TERMS AND CONDITIONS, and the GENERAL CONDITIONS AND NOTICE section of this report. No warranty is expressed or implied by the issuing of this report.

PROPOSED PROJECT

The scope of the proposed project was determined from consultation with Ms. Athena Novak of AHN & Associates, LLC, and the preliminary plans prepared by The Albert Group Architects, dated January 6, 2016. Final plans have not been prepared and await the conclusions and recommendations of this report. The project consists of construction of a five-story residential building over a subterranean parking level. The finished grade of the subterranean parking level is planned at elevation 9.0 feet above mean sea level. The ground level of the proposed building will consist of concrete-frame parking. The upper four levels will consist of wood-frame living spaces. The footprint of the subterranean parking level is planned to occupy almost the entire site, as shown on the enclosed Site Plan. Retaining walls up to 12 feet high are planned to support the excavation for the subterranean parking level. Column loads (dead and live) on foundations are expected to be moderate. Other onsite improvements include a 20-foot-long by 15-foot-wide, 5-foot-deep swimming pool, planned in the east end of the site, as shown on the enclosed Site Plan. The existing metal containers are to be removed from the site. Access to the site will be provided via a future vehicle bridge to be built over Centinela Creek from the terminus of Beethoven Street.

EXPLORATION

The scope of the field exploration was determined from our initial site visit and consultation with Ms. Athena Novak. The preliminary plans prepared by The Albert Group Architects, dated January 6, 2016, were a guide to our work on this project. Exploration was conducted using techniques normally applied to this type of project in this setting. This report is limited to the area of the exploration and the proposed project as shown on the enclosed Site Plan and cross sections. The scope of this exploration did not include an assessment of general site environmental conditions for the presence of contaminants in the earth materials and groundwater. Conditions affecting portions of the property outside the area explored are beyond the scope of this report.

Exploration was conducted on January 16 and 17, 2017, with the aid of an electronic piezocone penetrometer (CPT) and a hollow-stem-auger drill rig. It included drilling five borings and advancing three CPT soundings to depths of 31½ to 70 feet below existing grade. Samples of the earth materials were obtained and delivered to our soils engineering laboratory for testing and analysis. The borings tailings were visually logged by the project soils engineer. Following drilling, logging, and sampling, the borings were backfilled and mechanically tamped.

Office tasks included laboratory testing of selected soil samples, review of published maps and photos for the area, review of our files, review of agency files, preparation of cross sections, preparation of the Site Plan, engineering analysis, and preparation of this report. Earth materials exposed in the borings are described on the enclosed Log of Borings. Appendix I contains a discussion of the laboratory testing procedures and results. Appendix II contains the cone penetrometer results and interpretations. Appendix III contains the results of liquefaction analysis.

The proposed project and the locations of the borings and CPT soundings are shown on the enclosed Site Plan. Subsurface distribution of the earth materials and the proposed project are shown on Sections A and B.

RESEARCH

Research of agency records was conducted to locate geotechnical reports for the subject property. No geotechnical reports for the subject property were located.

SITE DESCRIPTION

The subject property consists of an irregularly-shaped, relatively-level, and graded parcel that is located just east of the Ballona Wetlands in the Del Rey section of the city of Los Angeles, California (33.9800° N Latitude, 118.4233° W Longitude). As depicted on the enclosed Aerial Vicinity Map, the property is bounded by Ballona Creek on the northwest, Centinela Creek on the south-southeast, the Marina (90) Freeway on the north, and the north service road of Centinela Creek Channel. The property is located approximately 1.7 miles west of the San Diego (405) Freeway. The property is currently vacant. Scattered stockpiles of wood, concrete, and asphalt debris cover the central and west portions of the property. In addition, about 13 metal containers are located in the eastern portion of the property. The surrounding area has been developed with commercial establishments, as well as single- and multi-family residential buildings.

Based on our review of historic aerial photographs and topographic maps (historicaerials.com), it appears that the subject property comprised a small portion of a large agricultural area prior to 1963. Based on the enclosed Historic Topographic Map, the ground surface elevation of the subject site was estimated to be 12.0 feet above mean sea level in 1924. The historic records also indicate that Centinela Creek was channelized between 1957 and 1963. Past grading on the site has consisted of placing fill, possibly during the channelization of Centinela Creek.

Vegetation on the site consists of a few scattered shrubs and small trees. Surface drainage is by sheetflow runoff down the contours of the land to the southeast.

GROUNDWATER

Groundwater was encountered in the borings and CPT soundings at the approximate depths and elevations shown on the following table:

Depth and Elevations of Observed Groundwater				
Boring/CPT No.	Ground Surface Elevation (feet above MSL)	Depth to Groundwater (feet)	Water Table Elevation (feet above MSL)	Remarks
B1	19.0	21.8	-2.8	-
B2	20.0	20.5	-0.5	-
B3	15.0	16.0	-1.0	-
B4	21.0	22.0	-1.0	-
B5	20.0	22.0	-2.0	-
CPT1	20.0	22.0	-2.0	-
CPT2	21.0	21.5	-0.5	-
CPT3	19.0	21.0	-2.0	-
CPT4	22.0	-	-	Caving - Hole open to 11.5 ft

In *Seismic Hazard Zone Report 036,* the California Geological Survey (CGS) has estimated the historically-highest groundwater level at the site was on the order of five feet below the ground surface (CGS, 1998). The historic-high groundwater level date is based on the water-well logs from the turn of the 20th Century (Mendenhall, 1905). Based on the original surface elevation of the site in 1924, the historic-high groundwater level is estimated to be at elevation 7.0 above mean sea level. Seasonal fluctuations in groundwater levels occur due to variations in climate, irrigation, development, and other factors not evident at the time of the exploration. Groundwater levels may also differ across the site. Groundwater can saturate earth materials causing subsidence or instability of slopes.

METHANE ZONES

The City of Los Angeles Ordinance No. 175790 established methane mitigation requirements and includes construction standards to control methane intrusion into buildings. The subject property is mapped within a Methane Zone. New buildings within a Methane Zone or Methane Buffer Zone must comply with Methane Mitigation Standards established by the Superintendent of Building.

A civil engineer experienced with methane detection and remediation should be consulted to conduct the necessary site testing and to provide a methane mitigation system in compliance with the City ordinance. The City of Los Angeles, Department of Building and Safety, has a Methane Mitigation Designer Interest List of consultants that are capable of performing the required testing and/or remediation.

EARTH MATERIALS

Fill (Afu)

The Historic Topographic Map indicates the subject property was at elevation 12 ±. The current elevations vary from 14 to 28 feet, including the stockpile, indicating 2 to 16 feet of fill has been placed. The maximum observed depth of fill in the borings is nine feet in Boring 4. The fill consists of layers of sand, clayey sand, and sandy clay that are yellowish-brown, brown, olive-brown, and dark brown, slightly moist to moist, loose to medium dense, and stiff to very stiff. The existing fill is not suitable for support of any type of structure. Based on the current configuration of the proposed building, nearly all the fill is expected to be removed during the excavation for the subterranean parking level.

Alluvium (Qa)

Natural alluvium underlies the subject site (Dibblee, 1991, and Poland, 1959). The upper 38 to 40 feet of alluvium generally consists of layers of clay, sandy clay, silty sand, and sandy silt that is olive-brown, dark brown, and dark gray, moist to very moist, medium dense, and stiff to very stiff. The alluvium below consists of gravelly sand that is gray to dark gray, slightly moist to moist, and dense to very dense.

GENERAL SEISMIC CONSIDERATIONS

Regional Faulting

The subject property is located in an active seismic region. Moderate to strong earthquakes can occur on numerous local faults. The United States Geological Survey, California Geological Survey (CGS), private consultants, and universities have been studying earthquakes in southern California for several decades. Early studies were directed toward earthquake prediction and estimation of the effects of strong ground shaking. Studies indicate that earthquake prediction is not practical and not sufficiently accurate to benefit the general public. Governmental agencies now require earthquake-resistant structures. The purpose of the code seismic-design parameters is to prevent collapse during strong ground shaking. Cosmetic damage should be expected.

Southern California faults are classified as "active" or "potentially active." Faults from past geologic periods of mountain building that do not display evidence of recent offset are considered "potentially active." Faults that have historically produced earthquakes or show evidence of movement within the past 11,000 years are known as "active faults." No known active faults cross the subject property, and the property is not located within a currently-designated Alquist-Priolo Earthquake Fault Zone (CGS, 2000). Therefore, the potential for future surface rupture onsite is considered nil.

The known regional local active and potentially-active fault that could produce the most significant ground shaking on the site include the Newport-Inglewood, Santa Monica, and Palos Verdes Faults. Forty-three faults were found within a 100-kilometer-radius search area from the site using EZ-FRISK V7.65 computer program. The results of seismic-source analysis are listed in Appendix IV. The closest mapped "active" fault is the Newport-Inglewood Fault, a Type B fault that is located 5.7 kilometers (3.6 miles) east of the site. The Newport-Inglewood Fault is capable of producing a maximum moment magnitude of 7.5 and an average slip rate of 1.5 ± 0.5 millimeters per year (Cao et al., 2003). The Elsinore Fault, a Type A fault, is located 34.6 kilometers (21.5 miles) east-southeast of the site. In addition, the San Andreas Fault, another Type A fault, is located 69.6

kilometers (43.3 miles) northeast of the site. General locations of regional active faults with respect to the subject site are shown on the enclosed Regional Fault Map (Appendix IV).

Seismic Design Coefficients

The following table lists the applicable City of Los Angeles Building Code seismic coefficients for the project:

SEISMIC COEFFICIENTS (2017 City of Los Angeles Building Code)		
Latitude = 33.9800° N Longitude = 118.4233° W	Short Period (0.2s)	One-Second Period
Earth Materials and Site Class from Table 20.3-1, ASCE Standard 7-10	Alluvium - D	
Mapped Spectral Accelerations from Figures 1613.3.1 (1) and 1613.3.1 (2) and USGS	S_s = 1.705 (g)	S_1 = 0.651 (g)
Site Coefficients from Tables 1613.3.3 (1) and 1613.3.3 (2) and USGS	F_A = 1.0	F_V = 1.5
Maximum Considered Spectral Response Accelerations from Equations 16-37 and 16-38, 2013 CBC	S_{MS} = 1.705 (g)	S_{M1} = 0.977 (g)
Design Spectral Response Accelerations from Equations 16-39 and 16-40, 2013 CBC	S_{DS} = 1.137 (g)	S_{D1} = 0.651 (g)
Maximum Considered Earthquake Geometric Mean (MCE_G) Peak Ground Acceleration, adjusted for Site Class effects	PGA_M = 0.644 (g)	

Reference: U.S. Geological Survey, **Geologic Hazards Science Center, U. S. Seismic Design Maps,** http://earthquake.usgs.gov/designmaps/us/application.php

The mapped spectral response acceleration parameter for the site for a 1-second period (S_1) is less than 0.75g. The design spectral response acceleration parameters for the site for a 1-second period (S_{D1}) is greater than 0.20g, and/or the short period (S_{DS}) is greater than 0.50g. Therefore, the project is considered to be in Seismic Design Category D.

The principal seismic hazard to the proposed project is strong ground shaking from earthquakes produced by local faults. Modern buildings are designed to resist ground shaking through the use of shear panels, moment frames, and reinforcement. Additional precautions may be taken, including strapping water heaters and securing furniture to walls and floors. It is likely that the subject property will be shaken by future earthquakes produced in southern California.

Ground Motion

A probabilistic seismic hazard deaggregation analysis was performed for the subject site. Seismic parameters were determined using currently-available earthquake and fault information, utilizing data from the United States Geological Survey (USGS) National Seismic Hazard Mapping Project (USGS, 2008). An averaging of three Next Generation Attenuation relations (Chiou-Youngs, 2008; Boore-Atkinson, 2008; and Campbell-Bozorgnia, 2008) were incorporated in the analysis. An average shear-wave velocity (Vs30) of 330 meters-per-second (Site Class D) was used in the analysis. Results of the probabilistic seismic hazard deaggregation analysis are shown in the following table:

Probabilistic Seismic Hazard Deaggregation Analysis		
Latitude = 33.9800° N Longitude = 118.4233° W	Percent Probability of Exceedance in 50 Years	
Shear-Wave Velocity = 330 Meters-per-Second	10%	2%
Return Period	475 Years	2,475 Years
Magnitude of the Predominant Earthquake (Mw)*	6.59	7.37
Distance to the Seismic Source (Km)*	13.8	6.8

* Modal Values (R,M,e0)

Reference: U.S. Geological Survey, 2008 Interactive Deaggregation, http://geohazards.usgs.gov/deaggint/2008/

Results of the analysis are graphically presented in the enclosed Seismic Hazard Deaggregation Charts 1 and 2 (Appendix IV).

Based on a Site Class D, the MCE_G peak ground acceleration adjusted for Site Class effects, PGA_M, is 0.644g. The pseudo-static seismic coefficient (k_h) was derived according to LADBS Memorandum dated July 16, 2014. The horizontal pseudo-static seismic coefficient (k_h) was selected as one-third of the PGA_M (0.21g) and was used in the seismic calculations for the cantilever and restrained retaining walls. These ground motions could occur at the site during the life of the project.

Liquefaction

The CGS has mapped the site within an area where historic occurrence of liquefaction or geological, geotechnical, and groundwater conditions indicate a potential for permanent ground displacement such that mitigation as defined in Public Resources Code Section 2693 (c) would be required (CGS, 1999), as shown on the enclosed Seismic Hazard Zones Map (Appendix IV).

Liquefaction is a process that occurs when saturated sediments are subjected to repeated strain reversals during an earthquake. The strain reversals cause increased pore water pressure such that the internal pore pressure approaches the overburden stress and the shear strength approaches zero. Liquefied soils may be subject to flow or excessive strain, which may induce settlement. Liquefaction occurs in soils below the groundwater table. Soils commonly subject to liquefaction include loose to medium-dense sand and silty sand. Predominantly fine-grained soils, such as silts and clay, are less susceptible to liquefaction. Generally, medium dense to dense sand-like soils with fines content (percent passing the No. 200 sieve) greater than 35 percent are not considered susceptible to liquefaction. In addition, cohesive soils with Plasticity Index (PI) values between 12 and 18 and a moisture content less than 80 percent of the Liquid Limit (LL) are not considered susceptible to liquefaction (CGS, 2008, and Bray and Sancio, 2006). Cohesive soils with PI greater than 18 may be susceptible to liquefaction, if considered sensitive (CGS, 2008). Soil sensitivity is the ratio of the undisturbed shear strength of a cohesive soil to the remolded shear strength at the same water content (Bowles, 1996). Based on the study conducted by Bray and Sancio on soils affected by the 1999 earthquakes in Taiwan and Turkey, soils with a PI greater than 18 tested at low confining effective stresses are not considered susceptible to liquefaction (Bray and Sancio, 2006).

Soils data collected in Borings 1 and 4 and CPT soundings 2 and 3 were utilized to quantify the liquefaction potential of the site. In order to satisfy the requirements of the LADBS, liquefaction analyses were performed based on the following two criteria.

Liquefaction Analysis Input Parameters		
	Criteria 1	Criteria 2
Peak Ground Acceleration (g)	0.430 (⅔ PGA_M)	0.644 (PGA_M)
Probability of Exceedance in 50 Years	10%	2%
Return Period	475 Years	2,475 Years
Earthquake Magnitude (Mw)	6.59	7.37
Factor of Safety	1.1	1.0

Reference: LADBS Memorandum, Letter to Geology and Soils Engineering Firms practicing in the City of Los Angeles, dated July 16, 2014.

For a conservative analysis, it was assumed that groundwater rose to the historic-high groundwater level, five feet below the ground surface (see "Groundwater" section of this report).

Laboratory testing consisting of Atterberg Limits (ASTM D 4318-10) and sieve analysis by wash method (ASTM D 1140-14) was performed on representative samples of the earth materials collected in Borings 1 and 4. The purpose of these tests was to determine the liquid limit, plasticity index (PI), and fines content (percent passing the No. 200 sieve) and incorporate the results in the liquefaction analysis. The results are shown on the Laboratory Testing program in Appendix I, as well as on the enclosed liquefaction calculations (Appendix III).

A liquefaction potential analysis based upon SPT data from Borings 1 and 4 is presented in Appendix III on the plates entitled "Liquefaction Susceptibility Analysis: SPT Method)." The column labeled "Factor of Safety" lists the calculated safety factor of each 2½-foot-thick layer of soil encountered in Borings 1 and 4. In addition, a borehole diameter correction factor (C_B) of 1.15 was incorporated in the analysis to account for the stress relief since the tip of the auger was raised a few inches from the bottom of the hole prior to driving the sampler. The stresses and safety factors for liquefaction were calculated using the methodology of Youd et al. (2001) and Special Publication 117A (CGS, 2008). Soils with a factor of safety less than 1.1 were considered susceptible to liquefaction.

Based on the results of Atterberg Limits laboratory tests conducted on several fine-grained soil samples obtained from Borings 1 and 4, the PI values of the clay and silt layers range from 13.1 to 21.5 percent. Quantitative evaluation and screening analysis was performed to determine the depths and limits of potentially-liquefiable soil layers encountered in Borings 1 and 4. The results are summarized in the following table:

Results of Quantitative Evaluation and Screening Analysis										
Boring No.	Layer Depth (feet)	Liquid Limit LL (%)	Plastic Limit PL (%)	Plasticity Index PI (%)	Fines Content (%)	Soil Type & Unit	Moisture Content w_c (%)	$(N_1)_{60cs}$	Screening Criteria (SP 117A, 2008, & Bray 2006)	Result
B1	7.5	-	-	-	71.9	Clay (CL)	-	41.0	CRR > CSR	Non-Liquefiable
B1	10	44.0	23.6	20.4	75.0	Clay (CL)	-	26.4	PI > 18, Not Sensitive	Non-Liquefiable
B1	12.5	48.9	27.4	21.5	92.5	Clay (CL)	-	20.7	PI > 18, Not Sensitive	Non-Liquefiable
B1	15.0	44.5	23.0	21.5	76.6	Clay (CL)	-	17.4	PI > 18, Not Sensitive	Non-Liquefiable
B1	22.5	-	-	-	72.2	Clay (CL)	-	35.7	PI > 18, Not Sensitive	Non-Liquefiable
B1	25.0	-	-	-	33.6	(SM)	-	26.0	CRR < CSR	Liquefiable
B1	27.5	-	-	-	63.9	Silt (ML)	-	30.0	CRR > CSR	Non-Liquefiable
B1	30.0	41.2	27.1	14.1	59.4	Silt (ML)	27.1	20.7	w_c/ LL ≤ 0.8	Non-Liquefiable
B1	32.5	39.3	19.4	19.9	-	Clay (CL)	-	8.1	PI > 18, Not Sensitive	Non-Liquefiable
B1	35.0	36.7	19.4	17.3	76.6	Clay(CL)	23.4	24.1	w_c/ LL ≤ 0.8	Non-Liquefiable
B1	37.5	-	-	-	54.7	Clay (CL)	-	30.4	CRR > CSR	Non-Liquefiable
B1	42.5	-	-	-	26.5	(SM)	-	32.2	CRR > CSR	Non-Liquefiable

Results of Quantitative Evaluation and Screening Analysis										
B1	45.0	-	-	-	69.5	Silt (ML)	-	34.0	CRR > CSR	Non-Liquefiable
B4	7.5	-	-	-	74.3	Clay (CL)	-	30.4	CRR > CSR	Non-Liquefiable
B4	10.0	-	-	-	68.8	Clay (CL)	-	32.3	CRR > CSR	Non-Liquefiable
B4	12.5	35.4	21.6	13.8	81.5	Clay (CL)	20.3	22.4	w_c/ LL ≤ 0.8	Non-Liquefiable
B4	17.5	39.4	23.5	15.9	72.6	Clay (CL)	21.9	23.1	w_c/ LL ≤ 0.8	Non-Liquefiable
B4	20.0	41.2	21.0	20.2	84.5	Clay (CL)	-	23.5	PI > 18, Not Sensitive	Non-Liquefiable
B4	22.5	34.3	18.1	16.2	70.8	Clay (CL)	25.6	15.2	w_c/ LL ≤ 0.8	Non-Liquefiable
B4	25.0	-	-	-	37.9	(SM)	-	30.6	CRR > CSR	Non-Liquefiable
B4	27.5	-	-	-	29.9	(SM)	-	34.0	CRR > CSR	Non-Liquefiable
B4	30.0	-	-	-	62.2	Silt (ML)	-	29.2	CRR > CSR	Non-Liquefiable
B4	32.5	-	-	-	65.3	Clay (CL)	-	31.5	CRR > CSR	Non-Liquefiable
B4	37.5	33.8	17.5	16.3	87.9	Clay (CL)	25.9	21.0	w_c/ LL ≤ 0.8	Non-Liquefiable
B4	40.0	-	-	-	71.8	Silt (ML)	-	35.1	CRR > CSR	Non-Liquefiable
B4	42.5	38.9	25.8	13.1	68.7	Silt (ML)	24.3	24.3	w_c/ LL ≤ 0.8	Non-Liquefiable
B4	47.5	-	-	-	67.5	Silt (ML)	-	31.0	CRR > CSR	Non-Liquefiable

Based on the results of sieve analysis and *in-situ* moisture contents, it is reasonable to conclude that the clay layers encountered in Boring 1 at depths of 17½ and 20 feet exhibit similar behavior as the clay layer encountered at the same depths in Boring 4. In addition, the clay layers encountered in Boring 4 at depths of 15 and 35 feet exhibit similar behavior as the clay layers encountered at the same depths in Boring 1. Therefore, the clay layers encountered between the depths of 7½ and 47½ feet are not considered susceptible to liquefaction.

A liquefaction analysis was also performed using the data obtained from CPT2 and CPT3. The results are presented in Appendix III on the plates entitled "Liquefaction Susceptibility Analysis: CPT Method (475-Yr Return)."

The results of liquefaction analysis indicate that the silty sand layer encountered in Boring 1 and CPT 3 at a depth of 25 feet may be susceptible to liquefaction.

Dynamic Settlement

Earthquake-induced volumetric strain and dissipation of pore pressure in saturated silts and sands after liquefaction can result in settlement. The potential for liquefaction-induced settlement was calculated using the methodology of Tokimatsu and Seed (1987) along with the SPT data, and Zhang et al. (2002) along with the CPT data. The seismic settlement potentials were calculated for the soil layers below the historic-high groundwater level (five feet below ground surface) and with a factor of safety for liquefaction less than 1.1 for Criteria 1, and less than 1.0 for Criteria 2, as described in the "Liquefaction" section above. The results are shown in the following table:

Liquefaction-Induced Dynamic Settlement (Based on Criteria 1)				
Boring/CPT No.	B1	B4	CPT2	CPT3
Layer Depth (feet)	25	-	-	25
Layer Thickness (feet)	2.5	-	-	2.0
Total Dynamic Settlement (inch)	0.53	-	-	0.48
Differential Dynamic Settlement (inch)	0.27	-	-	0.24

Differential dynamic settlement is taken as one-half the total dynamic settlement. Using Criteria 2, a total dynamic settlement potential of 0.49 to one inch is anticipated. According to the LADBS, the dynamic settlement calculated based on Criteria 2 is intended to evaluate the deformation of the proposed foundation system so that the proposed building will not lose its ability to carry gravity loads and that collapse of the structure will be prevented.

Lateral Spreading Hazard

Liquefied soils may be subject to lateral spreading flow failure where adjacent to slopes or "free-faces" such as steep slopes or embankments. A clean sand with a $(N_1)_{60}$ less than or equal to 15, and a safety factor for liquefaction less than 1.1 may be susceptible to lateral spreading. The subject property is bounded by free faces and channels adjacent to the north, west, and south property lines. However, based on the results of liquefaction analysis, the earth materials that are subject to liquefaction are deeper than the adjacent channels. Therefore, it is the opinion of Byer Geotechnical, Inc., that the lateral spreading hazard at the site is nil and no mitigation as defined in Public Resources Code Section 2693(c) is required for lateral spreading.

Seismically-Induced Landsliding

The CGS has not designated the property within a state zone requiring seismic landslide investigation per Public Resources Code, Section 2693 (c), as shown on the enclosed Seismic Hazard Zones Map (Appendix IV). The subject site is bounded by descending slopes that are 3:1 and flatter adjacent to the north and southwest property lines. Therefore, slope stability is not considered an issue.

Seiches and Tsunamis

Seiches are large waves generated in enclosed bodies of water, such as lakes and reservoirs, in response to ground shaking. Tsunamis are waves generated in large bodies of water by fault displacement or major ground movement. The site is not located near any lake or reservoir. In addition, the site is mapped immediately adjacent to tsunami inundation zones shown within the Ballona Creek and Centinela Creek Channels (CGS, 2009), as shown on the enclosed Tsunami Inundation Map (Appendix IV).

CONCLUSIONS AND RECOMMENDATIONS

General Findings

The conclusions and recommendations of this exploration are based upon review of the preliminary plans, review of published maps, five borings, three CPT soundings, research of available records, laboratory testing, engineering analysis, and years of experience performing similar studies on similar sites. It is the finding of Byer Geotechnical, Inc., that development of the proposed project is feasible from a geotechnical engineering standpoint, provided the advice and recommendations contained in this report are included in the plans and are implemented during construction.

The recommended bearing material is the firm natural alluvium, which is anticipated at the level of the subterranean parking level. Conventional foundations may be used to support the proposed five-story residential building over a subterranean parking level. Soils to be exposed at the finished grade of the subterranean parking level are expected to exhibit low expansion potential.

The earth materials surrounding and underlying the area of the proposed swimming pool are considered soft and unsuitable for support of the pool. It is recommended to support the proposed pool on future compacted fill. Recommendations for site preparation for the area of the proposed pool are included in the "Swimming Pool" section of this report.

Geotechnical issues affecting the project include temporary excavations up to 14 feet in height, including an estimate of the foundation embedment depth. Temporary shoring, consisting of soldier piles, is recommended to facilitate the construction of the subterranean parking level. Recommendations for temporary shoring are included in the "Temporary Excavations" section of this report.

Based on the current groundwater level data obtained from the borings and CPT soundings, groundwater will be encountered in temporary shoring pile excavations

Clay is anticipated at the bottom of excavation for the subterranean parking level. The clay is expected to be moist to very moist. During the construction process, pumping of the subgrade soil as a result of heavy equipment traversing the site may likely occur, resulting in an unstable subgrade. This can be mitigated by placing a 12-inch-thick layer of ½- to ¾-inch crushed gravel at the bottom of excavation prior to construction of the concrete slab-on-grade.

FOUNDATION DESIGN

Spread Footings

Continuous and/or pad footings may be used to support the proposed five-story residential building over a subterranean parking level, provided they are founded in firm alluvium. Continuous footings should be a minimum of 12 inches in width. Pad footings should be a minimum of 24-inches square. The following chart contains the recommended design parameters.

Bearing Material	Minimum Embedment Depth of Footing (Inches)	Vertical Bearing (psf)	Coefficient of Friction	Passive Earth Pressure (pcf)	Maximum Earth Pressure (psf)
Alluvium	24	2,000	0.30	200	4,000

Increases in the bearing value are allowable at a rate of 400 pounds-per-square-foot for each additional foot of footing width or depth to a maximum of 4,000 pounds-per-square-foot. For bearing calculations, the weight of the concrete in the footing may be neglected.

The bearing value shown above is for the total of dead and frequently applied live loads and may be increased by one-third for short duration loading, which includes the effects of wind or seismic forces. When combining passive and friction for lateral resistance, the passive component should be reduced by one-third.

Footings adjacent to retaining walls should be deepened below a 1:1 plane from the bottom of the lower retaining wall, or the footings should be designed as grade beams to bridge from the wall to the 1:1 plane.

All continuous footings should be reinforced with a minimum of four #4 steel bars: two placed near the top and two near the bottom of the footings. Footings should be cleaned of all loose soil, moistened, free of shrinkage cracks, and approved by the geotechnical engineer prior to placing forms, steel, or concrete.

Foundation Settlement

Settlement of the foundation system is expected to occur on initial application of loading. The static settlement analysis of the proposed building is based on the minimum and maximum allowable bearing pressures of 2,000 and 4,000 pounds-per-square-foot, respectively. Results of static settlement analysis indicate that a maximum total static settlement of 0.31 to 0.78 inch may be anticipated (see Calculation Sheets #1 and #2). Differential static settlement should not exceed 0.47 inch across the footprint of the proposed building.

Based on the results of liquefaction analysis performed on the site, a total dynamic settlement of 0.48 to 0.53 inch and a differential dynamic settlement of 0.24 to 0.27 inch (½ of total) are possible in the event of a strong earthquake nearby. Therefore, the combined total settlement (static and dynamic) is estimated to range from 0.79 to 1.31 inches, and the combined differential (static and dynamic) settlement is estimated to range from 0.71 to 0.74 inches.

SWIMMING POOL

The proposed swimming pool should derive support entirely from the future compacted fill. This will require over-excavation in accordance with the "Site Preparation - Removals" specifications below. The pool shall be constructed using a freestanding design. Pool walls should be designed for an inward pressure of 43 pounds-per-cubic-foot. A hydrostatic relief valve is recommended. If the spa is to be attached to the pool, the spa should be founded at the same depth as the portion of the pool it adjoins.

SITE PREPARATION - REMOVALS

Surficial materials consisting of existing fill and soft alluvium are present on the site. Remedial grading is recommended to improve site conditions. The existing fill and soft alluvium should be removed in the area of the proposed swimming pool (see Item B below) and replaced as certified compacted fill. The following general grading specifications may be used in preparation of the grading plan and job specifications. Byer Geotechnical would appreciate the opportunity of reviewing the plans to ensure that these recommendations are included. The grading contractor should be provided with a copy of this report.

A. The area to receive compacted fill should be prepared by removing all vegetation, debris, existing fill, and soft alluvium. The exposed excavated area should be observed by the soils engineer/geologist prior to placing compacted fill. Removal depths can be found in Item B below. The exposed grade should be scarified to a depth of six inches, moistened to optimum moisture content, and recompacted to 90 percent of the maximum dry density.

B. The area of the proposed swimming pool shall be excavated to a minimum depth of three feet below the bottom of the pool shell. The excavation shall extend beyond the edge of the pool a minimum of three feet or to the depth of fill below the pool shell. The excavated areas shall be observed by the soils engineer/geologist prior to placing compacted fill.

C. Fill, consisting of soil approved by the soils engineer, shall be placed in horizontal lifts, moistened as required, and compacted in six-inch layers with suitable compaction equipment. The excavated onsite materials are considered satisfactory for reuse in the controlled fills. Any imported fill shall be observed by the soils engineer prior to use in fill areas. Rocks larger than six inches in diameter shall not be used in the fill.

D. The moisture content of the fill should be near the optimum moisture content. When the moisture content of the fill is too wet or dry, the fill shall be moisture conditioned and mixed until the proper moisture is attained.

E. The fill shall be compacted to at least 90 percent of the maximum laboratory dry density for the material used. The maximum dry density shall be determined by ASTM D 1557-12 or equivalent.

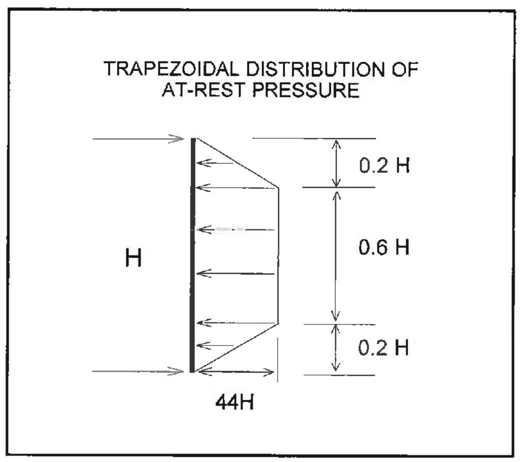
F. Field observation and testing shall be performed by the soils engineer during grading to assist the contractor in obtaining the required degree of compaction and the proper moisture content. Where compaction is less than required, additional compactive effort shall be made with adjustment of the moisture content, as necessary, until 90 percent relative compaction is obtained. A minimum of one compaction test is required for each 500 cubic yards or two vertical feet of fill placed.

RETAINING WALLS

General Design

Cantilever retaining walls up to 12 feet high, with a level backslope and uniform vehicular surcharge of 300 pounds, may be designed for an active equivalent fluid pressure of 43 pounds-per-cubic-foot (see Calculation Sheet #3). Retaining walls should be provided with a subdrain or weepholes covered with a minimum of 12 inches of ¾-inch crushed gravel.

Subterranean retaining walls, which will be restrained, should be designed for an at-rest lateral earth pressure of 44H, where H is the height of the wall. The diagram illustrates the trapezoidal distribution of earth pressure. The design earth pressures assume that the walls are free draining. Surcharge loads from vehicular traffic should be applied in the design of the restrained retaining walls.



Seismic analysis of the proposed cantilever and restrained retaining walls indicates that no additional loading due to seismic forces is required, since the calculated seismic thrust is less than the static active and at-rest design thrusts for retained heights up to 12 feet (see Calculation Sheet #4).

Subterranean retaining walls should be provided with a subdrain or weepholes covered with a minimum of 12 inches of ¾-inch crushed gravel. An alternative subdrain system consisting of Miradrain and gravel pockets connected to a solid pipe outlet may be used behind the subterranean retaining walls. A sump pump will be required for basement subdrains. The gravel pockets should be excavated to penetrate the slurry backfill behind the lagging to ensure contact with the older alluvium behind the lagging.

Backfill

Retaining wall backfill should be compacted to a minimum of 90 percent of the maximum dry density as determined by ASTM D 1557-12, or equivalent. Where access between the retaining wall and the temporary excavation prevents the use of compaction equipment, retaining walls should be backfilled with ¾-inch crushed gravel to within two feet of the ground surface. Where the area between the wall and the excavation exceeds 18 inches, the gravel must be vibrated or wheel-rolled, and tested for compaction. The upper two feet of backfill above the gravel should consist of a compacted-fill blanket to the surface. Restrained walls should not be backfilled until the restraining system is in place.

Foundation Design

Retaining wall footings may be sized per the "Spread Footings" section of this report.

Retaining Wall Deflection

It should be noted that non-restrained retaining walls can deflect up to one percent of their height in response to loading. This deflection is normal and results in lateral movement and settlement of the backfill toward the wall. The zone of influence is within a 1:1 plane from the bottom of the wall. Hard surfaces or footings placed on the retaining wall backfill should be designed to avoid the effects of differential settlement from this movement. Decking that caps a retaining wall should be provided with a flexible joint to allow for the normal deflection of the retaining wall. Decking that does not cap a retaining wall should not be tied to the wall. The space between the wall and the deck will require periodic caulking to prevent moisture intrusion into the retaining wall backfill.

TEMPORARY EXCAVATIONS

Temporary excavations will be required to construct the subterranean parking level of the proposed building. The excavations will be up to 14 feet in height, including an estimate of the foundation embedment depth, and will expose fill over alluvium. The fill should be trimmed to 1:1 for wall excavations. The alluvium is capable of maintaining vertical excavations up to five feet. Where vertical excavations in the alluvium exceed five feet in height, the upper portion should be trimmed to 1:1 (45 degrees).

Vertical excavations adjacent to the property lines will require the use of temporary shoring, such as soldier piles. Design values can be found in the "Soldier Piles" section below.

The geologist should be present during grading to see temporary slopes. All excavations should be stabilized within 30 days of initial excavation. Water should not be allowed to pond on top of the excavations nor to flow toward them. No vehicular surcharge should be allowed within three feet of the top of the cut.

Soldier Piles

Drilled, cast-in-place concrete soldier may be utilized as temporary shoring to support temporary excavations to construct the subterranean parking level of the proposed building. The piles should be a minimum of 18 inches in diameter and a minimum of eight feet into the alluvium below the excavation. Piles may be assumed fixed at three feet into the alluvium below the excavation. The piles may be designed for a skin friction of 400 pounds-per-square-foot for that portion of pile in contact with the alluvium below the excavation. Piles should be spaced a maximum of eight feet on center. The piles may be designed for an active equivalent fluid pressure of 30 pounds-per-cubic-foot (see Calculation Sheet #5). The equivalent fluid pressure should be multiplied by the pile spacing. The piles may be included in the permanent retaining wall.

Should groundwater be encountered in the pile excavations, it should be pumped out, or the water may be displaced by pumping concrete from the bottom with a hose. The tip of the hose shall be kept at least five feet below the concrete surface during pumping. When concrete is placed below water, the mix should be adjusted to achieve at least 1,000 pounds-per-square-inch more than the required strength.

Lateral Design

The friction value is for the total of dead and frequently applied live loads and may be increased by one-third for short duration loading, which includes the effects of wind or seismic forces. Resistance to lateral loading may be provided by passive earth pressure within the alluvium.

Passive earth pressure may be computed as an equivalent fluid having a density of 200 pounds-per-cubic-foot. The maximum allowable earth pressure is 4,000 pounds-per-square-foot. For design of isolated piles, the allowable passive and maximum earth pressures may be increased by 100 percent. Piles spaced more than 3-pile diameters on center may be considered isolated.

Lagging

Continuous lagging is anticipated between the soldier piles. The soldier piles should be designed for the full anticipated lateral pressure. However, the pressure on the lagging will be less due to arching in the soils. Lagging should be designed for the recommended earth pressure, but may be limited to a maximum value of 400 pounds-per-square-foot. The space behind lagging should be backfilled with cement slurry. Lagging should be placed behind the front flange of the shoring steel I-beams.

Deflection

Some deflection of the shored embankment should be anticipated. Where shoring is planned adjacent to existing structures, it is recommended that lateral deflection not exceed one-half of an inch. For shoring not surcharged by a structure, the allowable deflection is deferred to the structural engineer. If greater deflection occurs during construction, additional bracing or anchors may be necessary to minimize deflection. If desired to reduce the deflection of the shoring, a greater active pressure could be used in the shoring design.

FLOOR SLABS

Floor slabs should be cast over firm alluvium and reinforced with a minimum of #4 bars on 16-inch centers, each way. Clay is anticipated at the bottom of excavation for the subterranean parking level. The clay is expected to be moist to very moist. During the construction process, pumping of the subgrade soil as a result of heavy equipment traversing the site may likely occur, resulting in an unstable subgrade. This can be mitigated by placing a 12-inch-thick layer of ½ to ¾-inch crushed gravel, with a compacting effort, at the bottom of excavation prior to construction of the concrete slab-on-grade.

Slabs that will be provided with a floor covering should be protected by a polyethylene plastic vapor barrier. The barrier should be sandwiched between the layers of sand, about two inches each, to prevent punctures and aid in the concrete cure. A low-slump concrete may be used to minimize possible curling of the slab. The concrete should be allowed to cure properly before placing vinyl or other moisture-sensitive floor covering.

It should be noted that cracking of concrete slabs is common. The cracking occurs because concrete shrinks as it cures. Control joints, which are commonly used in exterior decking to control such cracking, are normally not used in interior slabs. The reinforcement recommended above is intended to reduce cracking and its proper placement is critical to the performance of the slab. The minor shrinkage cracks, which often form in interior slabs, generally do not present a problem when carpeting, linoleum, or wood floor coverings are used. The slab cracks can, however, lead to surface cracks in brittle floor coverings such as ceramic tile.

EXTERIOR CONCRETE DECKS

Decking should be cast over at least 18 inches of approved compacted fill and reinforced with a minimum of #3 bars placed 18 inches on center, each way. Decking that caps a retaining wall should be provided with a flexible joint to allow for the normal one to two percent deflection of the retaining wall. Decking that does not cap a retaining wall should not be tied to the wall. The space between the wall and the deck will require periodic caulking to prevent moisture intrusion into the retaining wall backfill. The subgrade should be moistened prior to placing concrete.

CEMENT TYPE AND CORROSION PROTECTION

A representative sample of the alluvium was obtained during the field exploration for laboratory testing. Corrosion test results are included in Appendix I. The results indicate that concrete structures in contact with the soils onsite will have negligible exposure to water-soluble sulfates in the soil. According to Table 4.3.1 of Section 4.2 of the ACI 318 Code, Type II cement may be used for concrete construction.

The results of the laboratory testing also indicate that the soil onsite is considered severely corrosive to ferrous metals. Special mitigation measures for corrosion protection of steel and other metallic elements in contact with the soil may be required. The corrosion information presented in Appendix IV of this report should be provided to the underground utility subcontractor.

DRAINAGE

Control of site drainage is important for the performance of the proposed project. Pad and roof drainage should be collected and transferred to the street or approved location in non-erosive drainage devices. Drainage should not be allowed to pond on the pad or against any foundation or retaining wall. Drainage should not be allowed to flow uncontrolled over any descending slope. Planters located within retaining wall backfill should be sealed to prevent moisture intrusion into the backfill. Drainage control devices require periodic cleaning, testing, and maintenance to remain effective.

Irrigation

Control of irrigation water is a necessary part of site maintenance. Soggy ground and perched water may result if irrigation water is excessively applied. Irrigation systems should be adjusted to provide the minimum water needed. Adjustments should be made for changes in climate and rainfall.

Low-Impact Development (LID) Requirements

Typically, infiltration systems are utilized in areas underlain by pervious granular earth materials that have high percolation characteristics. In addition, infiltration systems are normally planned at least 10 feet from adjacent property lines or public right-of-way, and 10 feet from a 1:1 plane projected from the bottom of adjacent structural foundations. However, since the site is located within a liquefaction zone and due to the presence of shallow groundwater, allowing water infiltration will likely increase the potential for liquefaction and the consequent dynamic settlement. Therefore, onsite infiltration is not recommended.

As an alternative, a biofiltration system may be installed on the site in accordance with the City of Los Angeles Best Management Practices (City of Los Angeles, 2011). A planter box may be used to capture and treat storm-water runoff through different soil layers before discharging water to the street storm drain. The planter box should be an impermeable rigid structure that is equipped with an underdrain to prevent water infiltration to the underlying subsurface earth materials. Planter boxes may be situated aboveground and placed adjacent to buildings. Planter boxes should be designed as freestanding and for an inward equivalent fluid pressure of 43 pounds-per-cubic-foot. This fluid pressure includes possible vehicular surcharge. Byer Geotechnical, Inc., should be provided with the final plans to verify the location of the planter boxes.

WATERPROOFING

Interior and exterior retaining walls are subject to moisture intrusion, seepage, and leakage, and should be waterproofed. Waterproofing paints, compounds, or sheeting can be effective if properly installed. Equally important is the use of a subdrain that daylights to the atmosphere. The subdrain should be covered with ¾-inch crushed gravel to help the collection of water. Landscape areas above the wall should be sealed or properly drained to prevent moisture contact with the wall or saturation of wall backfill.

PLAN REVIEW

Formal plans ready for submittal to the building department should be reviewed by Byer Geotechnical. Any change in scope of the project may require additional work.

SITE OBSERVATIONS DURING CONSTRUCTION

The building department requires that the geotechnical engineer provide site observations during grading and construction. Foundation excavations should be observed and approved by the geotechnical engineer or geologist prior to placing steel, forms, or concrete. The engineer/geologist should observe bottoms for fill, compaction of fill, pool excavations, temporary excavations, soldier piles, and subdrains. All fill that is placed should be approved by the geotechnical engineer and the building department prior to use for support of structural footings and floor slabs.

Please advise Byer Geotechnical, Inc., at least 24 hours prior to any required site visit. The building department stamped plans, the permits, and the geotechnical reports should be at the job site and available to our representative. The project consultant will perform the observation and post a notice at the job site with the findings. This notice should be given to the agency inspector.

FINAL REPORTS

The geotechnical engineer will prepare interim and final compaction reports upon request. The geologist will prepare reports summarizing pile excavations.

CONSTRUCTION SITE MAINTENANCE

It is the responsibility of the contractor to maintain a safe construction site. The area should be fenced and warning signs posted. All excavations must be covered and secured. Soil generated by foundation excavations should be either removed from the site or placed as compacted fill. Soil should not be spilled over any descending slope. Workers should not be allowed to enter any unshored trench excavations over five feet deep. Water shall not be allowed to saturate open footing trenches.

GENERAL CONDITIONS AND NOTICE

This report and the exploration are subject to the following conditions. Please read this section carefully; it limits our liability.

In the event of any changes in the design or location of any structure, as outlined in this report, the conclusions and recommendations contained herein may not be considered valid unless the changes are reviewed by Byer Geotechnical, Inc., and the conclusions and recommendations are modified or reaffirmed after such review.

The subsurface conditions, excavation characteristics, and geologic structure described herein have been projected from test excavations on the site and may not reflect any variations that occur between these test excavations or that may result from changes in subsurface conditions.

Fluctuations in the level of groundwater may occur due to variations in rainfall, temperature, irrigation, and other factors not evident at the time of the measurements reported herein. Fluctuations also may occur across the site. High groundwater levels can be extremely hazardous. Saturation of earth materials can cause subsidence or slippage of the site.

If conditions encountered during construction appear to differ from those disclosed herein, notify us immediately so we may consider the need for modifications. Compliance with the design concepts, specifications, and recommendations requires the review of the engineering geologist and geotechnical engineer during the course of construction.

THE EXPLORATION WAS PERFORMED ONLY ON A PORTION OF THE SITE, AND CANNOT BE CONSIDERED AS INDICATIVE OF THE PORTIONS OF THE SITE NOT EXPLORED.

This report, issued and made for the sole use and benefit of the client, is not transferable. Any liability in connection herewith shall not exceed the Phase I fee for the exploration and report or a negotiated fee per the Agreement. No warranty is expressed, implied, or intended in connection with the exploration performed or by the furnishing of this report.

THIS REPORT WAS PREPARED ON THE BASIS OF THE PRELIMINARY DEVELOPMENT PLAN FURNISHED. FINAL PLANS SHOULD BE REVIEWED BY THIS OFFICE AS ADDITIONAL GEOTECHNICAL WORK MAY BE REQUIRED.

Byer Geotechnical appreciates the opportunity to provide our service on this project. Any questions concerning the data or interpretation of this report should be directed to the undersigned.

Respectfully submitted,
BYER GEOTECHNICAL, INC.

Raffi S. Babayan
P. E. 72168

Robert I. Zweigler
G. E. 2120

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ENCLOSURES AND DISTRIBUTION

Enc: List of References (2 Pages)
Appendix I - Laboratory Testing and Log of Borings
- Laboratory Testing (4 Pages)
- Shear Test Diagram
- Consolidation Curves (4 Pages)
- Plasticity Charts (12 Pages)
- Log of Borings 1 - 5 (14 Pages)

Appendix II - Interpretation of Cone Penetration Test Data (18 Pages)
Appendix III - Results of Liquefaction Analysis
- Liquefaction Susceptibility Analysis: SPT Method (6 Pages/Sheets)
- Liquefaction Susceptibility Analysis: CPT Method (8 Sheets)

Appendix IV - Calculations and Figures
- Seismic Sources (2 Pages)
- Seismic Hazard Deaggregation Charts 1 and 2 (2 Pages)
- Static Settlement Calculation Sheets #1 and #2 (4 Pages)
- Retaining Wall Calculation Sheets #3 and #4 (2 Pages)
- Soldier Pile Calculation Sheet #5
- Aerial Vicinity Map
- Regional Topographic Map
- Historic Topographic Map
- Regional Geologic Map #1
- Regional Geologic Map #2
- Regional Fault Map
- Seismic Hazard Zones Map
- Historic-High Groundwater Map
- Tsunami Inundation Map

In Pocket: Site Plan
Sections A and B

xc:
(4) Addressee (E-mail and Mail)
(1) The Albert Group Architects, Attention: Steve Albert (E-mail and Mail)
(1) Ophir, Attention: Ilan Isrealy (E-mail)

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Software

EZ-FRISK 7.65, Risk Engineering, Inc.

APPENDIX I

Laboratory Testing and Log of Borings

LABORATORY TESTING

Undisturbed and bulk samples of the existing fill and alluvium were obtained from the borings and transported to the laboratory for testing and analysis. The samples were obtained by driving a ring-lined, barrel sampler conforming to ASTM D 3550-01 with successive drops of the sampler. Experience has shown that sampling causes some disturbance of the sample. However, the test results remain within a reasonable range. The samples were retained in brass rings of 2.50 inches outside diameter and 1.00 inch in height. The samples were stored in close fitting, waterproof containers for transportation to the laboratory.

Moisture-Density

The dry density of the samples was determined using the procedures outlined in ASTM D 2937-10. The moisture content of the samples was determined using the procedures outlined in ASTM D 2216-10. The results are shown on the enclosed Log of Borings.

Maximum Density

The maximum dry density and optimum moisture content of the future compacted fill were determined using the procedures outlined in ASTM D 1557-12, a five-layer standard. The results are shown in the following table.

Boring	Depth (Feet)	Earth Material	Soil Type and Color	Maximum Density (pcf)	Optimum Moisture %	Expansion Index
1	0 - 5	Fill	Sandy Clay Dark Olive-Brown	120.0	13.0	33 - Low

Expansion Test

To find the expansiveness of the soil, a swell test was performed using the procedures outlined in ASTM D 4829-11. Based upon the testing, the earth materials to be exposed at finished grade of the subterranean level are expected to exhibit low expansion potentials.

LABORATORY TESTING (Continued)

Shear Tests

Shear tests were performed on samples of the alluvium using the procedures outlined in ASTM D 3080-11 and a strain controlled, direct-shear machine manufactured by Soil Test, Inc. The rate of deformation was 0.025 inch per minute. The samples were tested in an artificially saturated condition. Following the shear test, the moisture content of the samples was determined to verify saturation. The results are plotted on the enclosed Shear Test Diagrams.

Consolidation

Consolidation tests were performed on *in situ* samples of the alluvium using the procedures outlined in ASTM D 2435-11. Results are graphed on the enclosed Consolidation Curves.

Atterberg Limits

Atterberg limits were determined on representative samples of the alluvium obtained from Borings B1, B3, and B5 using the procedures outlined in ASTM D 4318-10. The tests were performed to assist in the engineering classification of the fine-grained materials and to determine the Liquid Limit (LL) and Plasticity Index (PI). Results of Atterberg Limits are graphed on the enclosed Plasticity Charts and shown in the following table:

Results of Atterberg Limits Laboratory Tests						
Boring No.	Depth (feet)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Soil Type	Reference
B1	10.0	44.0	23.6	20.4	Clay (CL)	Plasticity Chart #1
B1	12.5	48.9	27.4	21.5	Clay (CL)	Plasticity Chart #2
B1	15.0	44.5	23.0	21.5	Clay (CL)	Plasticity Chart #3
B1	30.0	41.2	27.1	14.1	Silt (ML)	Plasticity Chart #4
B1	32.5	39.3	19.4	19.9	Clay (CL)	Plasticity Chart #5
B1	35.0	36.7	19.4	17.3	Clay (CL)	Plasticity Chart #6
B4	12.5	35.4	21.6	13.8	Clay (CL)	Plasticity Chart #7
B4	17.5	39.4	23.5	15.9	Clay (CL)	Plasticity Chart #8
B4	20.0	41.2	21.0	20.2	Clay (CL)	Plasticity Chart #9
B4	22.5	34.3	18.1	16.2	Clay (CL)	Plasticity Chart #10
B4	37.5	33.8	17.5	16.3	Clay (CL)	Plasticity Chart #11
B4	42.5	38.9	25.8	13.1	Silt (ML)	Plasticity Chart #12

LABORATORY TESTING (Continued)

Fines Content

Sieve analysis (wash method) was performed on representative samples of the alluvium obtained from Borings B1 and B3 using the procedures outlined in ASTM D 1140-14. The tests were performed to assist in the classification of the soil and to determine the fines content (percent passing #200 sieve). The results are shown on the enclosed Log of Borings B1 and B3, and are summarized in the following table.

Results of Sieve Analysis (Wash Method) Laboratory Tests							
Boring No.	Depth (feet)	Fines Content (%)	Soil Type	Boring No.	Depth (feet)	Fines Content (%)	Soil Type
B1	7.5	71.9	Sandy Clay (CL)	B4	7.5	74.3	Sandy Clay (CL)
B1	10.0	75.0	Clay w/Sand (CL)	B4	10.0	68.8	Sandy Clay (CL)
B1	12.5	92.5	Clay (CL)	B4	12.5	81.5	Clay (CL)
B1	15.0	76.6	Clay w/Sand (CL)	B4	15.0	82.9	Clay (CL)
B1	17.5	78.3	Clay (CL)	B4	17.5	72.6	Clay w/Sand (CL)
B1	20.0	87.2	Clay (CL)	B4	20.0	84.5	Clay w/Sand (CL)
B1	22.5	72.2	Clay w/Sand (CL)	B4	22.5	70.8	Sandy Clay (CL)
B1	25.0	33.6	Silty Sand (SM)	B4	25.0	37.9	Silty Sand (SM)
B1	27.5	63.9	Sandy Silt (ML)	B4	27.5	29.9	Silty Sand (SM)
B1	30.0	59.4	Sandy Silt (ML)	B4	30.0	62.2	Sandy Silt (ML)
B1	35.0	76.6	Clay w/Sand (CL)	B4	32.5	65.3	Sandy Clay (CL)
B1	37.5	54.7	Sandy Clay (CL)	B4	35.0	83.9	Clay w/Sand (CL)
B1	42.5	26.5	Silty Sand (SM)	B4	37.5	87.9	Clay w/Sand (CL)
B1	45.0	69.5	Sandy Silt (ML)	B4	40.0	71.8	Sandy Silt (ML)
				B4	42.5	68.7	Sandy Silt (ML)
				B4	47.5	67.5	Sandy Silt (ML)

LABORATORY TESTING (Continued)

Corrosion

A representative sample of the alluvium was transported to Environmental Geotechnology Laboratory for chemical testing. The testing was performed in accordance with Caltrans Standards 643 (pH), 422 (Chloride Content), 417 (Sulfate Content), and 532 (Resistivity). The results of the testing are reported in the following table:

CHEMICAL TEST RESULTS TABLE

Sample	Depth (Feet)	pH	Chloride (PPM)	Sulfate (%)	Resistivity (Ohm-cm)
B2	20 - 25	7.82	515	0.073	500

The sulfate content of the soil is negligible and not a factor in corrosion. The pH is near neutral and not a factor. The chloride content is greater than 500 ppm and is considered corrosive to ferrous metals. The resistivity indicates that the soil is considered severely corrosive to ferrous metals.

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tel 818.549.9959 fax 818.543.3747

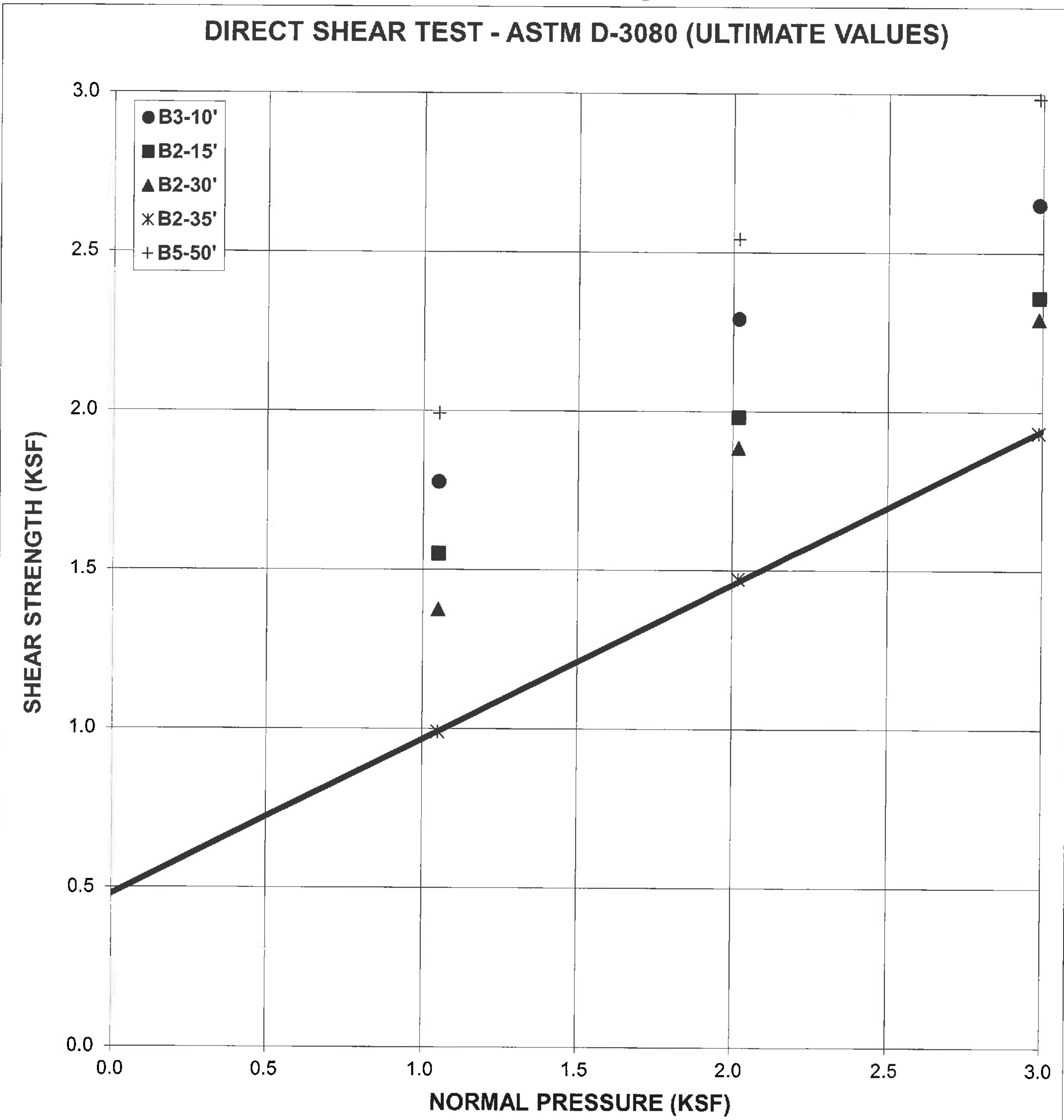
SHEAR TEST DIAGRAM #1

BG: 22590 ENGINEER: RSB
CLIENT: 5297 Marina Island, LLC

EARTH MATERIAL: **Alluvium**

Phi Angle = 26.0 degrees
Cohesion = 480 psf

Average Moisture Content 19.5%
Average Dry Density (pcf) 109.4
Average Saturation 99%



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CONSOLIDATION CURVE #1

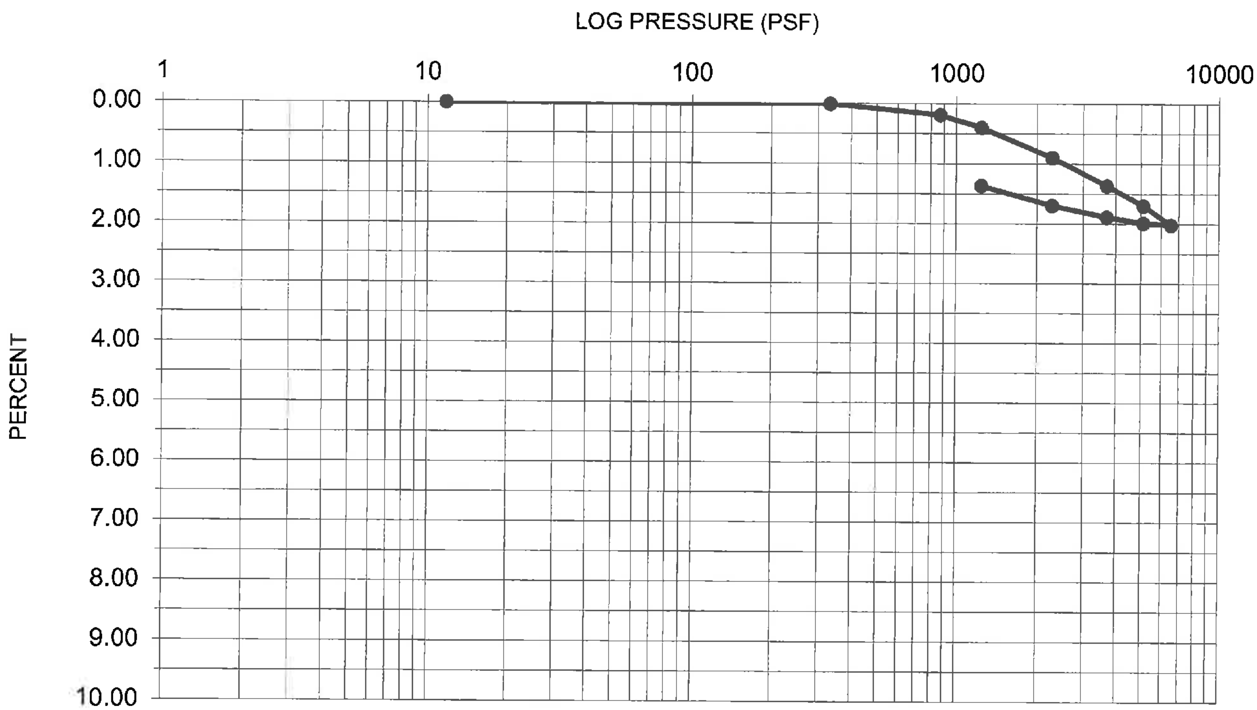
BG: **22590** ENGINEER: **RSB**

CLIENT: **5297 Marina Island, LLC**

Earth Material:	Alluvium
Sample Location:	B3-7.5'
Dry Weight (pcf):	90.4
Initial Moisture:	21.2%
Initial Saturation:	67.8%
Water Added at (psf)	1237

Specific Gravity:	2.65
Initial Void Ratio:	0.83
Compression Index (Cc):	0.055
Recompression Index (Cr):	0.023

CONSOLIDATION DIAGRAM (ASTM D 2435-04)



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CONSOLIDATION CURVE #2

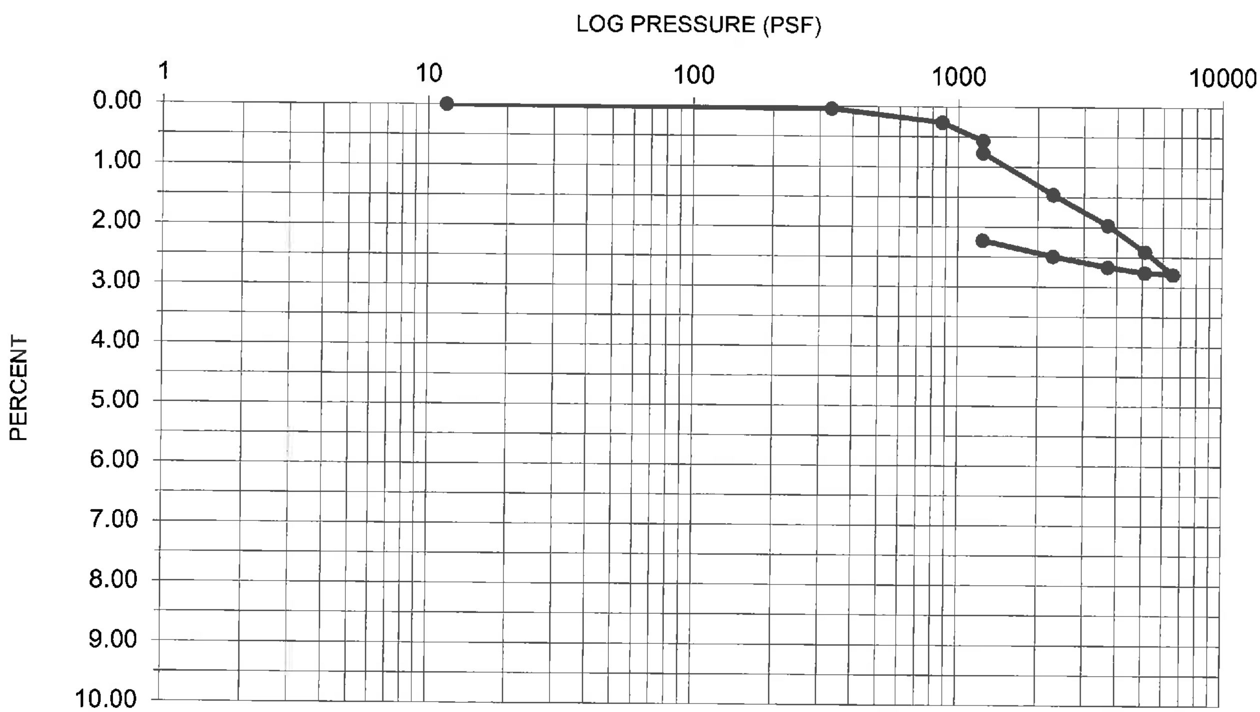
BG: 22590 ENGINEER: RSB

CLIENT: 5297 Marina Island, LLC

Earth Material:	Alluvium
Sample Location:	B2-25'
Dry Weight (pcf):	104.2
Initial Moisture:	22.1%
Initial Saturation:	100.0%
Water Added at (psf)	1237

Specific Gravity:	2.65
Initial Void Ratio:	0.59
Compression Index (Cc):	0.057
Recompression Index (Cr):	0.016

CONSOLIDATION DIAGRAM (ASTM D 2435-04)



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CONSOLIDATION CURVE #3

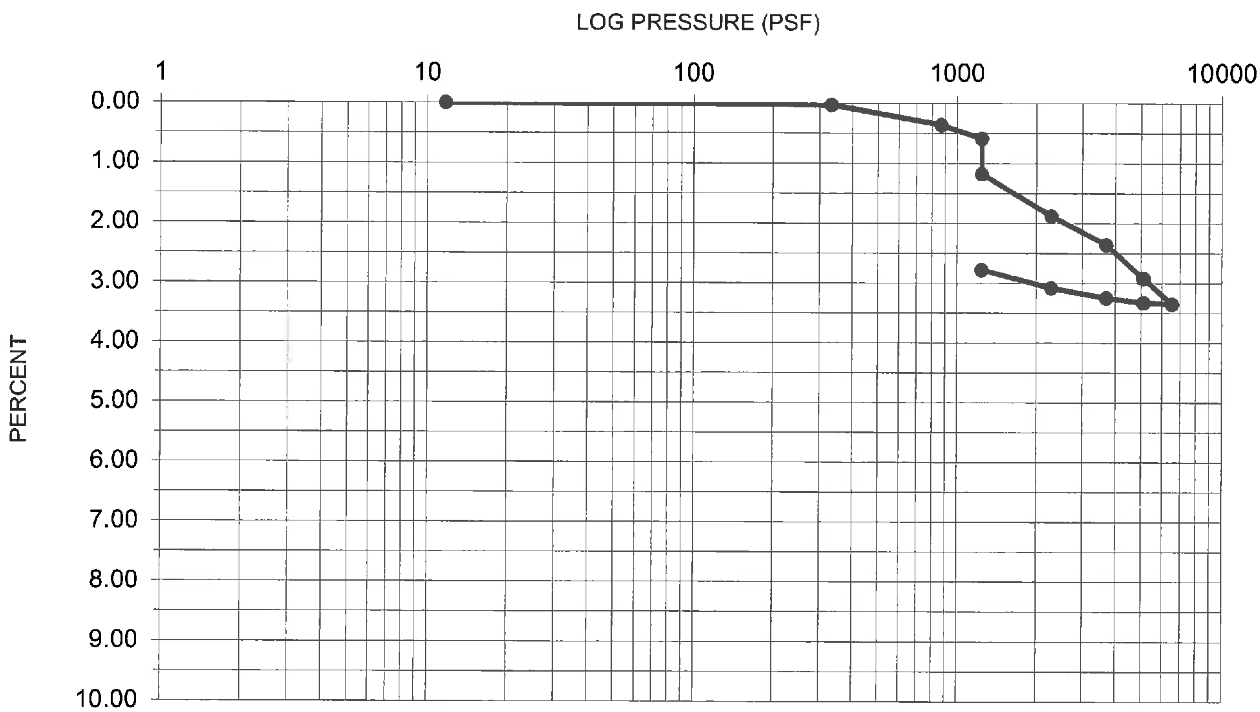
BG: **22590** ENGINEER: **RSB**

CLIENT: **5297 Marina Island, LLC**

Earth Material:	Alluvium
Sample Location:	B2-35'
Dry Weight (pcf):	105.5
Initial Moisture:	21.4%
Initial Saturation:	100.0%
Water Added at (psf)	1237

Specific Gravity:	2.65
Initial Void Ratio:	0.57
Compression Index (Cc):	0.063
Recompression Index (Cr):	0.018

CONSOLIDATION DIAGRAM (ASTM D 2435-04)



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CONSOLIDATION CURVE #4

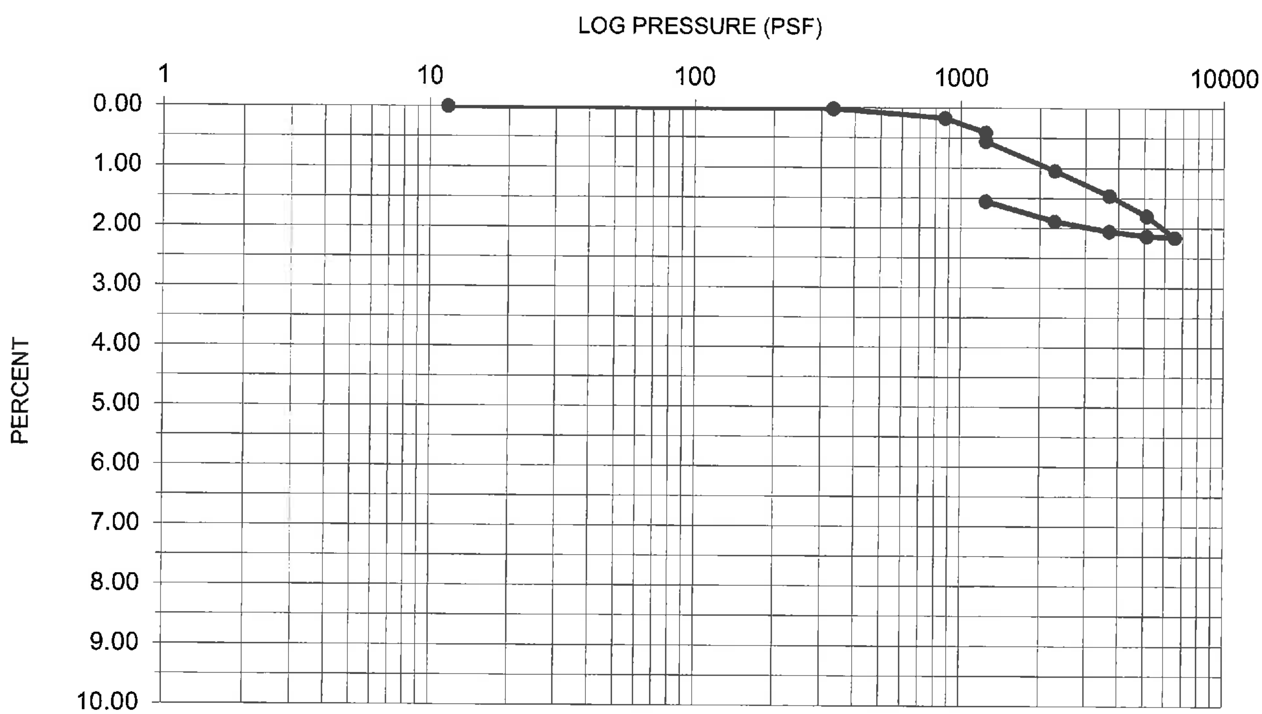
BG: **22590** ENGINEER: **RSB**

CLIENT: **5297 Marina Island, LLC**

Earth Material:	Alluvium
Sample Location:	B2-40'
Dry Weight (pcf):	104.3
Initial Moisture:	22.1%
Initial Saturation:	100.0%
Water Added at (psf)	1237

Specific Gravity:	2.65
Initial Void Ratio:	0.59
Compression Index (Cc):	0.054
Recompression Index (Cr):	0.020

CONSOLIDATION DIAGRAM (ASTM D 2435-04)



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PLASTICITY CHART #1

BG: 22590 ENGINEER: RSB

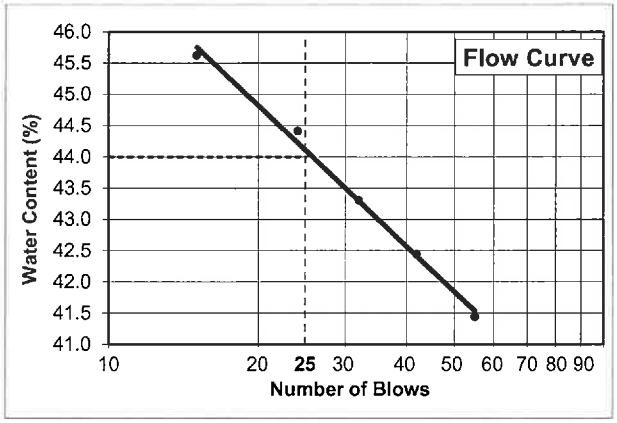
CLIENT: 5297 Marina Island, LLC

Test Pit No.: B1 **Sample No.:** S4 **Depth of Sample:** 10 Feet **Test Date:** 1/26/2017

Soil Description: Clay (CL)

Liquid Limit Determination

Can No.	A	B	C	D	E
Soil Wet Wt. + Can (g)	30.13	30.39	29.79	30.40	30.16
Soil Dry Wt. + Can (g)	26.69	27.05	26.62	26.92	26.87
Wt. of Can (g)	19.15	19.53	19.30	18.72	18.93
Wt. of Dry Soil (g)	7.54	7.52	7.32	8.20	7.94
Wt. of Moisture (g)	3.44	3.34	3.17	3.48	3.29
Water Content (%)	**45.6**	**44.4**	**43.3**	**42.4**	**41.4**
Number of Blows	**15**	**24**	**32**	**42**	**55**

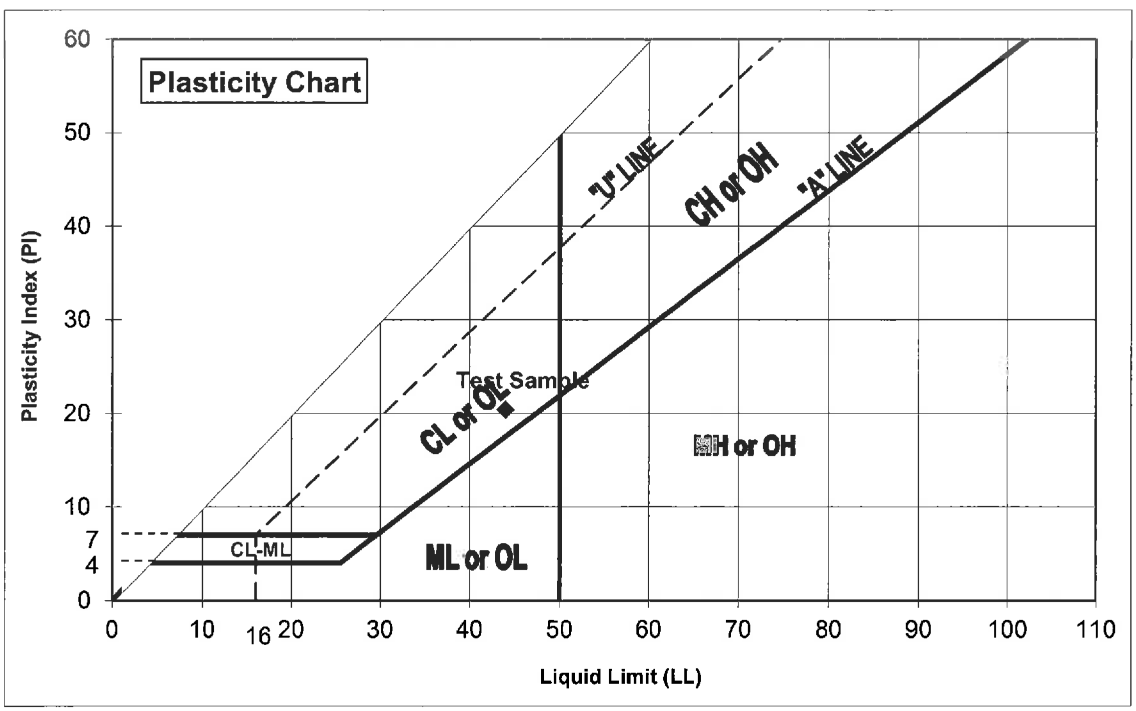


Plastic Limit Determination

Can No.	F				
Soil Wet Wt. + Can (g)	25.81				
Soil Dry Wt. + Can (g)	24.48				
Wt. of Can (g)	18.85				
Wt. of Dry Soil (g)	5.63				
Wt. of Moisture (g)	1.33				
Water Content (%)	**23.6**				

Average Water Content (%) = **23.6**

Liquid Limit, LL = 44.0
Plastic Limit, PL = 23.6
Plasticity Index, PI = 20.4



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PLASTICITY CHART #2

BG: 22590 ENGINEER: RSB

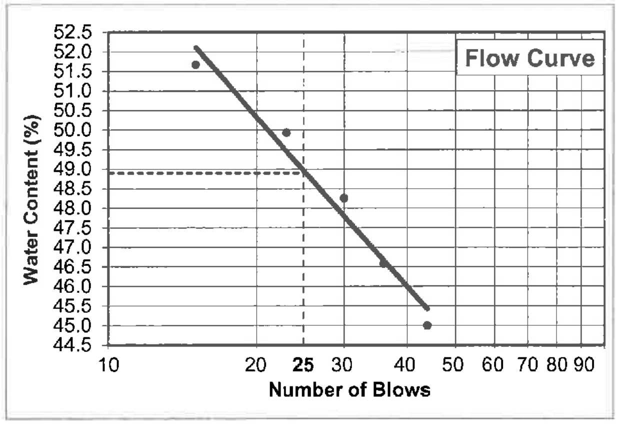
CLIENT: 5297 Marina Island, LLC

Test Pit No.: B1 **Sample No.:** S5 **Depth of Sample:** 12.5 feet **Test Date:** 1/26/2017

Soil Description: Clay (CL)

Liquid Limit Determination

Can No.	A	B	C	D	E
Soil Wet Wt. + Can (g)	30.25	29.98	29.58	29.96	30.16
Soil Dry Wt. + Can (g)	26.39	26.34	26.25	26.48	26.61
Wt. of Can (g)	18.92	19.05	19.35	19.01	18.72
Wt. of Dry Soil (g)	7.47	7.29	6.90	7.47	7.89
Wt. of Moisture (g)	3.86	3.64	3.33	3.48	3.55
Water Content (%)	**51.7**	**49.9**	**48.3**	**46.6**	**45.0**
Number of Blows	**15**	**23**	**30**	**36**	**44**

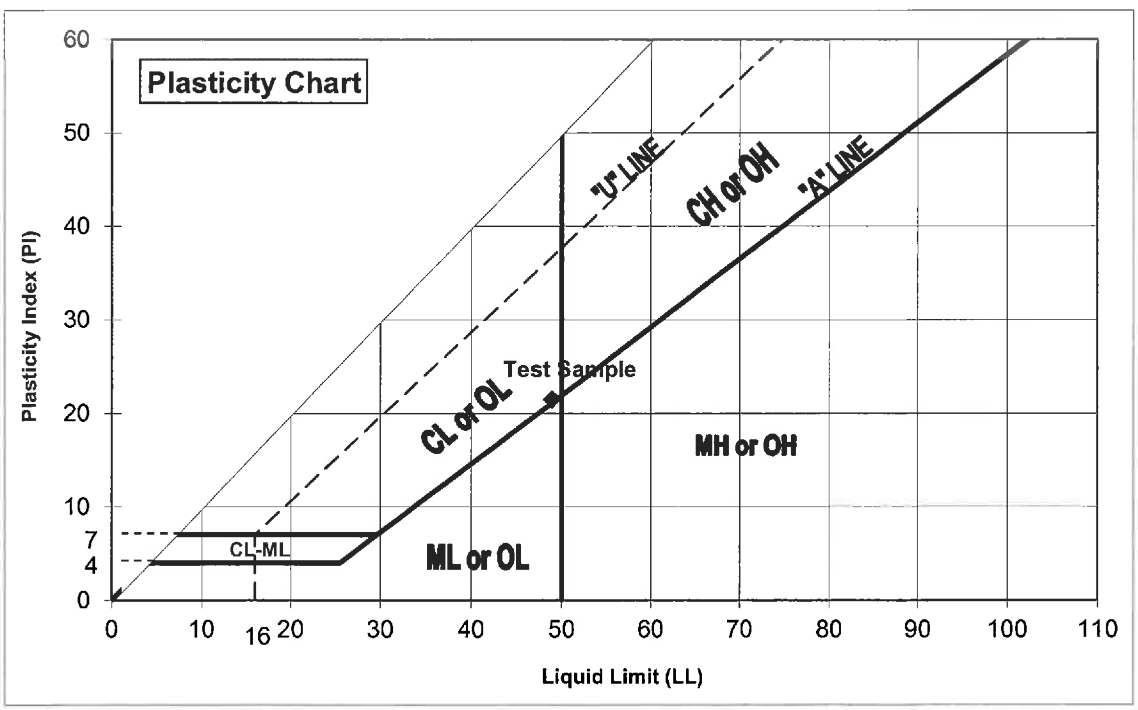


Plastic Limit Determination

Can No.	F				
Soil Wet Wt. + Can (g)	25.83				
Soil Dry Wt. + Can (g)	24.29				
Wt. of Can (g)	18.67				
Wt. of Dry Soil (g)	5.62				
Wt. of Moisture (g)	1.54				
Water Content (%)	**27.4**				

Average Water Content (%) = **27.4**

Liquid Limit, LL = 48.9
Plastic Limit, PL = 27.4
Plasticity Index, PI = 21.5



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PLASTICITY CHART #3

BG: 22590 ENGINEER: RSB

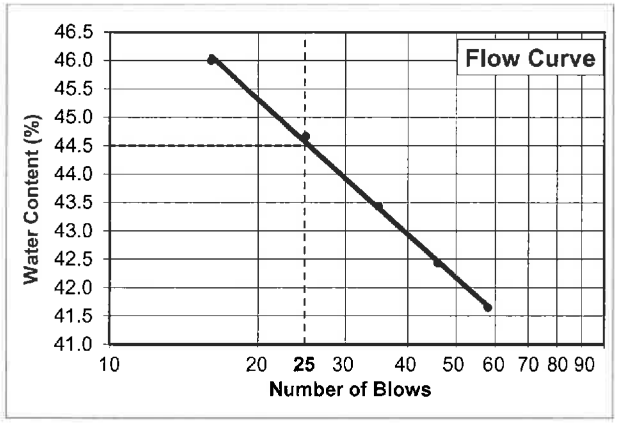
CLIENT: 5297 Marina Island, LLC

Test Pit No.: B1 **Sample No.:** S6 **Depth of Sample:** 15 feet **Test Date:** 1/27/2017

Soil Description: Clay (CL)

Liquid Limit Determination

Can No.	A	B	C	D	E
Soil Wet Wt. + Can (g)	29.95	30.12	29.75	30.97	30.66
Soil Dry Wt. + Can (g)	26.50	26.73	26.61	27.41	27.17
Wt. of Can (g)	19.00	19.14	19.38	19.02	18.79
Wt. of Dry Soil (g)	7.50	7.59	7.23	8.39	8.38
Wt. of Moisture (g)	3.45	3.39	3.14	3.56	3.49
Water Content (%)	**46.0**	**44.7**	**43.4**	**42.4**	**41.6**
Number of Blows	**16**	**25**	**35**	**46**	**58**

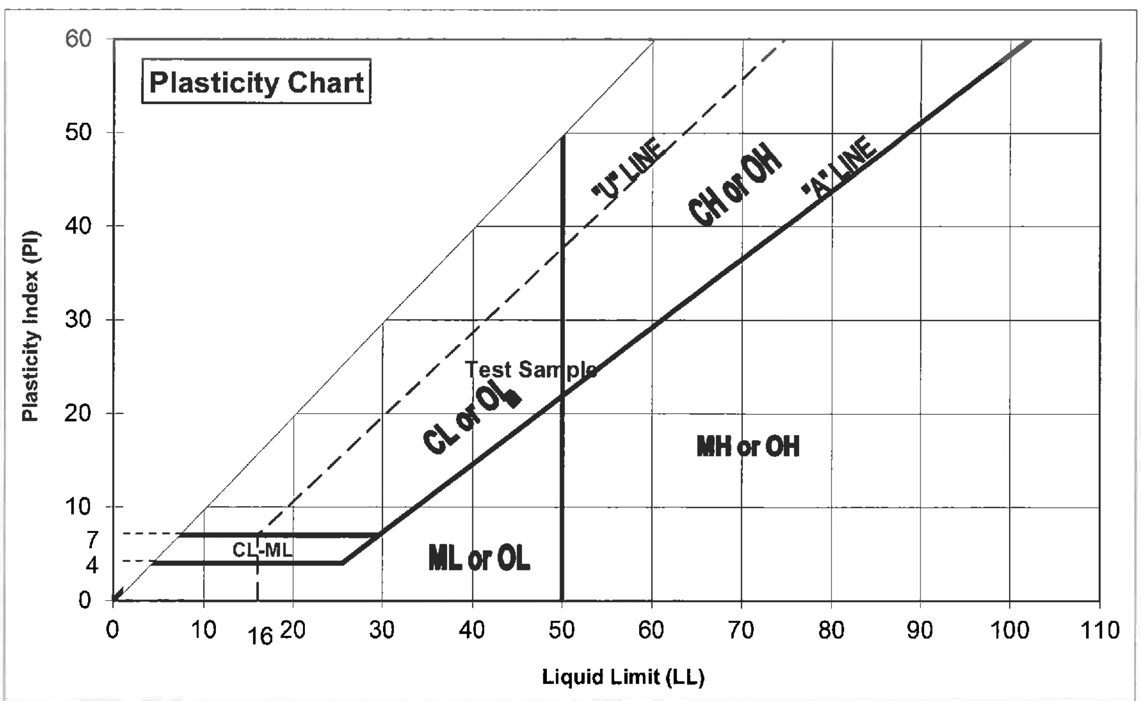


Plastic Limit Determination

Can No.	F				
Soil Wet Wt. + Can (g)	25.94				
Soil Dry Wt. + Can (g)	24.59				
Wt. of Can (g)	18.72				
Wt. of Dry Soil (g)	5.87				
Wt. of Moisture (g)	1.35				
Water Content (%)	**23.0**				

Average Water Content (%) = **23.0**

Liquid Limit, LL = 44.5
Plastic Limit, PL = 23.0
Plasticity Index, PI = 21.5



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PLASTICITY CHART #4

BG: 22590 ENGINEER: RSB

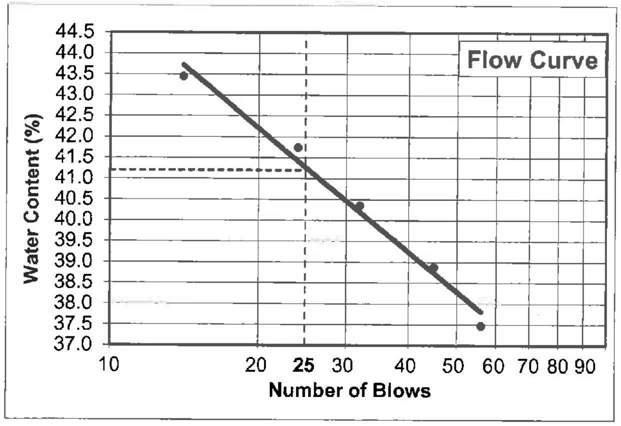
CLIENT: 5297 Marina Island, LLC

Test Pit No.: B1 **Sample No.:** S12 **Depth of Sample:** 30 feet **Test Date:** 1/27/2017

Soil Description: Silt (ML)

Liquid Limit Determination

Can No.	A	B	C	D	E
Soil Wet Wt. + Can (g)	29.83	30.04	29.71	30.88	30.42
Soil Dry Wt. + Can (g)	26.55	26.83	26.74	27.56	27.25
Wt. of Can (g)	19.00	19.14	19.38	19.02	18.79
Wt. of Dry Soil (g)	7.55	7.69	7.36	8.54	8.46
Wt. of Moisture (g)	3.28	3.21	2.97	3.32	3.17
Water Content (%)	**43.4**	**41.7**	**40.4**	**38.9**	**37.5**
Number of Blows	**14**	**24**	**32**	**45**	**56**

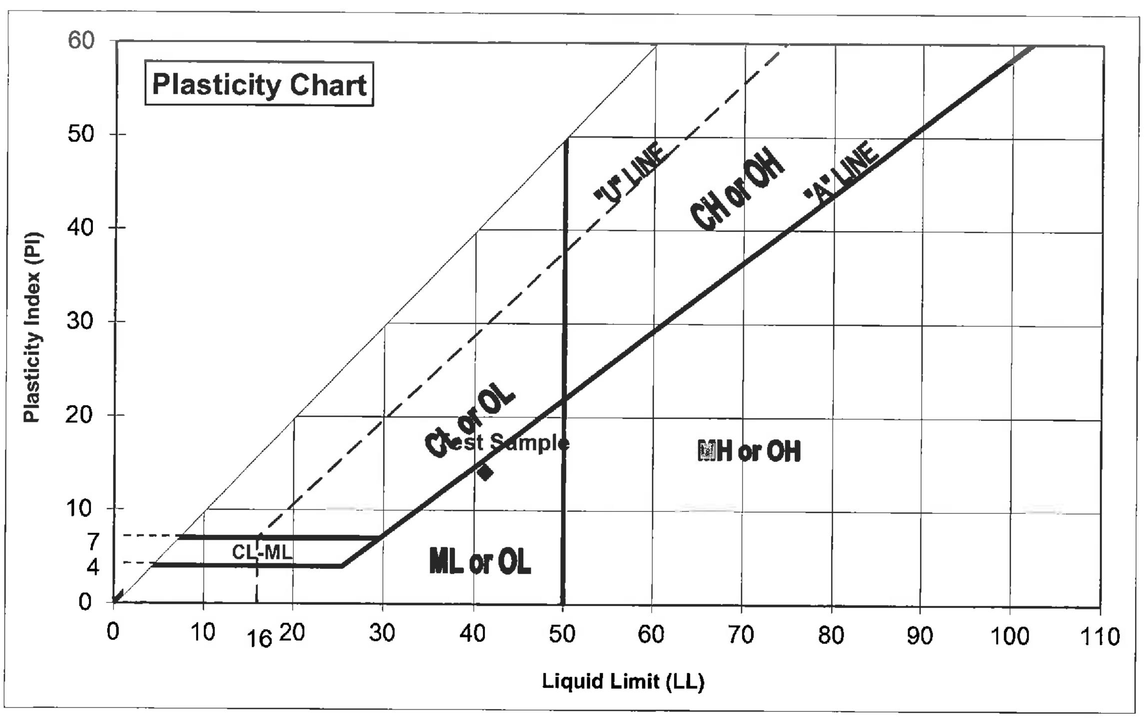


Plastic Limit Determination

Can No.	F				
Soil Wet Wt. + Can (g)	26.31				
Soil Dry Wt. + Can (g)	24.69				
Wt. of Can (g)	18.72				
Wt. of Dry Soil (g)	5.97				
Wt. of Moisture (g)	1.62				
Water Content (%)	**27.1**				

Average Water Content (%) = **27.1**

Liquid Limit, LL = 41.2
Plastic Limit, PL = 27.1
Plasticity Index, PI = 14.1



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PLASTICITY CHART #5

BG: 22590 ENGINEER: RSB

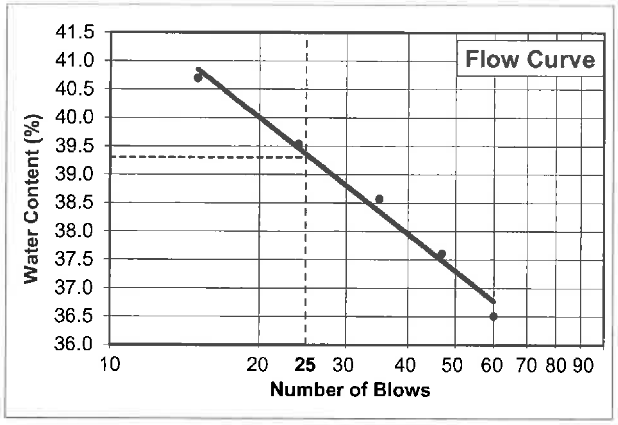
CLIENT: 5297 Marina Island, LLC

Test Pit No.: B1 **Sample No.:** S13 **Depth of Sample:** 32.5 feet **Test Date:** 1/27/2017

Soil Description: Clay (CL)

Liquid Limit Determination

Can No.	A	B	C	D	E
Soil Wet Wt. + Can (g)	30.87	29.64	29.91	29.64	30.02
Soil Dry Wt. + Can (g)	27.48	26.73	26.94	26.65	27.03
Wt. of Can (g)	19.15	19.37	19.24	18.70	18.84
Wt. of Dry Soil (g)	8.33	7.36	7.70	7.95	8.19
Wt. of Moisture (g)	3.39	2.91	2.97	2.99	2.99
Water Content (%)	**40.7**	**39.5**	**38.6**	**37.6**	**36.5**
Number of Blows	**15**	**24**	**35**	**47**	**60**

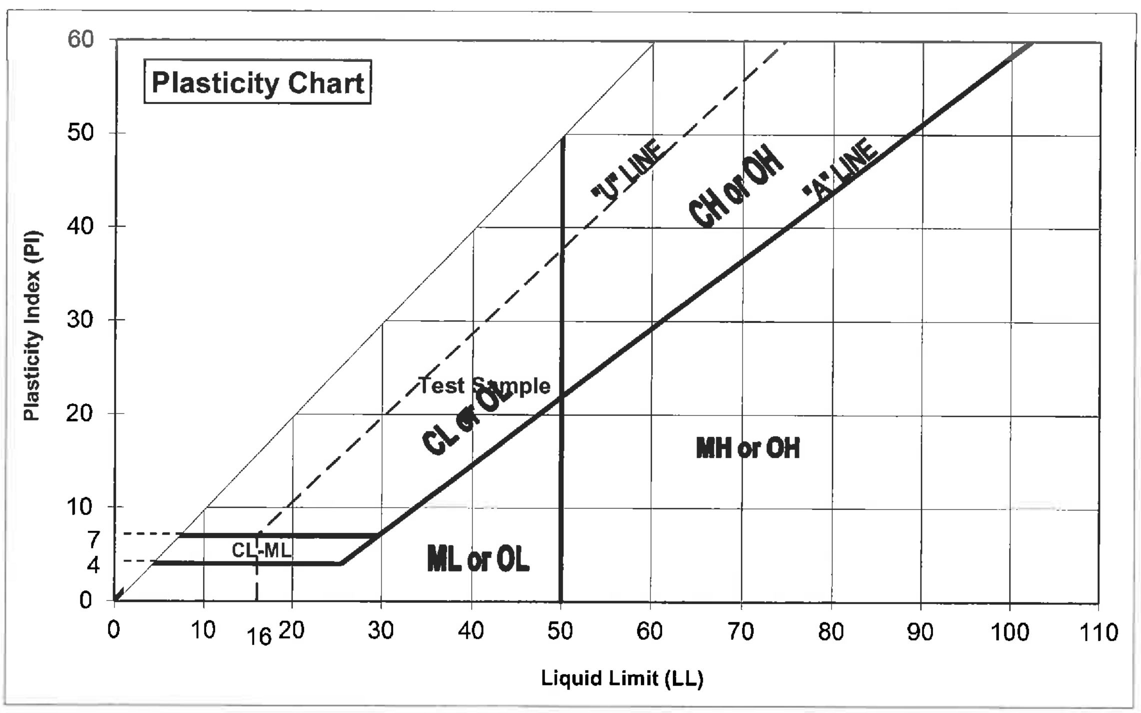


Plastic Limit Determination

Can No.	F				
Soil Wet Wt. + Can (g)	25.61				
Soil Dry Wt. + Can (g)	24.50				
Wt. of Can (g)	18.77				
Wt. of Dry Soil (g)	5.73				
Wt. of Moisture (g)	1.11				
Water Content (%)	**19.4**				

Average Water Content (%) = **19.4**

Liquid Limit, LL = 39.3
Plastic Limit, PL = 19.4
Plasticity Index, PI = 19.9



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PLASTICITY CHART #6

BG: 22590 ENGINEER: RSB

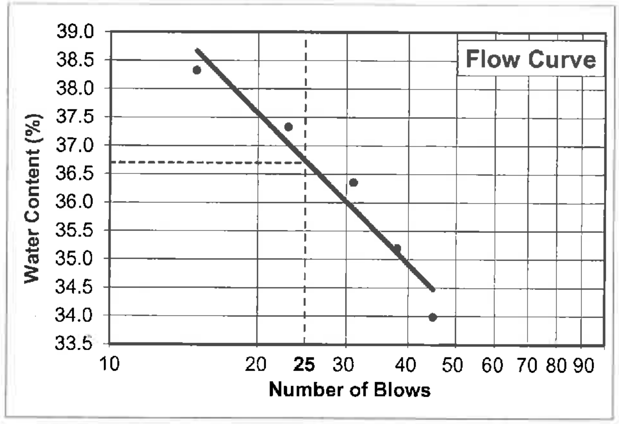
CLIENT: 5297 Marina Island, LLC

Test Pit No.: B1 **Sample No.:** S14 **Depth of Sample:** 35 feet **Test Date:** 1/28/2017

Soil Description: Clay (CL)

Liquid Limit Determination

Can No.	A	B	C	D	E
Soil Wet Wt. + Can (g)	30.69	30.41	30.50	29.53	29.75
Soil Dry Wt. + Can (g)	27.49	27.42	27.49	26.70	26.98
Wt. of Can (g)	19.14	19.41	19.21	18.66	18.83
Wt. of Dry Soil (g)	8.35	8.01	8.28	8.04	8.15
Wt. of Moisture (g)	3.20	2.99	3.01	2.83	2.77
Water Content (%)	**38.3**	**37.3**	**36.4**	**35.2**	**34.0**
Number of Blows	**15**	**23**	**31**	**38**	**45**

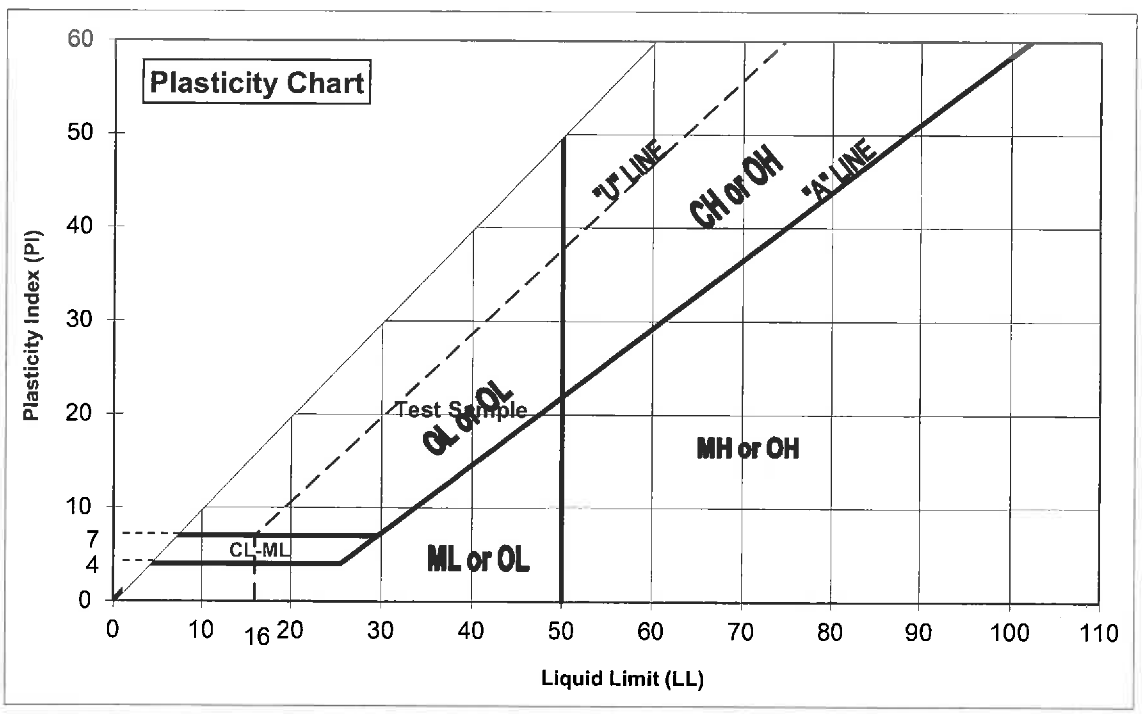


Plastic Limit Determination

Can No.	F				
Soil Wet Wt. + Can (g)	25.94				
Soil Dry Wt. + Can (g)	24.76				
Wt. of Can (g)	18.69				
Wt. of Dry Soil (g)	6.07				
Wt. of Moisture (g)	1.18				
Water Content (%)	**19.4**				

Average Water Content (%) = **19.4**

Liquid Limit, LL = 36.7
Plastic Limit, PL = 19.4
Plasticity Index, PI = 17.3



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PLASTICITY CHART #7

BG: 22590 ENGINEER: RSB

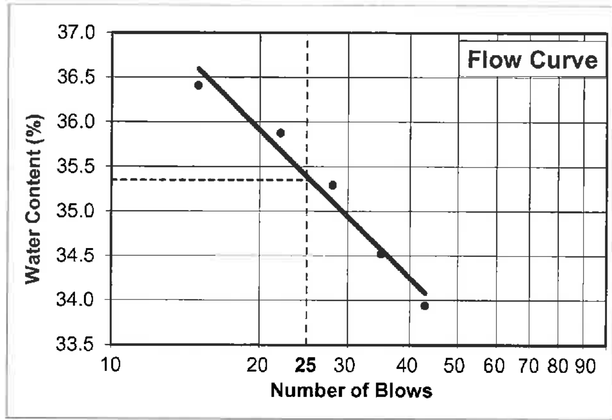
CLIENT: 5297 Marina Island, LLC

Test Pit No.: B4 **Sample No.:** S5 **Depth of Sample:** 12.5 feet **Test Date:** 1/31/2017

Soil Description: Clay (CL)

Liquid Limit Determination

Can No.	A	B	C	D	E
Soil Wet Wt. + Can (g)	29.96	30.26	29.83	30.40	30.58
Soil Dry Wt. + Can (g)	27.12	27.39	27.07	27.40	27.61
Wt. of Can (g)	19.32	19.39	19.25	18.71	18.86
Wt. of Dry Soil (g)	7.80	8.00	7.82	8.69	8.75
Wt. of Moisture (g)	2.84	2.87	2.76	3.00	2.97
Water Content (%)	**36.4**	**35.9**	**35.3**	**34.5**	**33.9**
Number of Blows	**15**	**22**	**28**	**35**	**43**

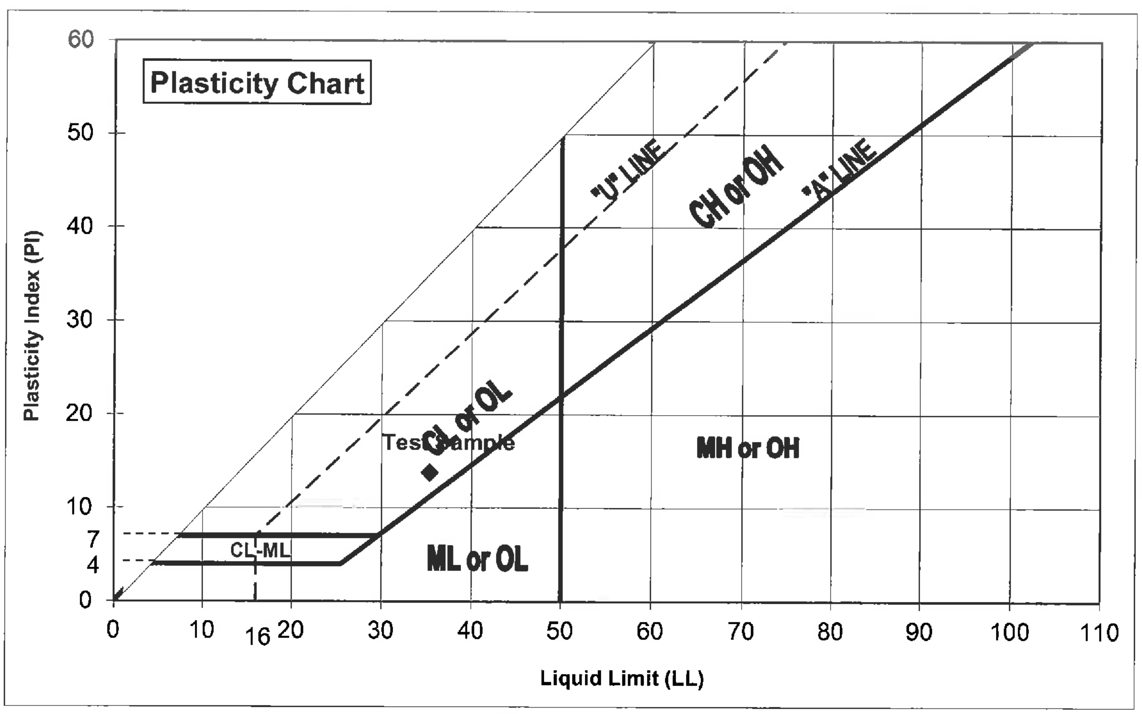


Plastic Limit Determination

Can No.	F				
Soil Wet Wt. + Can (g)	25.62				
Soil Dry Wt. + Can (g)	24.40				
Wt. of Can (g)	18.74				
Wt. of Dry Soil (g)	5.66				
Wt. of Moisture (g)	1.22				
Water Content (%)	**21.6**				

Average Water Content (%) = **21.6**

Liquid Limit, LL = 35.4
Plastic Limit, PL = 21.6
Plasticity Index, PI = 13.8



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PLASTICITY CHART #8

BG: 22590 ENGINEER: RSB

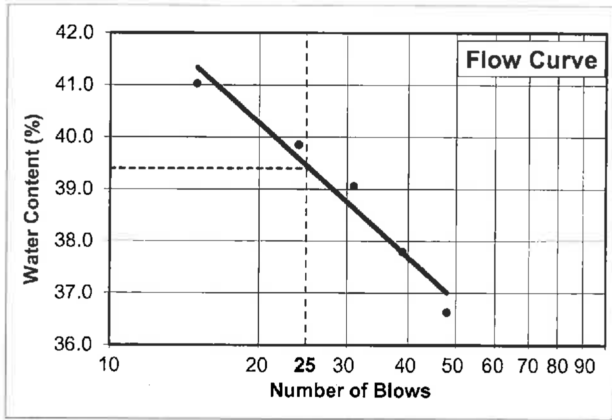
CLIENT: 5297 Marina Island, LLC

Test Pit No.: B4 **Sample No.:** S7 **Depth of Sample:** 17.5 feet **Test Date:** 1/31/2017

Soil Description: Clay (CL)

Liquid Limit Determination

Can No.	A	B	C	D	E
Soil Wet Wt. + Can (g)	30.17	30.42	29.68	29.52	29.48
Soil Dry Wt. + Can (g)	26.97	27.18	26.79	26.64	26.63
Wt. of Can (g)	19.17	19.05	19.39	19.02	18.85
Wt. of Dry Soil (g)	7.80	8.13	7.40	7.62	7.78
Wt. of Moisture (g)	3.20	3.24	2.89	2.88	2.85
Water Content (%)	**41.0**	**39.9**	**39.1**	**37.8**	**36.6**
Number of Blows	**15**	**24**	**31**	**39**	**48**

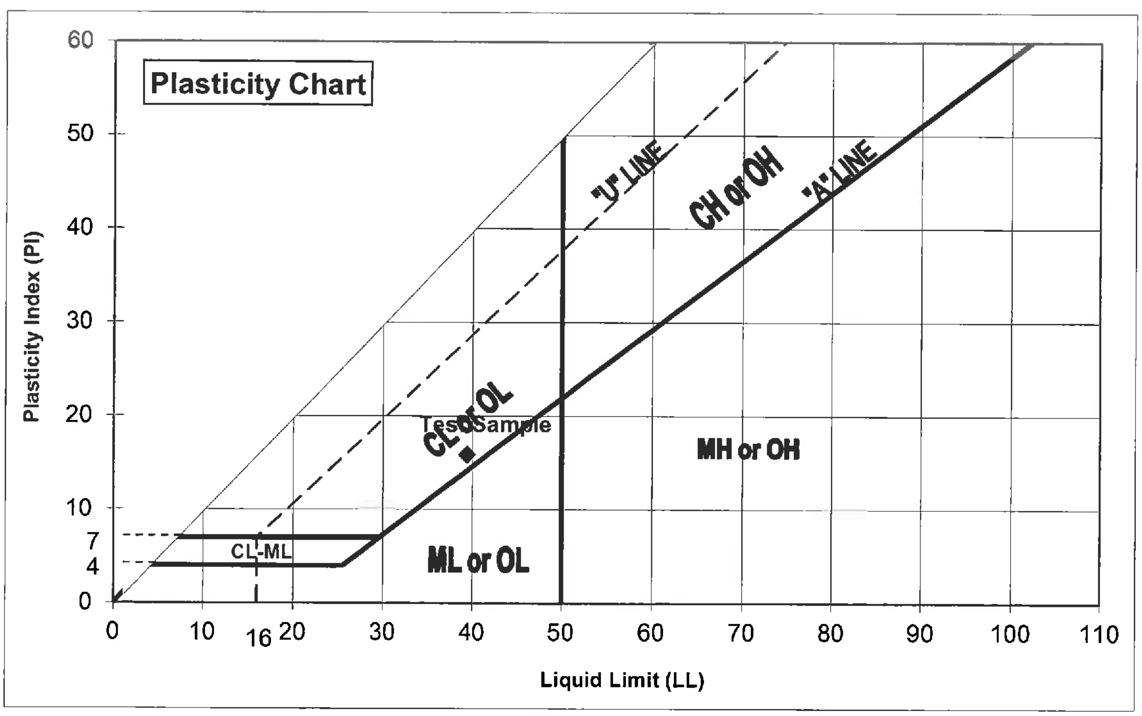


Plastic Limit Determination

Can No.	F				
Soil Wet Wt. + Can (g)	25.81				
Soil Dry Wt. + Can (g)	24.46				
Wt. of Can (g)	18.71				
Wt. of Dry Soil (g)	5.75				
Wt. of Moisture (g)	1.35				
Water Content (%)	**23.5**				

Average Water Content (%) = **23.5**

Liquid Limit, LL = 39.4
Plastic Limit, PL = 23.5
Plasticity Index, PI = 15.9



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tel 818.549.9959 fax 818.543.3747

PLASTICITY CHART #9

BG: 22590 ENGINEER: RSB

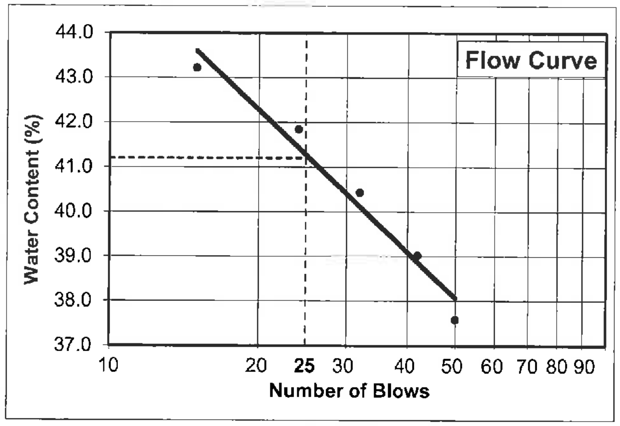
CLIENT: 5297 Marina Island, LLC

Test Pit No.: B4 **Sample No.:** S8 **Depth of Sample:** 20 feet **Test Date:** 2/1/2017

Soil Description: Clay (CL)

Liquid Limit Determination

Can No.	A	B	C	D	E
Soil Wet Wt. + Can (g)	30.65	29.61	30.28	29.54	29.16
Soil Dry Wt. + Can (g)	27.24	26.61	27.11	26.50	26.36
Wt. of Can (g)	19.35	19.44	19.27	18.71	18.91
Wt. of Dry Soil (g)	7.89	7.17	7.84	7.79	7.45
Wt. of Moisture (g)	3.41	3.00	3.17	3.04	2.80
Water Content (%)	**43.2**	**41.8**	**40.4**	**39.0**	**37.6**
Number of Blows	**15**	**24**	**32**	**42**	**50**

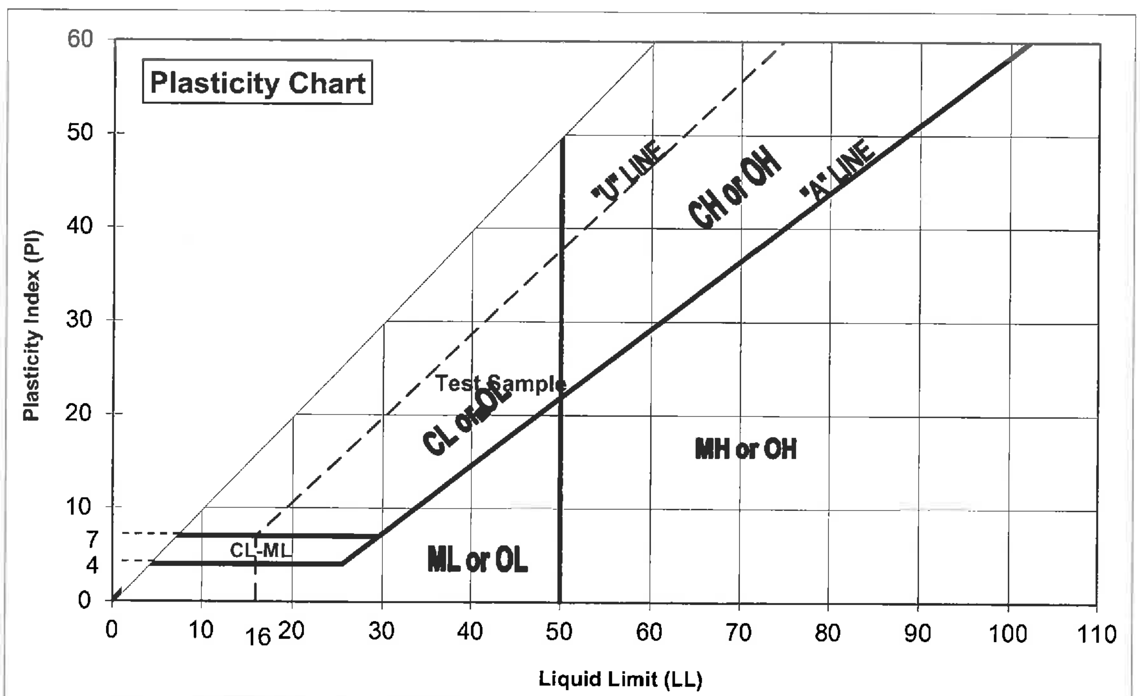


Plastic Limit Determination

Can No.	F				
Soil Wet Wt. + Can (g)	25.72				
Soil Dry Wt. + Can (g)	24.51				
Wt. of Can (g)	18.75				
Wt. of Dry Soil (g)	5.76				
Wt. of Moisture (g)	1.21				
Water Content (%)	**21.0**				

Average Water Content (%) = **21.0**

Liquid Limit, LL = 41.2
Plastic Limit, PL = 21.0
Plasticity Index, PI = 20.2



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tel 818.549.9959 fax 818.543.3747

PLASTICITY CHART #10

BG: 22590 ENGINEER: RSB

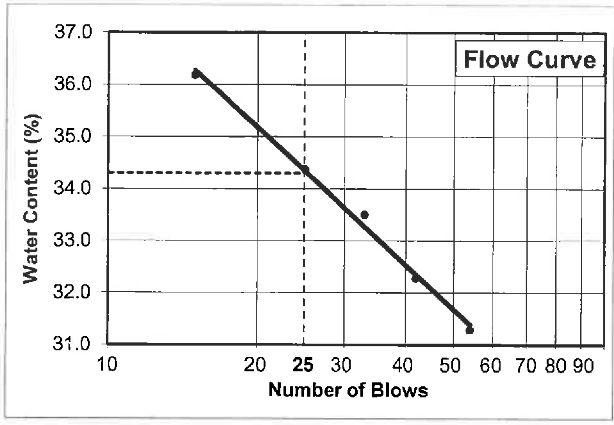
CLIENT: 5297 Marina Island, LLC

Test Pit No.: B4 **Sample No.:** S9 **Depth of Sample:** 22.5 feet **Test Date:** 2/1/2017

Soil Description: Clay (CL)

Liquid Limit Determination

Can No.	A	B	C	D	E
Soil Wet Wt. + Can (g)	30.01	29.59	30.42	30.34	29.31
Soil Dry Wt. + Can (g)	27.13	26.92	27.72	27.58	26.81
Wt. of Can (g)	19.17	19.15	19.66	19.03	18.82
Wt. of Dry Soil (g)	7.96	7.77	8.06	8.55	7.99
Wt. of Moisture (g)	2.88	2.67	2.70	2.76	2.50
Water Content (%)	**36.2**	**34.4**	**33.5**	**32.3**	**31.3**
Number of Blows	**15**	**25**	**33**	**42**	**54**

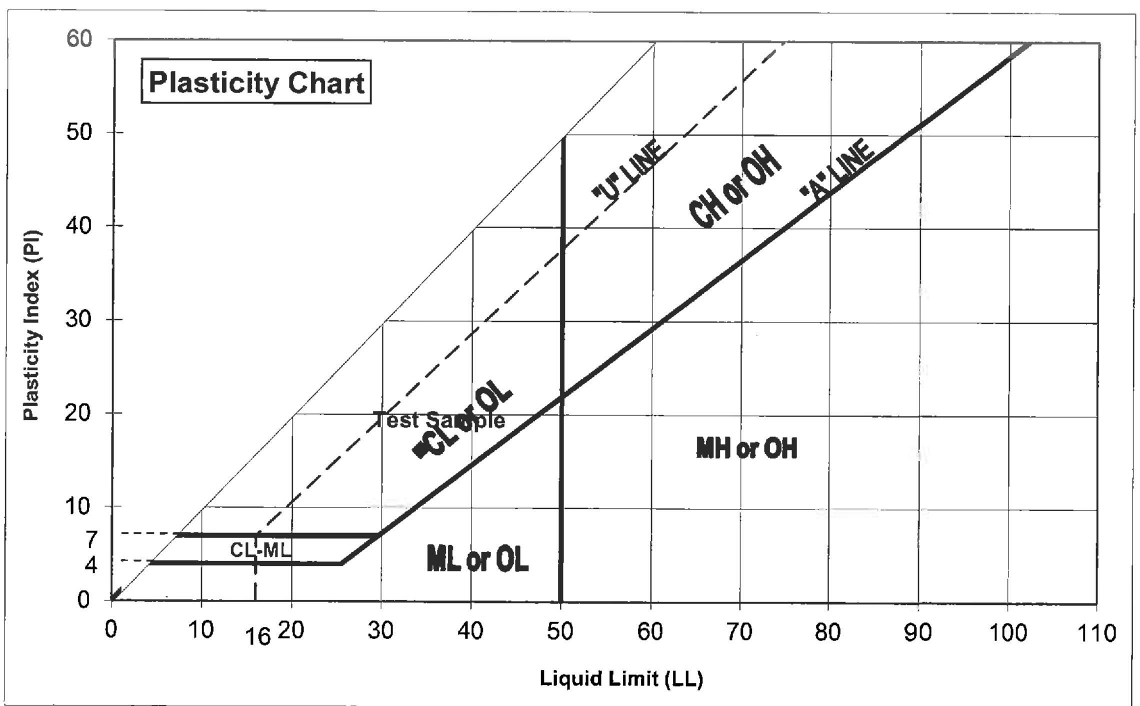


Plastic Limit Determination

Can No.	F				
Soil Wet Wt. + Can (g)	25.53				
Soil Dry Wt. + Can (g)	24.49				
Wt. of Can (g)	18.73				
Wt. of Dry Soil (g)	5.76				
Wt. of Moisture (g)	1.04				
Water Content (%)	**18.1**				

Average Water Content (%) = **18.1**

Liquid Limit, LL = 34.3
Plastic Limit, PL = 18.1
Plasticity Index, PI = 16.2



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PLASTICITY CHART #11

BG: 22590 ENGINEER: RSB

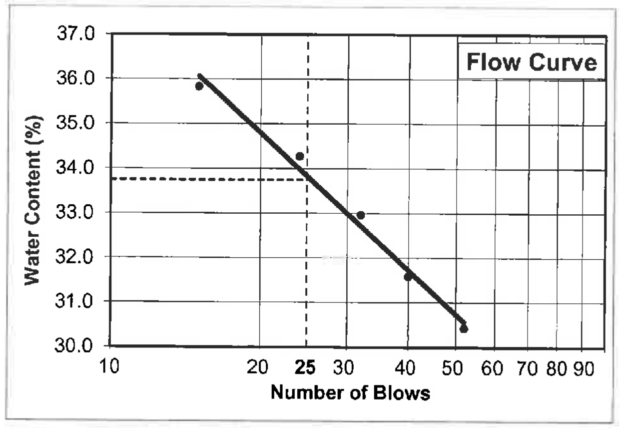
CLIENT: 5297 Marina Island, LLC

Test Pit No.: B4 **Sample No.:** S15 **Depth of Sample:** 37.5 feet **Test Date:** 2/2/2017

Soil Description: Clay (CL)

Liquid Limit Determination

Can No.	A	B	C	D	E
Soil Wet Wt. + Can (g)	30.05	29.61	30.39	30.32	29.28
Soil Dry Wt. + Can (g)	27.18	26.94	27.73	27.61	26.84
Wt. of Can (g)	19.17	19.15	19.66	19.03	18.82
Wt. of Dry Soil (g)	8.01	7.79	8.07	8.58	8.02
Wt. of Moisture (g)	2.87	2.67	2.66	2.71	2.44
Water Content (%)	**35.8**	**34.3**	**33.0**	**31.6**	**30.4**
Number of Blows	**15**	**24**	**32**	**40**	**52**

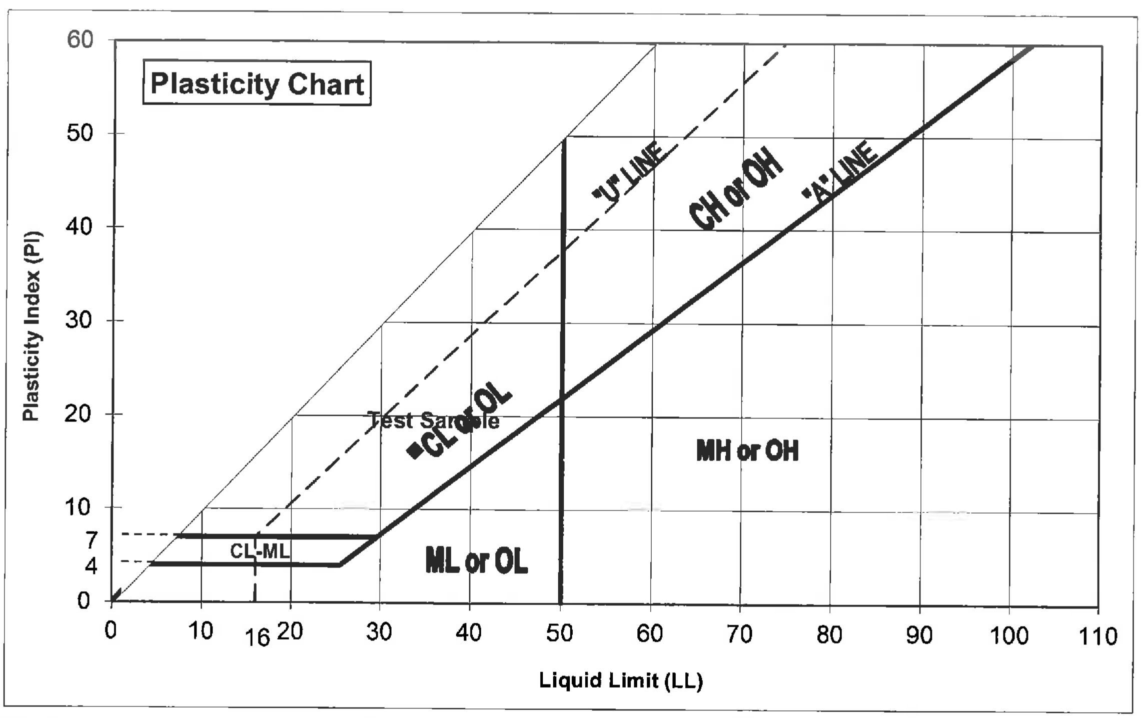


Plastic Limit Determination

Can No.	F				
Soil Wet Wt. + Can (g)	25.65				
Soil Dry Wt. + Can (g)	24.62				
Wt. of Can (g)	18.73				
Wt. of Dry Soil (g)	5.89				
Wt. of Moisture (g)	1.03				
Water Content (%)	**17.5**				

Average Water Content (%) = **17.5**

Liquid Limit, LL = 33.8
Plastic Limit, PL = 17.5
Plasticity Index, PI = 16.3



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tel 818.549.9959 fax 818.543.3747

PLASTICITY CHART #12

BG: 22590 ENGINEER: RSB

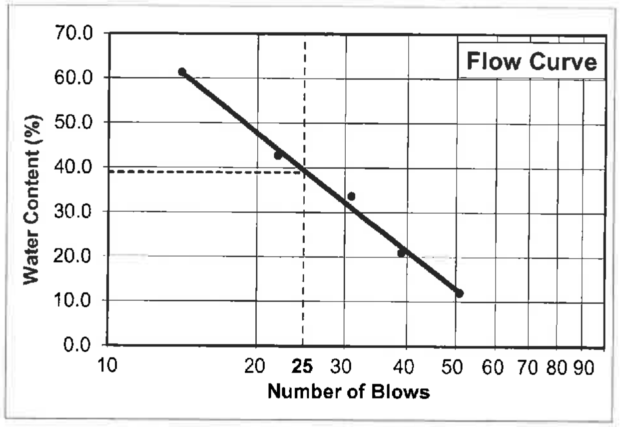
CLIENT: 5297 Marina Island, LLC

Test Pit No.: B4 **Sample No.:** S17 **Depth of Sample:** 42.5 feet **Test Date:** 2/2/2017

Soil Description: Silt (ML)

Liquid Limit Determination

Can No.	A	B	C	D	E
Soil Wet Wt. + Can (g)	30.03	29.64	30.42	30.16	29.34
Soil Dry Wt. + Can (g)	25.90	26.50	27.71	28.23	28.21
Wt. of Can (g)	19.17	19.15	19.66	19.03	18.82
Wt. of Dry Soil (g)	6.73	7.35	8.05	9.20	9.39
Wt. of Moisture (g)	4.13	3.14	2.71	1.93	1.13
Water Content (%)	**61.4**	**42.7**	**33.7**	**21.0**	**12.0**
Number of Blows	**14**	**22**	**31**	**39**	**51**

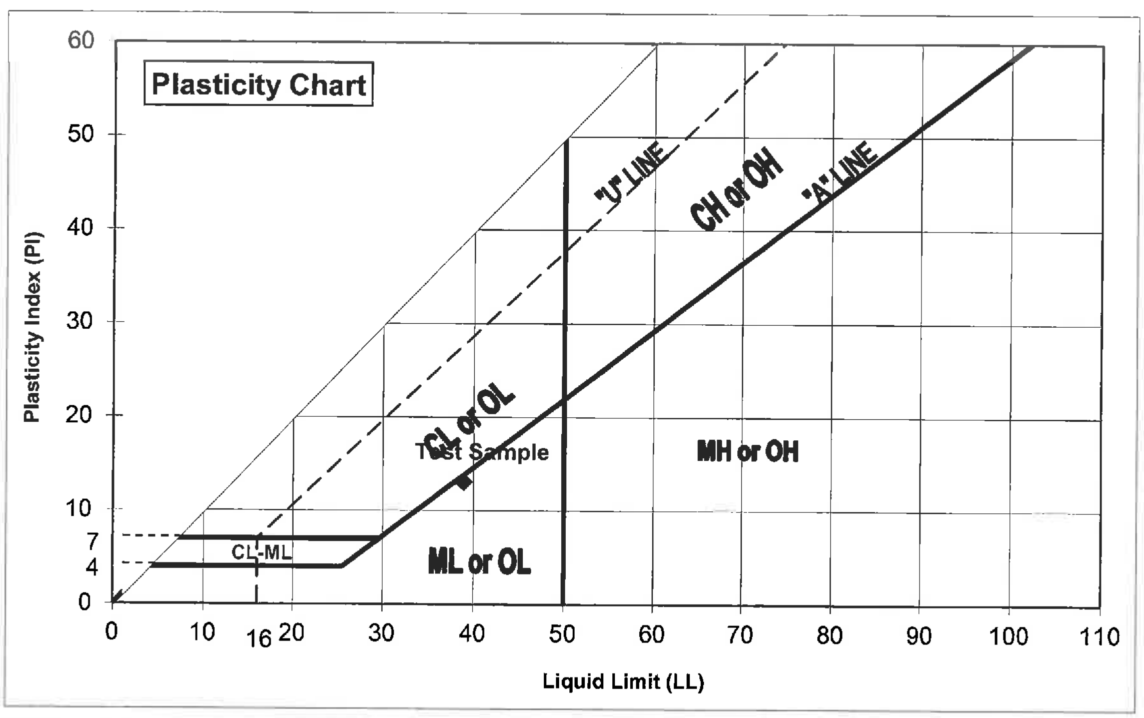


Plastic Limit Determination

Can No.	F				
Soil Wet Wt. + Can (g)	25.71				
Soil Dry Wt. + Can (g)	24.28				
Wt. of Can (g)	18.73				
Wt. of Dry Soil (g)	5.55				
Wt. of Moisture (g)	1.43				
Water Content (%)	**25.8**				

Average Water Content (%) = **25.8**

Liquid Limit, LL = 38.9
Plastic Limit, PL = 25.8
Plasticity Index, PI = 13.1



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1461 E. CHEVY CHASE DR., SUITE 200
GLENDALE, CA 91206
818.549.9959 TEL
818.543.3747 FAX

LOG OF BORING B1

BG No. 22590

CLIENT 5297 Marina Island, LLC REPORT DATE 2/10/17 DRILL DATE 1/16/17
PROJECT LOCATION 5000 S. Beethoven St., Del Rey, California LOGGED BY JHP/RSB
CONTRACTOR 2R Drilling DRILLING METHOD Hollow-Stem Auger HOLE SIZE 8-inch diameter
DRIVE WEIGHT 140-Pound Automatic Hammer HAMMER DROP 30 Inches ELEV. TOP OF HOLE 19 ft

ELEVATION (ft)	DEPTH (ft)	EARTH MATERIAL DESCRIPTION	GRAPHIC SYMBOL	USCS UNIT	SAMPLE TYPE & NUMBER	BLOW COUNT (Per 6 Inches)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SATURATION (%)	TYPE OF TEST
	0	(SP) Surface: Dry shrubs and dirt. **FILL (Afu):** 0 - 2.5': SAND, brown, slightly moist, fine to medium sand, some fine gravel.		SP						
		(CL) 2.5': CLAY, olive-brown to dark gray, moist, stiff.		CL	Bag1 S1	4 5 6	22			Max, EI
15	5	(CL) 5': Sandy CLAY, olive-brown to light gray, moist, very stiff, some organics, rootlets.		CL	S2	7 11 12	12			
10		(CL) **7.5': ALLUVIUM (Qa):** 7.5': Sandy CLAY, light olive-gray to dark olive-brown, moist, very stiff, fine to medium sand, some coarse sand, 71.9% fines.		CL	S3	8 8 9	13.3			Sieve Wash (-#200)
	10	(CL) 10': CLAY with Sand, dark brown, moist, stiff, fine to medium sand, 75% fines, LL= 44, PI= 20.4.		CL	S4	7 6 5	16.5			Atterberg Limits, Sieve Wash (-#200)
5		(CL) 12.5': CLAY, dark olive-brown, moist, stiff, trace fine sand, 92.5% fines, LL= 48.9, PI= 21.5.		CL	S5	4 5 4	18.5			Atterberg Limits, Sieve Wash (-#200)
	15	(CL) 15': CLAY with Sand, dark brown, moist, medium stiff, fine to medium sand, trace fine gravel, 76.6% fines, LL= 44.5, PI= 21.5.		CL	S6	3 3 4	22.6			Atterberg Limits, Sieve Wash (-#200)
0		(CL) 17.5': CLAY, dark grayish-brown to olive-brown, moist to very moist, stiff, 78.3% fines.		CL	S7	3 4 5	27.6			Sieve Wash (-#200)
	20	(CL) 20': CLAY, dark gray, moist, medium stiff to stiff, 87.2% fines. 21.8': Groundwater.		CL	S8	3 4 4	23.6			Sieve Wash (-#200)
-5	25	(CL) 22.5': CLAY with Sand, dark gray, moist, very stiff, fine to medium sand, trace coarse sand, 72.2% fines.		CL	S9	4 10 11	17.2			Sieve Wash (-#200)

Bulk Sample   Standard Penetration Test

BYER GEOTECHNICAL, INC.

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GLENDALE, CA 91206
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818.543.3747 FAX

LOG OF BORING B1

BG No. 22590

CLIENT 5297 Marina Island, LLC **REPORT DATE** 2/10/17 **DRILL DATE** 1/16/17

PROJECT LOCATION 5000 S. Beethoven St., Del Rey, California **LOGGED BY** JHP/RSB

CONTRACTOR 2R Drilling **DRILLING METHOD** Hollow-Stem Auger **HOLE SIZE** 8-inch diameter

DRIVE WEIGHT 140-Pound Automatic Hammer **HAMMER DROP** 30 Inches **ELEV. TOP OF HOLE** 19 ft

ELEVATION (ft)	DEPTH (ft)	EARTH MATERIAL DESCRIPTION	GRAPHIC SYMBOL	USCS UNIT	SAMPLE TYPE & NUMBER	BLOW COUNT (Per 6 Inches)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SATURATION (%)	TYPE OF TEST
	25	(SM) 25': Silty SAND, dark gray, moist, loose to medium dense, fine to medium sand, trace coarse sand, 33.6% fines.		SM	S10	5 7 8	14.8			Sieve Wash (-#200)
-10		(ML) 27.5': Sandy SILT, dark gray, moist, very stiff, fine to medium sand, trace fine gravel, 63.9% fines.		ML	S11	2 6 12	17.8			Sieve Wash (-#200)
	30	(ML) 30': Sandy SILT, dark gray, moist to very moist, stiff, fine to medium sand, 59.4% fines, LL= 41.2, PI= 14.1.		ML	S12	6 4 7	27.1			Atterberg Limits, Sieve Wash (-#200)
-15		(CL) 32.5': CLAY, dark gray, moist, medium stiff, some fine sand, LL= 39.3, PI= 19.9.		CL	S13	3 3 4	24.8			Atterberg Limits
	35	(CL) 35': CLAY with Sand, dark gray, moist, stiff, fine sand, 76.6% fines, LL= 36.7, PI= 17.3.		CL	S14	4 6 8	23.4			Atterberg Limits, Sieve Wash (-#200)
-20		(CL) 37.5': Sandy CLAY, dark gray, moist to very moist, very stiff, 54.7% fines.		CL	S15	4 4 15	27.4			Sieve Wash (-#200)
	40	(SP) 40': SAND, dark gray, moist to very moist, dense, fine to medium sand, some coarse sand, some silt pockets.		SP	S16	11 15 16	20			
-25		(SM) 42.5': Silty SAND, dark gray, moist, medium dense, fine to medium sand, trace coarse sand, 26.5% fines.		SM	S17	11 9 14	21.8			Sieve Wash (-#200)
	45	(ML) 45': Sandy SILT, dark gray, moist, very stiff, fine sand, 69.5% fines.		ML	S18	5 8 15	21.8			Sieve Wash (-#200)
-30	50	(SW) 47.5': Gravelly SAND, dark gray, slightly moist to moist, dense, fine to coarse sand, fine to coarse gravel up to 1.5 inches.		SW	S19	27 26 14	9.4			

Bulk Sample   Standard Penetration Test

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BYER GEOTECHNICAL, INC.

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GLENDALE, CA 91206
818.549.9959 TEL
818.543.3747 FAX

LOG OF BORING B1

BG No. 22590

CLIENT 5297 Marina Island, LLC REPORT DATE 2/10/17 DRILL DATE 1/16/17

PROJECT LOCATION 5000 S. Beethoven St., Del Rey, California LOGGED BY JHP/RSB

CONTRACTOR 2R Drilling DRILLING METHOD Hollow-Stem Auger HOLE SIZE 8-inch diameter

DRIVE WEIGHT 140-Pound Automatic Hammer HAMMER DROP 30 Inches ELEV. TOP OF HOLE 19 ft

ELEVATION (ft)	DEPTH (ft)	EARTH MATERIAL DESCRIPTION	GRAPHIC SYMBOL	USCS UNIT	SAMPLE TYPE & NUMBER	BLOW COUNT (Per 6 Inches)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SATURATION (%)	TYPE OF TEST
	50	(SW) 50': Gravelly SAND, dark gray, slightly moist to moist, very dense, fine to coarse sand, fine to coarse gravel up to 1.5 inches.		SW	S20	15 30 38	10.4			
-35		(SW) 52.5': Gravelly SAND, dark gray, slightly moist to moist, very dense, fine to coarse sand, fine to coarse gravel up to 1.5 inches.		SW	S21	8 18 35	9.7			
	55	(SW) 55': Gravelly SAND, dark gray, slightly moist to moist, dense, fine to coarse sand, fine to coarse gravel up to 1.5 inches.		SW	S22	10 20 15	10.2			
-40		(SW) 57.5': Gravelly SAND, gray, moist, dense, fine to coarse sand, fine to coarse gravel up to 1.5 inches.		SW	S23	14 17 28	15.2			
	60	(SP) 60': SAND, gray, moist, very dense, fine sand, some fine gravel.		SP	S24	18 50/4"	17.6			

End at 61 Feet; Groundwater at 21.8 Feet; Fill to 7.5 Feet.

Bulk Sample Standard Penetration Test

BYER GEOTECHNICAL, INC.

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LOG OF BORING B2

BG No. 22590

CLIENT 5297 Marina Island, LLC REPORT DATE 2/10/17 DRILL DATE 1/16/17

PROJECT LOCATION 5000 S. Beethoven St., Del Rey, California LOGGED BY JHP

CONTRACTOR 2R Drilling DRILLING METHOD Hollow-Stem Auger HOLE SIZE 8-inch diameter

DRIVE WEIGHT 140-Pound Automatic Hammer HAMMER DROP 30 Inches ELEV. TOP OF HOLE 20 ft

ELEVATION (ft)	DEPTH (ft)	EARTH MATERIAL DESCRIPTION	USCS UNIT	SAMPLE TYPE & NUMBER	BLOW COUNT (Per 6 Inches)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SATURATION (%)	TYPE OF TEST
20	0	(SC) Surface: Sparse grass and dirt. **FILL (Afu):** 0 - 2.5': Clayey SAND, dark brown, slightly moist, fine to medium sand, some fine gravel.	SC						
		(CL) 2.5': Sandy CLAY, dark brown to yellowish-brown, moist, stiff, fine to medium sand, trace fine gravel.	CL	R1	3 5 11	11.9	123.8	93.9	
15	5	(CL) 5': Sandy CLAY, dark brown to yellowish-brown, moist, stiff, fine to medium sand, trace fine gravel, some coarse gravel.	CL	R2	6 10 11	12.9	116.1	80.3	
		(CL) 7.5': Top: CLAY, mottled dark brown to dark olive-brown, moist, very stiff, some fine sand.	CL	R3	8 12 17	20	110.9	100	
		(CL) **8.5' ALLUVIUM (Qa):** Bottom: CLAY, dark brown, moist, very stiff.	CL						
10	10	(CL) 10': CLAY, dark brown, moist, stiff, trace fine sand.	CL	R4	5 7 13	22.5	99.7	90.5	
		(CL) 12.5': CLAY, olive-gray, moist, stiff, trace fine sand.	CL	R5	6 9 12	27.4	94.7	97.2	
5	15	(CL) 15': CLAY, dark brown, moist, very stiff, trace fine sand.	CL	R6	6 11 15	22.1	104.3	100	Direct Shear, Consolidation
0	20	▽ (CL) 20': Sandy CLAY, dark gray, moist, stiff, fine sand. 20.5': Groundwater.	CL	R7	5 10 7	21.5	106.4	100	Corrosion Suite
				Bag2					
-5	25								

■ Ring Sample ▯ Bulk Sample

BYER GEOTECHNICAL, INC.

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LOG OF BORING B2

BG No. 22590

CLIENT 5297 Marina Island, LLC REPORT DATE 2/10/17 DRILL DATE 1/16/17

PROJECT LOCATION 5000 S. Beethoven St., Del Rey, California LOGGED BY JHP

CONTRACTOR 2R Drilling DRILLING METHOD Hollow-Stem Auger HOLE SIZE 8-inch diameter

DRIVE WEIGHT 140-Pound Automatic Hammer HAMMER DROP 30 Inches ELEV. TOP OF HOLE 20 ft

ELEVATION (ft)	DEPTH (ft)	EARTH MATERIAL DESCRIPTION	GRAPHIC SYMBOL	USCS UNIT	SAMPLE TYPE & NUMBER	BLOW COUNT (Per 6 Inches)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SATURATION (%)	TYPE OF TEST
-5	25	(SM) 25': Silty SAND, dark gray, moist, loose, fine sand.		SM	R8	5 5 7	22.1	104.2	100	Consolidation
-10	30	(ML) 30': Sandy SILT, dark gray, moist, very stiff, fine sand.		ML	R9	4 13 13	23.9	103.3	100	Direct Shear
-15	35	(CL) 35': CLAY, dark gray, moist, stiff to very stiff, trace fine sand.		CL	R10	6 11 14	21.4	105.5	100	Direct Shear, Consolidation
-20	40	(SM) 40': Silty SAND, dark gray, moist, medium dense, fine sand.		SM	R11	5 14 24	22.1	104.3	100	Consolidation
-25	45	(SW) 45': From Cuttings: SAND, dark gray, slightly moist, very dense, fine to coarse sand.		SW	R12	18 50				No Recovery
-30	50									

Ring Sample   Bulk Sample

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LOG OF BORING B2

BG No. 22590

CLIENT 5297 Marina Island, LLC **REPORT DATE** 2/10/17 **DRILL DATE** 1/16/17

PROJECT LOCATION 5000 S. Beethoven St., Del Rey, California **LOGGED BY** JHP

CONTRACTOR 2R Drilling **DRILLING METHOD** Hollow-Stem Auger **HOLE SIZE** 8-inch diameter

DRIVE WEIGHT 140-Pound Automatic Hammer **HAMMER DROP** 30 Inches **ELEV. TOP OF HOLE** 20 ft

ELEVATION (ft)	DEPTH (ft)	EARTH MATERIAL DESCRIPTION	GRAPHIC SYMBOL	USCS UNIT	SAMPLE TYPE & NUMBER	BLOW COUNT (Per 6 Inches)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SATURATION (%)	TYPE OF TEST
-30	50									
		(SW) 50': Gravelly SAND, dark gray, slightly moist, very dense, fine to coarse sand, fine to coarse gravel up to 2 inches.		SW	R13	50	7.5	134.3	86.2	

End at 50.5 Feet; Groundwater at 20.5 Feet; Fill to 8.5 Feet.

BORING LOG BYER BY RSB - GINT STD US BYER.GDT - 2/10/17 13:54 - P:\22000 - 22999\22590 5297 MARINA ISLAND, LLC\22590 BORING LOGS.GPJ

Ring Sample   Bulk Sample

BYER GEOTECHNICAL, INC.

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GLENDALE, CA 91206
818.549.9959 TEL
818.543.3747 FAX

LOG OF BORING B3

BG No. 22590

CLIENT 5297 Marina Island, LLC REPORT DATE 2/10/17 DRILL DATE 1/16/17
PROJECT LOCATION 5000 S. Beethoven St., Del Rey, California LOGGED BY JHP
CONTRACTOR 2R Drilling DRILLING METHOD Hollow-Stem Auger HOLE SIZE 8-inch diameter
DRIVE WEIGHT 140-Pound Automatic Hammer HAMMER DROP 30 Inches ELEV. TOP OF HOLE 15 ft

ELEVATION (ft)	DEPTH (ft)	EARTH MATERIAL DESCRIPTION	GRAPHIC SYMBOL	USCS UNIT	SAMPLE TYPE & NUMBER	BLOW COUNT (Per 6 Inches)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SATURATION (%)	TYPE OF TEST
15	0	(SP) Surface: Sparse grass and dirt. **FILL (Afu):** 0 - 2.5': SAND, dark brown, slightly moist, fine to medium sand, some fine gravel.		SP						
		(CL) 2.5': Top: CLAY, mottled dark brown to olive-brown, moist, hard, some fine to medium sand, trace fine gravel.		CL	R1	13 22 32	13.9	119.2	94.8	
		(CL) **3.5': ALLUVIUM (Qa):** Bottom: CLAY, dark brown, moist, very stiff, some fine sand.		CL						
10	5	(CL) 5': CLAY, dark brown, moist, very stiff, some fine to medium sand.		CL	R2	14 17 20	19.7	106.9	95.2	
		(CL) 7.5': CLAY, olive-gray, moist, stiff.		CL	R3	8 9 11	21.2	90.4	67.8	Consolidation
5	10	(CL) 10': CLAY, dark brown, moist, very stiff, fine sand, some medium sand.		CL	R4	9 17 22	20.8	107.5	100	Direct Shear
0	15	(CL) 15': Sandy CLAY, dark gray, moist, medium stiff, fine sand. ▽ 16': Groundwater.		CL	R5	4 7 8	17.3	115.8	100	
-5	20	(ML) 20': Sandy SILT, dark gray, slightly moist to moist, medium stiff, fine to medium sand, some fine to coarse gravel.		ML	R6	4 9 6	11.9	120.7	85	
-10	25									

■ Ring Sample

BORING LOG BYER BY RSB - GINT STD US BYER.GDT - 2/10/17 13:54 - P:\22000 - 22999\22590 5297 MARINA ISLAND, LLC\22590 BORING LOGS.GPJ

BYER GEOTECHNICAL, INC.
1461 E. CHEVY CHASE DR., SUITE 200
GLENDALE, CA 91206
818.549.9959 TEL
818.543.3747 FAX

LOG OF BORING B3

BG No. 22590

CLIENT 5297 Marina Island, LLC REPORT DATE 2/10/17 DRILL DATE 1/16/17

PROJECT LOCATION 5000 S. Beethoven St., Del Rey, California LOGGED BY JHP

CONTRACTOR 2R Drilling DRILLING METHOD Hollow-Stem Auger HOLE SIZE 8-inch diameter

DRIVE WEIGHT 140-Pound Automatic Hammer HAMMER DROP 30 Inches ELEV. TOP OF HOLE 15 ft

ELEVATION (ft)	DEPTH (ft)	EARTH MATERIAL DESCRIPTION	GRAPHIC SYMBOL	USCS UNIT	SAMPLE TYPE & NUMBER	BLOW COUNT (Per 6 Inches)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SATURATION (%)	TYPE OF TEST
-10	25									
		(SM) 25': Silty SAND, dark gray, moist, medium dense, fine to medium sand.		SM	R7	9 10 15	23.9	106.7	100	
-15	30									
		(CL) 30': CLAY, dark gray, moist, very stiff, some fine sand.		CL	R8	6 12 20	20.1	107.2	98.2	

End at 31.5 Feet; Groundwater at 16 Feet; Fill to 3.5 Feet.

Ring Sample

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818.543.3747 FAX

LOG OF BORING B4

BG No. 22590

CLIENT 5297 Marina Island, LLC **REPORT DATE** 2/10/17 **DRILL DATE** 1/17/17
PROJECT LOCATION 5000 S. Beethoven St., Del Rey, California **LOGGED BY** JHP
CONTRACTOR 2R Drilling **DRILLING METHOD** Hollow-Stem Auger **HOLE SIZE** 8-inch diameter
DRIVE WEIGHT 140-Pound Automatic Hammer **HAMMER DROP** 30 Inches **ELEV. TOP OF HOLE** 21 ft

ELEVATION (ft)	DEPTH (ft)	EARTH MATERIAL DESCRIPTION	GRAPHIC SYMBOL	USCS UNIT	SAMPLE TYPE & NUMBER	BLOW COUNT (Per 6 Inches)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SATURATION (%)	TYPE OF TEST
	0	(SC) Surface: Dry shrubs and dirt.		SC						
20		**FILL (Afu):** 0 - 2.5': Clayey SAND, olive-brown, slightly moist, fine to medium sand, some fine gravel.								
		(CL) 2.5': Sandy CLAY, dark olive-brown, moist, stiff, fine to medium sand.		CL	S1	3 4 6	17.7			
	5	(SW) 5': Top: SAND, olive-brown, slightly moist, loose, fine to coarse sand, some fine gravel.		SW	S2	3 3 3	15.5			
15		(CL) Bottom: Sandy CLAY, dark olive-brown, moist, medium stiff, fine sand.		CL						
		(CL) 7.5': Sandy CLAY, mottled olive-brown and brown, moist, stiff, some fine sand, metal debris, 74.3% fines.		CL	S3	4 5 7	12.4			Sieve Wash (-#200)
		(CL) **9': ALLUVIUM (Qa):**		CL						
10	10	(CL) 10': Sandy CLAY, olive-brown and brown, moist, stiff, some fine sand, 68.8% fines.		CL	S4	4 7 7	12.5			Sieve Wash (-#200)
		(CL) 12.5': CLAY, dark brown, moist, stiff, some fine sand, 81.5% fines, LL= 35.4, PI= 13.8.		CL	S5	7 6 4	20.3			Atterberg Limits, Sieve Wash (-#200)
5	15	(CL) 15': CLAY, dark brown, moist, stiff, some fine sand, 82.9% fines.		CL	S6	4 4 5	21.7			Sieve Wash (-#200)
		(CL) 17.5': CLAY with Sand, dark brown, moist, stiff, some fine sand, 72.6% fines, LL= 39.4, PI= 15.9.		CL	S7	4 5 6	21.9			Atterberg Limits, Sieve Wash (-#200)
0	20	(CL) 20': CLAY with Sand, dark gray, moist, stiff, fine sand, 84.5% fines, LL= 41.2, PI= 20.2.		CL	S8	3 5 7	21.7			Atterberg Limits, Sieve Wash (-#200)
		▽ 22': Groundwater.								
		(CL) 22.5': Sandy CLAY, dark gray, moist, medium stiff, fine sand, 70.8% fines, LL= 34.3, PI= 16.2.		CL	S9	2 3 4	25.6			Atterberg Limits, Sieve Wash (-#200)
	25									

Standard Penetration Test

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818.549.9959 TEL
818.543.3747 FAX

LOG OF BORING B4

BG No. 22590

CLIENT 5297 Marina Island, LLC REPORT DATE 2/10/17 DRILL DATE 1/17/17
PROJECT LOCATION 5000 S. Beethoven St., Del Rey, California LOGGED BY JHP
CONTRACTOR 2R Drilling DRILLING METHOD Hollow-Stem Auger HOLE SIZE 8-inch diameter
DRIVE WEIGHT 140-Pound Automatic Hammer HAMMER DROP 30 Inches ELEV. TOP OF HOLE 21 ft

ELEVATION (ft)	DEPTH (ft)	EARTH MATERIAL DESCRIPTION	GRAPHIC SYMBOL	USCS UNIT	SAMPLE TYPE & NUMBER	BLOW COUNT (Per 6 Inches)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SATURATION (%)	TYPE OF TEST
-5	25	(SM) 25': Silty SAND, dark gray, moist, medium dense, fine to medium sand, 37.9% fines.		SM	S10	6 10 8	20.4			Sieve Wash (-#200)
		(SM) 27.5': Silty SAND, dark gray, moist, medium dense, fine to coarse sand, trace fine gravel, 29.9% fines.		SM	S11	14 13 9	14.9			Sieve Wash (-#200)
-10	30	(ML) 30': Sandy SILT, dark gray, moist, stiff, fine sand, trace medium sand, 62.2% fines.		ML	S12	3 5 12	22.6			Sieve Wash (-#200)
		(CL) 32.5': Sandy CLAY, dark gray, moist, very stiff, fine sand, 65.3% fines.		CL	S13	4 7 12	25.5			Sieve Wash (-#200)
-15	35	(CL) 35': CLAY with Sand, dark gray, moist, stiff, fine sand, 83.9% fines.		CL	S14	3 3 5	24.4			Sieve Wash (-#200)
		(CL) 37.5': CLAY with Sand, dark gray, moist, stiff, fine sand, 87.9% fines, LL= 33.8, PI= 16.3.		CL	S15	3 5 7	25.9			Atterberg Limits, Sieve Wash (-#200)
-20	40	(ML) 40': Sandy SILT, dark gray, moist, very stiff, fine sand, 71.8% fines.		ML	S16	6 9 14	23.1			Sieve Wash (-#200)
		(ML) 42.5': Sandy SILT, dark gray, moist, stiff to very stiff, fine sand, 68.7% fines, LL= 38.9, PI= 13.1.		ML	S17	3 6 9	24.3			Atterberg Limits, Sieve Wash (-#200)
-25	45	(SM) 45': Silty SAND, dark gray, moist, dense, fine to medium sand, some coarse sand, trace fine gravel.		SM	S18	12 19 22	15.7			
		(ML) 47.5': Sandy SILT, dark gray, moist, very stiff, fine sand, trace medium sand, 67.5% fines.		ML	S19	4 8 13	19.7			Sieve Wash (-#200)
	50									

Standard Penetration Test

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LOG OF BORING B4

BG No. 22590

CLIENT 5297 Marina Island, LLC REPORT DATE 2/10/17 DRILL DATE 1/17/17

PROJECT LOCATION 5000 S. Beethoven St., Del Rey, California LOGGED BY JHP

CONTRACTOR 2R Drilling DRILLING METHOD Hollow-Stem Auger HOLE SIZE 8-inch diameter

DRIVE WEIGHT 140-Pound Automatic Hammer HAMMER DROP 30 Inches ELEV. TOP OF HOLE 21 ft

ELEVATION (ft)	DEPTH (ft)	EARTH MATERIAL DESCRIPTION	GRAPHIC SYMBOL	USCS UNIT	SAMPLE TYPE & NUMBER	BLOW COUNT (Per 6 Inches)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SATURATION (%)	TYPE OF TEST
-30	50	(SP) 50': SAND, dark gray, moist, dense, fine to medium sand, some coarse sand.		SP	S20	12 15 19	21.2			
		(SW) 52.5': Gravelly SAND, dark gray, slightly moist, dense, fine to coarse sand, fine to coarse gravel up to 1.5 inches.		SW	S21	14 25 26	9			
-35	55	(SW) 55': SAND with Gravel, dark gray, slightly moist to moist, very dense, fine to coarse sand, fine to coarse gravel up to 1.5 inches.		SW	S22	25 50/4"	11.6			
-40	60	(SW) 60': SAND with Gravel, dark gray, slightly moist to moist, very dense, fine to coarse sand, fine to coarse gravel up to 1.5 inches.		SW	S24	20 50/5"	12.3			

End at 61 Feet; Groundwater at 22 Feet; Fill to 9 Feet.

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LOG OF BORING B5

BG No. 22590

CLIENT 5297 Marina Island, LLC REPORT DATE 2/10/17 DRILL DATE 1/17/17

PROJECT LOCATION 5000 S. Beethoven St., Del Rey, California LOGGED BY JHP

CONTRACTOR 2R Drilling DRILLING METHOD Hollow-Stem Auger HOLE SIZE 8-inch diameter

DRIVE WEIGHT 140-Pound Automatic Hammer HAMMER DROP 30 Inches ELEV. TOP OF HOLE 20 ft

ELEVATION (ft)	DEPTH (ft)	EARTH MATERIAL DESCRIPTION	GRAPHIC SYMBOL	USCS UNIT	SAMPLE TYPE & NUMBER	BLOW COUNT (Per 6 Inches)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SATURATION (%)	TYPE OF TEST
20	0	(SP) Surface: Sparse grass and dirt. **FILL (Afu):** 0 - 5': SAND, yellowish-brown, slightly moist, fine to medium sand, some fine gravel.		SP						
15	5	(SC) 5': Clayey SAND, mottled dark olive-brown to tan, slightly moist to moist, medium dense, fine to coarse sand, some fine gravel.		SC	R1	5 9 13	10.3	112.9	58.8	
		(CL) **8.5': ALLUVIUM (Qa):**		CL						
10	10	(CL) 10': Sandy CLAY, dark brown, moist, very stiff, fine sand, trace medium sand.		CL	R2	15 22 23	17.9	99.5	71.8	
		(ML) 12.5': SILT, olive-brown, slightly moist to moist, stiff.		ML	R3	10 12 12	12.7	96.1	46.8	
5	15	(CL) 15': CLAY, dark brown, moist, very stiff, some fine sand.		CL	R4	10 19 26	19.3	108.5	97.6	
0	20	(CL) 20': CLAY, dark gray, moist, stiff, trace fine sand. 22': Groundwater.		CL	R5	4 6 7	23.3	103.1	100	
-5	25									

Ring Sample

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1461 E. CHEVY CHASE DR., SUITE 200
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LOG OF BORING B5

BG No. 22590

CLIENT 5297 Marina Island, LLC REPORT DATE 2/10/17 DRILL DATE 1/17/17
PROJECT LOCATION 5000 S. Beethoven St., Del Rey, California LOGGED BY JHP
CONTRACTOR 2R Drilling DRILLING METHOD Hollow-Stem Auger HOLE SIZE 8-inch diameter
DRIVE WEIGHT 140-Pound Automatic Hammer HAMMER DROP 30 Inches ELEV. TOP OF HOLE 20 ft

ELEVATION (ft)	DEPTH (ft)	EARTH MATERIAL DESCRIPTION	GRAPHIC SYMBOL	USCS UNIT	SAMPLE TYPE & NUMBER	BLOW COUNT (Per 6 Inches)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SATURATION (%)	TYPE OF TEST
-5	25	(SM) 25': Silty SAND, dark gray, moist, medium dense, fine sand.		SM	R6	5 10 14	23.1	105	100	
-10	30	(CL) 30': CLAY, dark gray, moist, medium stiff, some fine sand.		CL	R7	5 6 6	33.7	93.8	100	
-15	35	(CL) 35': Sandy CLAY, dark gray, moist, stiff, fine sand.		CL	R8	5 7 11	23.4	104.8	100	
-20	40	(CL) 40': Sandy CLAY, dark gray, moist, very stiff, fine sand.		CL	R9	12 11 14	29.9	96.6	100	
-25	45	(ML) 45': Sandy SILT, dark gray, moist, stiff, fine sand.		ML	R10	8 10 10	18.8	113	100	
-30	50									

Ring Sample

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GLENDALE, CA 91206
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818.543.3747 FAX

LOG OF BORING B5

BG No. 22590

CLIENT 5297 Marina Island, LLC **REPORT DATE** 2/10/17 **DRILL DATE** 1/17/17

PROJECT LOCATION 5000 S. Beethoven St., Del Rey, California **LOGGED BY** JHP

CONTRACTOR 2R Drilling **DRILLING METHOD** Hollow-Stem Auger **HOLE SIZE** 8-inch diameter

DRIVE WEIGHT 140-Pound Automatic Hammer **HAMMER DROP** 30 Inches **ELEV. TOP OF HOLE** 20 ft

ELEVATION (ft)	DEPTH (ft)	EARTH MATERIAL DESCRIPTION	GRAPHIC SYMBOL	USCS UNIT	SAMPLE TYPE & NUMBER	BLOW COUNT (Per 6 Inches)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SATURATION (%)	TYPE OF TEST
-30	50									
		(SW) 50': Gravelly SAND, dark gray, slightly moist to moist, very dense, fine to coarse sand, some fine gravel.		SW	R11	30 50	12.4	126.2	100	

End at 51 Feet; Groundwater at 22 Feet; Fill to 8.5 Feet.

Ring Sample

APPENDIX II

Interpretation of Cone Penetration Test Data

SUMMARY

OF

CONE PENETRATION TEST DATA

Project:

Del Rey Pointe Mixed-Use Development
5000 Beethoven Street
Playa Vista, CA
January 16, 2017

Prepared for:

Mr. Raffi Babayan
Byer Geotechnical, Inc.
1461 E. Chevy Chase Drive, Ste 200
Glendale, CA 91206-4090
Office (818) 549-9959 / Fax (818) 543-3747

Prepared by:

KTE

KEHOE TESTING & ENGINEERING
5415 Industrial Drive
Huntington Beach, CA 92649-1518
Office (714) 901-7270 / Fax (714) 901-7289
www.kehoetesting.com

TABLE OF CONTENTS

SUMMARY

OF

CONE PENETRATION TEST DATA

1. INTRODUCTION

This report presents the results of a Cone Penetration Test (CPT) program carried out for the Del Rey Pointe Mixed-Use Development project located at 5000 Beethoven Street in Playa Vista, California. The work was performed by Kehoe Testing & Engineering (KTE) on January 16, 2017. The scope of work was performed as directed by Byer Geotechnical, Inc. personnel.

2. SUMMARY OF FIELD WORK

The fieldwork consisted of performing CPT soundings at five locations to determine the soil lithology. Groundwater measurements and hole collapse depths provided in **TABLE 2.1** are for information only. The readings indicate the apparent depth to which the hole is open and the apparent water level (if encountered) in the CPT probe hole at the time of measurement upon completion of the CPT. KTE does not warranty the accuracy of the measurements and the reported water levels may not represent the true or stabilized groundwater levels.

LOCATION	DEPTH OF CPT (ft)	COMMENTS/NOTES:
CPT-1	46	Groundwater @ 22.0 ft
CPT-2	57	Refusal, groundwater @ 21.5 ft
CPT-3	70	Groundwater @ 21.0 ft
CPT-4	11	Refusal, hole open to 4.0 ft (dry)
CPT-4A	51	Refusal, hole open to 11.5 ft (dry)

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 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.

Tables of basic CPT output from the interpretation program CPeT-IT are provided for CPT data averaged over one foot intervals in the Appendix. We recommend a geotechnical engineer review the assumed input parameters and the calculated output from the CPeT-IT program. A summary of the equations used for the tabulated parameters is provided in the Appendix.

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

Richard W. Koester, Jr.
General Manager

01/19/17-kk-7905

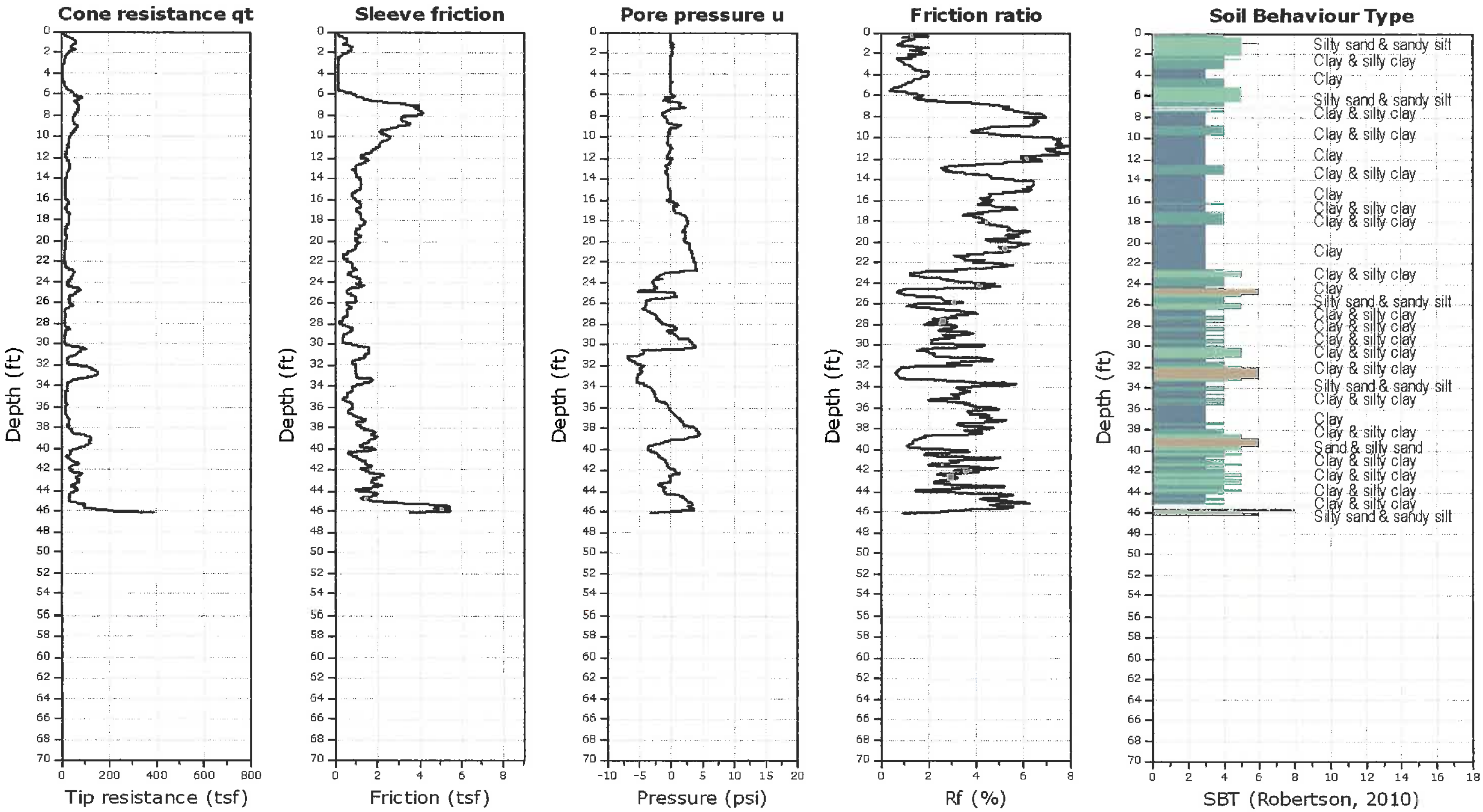
APPENDIX

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

CPT-1

Project: **Byer Geotechnical, Inc/Del Rey Pointe Mixed-Use Development**
Location: **5000 Bethoveen St Playa Vista, CA**

Total depth: 46.08 ft, Date: 1/16/2017
Cone Type: Vertek

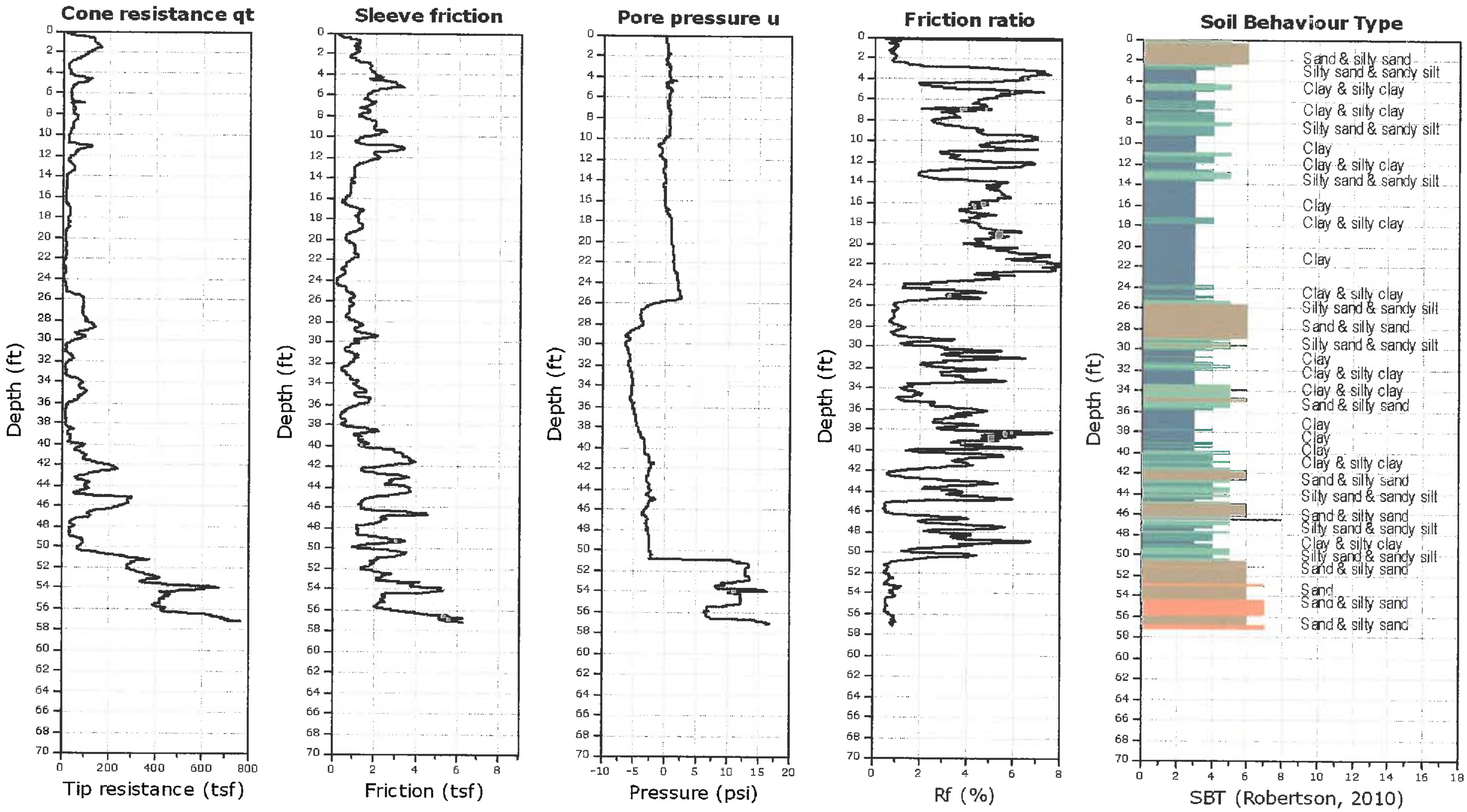


Project file: C:\ByerPlayaVista1-17\Plot Data\Plots.cpt

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

Project: Byer Geotechnical, Inc/Del Rey Pointe Mixed-Use Development
Location: 5000 Bethoveen St Playa Vista, CA

CPT-2
Total depth: 57.15 ft, Date: 1/16/2017
Cone Type: Vertek



CPeT-IT v.2.0.1.50 - CPTU data presentation & interpretation software - Report created on: 1/30/2017, 1:19:53 PM
Project file: C:\ByerPlayaVista1-17\Plot Data\Plots.cpt

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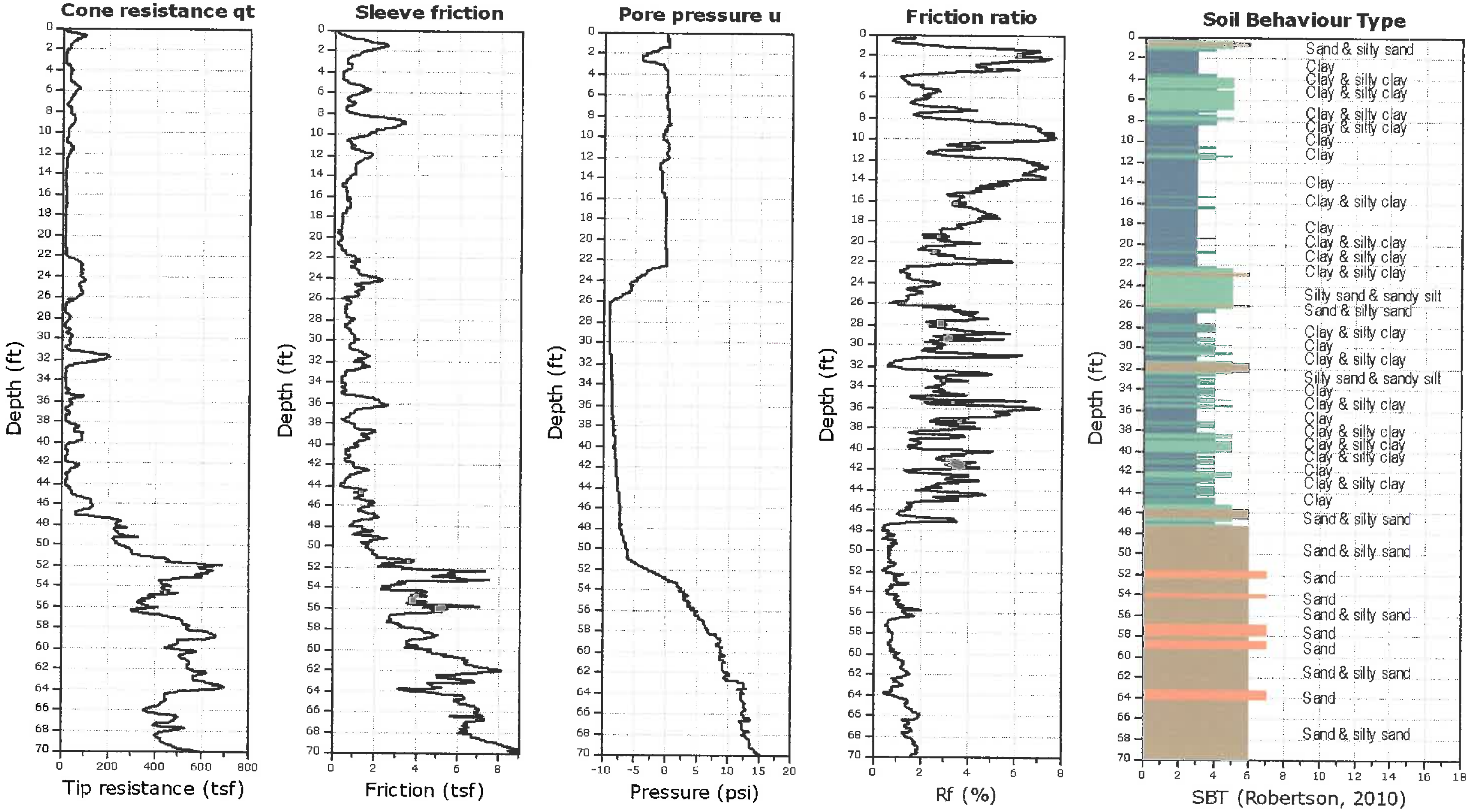
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

Project: Byer Geotechnical, Inc/Del Rey Pointe Mixed-Use Development
Location: 5000 Bethoveen St Playa Vista, CA

CPT-3
Total depth: 70.08 ft, Date: 1/16/2017
Cone Type: Vertek



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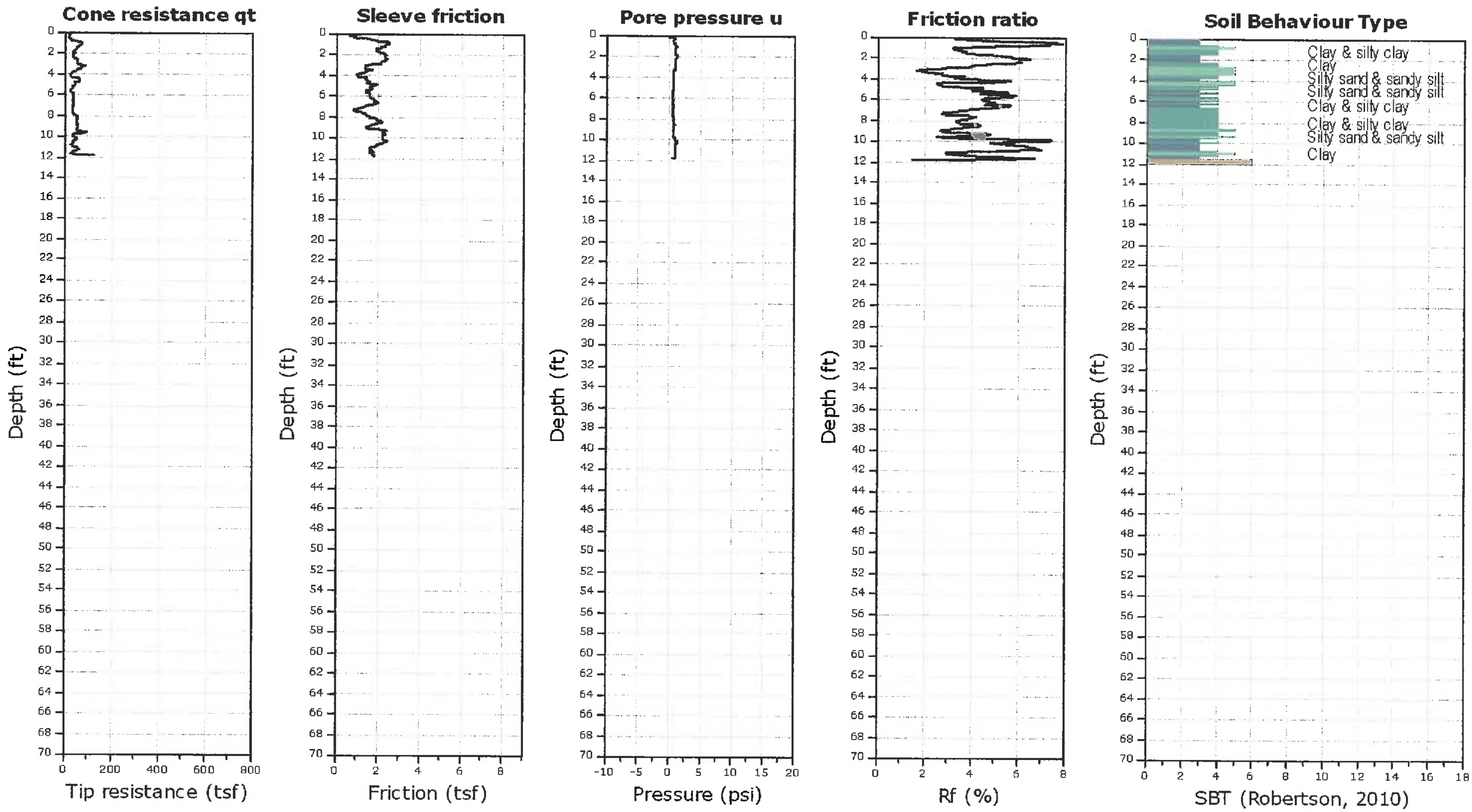
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

Project: Byer Geotechnical, Inc/Del Rey Pointe Mixed-Use Development
Location: 5000 Bethoveen St Playa Vista, CA

CPT-4
Total depth: 11.71 ft, Date: 1/16/2017
Cone Type: Vertek



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714-901-7270
rich@kehoetesting.com
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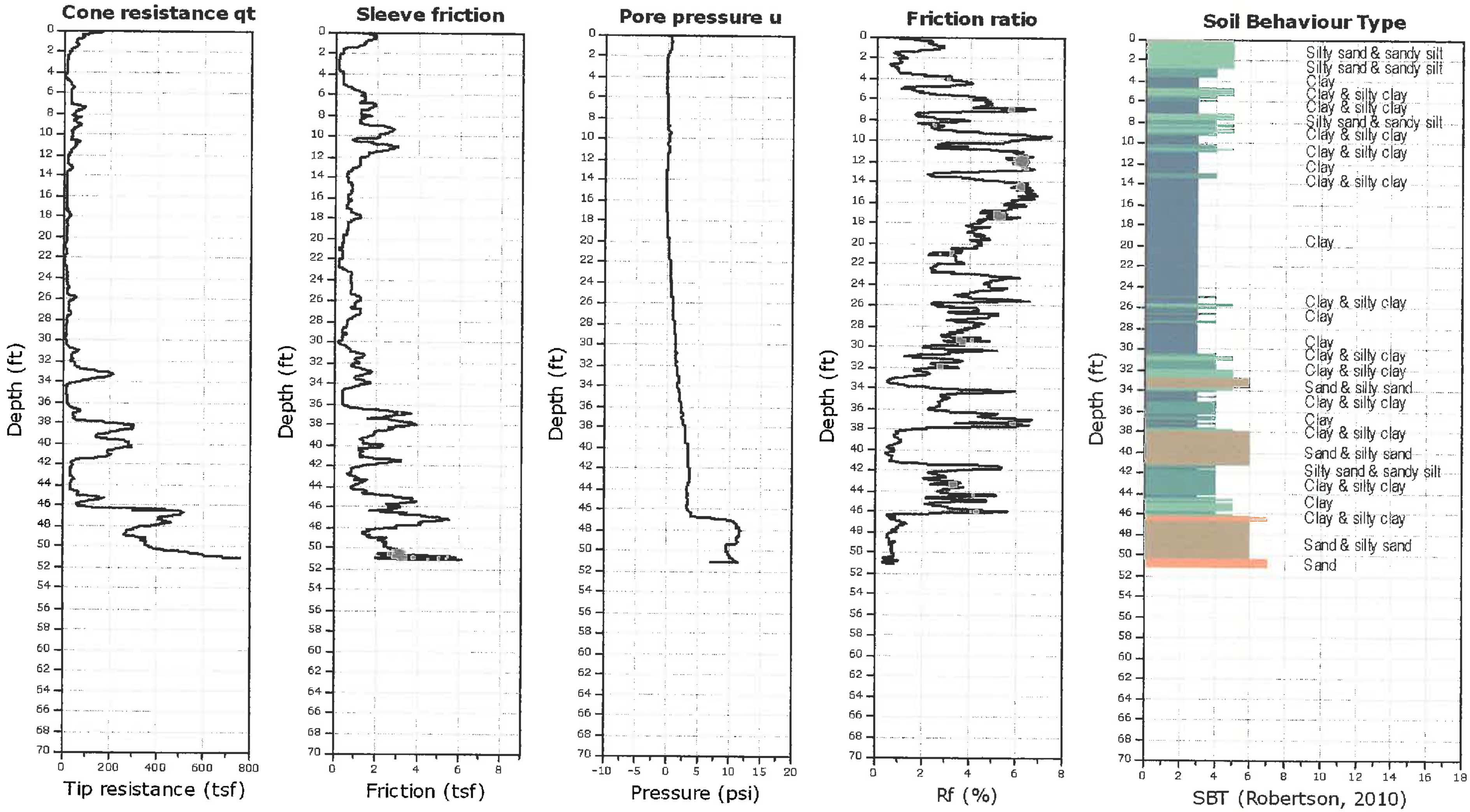
Project: Byer Geotechnical, Inc/Del Rey Pointe Mixed-Use Development
Location: 5000 Bethoveen St Playa Vista, CA

CPT-4A
Total depth: 51.14 ft, Date: 1/16/2017
Cone Type: Vertek



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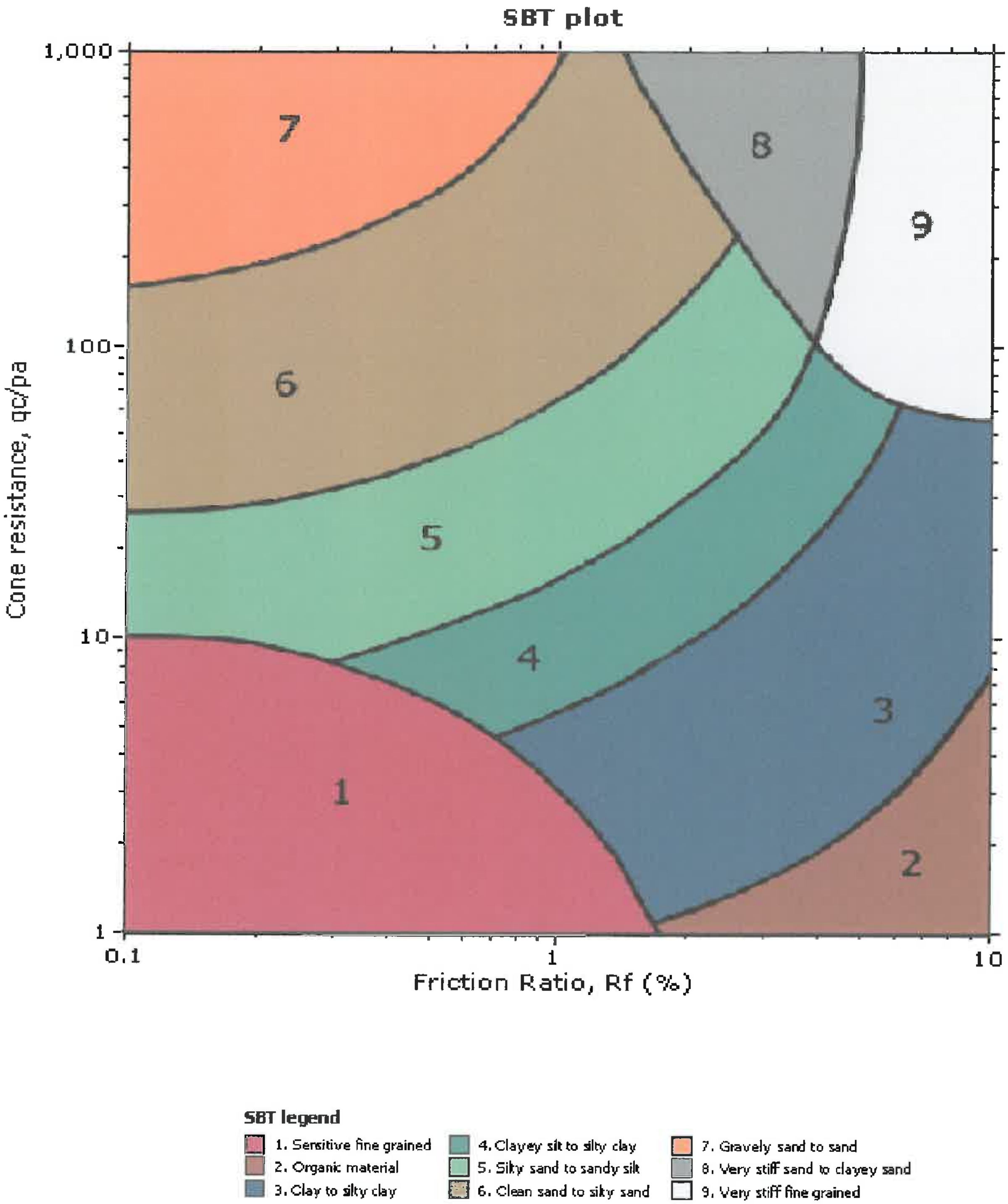


Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ã (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn	U2	I(B)	Mod. SB
	CPT-1	**In situ data**										**Basic output data**											
1	62.45	0.52	0.13	2.5	62.45	0.84	6	2.05	115.6	0.06	0	0.06	1078.7	0.84	0	6	0.46	3.8	1.6	224.28	0.17	90.91	
2	32.58	0.63	0.23	2.7	32.58	1.92	5	2.49	115.35	0.12	0	0.12	280.99	1.93	0	5	0.63	4.07	2.04	124.81	0.15	43.37	
3	10.65	0.1	0	2.9	10.65	0.98	4	2.75	99.51	0.17	0	0.17	63.49	1	0	5	0.72	3.79	2.25	37.58	0	44.29	
4	5.22	0.1	0	3.1	5.22	2	3	3.17	97.77	0.21	0	0.21	23.39	2.09	0	4	0.88	4.06	2.67	19.22	0	26.55	
5	11.28	0.1	0.09	3.6	11.28	0.93	4	2.72	99.65	0.26	0	0.26	41.73	0.95	0	5	0.75	2.84	2.33	29.53	0.02	40.34	
6	54.2	0.94	0.26	3.9	54.2	1.73	5	2.29	119.56	0.32	0	0.32	166.41	1.74	0	5	0.64	2.14	2.05	109.15	0.06	45.76	
7	72.05	3.76	1.29	3.9	72.07	5.22	4	2.54	130.39	0.39	0	0.39	184.27	5.24	0	9	0.76	2.14	2.34	144.89	0.24	18.66	
8	53.88	3.34	-1.1	3.9	53.87	6.2	3	2.68	128.82	0.45	0	0.45	117.86	6.26	0	9	0.82	2.01	2.49	101.24	-0.18	15.82	
9	65.68	3.13	1.19	3.9	65.7	4.77	4	2.53	128.83	0.52	0	0.52	125.9	4.81	0	9	0.78	1.75	2.38	107.79	0.17	20.03	
10	36.03	2.61	-0.37	3.9	36.02	7.25	3	2.84	126.03	0.58	0	0.58	61.03	7.37	0	3	0.91	1.72	2.7	57.67	-0.05	13.68	
11	27.88	1.98	0.18	4	27.88	7.12	3	2.91	123.4	0.64	0	0.64	42.4	7.28	0	3	0.94	1.6	2.79	41.21	0.02	13.84	
12	21.09	1.36	-0.17	4	21.09	6.44	3	2.97	119.94	0.7	0	0.7	29.02	6.66	0	3	0.98	1.49	2.87	28.74	-0.02	14.82	
13	34.57	0.94	-0.64	4	34.56	2.72	4	2.56	118.46	0.76	0	0.76	44.38	2.78	0	4	0.83	1.32	2.49	42.01	-0.06	27.84	
14	20.57	1.15	-0.48	4.2	20.57	5.59	3	2.94	118.66	0.82	0	0.82	24.05	5.82	0	3	0.99	1.28	2.88	23.97	-0.04	16.22	
15	18.59	1.15	-0.18	4.3	18.59	6.18	3	3	118.41	0.88	0	0.88	20.12	6.49	0	3	1	1.2	2.97	20.12	-0.02	15.02	
16	20.57	0.94	-0.58	4.3	20.57	4.57	3	2.88	117.19	0.94	0	0.94	20.9	4.79	0	3	0.99	1.13	2.87	20.87	-0.04	18.17	
17	21.93	1.04	0.61	4.3	21.94	4.76	3	2.87	118.12	1	0	1	20.98	4.99	0	3	0.99	1.06	2.88	20.98	0.04	17.74	
18	31.64	1.36	2.68	4.3	31.67	4.29	4	2.72	120.94	1.06	0	1.06	28.93	4.43	0.01	4	0.94	1	2.74	28.93	0.18	19.63	
19	16.29	1.04	1.93	4.4	16.31	6.4	3	3.05	117.4	1.12	0	1.12	13.61	6.87	0.01	3	1	0.95	3.11	13.61	0.12	14.44	
20	19.01	1.04	2.45	4.4	19.04	5.49	3	2.96	117.77	1.18	0	1.18	15.19	5.85	0.01	3	1	0.9	3.03	15.19	0.15	15.86	
21	14.52	0.73	3.29	4.4	14.56	5.02	3	3.02	114.51	1.23	0	1.23	10.8	5.49	0.02	3	1	0.86	3.13	10.8	0.19	16.09	
22	13.78	0.63	3.76	4.4	13.83	4.53	3	3.01	113.26	1.29	0.03	1.26	9.96	5	0.02	3	1	0.84	3.13	9.96	0.19	16.67	
23	51.48	0.73	-0.09	4.4	51.48	1.42	5	2.25	117.59	1.35	0.06	1.29	38.98	1.46	0	5	0.79	0.86	2.32	40.57	-0.05	39.16	
24	26.73	1.25	-2.97	4.4	26.7	4.69	3	2.8	119.93	1.41	0.09	1.31	19.23	4.96	-0.01	3	1	0.8	2.91	19.23	-0.23	17.88	
25	63.49	0.52	0.72	4.5	63.5	0.82	6	2.04	115.64	1.47	0.12	1.34	46.24	0.84	0	5	0.72	0.84	2.11	49.43	-0.05	53.25	
26	33.52	0.52	-3.86	4.6	33.47	1.56	5	2.42	114.08	1.52	0.16	1.37	23.37	1.63	-0.01	4	0.88	0.8	2.53	24.1	-0.32	31.17	
27	13.89	0.52	-2.82	4.5	13.85	3.77	3	2.96	111.93	1.58	0.19	1.39	8.82	4.25	-0.03	3	1	0.76	3.13	8.82	-0.28	17.5	
28	11.17	0.21	-1.18	4.6	11.16	1.87	4	2.87	104.7	1.63	0.22	1.41	6.74	2.19	-0.03	3	1	0.75	3.07	6.74	-0.21	19.75	
29	16.08	0.52	0.58	4.6	16.09	3.25	3	2.87	112.29	1.69	0.25	1.44	10.01	3.63	-0.01	3	1	0.74	3.04	10.01	-0.14	18.83	
30	16.92	0.73	3.5	4.6	16.96	4.31	3	2.93	114.88	1.75	0.28	1.46	10.39	4.8	0	3	1	0.72	3.1	10.39	-0.02	17	
31	66	1.46	-4.83	4.6	65.94	2.22	5	2.29	123.27	1.81	0.31	1.49	42.9	2.28	-0.01	5	0.84	0.75	2.4	45.39	-0.44	31.93	
32	33.94	0.94	-4.7	4.6	33.88	2.77	4	2.57	118.41	1.87	0.34	1.52	21.02	2.94	-0.02	4	0.96	0.7	2.73	21.32	-0.45	23.62	
33	141.5	1.04	-5.14	4.7	141.44	0.74	6	1.73	122.67	1.93	0.37	1.55	89.83	0.75	-0.01	6	0.62	0.79	1.82	104.08	-0.48	77.13	
34	25.9	0.84	-3.3	4.8	25.86	3.23	4	2.71	116.89	1.99	0.41	1.58	15.11	3.5	-0.03	3	1	0.67	2.89	15.11	-0.41	20.43	
35	15.87	0.52	-2.39	4.9	15.84	3.3	3	2.88	112.25	2.04	0.44	1.61	8.6	3.78	-0.04	3	1	0.66	3.11	8.6	-0.38	18.14	
36	17.75	0.84	-0.37	4.9	17.75	4.71	3	2.94	115.97	2.1	0.47	1.63	9.59	5.34	-0.03	3	1	0.65	3.16	9.59	-0.3	16.16	
37	26.11	1.15	1.23	4.9	26.12	4.4	3	2.79	119.24	2.16	0.5	1.66	14.43	4.79	-0.02	3	1	0.64	2.99	14.43	-0.25	17.55	
38	30.91	1.36	3.92	5	30.96	4.39	4	2.74	120.88	2.22	0.53	1.69	17.01	4.72	-0.01	3	1	0.63	2.93	17.01	-0.15	17.96	
39	121.76	1.78	1.8	5	121.78	1.46	6	1.97	126.18	2.28	0.56	1.72	69.41	1.49	0	5	0.73	0.7	2.1	79.11	-0.25	47.52	
40	57.43	1.88	-3.38	5.1	57.39	3.28	4	2.45	124.77	2.35	0.59	1.75	31.41	3.41	-0.02	4	0.93	0.62	2.63	32.46	-0.48	23.48	
41	38.01	1.15	-1.01	5.1	38	3.02	4	2.56	120.16	2.41	0.62	1.78	19.98	3.23	-0.02	4	0.99	0.6	2.77	20.07	-0.39	22.31	
42	41.56	1.36	0.64	5.2	41.57	3.27	4	2.55	121.6	2.47	0.66	1.81	21.59	3.47	-0.02	4	0.99	0.59	2.77	21.7	-0.34	21.81	
43	70.91	1.78	0.07	5.2	70.91	2.5	5	2.31	124.86	2.53	0.69	1.84	37.11	2.6	-0.01	4	0.88	0.61	2.49	39.57	-0.37	28.7	
44	62.55	1.04	-1.19	5.2	62.54	1.67	5	2.23	120.68	2.59	0.72	1.87	32.03	1.74	-0.01	5	0.86	0.61	2.42	34.66	-0.43	34.26	
45	33.31	1.98	2.86	5.3	33.35	5.95	3	2.8	123.84	2.65	0.75	1.9	16.14	6.46	-0.02	3	1	0.56	3.04	16.14	-0.29	14.99	
46	221.39	0	0.02	5.4	221.39	0	0	0	87.36	2.69	0.78	1.91	114.21	0	0	0	1	0.55	4.06	114.21	-0.41	177.44	

Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ã (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn	U2	K(B)	Mod. SB
	CPT-2	In situ data										Basic output data											
1	135.13	1.04	0.18	0.2	135.13	0.77	6	1.76	122.55	0.06	0	0.06	2202.8	0.77	0	6	0.39	3.05	1.42	388.77	0.22	107.61	
2	111.01	0.94	0.2	0.4	111.01	0.85	6	1.85	121.3	0.12	0	0.12	908.84	0.85	0	6	0.45	2.62	1.54	274.47	0.12	94	
3	32.37	1.67	0.52	0.3	32.38	5.16	3	2.77	122.51	0.18	0	0.18	175.83	5.19	0	9	0.77	3.85	2.39	117	0.2	18.75	
4	31.01	1.98	0.63	0.2	31.02	6.4	3	2.85	123.66	0.24	0	0.24	125.64	6.45	0	9	0.82	3.32	2.52	96.44	0.18	15.39	
5	59.94	3.03	0.16	0.3	59.94	5.05	4	2.58	128.36	0.31	0	0.31	192.87	5.08	0	9	0.75	2.53	2.33	142.33	0.04	19.21	
6	35.19	1.57	0.37	0.3	35.2	4.45	4	2.7	122.24	0.37	0	0.37	94.03	4.5	0	4	0.8	2.32	2.45	76.42	0.07	20.89	
7	36.97	1.67	0.23	0.4	36.97	4.52	4	2.69	122.83	0.43	0	0.43	84.62	4.57	0	4	0.81	2.08	2.48	71.66	0.04	20.53	
8	50.02	1.15	0.46	0.8	50.03	2.3	5	2.39	120.83	0.49	0	0.49	100.66	2.32	0	5	0.72	1.74	2.22	81.27	0.07	35.31	
9	43.02	1.88	0.64	1	43.03	4.37	4	2.63	124.06	0.55	0	0.55	76.65	4.43	0	4	0.82	1.7	2.48	68.3	0.08	21.04	
10	25.69	1.46	-0.18	0.9	25.69	5.69	3	2.87	120.97	0.61	0	0.61	40.79	5.83	0	3	0.92	1.65	2.73	39.07	-0.02	16.48	
11	106.83	3.24	-0.69	1	106.82	3.03	5	2.25	130.26	0.68	0	0.68	156.13	3.05	0	5	0.71	1.37	2.16	137.11	-0.07	30.13	
12	36.55	2.19	-0.37	1.2	36.55	6	3	2.78	124.79	0.74	0	0.74	48.23	6.13	0	3	0.91	1.38	2.7	46.76	-0.04	15.93	
13	48.98	0.94	-0.55	1.1	48.97	1.92	5	2.35	119.31	0.8	0	0.8	60.08	1.95	0	5	0.76	1.23	2.29	56.21	-0.05	36.85	
14	16.4	0.94	0	1.1	16.4	5.73	3	3.02	116.64	0.86	0	0.86	18.06	6.05	0	3	1	1.23	2.98	18.06	0	15.65	
15	15.46	0.84	-0.28	1.1	15.45	5.41	3	3.02	115.63	0.92	0	0.92	15.83	5.75	0	3	1	1.15	3.01	15.83	-0.02	16.04	
16	11.8	0.52	-0.18	1	11.8	4.43	3	3.06	111.54	0.97	0	0.97	11.12	4.82	0	3	1	1.09	3.08	11.12	-0.01	17.08	
17	28.3	1.36	0.09	0.9	28.3	4.8	3	2.79	120.66	1.03	0	1.03	26.37	4.98	0	3	0.97	1.02	2.81	26.35	0.01	18.07	
18	25.79	1.15	0.84	0.9	25.8	4.45	3	2.8	119.21	1.09	0	1.09	22.59	4.65	0	3	0.98	0.97	2.84	22.61	0.06	18.62	
19	24.64	1.25	0.83	0.8	24.65	5.08	3	2.85	119.74	1.15	0	1.15	20.37	5.33	0	3	1	0.92	2.91	20.37	0.05	17	
20	13.58	0.63	1.01	0.8	13.59	4.61	3	3.02	113.21	1.21	0	1.21	10.23	5.06	0.01	3	1	0.87	3.12	10.23	0.06	16.61	
21	14.1	1.04	1.2	0.9	14.11	7.4	3	3.14	117.04	1.27	0	1.27	10.12	8.13	0.01	3	1	0.83	3.26	10.12	0.07	13.21	
22	9.92	0.84	1.2	0.9	9.94	8.41	3	3.29	114.56	1.33	0.03	1.29	6.65	9.7	0.01	2	1	0.82	3.45	6.65	0.04	12.38	
23	9.29	0.52	1.56	0.8	9.31	5.61	3	3.2	110.96	1.38	0.06	1.32	6.01	6.58	0.01	3	1	0.8	3.38	6.01	0.04	14.61	
24	8.04	0.1	1.93	1.1	8.06	1.29	4	2.91	98.83	1.43	0.09	1.34	4.96	1.57	0.01	3	1	0.79	3.12	4.96	0.03	19.23	
25	20.36	0.63	2.21	1.1	20.39	3.07	4	2.77	114.2	1.49	0.12	1.36	13.87	3.31	0	3	1	0.78	2.91	13.87	0.03	20.58	
26	89.18	0.84	-1.74	1.2	89.16	0.94	6	1.95	119.91	1.55	0.16	1.39	62.94	0.95	0	6	0.69	0.83	2.03	68.56	-0.2	58.03	
27	86.47	0.73	-3.99	1.2	86.42	0.85	6	1.93	118.85	1.61	0.19	1.42	59.72	0.86	-0.01	6	0.69	0.82	2.02	65.5	-0.33	59.71	
28	99.94	1.04	-3.68	1.2	99.89	1.05	6	1.94	121.82	1.67	0.22	1.45	67.75	1.06	0	6	0.69	0.8	2.03	74.69	-0.33	56.68	
29	98.79	1.15	-6.16	1.4	98.71	1.16	6	1.98	122.49	1.73	0.25	1.48	65.53	1.18	-0.01	5	0.71	0.79	2.07	72.3	-0.47	52.88	
30	47.41	1.25	-6.25	1.5	47.33	2.65	5	2.45	121.33	1.79	0.28	1.51	30.17	2.75	-0.02	4	0.9	0.73	2.58	31.21	-0.48	28.44	
31	14.93	0.84	-5.85	1.6	14.86	5.62	3	3.05	115.54	1.85	0.31	1.54	8.47	6.42	-0.06	3	1	0.69	3.25	8.47	-0.48	14.85	
32	23.81	0.73	-5.89	1.7	23.74	3.08	4	2.72	115.7	1.91	0.34	1.56	13.97	3.35	-0.04	3	1	0.68	2.91	13.97	-0.49	20.53	
33	16.81	0.63	-5.43	1.8	16.75	3.74	3	2.89	113.72	1.96	0.37	1.59	9.31	4.24	-0.05	3	1	0.67	3.11	9.31	-0.48	17.64	
34	83.23	0.94	-5.41	1.8	83.16	1.13	6	2.02	120.6	2.02	0.41	1.62	50.17	1.16	-0.01	5	0.74	0.73	2.15	55.9	-0.49	48.91	
35	101.92	1.04	-5.54	1.8	101.85	1.03	6	1.93	121.87	2.08	0.44	1.65	60.57	1.05	-0.01	6	0.71	0.73	2.05	68.91	-0.51	55.52	
36	27.78	1.15	-5.28	1.9	27.71	4.14	4	2.75	119.39	2.14	0.47	1.68	15.26	4.49	-0.03	3	1	0.63	2.96	15.26	-0.51	18.23	
37	12.11	0.31	-4.82	1.9	12.05	2.6	3	2.91	107.85	2.2	0.5	1.7	5.8	3.18	-0.09	3	1	0.62	3.21	5.8	-0.5	17.87	
38	14.1	0.42	-4.41	1.9	14.04	2.97	3	2.89	110.33	2.25	0.53	1.72	6.85	3.54	-0.07	3	1	0.61	3.17	6.85	-0.49	17.87	
39	23.81	1.25	-3.68	2	23.76	5.27	3	2.87	119.65	2.31	0.56	1.75	12.25	5.84	-0.04	3	1	0.6	3.1	12.25	-0.47	15.72	
40	97.12	1.36	-3.17	2	97.08	1.4	5	2.03	123.67	2.37	0.59	1.78	53.16	1.43	-0.01	5	0.77	0.67	2.18	60.08	-0.46	44.89	
41	99.94	3.45	-2.39	2.1	99.91	3.45	5	2.31	130.55	2.44	0.62	1.82	53.68	3.54	-0.01	4	0.87	0.62	2.46	57.47	-0.44	24.7	
42	201.13	2.4	-2.48	2.2	201.1	1.19	6	1.76	129.62	2.5	0.66	1.85	107.39	1.21	0	6	0.65	0.69	1.88	130.3	-0.45	61.65	
43	97.12	3.55	-2.97	2.2	97.08	3.66	5	2.33	130.7	2.57	0.69	1.88	50.18	3.76	-0.01	4	0.89	0.6	2.5	53.39	-0.48	23.43	
44	95.97	3.55	-2.57	2.2	95.94	3.7	5	2.34	130.67	2.64	0.72	1.92	48.66	3.81	-0.01	4	0.9	0.59	2.52	51.65	-0.47	23.13	
45	187.03	1.78	-1.69	2.2	187.01	0.95	6	1.71	127.23	2.7	0.75	1.95	94.52	0.96	0	6	0.65	0.67	1.85	117.37	-0.45	69.58	
46	245.3	1.36	-3.28	2.3	245.26	0.55	6	1.47	125.93	2.76	0.78	1.98	122.37	0.56	0	6	0.55	0.71	1.59	162.38	-0.51	107.13	
47	123.22	2.4	-2.76	2.4	123.19	1.95	5	2.06	128.42	2.83	0.81	2.01	59.74	2	-0.01	5	0.8	0.6	2.23	68.11	-0.5	37.93	
48	49.5	1.15	-2.85	2.5	49.46	2.32	5	2.4	120.8	2.89	0.84	2.04	22.79	2.47	-0.02	4	0.96	0.53	2.65	23.47	-0.51	26.17	
49	43.55	2.51	-2.43	2.5	43.52	5.76	3	2.71	126.2	2.95	0.87	2.08	19.54	6.18	-0.03	3	1	0.51	2.97	19.54	-0.51	15.49	
50	69.55	1.57	-2.57	2.5	69.52	2.25	5	2.28	123.9	3.01	0.9	2.11	31.57	2.36	-0.02	4	0.91	0.54	2.51	33.65	-0.52	29.25	
51	270.26	2.09	10.81	2.5	270.39	0.77	6	1.54	129.32	3.08	0.94	2.14	124.91	0.78	0	6	0.59	0.66	1.67	166.93	-0.07	88.28	
52	276.84	1.36	12.97	2.8	277	0.49	6	1.39	126.22	3.14	0.97	2.17	126.09	0.5	0	6	0.54	0.68	1.53	176.11	-0.02	118.31	
53	413.95	2.09	11.79	2.9	414.09	0.5	7	1.27	130.36	3.2	1	2.21	186.27	0.51	0	6	0.48	0.7	1.39	272.17	-0.07	135.44	
54	598.16	5.01	10.97	2.9	598.29	0.84	6	1.35	137.28	3.27	1.03	2.24	265.24	0.84	0	6	0.51	0.68	1.45	383.92	-0.11	100.13	
55	436.19	2.3	11.99	3.1	436.34	0.53	7	1.27	131.18	3.34	1.06	2.28	190.1	0.53	0	6	0.49	0.69	1.39	281.52	-0.09	132.89	
56	437.76	2.82	6.37	3.2	437.84	0.64	6	1.34	132.69	3.4	1.09	2.31	187.83	0.65	0	6	0.52	0.67	1.46	274.31	-0.27	114.63	
57	704.88	0	16.6	2.7	705.09	0	0	0	87.36	3.45	1.12	2.33	301.73	0	0	0	1	0.46	4.06	301.73	0.03	445.33	

CPT-3 In situ data

Basic output data

Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ã (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn	U2	K(B)	Mod. SBT
1	61.51	1.57	0.13	0.2	61.51	2.55	5	2.36	123.6	0.06	0	0.06	993.63	2.55	0	8	0.58	5.19	1.9	301.49	0.15	37.15	
2	25.58	1.57	-3.42	0.2	25.54	6.13	3	2.9	121.46	0.12	0	0.12	207.32	6.16	-0.01	9	0.78	5.38	2.43	129.18	-2.01	16.07	
3	14.41	0.63	-1.26	0.3	14.4	4.35	3	2.99	113.36	0.18	0	0.18	79.36	4.41	-0.01	4	0.82	4.29	2.53	57.68	-0.51	20.88	
4	39.47	0.42	0	0.4	39.47	1.06	5	2.27	112.85	0.24	0	0.24	166.54	1.06	0	6	0.61	2.49	1.95	92.22	0	60.78	
5	33.83	0.63	0.09	0.4	33.84	1.85	5	2.46	115.44	0.29	0	0.29	114.34	1.87	0	5	0.69	2.43	2.18	76.96	0.02	40.68	
6	57.75	1.25	-0.18	0.4	57.75	2.17	5	2.33	121.82	0.35	0	0.35	161.98	2.18	0	5	0.67	2.08	2.11	112.77	-0.04	38.82	
7	27.46	0.94	0.09	0.4	27.47	3.42	4	2.7	117.9	0.41	0	0.41	65.46	3.47	0	4	0.81	2.14	2.47	54.76	0.02	24.88	
8	35.51	1.04	0.18	0.2	35.51	2.94	4	2.58	119.29	0.47	0	0.47	74.1	2.98	0	5	0.78	1.88	2.38	62.09	0.03	28.26	
9	46.37	3.24	0.09	0.2	46.37	6.98	3	2.76	128.22	0.54	0	0.54	85.35	7.06	0	9	0.87	1.8	2.6	78.01	0.01	14.17	
10	22.35	1.67	-0.64	0.2	22.34	7.48	3	3	121.6	0.6	0	0.6	36.37	7.68	0	3	0.96	1.73	2.85	35.62	-0.08	13.27	
11	26.84	0.94	0.18	0.3	26.84	3.5	4	2.72	117.84	0.66	0	0.66	39.87	3.59	0	4	0.87	1.52	2.6	37.49	0.02	23.21	
12	27.67	1.78	0.18	0.3	27.68	6.41	3	2.88	122.57	0.72	0	0.72	37.54	6.59	0	3	0.95	1.44	2.79	36.78	0.02	14.98	
13	15.56	1.04	-1.1	0.4	15.55	6.72	3	3.08	117.28	0.78	0	0.78	19.02	7.07	-0.01	3	1	1.36	3.01	19.02	-0.1	14.19	
14	14.2	0.73	-1.01	0.5	14.19	5.15	3	3.04	114.45	0.83	0	0.83	16.02	5.47	-0.01	3	1	1.27	2.99	16.02	-0.09	16.5	
15	9.71	0.42	-0.92	0.5	9.7	4.31	3	3.12	109.43	0.89	0	0.89	9.92	4.74	-0.01	3	1	1.19	3.12	9.92	-0.07	17.02	
16	18.38	0.63	-0.28	0.6	18.38	3.41	3	2.84	113.95	0.95	0	0.95	18.43	3.59	0	3	0.97	1.12	2.83	18.38	-0.02	20.86	
17	16.08	0.73	-0.28	0.6	16.08	4.55	3	2.96	114.75	1	0	1	15.03	4.85	0	3	1	1.05	2.98	15.03	-0.02	17.52	
18	9.61	0.42	-0.28	0.7	9.6	4.35	3	3.12	109.4	1.06	0	1.06	8.08	4.89	0	3	1	1	3.2	8.08	-0.02	16.51	
19	11.28	0.31	-0.28	0.8	11.27	2.78	3	2.96	107.69	1.11	0	1.11	9.14	3.08	0	3	1	0.95	3.04	9.14	-0.02	19.5	
20	10.76	0.42	-0.18	0.8	10.75	3.88	3	3.06	109.68	1.17	0	1.17	8.22	4.36	0	3	1	0.91	3.16	8.22	-0.01	17.22	
21	12.53	0.31	-0.09	0.9	12.53	2.5	3	2.89	107.94	1.22	0	1.22	9.27	2.77	0	3	1	0.87	3	9.27	-0.01	20.14	
22	20.36	1.04	0	1	20.36	5.13	3	2.92	117.94	1.28	0.03	1.25	15.29	5.47	0	3	1	0.85	3.01	15.29	-0.03	16.46	
23	81.56	0.94	-2.83	1.1	81.52	1.15	6	2.04	120.55	1.34	0.06	1.28	62.79	1.17	0	5	0.71	0.88	2.09	66.34	-0.21	51.66	
24	80.41	2.09	-5.04	1.1	80.35	2.6	5	2.28	126.36	1.4	0.09	1.31	60.31	2.65	-0.01	5	0.8	0.84	2.34	62.86	-0.35	30.83	
25	75.92	1.36	-5.86	1.3	75.85	1.79	5	2.19	123.07	1.46	0.12	1.34	55.53	1.83	-0.01	5	0.77	0.83	2.26	58.58	-0.41	38.77	
26	67.36	0.63	-8.74	1.4	67.25	0.93	6	2.05	117.11	1.52	0.16	1.37	48.09	0.95	-0.01	5	0.73	0.83	2.13	51.59	-0.57	51.68	
27	14.2	0.52	-9.1	1.4	14.09	3.71	3	2.95	111.97	1.58	0.19	1.39	8.99	4.17	-0.07	3	1	0.76	3.12	8.99	-0.61	17.66	
28	31.43	0.94	-9.1	1.5	31.32	3	4	2.62	118.22	1.64	0.22	1.42	20.91	3.17	-0.03	4	0.96	0.75	2.75	21.13	-0.62	22.74	
29	23.81	0.84	-9.04	1.5	23.7	3.53	4	2.76	116.68	1.7	0.25	1.45	15.21	3.8	-0.04	3	1	0.73	2.91	15.21	-0.62	19.73	
30	38.22	1.04	-9.01	1.6	38.11	2.74	4	2.53	119.47	1.76	0.28	1.48	24.64	2.87	-0.03	4	0.93	0.73	2.66	25.18	-0.63	24.72	
31	19.42	1.15	-9.01	1.6	19.31	5.95	3	2.98	118.51	1.82	0.31	1.5	11.64	6.56	-0.05	3	1	0.7	3.15	11.64	-0.64	14.78	
32	171.99	1.04	-8.92	1.8	171.88	0.61	6	1.61	123.14	1.88	0.34	1.53	110.85	0.61	-0.01	6	0.57	0.81	1.69	130.22	-0.64	93.49	
33	20.57	0.52	-8.83	1.9	20.46	2.55	4	2.72	112.88	1.93	0.37	1.56	11.89	2.82	-0.05	3	1	0.68	2.92	11.89	-0.65	21.15	
34	18.27	0.42	-8.64	2	18.17	2.3	4	2.74	110.96	1.99	0.41	1.58	10.22	2.58	-0.06	3	1	0.67	2.95	10.22	-0.65	20.98	
35	27.46	0.42	-8.64	2	27.36	1.53	5	2.49	111.95	2.04	0.44	1.61	15.74	1.65	-0.04	4	0.95	0.67	2.68	16.09	-0.66	27.02	
36	32.69	2.3	-8.6	2	32.58	7.05	3	2.86	124.85	2.11	0.47	1.64	18.59	7.54	-0.04	3	1	0.65	3.04	18.59	-0.86	13.6	
37	28.4	0.84	-8.55	2.1	28.3	2.95	4	2.65	117.11	2.17	0.5	1.67	15.68	3.2	-0.04	3	1	0.63	2.85	15.68	-0.67	21.38	
38	22.14	0.94	-8.39	2.1	22.04	4.27	3	2.84	117.36	2.22	0.53	1.69	11.7	4.74	-0.06	3	1	0.62	3.06	11.7	-0.67	17.29	
39	73.31	1.36	-8.28	2.2	73.21	1.85	5	2.21	122.98	2.29	0.56	1.72	41.13	1.91	-0.02	5	0.83	0.67	2.36	44.67	-0.67	35.16	
40	46.26	1.04	-8.37	2.3	46.16	2.26	5	2.41	119.93	2.35	0.59	1.75	24.99	2.38	-0.03	4	0.93	0.63	2.6	25.96	-0.68	27.27	
41	23.5	0.73	-8.09	2.4	23.4	3.12	4	2.73	115.67	2.4	0.62	1.78	11.8	3.48	-0.06	3	1	0.59	2.98	11.8	-0.88	19.62	
42	46.16	0.94	-7.91	2.4	46.06	2.04	5	2.39	119.16	2.46	0.66	1.81	24.11	2.16	-0.03	4	0.92	0.61	2.59	25.14	-0.68	28.3	
43	25.58	0.84	-7.88	2.5	25.49	3.28	4	2.72	116.85	2.52	0.69	1.84	12.51	3.64	-0.05	3	1	0.58	2.97	12.51	-0.68	19.49	
44	18.07	0.42	-7.63	2.6	17.97	2.32	4	2.74	110.93	2.58	0.72	1.86	8.28	2.71	-0.08	3	1	0.57	3.04	8.28	-0.68	19.77	
45	42.08	1.36	-7.54	2.6	41.99	3.23	4	2.55	121.62	2.64	0.75	1.89	20.83	3.45	-0.03	4	1	0.56	2.78	20.86	-0.68	21.74	
46	127.51	1.67	-7.36	2.8	127.42	1.31	6	1.93	125.85	2.7	0.78	1.92	64.93	1.34	-0.01	5	0.73	0.65	2.08	76.06	-0.68	50.06	
47	63.18	2.09	-7.27	2.9	63.09	3.31	4	2.43	125.77	2.76	0.81	1.95	30.9	3.46	-0.02	4	0.95	0.56	2.64	31.9	-0.68	23.22	
48	233.6	0.84	-7.17	2.9	233.52	0.36	6	1.37	122.26	2.82	0.84	1.98	116.37	0.36	-0.01	6	0.51	0.73	1.49	158.09	-0.69	132.09	
49	249.27	2.19	-6.81	2.9	249.18	0.88	6	1.6	129.48	2.89	0.87	2.02	122.17	0.89	-0.01	6	0.6	0.68	1.73	157.72	-0.88	79.7	
50	248.64	1.57	-6.26	2.3	248.56	0.63	6	1.5	127.01	2.95	0.9	2.05	119.91	0.64	-0.01	6	0.57	0.69	1.63	159.51	-0.86	98.71	
51	328.84	2.09	-5.98	2.1	328.77	0.64	6	1.42	129.79	3.02	0.94	2.08	156.46	0.64	0	6	0.53	0.7	1.53	214.66	-0.86	108.2	
52	651.42	3.34	-2.92	1.7	651.38	0.51	7	1.15	134.9	3.09	0.97	2.12	306.05	0.52	0	7	0.42	0.75	1.23	457.51	-0.56	152.87	
53	590.22	5.74	0.55	0.8	590.23	0.97	6	1.41	137.28	3.15	1	2.16	272.34	0.98	0	6	0.52	0.69	1.5	382.16	-0.44	88.35	
54	441.1	2.61	2.3	0.7	441.13	0.59	7	1.31	132.14	3.22	1.03	2.19	199.91	0.6	0	6	0.49	0.7	1.42	288.92	-0.39	123.4	
55	377.82	3.86	3.04	1	377.85	1.02	6	1.53	134.64	3.29	1.06	2.23	168.22	1.03	0	6	0.59	0.65	1.66	228.58	-0.38	78.02	
56	370.09	4.7	4.35	0.9	370.14	1.27	6	1.62	136.02	3.36	1.09	2.26	162.04	1.28	0	6	0.62	0.62	1.75	215.87	-0.34	65.17	
57	475.87	2.82	6.1	0	475.95	0.59	7	1.29	132.89	3.42	1.12	2.3	205.56	0.6	0	6	0.49	0.68	1.4	304.64	-0.3	124.97	
58	535.61	4.28	6.9	-0.1	535.69	0.8	6	1.36	136.24	3.49	1.15	2.34	227.87	0.8	0	6	0.52	0.66	1.47	332.9	-0.28	101.51	
59	641.29	3.86	8.82	-0.1	641.4	0.6	7	1.21	135.93	3.56	1.19	2.37	268.86	0.61	0	7	0.46	0.69	1.32	414.54	-0.23	132.21	
60	444.65	4.7	8.92	-0.2	444.76	1.06	6	1.5	136.47	3.63	1.22	2.41	183.09	1.07	0	6	0.59	0.62	1.64	257.02	-0.24	77.67	
61	517.12	6.47	9.42	-0.2	517.24	1.25	6	1.53	137.28	3.69	1.25	2.45	209.88	1.26	0	6	0.6	0.61	1.66	294.15	-0.23	68.99	
62	543.44	8.04	9.75	-0.2	543.56	1.48	6	1.58	137.28	3.76	1.28	2.48	217.28	1.49	0	6	0.62	0.59	1.71	300.74	-0.23	59.99	
63	563.28	6.68	12.32	-0.2	563.43	1.19	6	1.49	137.28	3.83	1.31	2.52	221.91	1.19	0	6	0.59	0.6	1.62	317.93	-0.17	72.92	
64	640.14	3.86	12.16	-0.2	640.29	0.6	7	1.21	135.92	3.9	1.34	2.56	248.74	0.61	0	7	0.48	0.66	1.33	394.24	-0.18	130.67	
65	446.32	5.95	12.6	-0.1	446.48	1.33	6	1.59	137.28	3.97	1.37	2.6	170.46	1.35	0	6	0.64	0.57	1.74	236.5	-0.18	63.51	
66	353.9	6.79	12.26	0	354.05	1.92	6	1.78	137.28	4.04	1.4	2.63	132.91	1.94	0	6	0.72	0.52	1.95	172.03	-0.2	45.1	
67	479.95	6.47	12.32	0	480.1	1.35	6	1.58	137.28	4.11	1.44	2.67	178.21	1.36	0	6	0.63	0.56	1.73	250.02	-0.21	63.41	
68	474.93	6.16	12.37	0	475.09	1.3	6	1.56	137.28	4.17	1.47	2.71	173.88	1.31	0	6	0.63	0.55	1.72	245.49	-0.21	65.31	
69	423.03	7.83	13.43	0	423.2	1.85	6	1.72	137.28	4.24	1.5	2.75	152.59	1.87	0	6	0.7	0.51	1.89	203.02	-0.19	47.39	
70	576.65	0	15.24	0	576.83	0	0	0	87.36	4.29	1.53	2.76	207.58	0	0	0	1	0.38	4.06	207.58	-0.16	310.83	

CPT-4 In situ data **Basic output data**

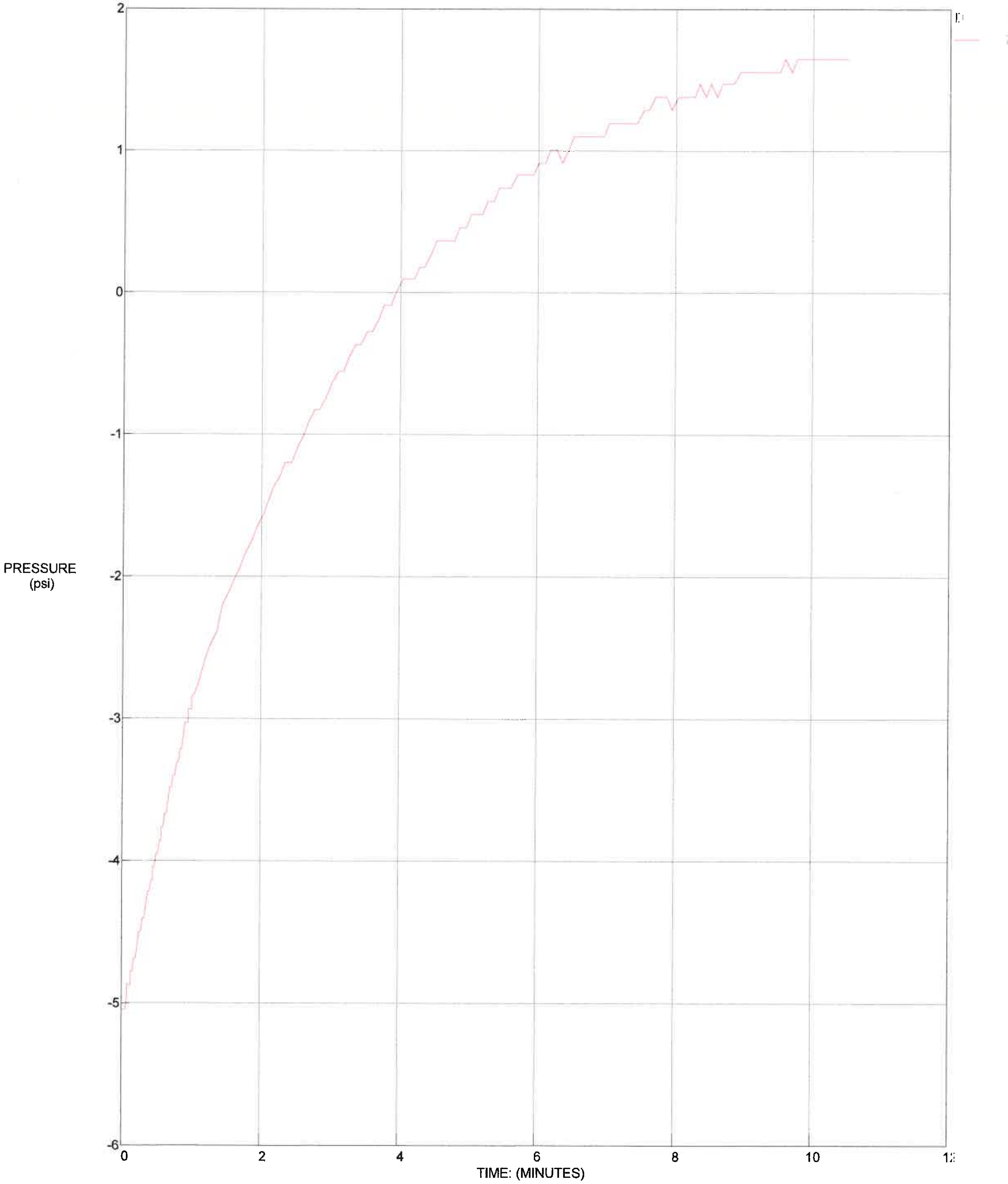
Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ã (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn	U2	I(B)	Mod. SB
1	74.56	2.4	1.1	0.1	74.57	3.22	5	2.37	127.2	0.06	0	0.06	1170.8	3.22	0	8	0.6	5.33	1.95	375.48	1.25	30.11	
2	37.49	2.3	1.1	0.2	37.5	6.13	3	2.78	125.2	0.13	0	0.13	295.98	6.15	0	9	0.75	4.94	2.35	174.45	0.63	16.15	
3	56.29	1.46	0.92	0.2	56.3	2.6	5	2.39	122.88	0.19	0	0.19	299.16	2.61	0	5	0.65	3.06	2.06	162.14	0.35	34.95	
4	24.75	1.04	0.64	0	24.76	4.22	3	2.8	118.42	0.25	0	0.25	99.31	4.26	0	4	0.79	3.17	2.45	73.52	0.19	21.79	
5	41.25	1.67	0.64	0	41.26	4.05	4	2.62	123.1	0.31	0	0.31	132.78	4.08	0	9	0.76	2.55	2.35	98.75	0.15	22.98	
6	34.98	1.57	0.55	0.2	34.99	4.48	4	2.7	122.23	0.37	0	0.37	93.68	4.52	0	4	0.8	2.33	2.46	76.19	0.11	20.78	
7	34.36	1.36	0.55	0.2	34.36	3.95	4	2.67	121.13	0.43	0	0.43	78.89	4	0	4	0.81	2.07	2.46	66.27	0.09	22.76	
8	51.48	1.67	0.64	0.3	51.49	3.24	4	2.49	123.64	0.49	0	0.49	103.69	3.28	0	5	0.76	1.78	2.32	86.01	0.09	27.29	
9	53.57	1.46	0.64	0.4	53.58	2.73	5	2.42	122.76	0.55	0	0.55	95.85	2.76	0	5	0.74	1.62	2.28	81.2	0.08	31.03	
10	37.7	2.19	1.01	0.1	37.71	5.82	3	2.76	124.87	0.62	0	0.62	60.25	5.91	0	4	0.88	1.61	2.63	56.51	0.12	16.46	
11	41.04	1.57	1.01	0	41.05	3.82	4	2.6	122.62	0.68	0	0.68	59.63	3.88	0	4	0.84	1.45	2.5	55.4	0.11	22.95	
12	27.67	1.78	0.18	0.3	27.68	6.41	3	2.88	122.57	0.74	0	0.74	36.48	6.59	0	3	0.95	1.41	2.8	35.84	0.02	14.97	

CPT-4A **In situ data** **Basic output data**

Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ā (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn	U2	I(B)	Mod. SB`
1	51.59	1.36	0.37	0.1	51.59	2.63	5	2.42	122.13	0.06	0	0.06	843.34	2.63	0	8	0.6	5.47	1.95	266.25	0.43	35.81	
2	25.27	0.31	-0.03	0.3	25.27	1.24	5	2.47	109.66	0.12	0	0.12	216.92	1.25	0	6	0.62	3.92	2	93.28	-0.02	55.48	
3	12.43	0.1	-0.18	0.3	12.42	0.84	4	2.66	99.89	0.17	0	0.17	73.95	0.85	0	5	0.69	3.59	2.18	41.62	-0.08	48.95	
4	10.76	0.31	-0.2	0.2	10.75	2.91	3	2.98	107.57	0.22	0	0.22	47.97	2.97	0	4	0.83	3.69	2.55	36.72	-0.07	26.07	
5	30.7	0.42	-0.22	0.2	30.7	1.36	5	2.42	112.24	0.28	0	0.28	110.33	1.37	0	5	0.67	2.46	2.11	70.68	-0.06	48.3	
6	31.64	1.36	-0.08	0.4	31.64	4.29	4	2.72	120.93	0.34	0	0.34	93.1	4.34	0	4	0.8	2.5	2.45	73.99	-0.02	21.49	
7	34.04	1.88	-0.05	0.5	34.04	5.52	3	2.78	123.49	0.4	0	0.4	84.52	5.59	0	9	0.84	2.27	2.54	72.12	-0.01	17.36	
8	40.1	1.46	0.09	0.5	40.1	3.65	4	2.6	122.05	0.46	0	0.46	86.38	3.69	0	4	0.79	1.93	2.41	72.36	0.01	24.45	
9	72.05	2.3	0.09	0.3	72.06	3.19	5	2.38	126.79	0.52	0	0.52	136.95	3.21	0	5	0.73	1.67	2.23	112.84	0.01	28.41	
10	36.45	2.09	0.25	0.2	36.45	5.73	3	2.77	124.43	0.58	0	0.58	61.35	5.82	0	4	0.88	1.68	2.62	57.04	0.03	16.67	
11	50.02	3.03	0.23	0.3	50.02	6.05	3	2.69	127.92	0.65	0	0.65	76.12	6.13	0	9	0.86	1.53	2.58	71.2	0.03	16.03	
12	22.77	1.46	0.09	0.4	22.77	6.42	3	2.95	120.67	0.71	0	0.71	31.11	6.63	0	3	0.97	1.47	2.85	30.71	0.01	14.88	
13	28.2	0.94	-0.18	0.5	28.19	3.33	4	2.69	117.96	0.77	0	0.77	35.72	3.43	0	4	0.88	1.33	2.61	34.39	-0.02	23.63	
14	9.71	0.52	-0.18	0.6	9.71	5.38	3	3.18	111.06	0.82	0	0.82	10.79	5.88	0	3	1	1.29	3.15	10.79	-0.02	15.58	
15	13.05	0.84	-0.18	0.6	13.05	6.4	3	3.12	115.22	0.88	0	0.88	13.81	6.86	0	3	1	1.2	3.11	13.81	-0.02	14.45	
16	10.86	0.63	-0.18	1	10.86	5.77	3	3.16	112.67	0.94	0	0.94	10.58	6.32	0	3	1	1.13	3.17	10.58	-0.01	15.04	
17	12.22	0.63	-0.18	1.1	12.22	5.13	3	3.09	112.95	0.99	0	0.99	11.29	5.58	0	3	1	1.06	3.12	11.29	-0.01	16	
18	25.58	1.15	-0.09	1.2	25.58	4.49	3	2.8	119.19	1.05	0	1.05	23.29	4.68	0	3	0.98	1	2.83	23.29	-0.01	18.59	
19	15.04	0.63	0.09	1.3	15.04	4.17	3	2.96	113.46	1.11	0	1.11	12.55	4.5	0	3	1	0.95	3.02	12.55	0.01	17.83	
20	9.29	0.42	0.18	1.3	9.3	4.49	3	3.14	109.32	1.16	0	1.16	6.98	5.14	0	3	1	0.91	3.26	6.98	0.01	16.04	
21	8.98	0.21	0.28	1.5	8.98	2.32	3	3	104.17	1.22	0	1.22	6.38	2.69	0	3	1	0.87	3.13	6.38	0.02	18.8	
22	8.04	0.21	0.37	1.5	8.05	2.6	3	3.06	103.9	1.27	0.03	1.24	5.48	3.08	0	3	1	0.85	3.22	5.48	0	17.81	
23	10.76	0.42	0.41	1.5	10.76	3.88	3	3.06	109.68	1.32	0.06	1.26	7.48	4.43	0	3	1	0.84	3.2	7.48	-0.03	16.95	
24	15.14	0.73	0.64	1.5	15.15	4.83	3	3	114.61	1.38	0.09	1.29	10.7	5.31	0	3	1	0.82	3.12	10.7	-0.04	16.32	
25	21.2	0.73	0.74	1.6	21.21	3.45	4	2.79	115.43	1.44	0.12	1.31	15.05	3.7	0	3	1	0.81	2.91	15.05	-0.05	19.94	
26	44.69	1.25	0.83	1.6	44.7	2.8	4	2.49	121.19	1.5	0.16	1.34	32.16	2.9	0	4	0.9	0.81	2.58	32.98	-0.07	25.95	
27	25.58	1.25	0.92	1.6	25.6	4.9	3	2.83	119.83	1.56	0.19	1.37	17.52	5.21	-0.01	3	1	0.77	2.95	17.52	-0.09	17.06	
28	14.52	0.63	1.1	1.6	14.53	4.31	3	2.98	113.38	1.62	0.22	1.4	9.24	4.85	-0.01	3	1	0.76	3.15	9.24	-0.1	16.75	
29	11.07	0.31	1.26	1.5	11.08	2.83	3	2.97	107.65	1.67	0.25	1.42	6.63	3.33	-0.02	3	1	0.75	3.17	6.63	-0.11	18.06	
30	10.23	0.21	1.38	1.6	10.25	2.04	3	2.92	104.49	1.72	0.28	1.44	5.92	2.45	-0.02	3	1	0.73	3.14	5.92	-0.13	18.84	
31	65.16	1.04	1.47	1.7	65.18	1.6	5	2.2	120.78	1.78	0.31	1.47	43.12	1.65	0	5	0.8	0.77	2.31	46.06	-0.14	38.43	
32	37.7	1.04	1.47	1.8	37.72	2.77	4	2.54	119.44	1.84	0.34	1.5	23.93	2.91	-0.01	4	0.94	0.72	2.68	24.43	-0.16	24.4	
33	177	1.57	1.72	1.9	177.03	0.88	6	1.71	126.18	1.91	0.37	1.53	114.4	0.89	0	6	0.6	0.8	1.79	132.48	-0.16	75.59	
34	59.63	1.57	1.65	1.8	59.65	2.63	5	2.38	123.53	1.97	0.41	1.56	36.94	2.72	0	4	0.88	0.71	2.51	38.73	-0.18	27.82	
35	13.26	0.42	2.11	2	13.29	3.14	3	2.93	110.19	2.02	0.44	1.59	7.11	3.71	-0.03	3	1	0.67	3.17	7.11	-0.18	17.75	
36	18.27	0.42	2.21	2	18.3	2.28	4	2.73	110.97	2.08	0.47	1.61	10.08	2.57	-0.02	3	1	0.66	2.96	10.08	-0.19	20.93	
37	45.74	3.03	2.3	2.1	45.77	6.62	3	2.74	127.7	2.14	0.5	1.64	26.57	6.94	-0.01	3	1	0.64	2.9	26.57	-0.2	14.37	
38	216.69	3.76	2.93	2.4	216.72	1.73	6	1.86	133.08	2.21	0.53	1.68	127.88	1.75	0	6	0.67	0.73	1.96	148.56	-0.19	48	
39	171.16	1.78	2.85	2.7	171.19	1.04	6	1.77	127.01	2.27	0.56	1.71	98.8	1.05	0	6	0.64	0.73	1.87	117.2	-0.21	65.85	
40	281.33	2.19	3.4	2.8	281.37	0.78	6	1.53	129.77	2.34	0.59	1.74	160.04	0.79	0	6	0.55	0.76	1.61	200.6	-0.2	92.51	
41	199.77	1.25	3.4	3	199.81	0.63	6	1.57	124.84	2.4	0.62	1.77	111.24	0.63	0	6	0.57	0.74	1.68	138.76	-0.21	94.1	
42	37.59	1.36	3.58	2.9	37.64	3.61	4	2.62	121.36	2.46	0.66	1.8	19.5	3.86	-0.01	3	1	0.59	2.83	19.5	-0.22	20.31	
43	31.33	0.84	3.58	3	31.37	2.66	4	2.59	117.36	2.52	0.69	1.83	15.75	2.9	-0.01	4	1	0.58	2.83	15.75	-0.23	22.28	
44	31.33	0.84	3.22	3	31.37	2.66	4	2.59	117.36	2.58	0.72	1.86	15.49	2.9	-0.02	4	1	0.57	2.83	15.49	-0.26	22.17	
45	78.42	3.03	3.31	3	78.47	3.86	4	2.41	129.02	2.64	0.75	1.89	40.07	3.99	-0.01	4	0.93	0.58	2.6	41.76	-0.27	21.88	
46	59.52	3.24	3.38	3.1	59.56	5.43	4	2.6	128.84	2.71	0.78	1.93	29.53	5.69	-0.01	3	1	0.55	2.81	29.53	-0.28	16.6	
47	470.44	5.01	9.38	3.1	470.56	1.07	6	1.49	137.08	2.77	0.81	1.96	238.29	1.07	0	6	0.55	0.71	1.58	315.49	-0.07	79.77	
48	352.65	3.03	11.58	3.2	352.79	0.86	6	1.49	132.69	2.84	0.84	2	175.14	0.87	0	6	0.55	0.7	1.6	232.59	0	89.42	
49	279.66	1.78	11.21	3.4	279.79	0.63	6	1.46	128.21	2.9	0.87	2.03	136.33	0.64	0	6	0.55	0.7	1.59	182.78	-0.03	102.99	
50	367.27	2.72	9.56	3.5	367.39	0.74	6	1.43	131.99	2.97	0.9	2.07	176.4	0.75	0	6	0.54	0.7	1.54	240.72	-0.1	100.55	
51	678.15	0	10.73	3.9	678.28	0	0	0	87.36	3.01	0.94	2.08	324.91	0	0	0	1	0.51	4.06	324.91	-0.08	478.44	

DISSIPATION

TEST ID: CPT-1
LOCATION: PlayaVista
TEST DATE: Mon 16/Jan/2017
CLIENT: Byer Geotechnical,Inc.



Presented below is a list of formulas used for the estimation of various soil properties. The formulas are presented in SI unit system and assume that all components are expressed in the same units.

:: Unit Weight, g (kN/m³) ::

$$g = g_w \cdot \left(0.27 \cdot \log(R_f) + 0.36 \cdot \log(\frac{q_t}{p_a}) + 1.236\right)$$

where g_w = water unit weight

:: Permeability, k (m/s) ::

$$I_c < 3.27 \text{ and } I_c > 1.00 \text{ then } k = 10^{0.952-3.04 \cdot I_c}$$

$$I_c \leq 4.00 \text{ and } I_c > 3.27 \text{ then } k = 10^{-4.52-1.37 \cdot I_c}$$

:: N_{SPT} (blows per 30 cm) ::

$$N_{60} = \left(\frac{q_c}{P_a}\right) \cdot \frac{1}{10^{1.1268-0.2817 \cdot I_c}}$$

$$N_{1(60)} = Q_{tn} \cdot \frac{1}{10^{1.1268-0.2817 \cdot I_c}}$$

:: Young's Modulus, Es (MPa) ::

$$(q_t - \sigma_v) \cdot 0.015 \cdot 10^{0.55 \cdot I_c + 1.68}$$

(applicable only to $I_c < I_{c\_cutoff}$)

:: Relative Density, Dr (%) ::

$$100 \cdot \sqrt{\frac{Q_{tn}}{k_{DR}}}$$

(applicable only to SBT_n: 5, 6, 7 and 8 or $I_c < I_{c\_cutoff}$)

:: State Parameter, ψ ::

$$\psi = 0.56 - 0.33 \cdot \log(Q_{tn,cs})$$

:: Peak drained friction angle, φ (°) ::

$$\varphi = 17.60 + 11 \cdot \log(Q_{tn})$$

(applicable only to SBT_n: 5, 6, 7 and 8)

:: 1-D constrained modulus, M (MPa) ::

If $I_c > 2.20$

$\alpha = 14$ for $Q_{tn} > 14$

$\alpha = Q_{tn}$ for $Q_{tn} \leq 14$

$M_{CPT} = \alpha \cdot (q_t - \sigma_v)$

If $I_c \leq 2.20$

$$M_{CPT} = (q_t - \sigma_v) \cdot 0.0188 \cdot 10^{0.55 \cdot I_c + 1.68}$$

:: Small strain shear Modulus, Go (MPa) ::

$$G_0 = (q_t - \sigma_v) \cdot 0.0188 \cdot 10^{0.55 \cdot I_c + 1.68}$$

:: Shear Wave Velocity, Vs (m/s) ::

$$V_s = \left(\frac{G_0}{\rho}\right)^{0.50}$$

:: Undrained peak shear strength, Su (kPa) ::

$N_{kt} = 10.50 + 7 \cdot \log(F_r)$ or user defined

$$S_u = \frac{(q_t - \sigma_v)}{N_{kt}}$$

(applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: Remolded undrained shear strength, Su(rem) (kPa) ::

$S_{u(rem)} = f_s$ (applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: Overconsolidation Ratio, OCR ::

$$k_{OCR} = \left[\frac{Q_{tn}^{0.20}}{0.25 \cdot (10.50 + 7 \cdot \log(F_r))}\right]^{1.25}$$ or user defined

$OCR = k_{OCR} \cdot Q_{tn}$

(applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: In situ Stress Ratio, Ko ::

$$K_0 = (1 - \sin\varphi') \cdot OCR^{\sin\varphi'}$$

(applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: Soil Sensitivity, S_t ::

$$S_t = \frac{N_S}{F_r}$$

(applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: Effective Stress Friction Angle, φ' (°) ::

$$\varphi' = 29.5° \cdot B_q^{0.121} \cdot (0.256 + 0.336 \cdot B_q + \log Q_t)$$

(applicable for $0.10 < B_q < 1.00$)

References

- Robertson, P.K., Cabal K.L., Guide to Cone Penetration Testing for Geotechnical Engineering, Gregg Drilling & Testing, Inc., 5th Edition, November 2012
- Robertson, P.K., Interpretation of Cone Penetration Tests - a unified approach., Can. Geotech. J. 46(11): 1337–1355 (2009)

APPENDIX III

Results of Liquefaction Analysis

Liquefaction Susceptibility Analysis: SPT Method (475-Yr Return)
(Input Data)

Project No.: 22590 Client: 5297 Marina Island, LLC
Project Description.: Proposed Mixed-Use Development
Engineer: RSB/JHP

Boring No.	Top Elevation (ft)	Total Depth (ft)	Existing GW Depth (ft)	Design GW Depth (ft)	Recommended Fill Depth (ft)
B1	19.5	60	21.8	5	0
B4	21	60	22	5	0

Peak Ground Acceleration:	0.43
Earthquake Magnitude:	6.59
Probability of Exceedance in 50 Years:	10%
Borehole Diamter (inches):	8
Delivered Energy Ratio, ERm (%):	75
Energy Ratio Correction Factor, $C_{E:}$	1.25
Borehole Diameter Correction Factor, $C_{B:}$	1.15
Rod Length Correction Factor, $C_{R:}$	1
Sampler Correction with or without Liners, $C_{S:}$	1
Minimum Factor of Safety, FS_{liq}:	1.1

References: - *Youd, T. L., et. al. (2001), Liquefaction Resistane of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils, ASCE, Journal of Geotechnical and Geoenvironmental Engineering, Vol. 127, No. 10, October 2001.*

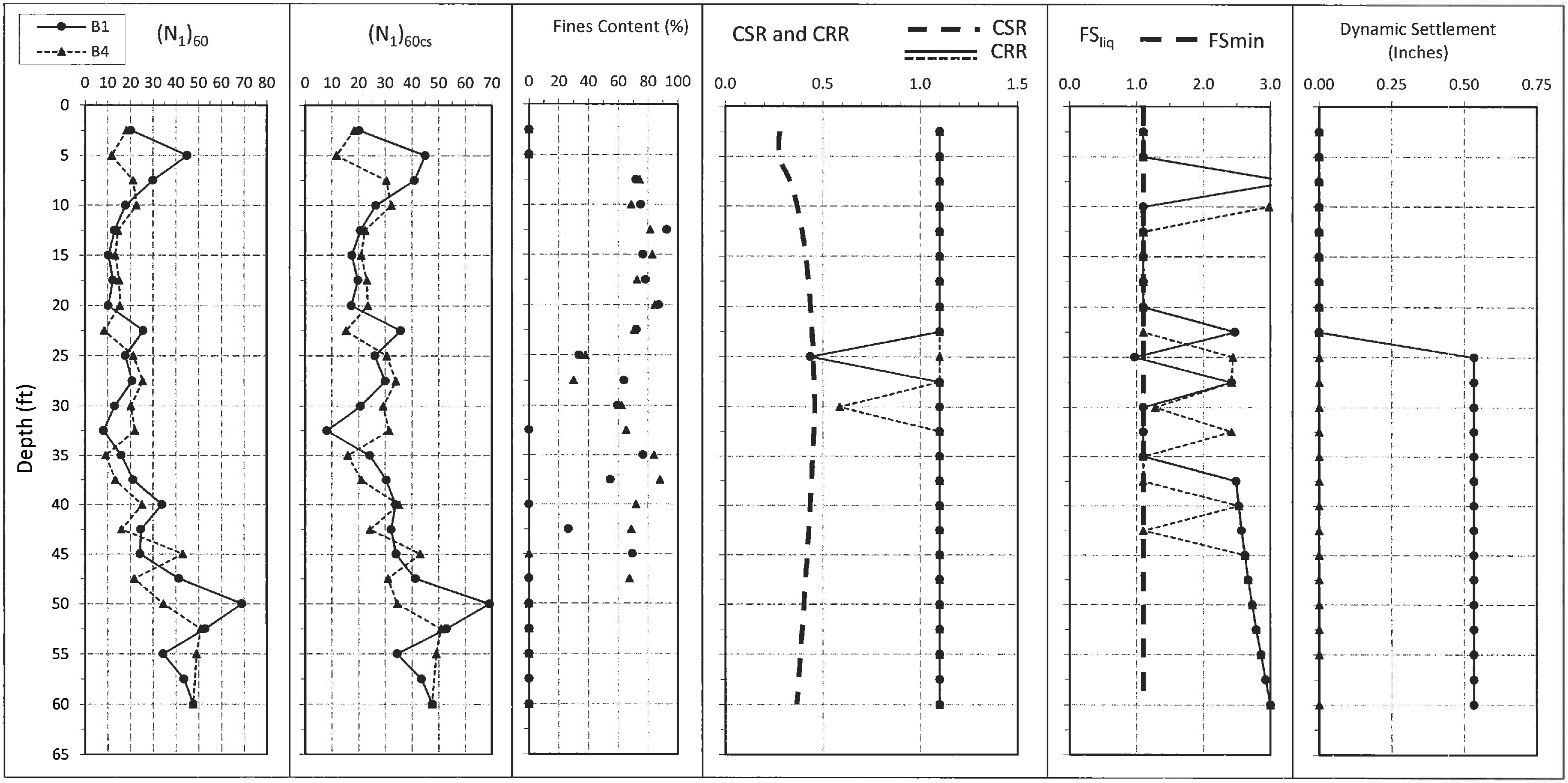
- *Tokimatsu and Seed (1987), Evaluation of Settlements in Sands due to Earthquake Shaking, American Society for Civil Engineers, Journal of Geotechnical Engineering, Vol. 113, No. 8, August, 1987.*

- *California Geological Survey (2008), Special Publication 117A, Guidelines for Evaluating and Mitigating Seismic Hazards in California.*

- *County of Los Angeles, Department of Public Works (2009), Liquefaction/Lateral Spreading, Administrative Manual, Publication No. GS 045-0, May 28, 2009.*

Liquefaction Susceptibility Analysis: SPT Method (475-Yr Return)

Project No.: 22590
Client: 5297 Marina Island, LLC
Engineer: RSB/JHP
Project Description.: Proposed Mixed-Use Development



Graphical Representation of the SPT Liquefaction Susceptibility Analysis - Borings B1 and B4

(Based on the Methodology of Youd et. al. (2001) and Tokimatsu (1987))

Liquefaction Susceptibility Analysis: SPT Method
(475-Yr Return)

Project No.: 22590 Client: 5297 Marina Island, LLC
Project Description.: Proposed Mixed-Use Development Engineer: RSB/JHP

Energy Ratio Correction Factor, C_E = 1.25
Borehole Diameter Correction Factor, C_B = 1.15
Sampler Correction with or without Liners, C_S = 1 (No Liners)

Boring No.	SPT Depth (ft)	Elev. (ft)	Approximate Layer Depth (ft)	Approx Layer Thick. (ft)	Soil Type (USCS)	Screening Analysis & Behavior (Based on Laboratory Testing, Existing Conditions, and Project Configuration)		Fines Content FC (%)	Plasticity Index PI (%)	Liquid Limit LL (%)	Moisture Content w_c (%)	w_c / LL	Unit Weight γ_t (pcf)	SPT Blow Count Nm (blows/ft)	C_R	N_{60}	σ_{vc} (psf)	σ'_{vc} (psf) (Current) (GW)	σ'_v (psf) (Hist.) (GW)	C_N (Youd) (2001)	$(N_1)_{60}$	α	β	$(N_1)_{60cs}$ for Clean Sand	Stress Red. Coef. r_d	CSR	MSF	$CRR_{7.5}$	CRR Adjusted with MSF	Factor of Safety FS_{liq} (Min FS = 1.1)	(Liquefiable/ Non Liquefiable)	Post-Liquefaction Reconsolidation Settlement: Vol. Strain ε_v	Seismic Settle. (in)	Cum. Settle. (in)
B1	2.5	17.0	0 to 3.8	3.8	CL	Basement					22.0		120	11	0.75	11.9	300.0	300.0	300.0	1.70	20.2	0.00	1.00	20.2	0.994	0.278	1.39	N/A	N/A	N/A	Non Liq	0.0000	0.00	0.00
B1	5	14.5	3.8 to 6.3	2.5	CL	Basement					12.0		120	23	0.80	26.5	600.0	600.0	600.0	1.70	45.0	0.00	1.00	45.0	0.988	0.276	1.39	N/A	N/A	N/A	Non Liq	0.0000	0.00	0.00
B1	7.5	12.0	6.3 to 8.8	2.5	CL			71.9			13.3		120	17	0.80	19.6	900.0	900.0	744.0	1.53	30.0	5.00	1.20	41.0	0.983	0.332	1.39	(N1)60cs >= 30	1.100	3.31	Non Liq	0.0000	0.00	0.00
B1	10	9.5	8.8 to 11.3	2.5	CL	PI>18 & Insensitive		75.0	20.4	44.0	16.5		120	11	0.85	13.4	1200.0	1200.0	888.0	1.33	17.8	5.00	1.20	26.4	0.977	0.369	1.39	0.323	Non Liq	N/A	Non Liq	0.0000	0.00	0.00
B1	12.5	7.0	11.3 to 13.8	2.5	CL	PI>18 & Insensitive		92.5	21.5	48.9	18.5		120	9	0.85	11.0	1500.0	1500.0	1032.0	1.19	13.1	5.00	1.20	20.7	0.971	0.394	1.39	0.224	Non Liq	N/A	Non Liq	0.0000	0.00	0.00
B1	15	4.5	13.8 to 16.3	2.5	CL	PI>18 & Insensitive		76.6	21.5	44.5	22.6		120	7	0.95	9.6	1800.0	1800.0	1176.0	1.08	10.4	5.00	1.20	17.4	0.965	0.413	1.39	0.186	Non Liq	N/A	Non Liq	0.0000	0.00	0.00
B1	17.5	2.0	16.3 to 18.8	2.5	CL	Similar to	B4-17.5'	78.3			27.6		120	9	0.95	12.3	2100.0	2100.0	1320.0	1.00	12.3	5.00	1.20	19.8	0.959	0.426	1.39	0.213	Non Liq	N/A	Non Liq	0.0000	0.00	0.00
B1	20	-0.5	18.8 to 21.3	2.5	CL	Similar to	B4-20'	87.2			23.6		120	8	0.95	10.9	2400.0	2400.0	1464.0	0.94	10.3	5.00	1.20	17.3	0.953	0.437	1.39	0.184	Non Liq	N/A	Non Liq	0.0000	0.00	0.00
B1	22.5	-3.0	21.3 to 23.8	2.5	CL			72.2			17.2		120	21	0.95	28.7	2700.0	2656.3	1608.0	0.89	25.6	5.00	1.20	35.7	0.948	0.445	1.39	(N1)60cs >= 30	1.100	2.47	Non Liq	0.0000	0.00	0.00
B1	25	-5.5	23.8 to 26.3	2.5	SM			33.6			14.8		120	15	0.95	20.5	3000.0	2800.3	1752.0	0.87	17.8	4.91	1.18	26.0	0.942	0.451	1.39	0.313	0.436	0.97	Liq	0.0178	0.53	0.53
B1	27.5	-8.0	26.3 to 28.8	2.5	ML			63.9			17.8		120	18	0.95	24.6	3300.0	2944.3	1896.0	0.85	20.8	5.00	1.20	30.0	0.936	0.455	1.39	(N1)60cs >= 30	1.100	2.42	Non Liq	0.0000	0.00	0.53
B1	30	-10.5	28.8 to 31.3	2.5	ML	Wc/LL <= 0.8		59.4	14.1	41.2	27.1	0.66	120	11	1.00	15.8	3600.0	3088.3	2040.0	0.83	13.1	5.00	1.20	20.7	0.93	0.459	1.39	0.224	Non Liq	N/A	Non Liq	0.0000	0.00	0.53
B1	32.5	-13.0	31.3 to 33.8	2.5	CL	PI>18 & Insensitive			19.9	39.3	24.8		120	7	1.00	10.1	3900.0	3232.3	2184.0	0.81	8.1	0.00	1.00	8.1	0.91	0.454	1.39	0.097	Non Liq	N/A	Non Liq	0.0000	0.00	0.53
B1	35	-15.5	33.8 to 36.3	2.5	CL	Wc/LL <= 0.8		76.6	17.3	36.7	23.4	0.64	120	14	1.00	20.1	4200.0	3376.3	2328.0	0.79	15.9	5.00	1.20	24.1	0.889	0.448	1.39	0.275	Non Liq	N/A	Non Liq	0.0000	0.00	0.53
B1	37.5	-18.0	36.3 to 38.8	2.5	CL			54.7			27.4		120	19	1.00	27.3	4500.0	3520.3	2472.0	0.78	21.2	5.00	1.20	30.4	0.869	0.442	1.39	(N1)60cs >= 30	1.100	2.49	Non Liq	0.0000	0.00	0.53
B1	40	-20.5	38.8 to 41.3	2.5	SP						20.0		120	31	1.00	44.6	4800.0	3664.3	2616.0	0.76	33.9	0.00	1.00	33.9	0.848	0.435	1.39	(N1)60cs >= 30	1.100	2.53	Non Liq	0.0000	0.00	0.53
B1	42.5	-23.0	41.3 to 43.8	2.5	SM			26.5			21.8		120	23	1.00	33.1	5100.0	3808.3	2760.0	0.75	24.6	4.43	1.13	32.2	0.828	0.428	1.39	(N1)60cs >= 30	1.100	2.57	Non Liq	0.0000	0.00	0.53
B1	45	-25.5	43.8 to 46.3	2.5	ML			69.5			21.8		120	23	1.00	33.1	5400.0	3952.3	2904.0	0.73	24.2	5.00	1.20	34.0	0.808	0.420	1.39	(N1)60cs >= 30	1.100	2.62	Non Liq	0.0000	0.00	0.53
B1	47.5	-28.0	46.3 to 48.8	2.5	SW						9.4		120	40	1.00	57.5	5700.0	4096.3	3048.0	0.72	41.3	0.00	1.00	41.3	0.787	0.411	1.39	(N1)60cs >= 30	1.100	2.67	Non Liq	0.0000	0.00	0.53
B1	50	-30.5	48.8 to 51.3	2.5	SW						10.4		120	68	1.00	97.8	6000.0	4240.3	3192.0	0.71	69.1	0.00	1.00	69.1	0.767	0.403	1.39	(N1)60cs >= 30	1.100	2.73	Non Liq	0.0000	0.00	0.53
B1	52.5	-33.0	51.3 to 53.8	2.5	SW						9.7		120	53	1.00	76.2	6300.0	4384.3	3336.0	0.69	52.9	0.00	1.00	52.9	0.747	0.394	1.39	(N1)60cs >= 30	1.100	2.79	Non Liq	0.0000	0.00	0.53
B1	55	-35.5	53.8 to 56.3	2.5	SW						10.2		120	35	1.00	50.3	6600.0	4528.3	3480.0	0.68	34.4	0.00	1.00	34.4	0.726	0.385	1.39	(N1)60cs >= 30	1.100	2.86	Non Liq	0.0000	0.00	0.53
B1	57.5	-38.0	56.3 to 58.8	2.5	SW						15.2		120	45	1.00	64.7	6900.0	4672.3	3624.0	0.67	43.5	0.00	1.00	43.5	0.706	0.376	1.39	(N1)60cs >= 30	1.100	2.93	Non Liq	0.0000	0.00	0.53
B1	60	-40.5	58.8 to 61.5	2.7	SP						17.6		120	50	1.00	71.9	7200.0	4816.3	3768.0	0.66	47.6	0.00	1.00	47.6	0.686	0.366	1.39	(N1)60cs >= 30	1.100	3.00	Non Liq	0.0000	0.00	0.53
B4	2.5	18.5	0 to 3.8	3.8	CL	Basement					17.7		120	10	0.75	10.8	300.0	300.0	300.0	1.70	18.3	0.00	1.00	18.3	0.994	0.278	1.39	N/A	N/A	N/A	Non Liq	0.0000	0.00	0.00
B4	5	16.0	3.8 to 6.3	2.5	CL	Basement					15.5		120	6	0.80	6.9	600.0	600.0	600.0	1.70	11.7	0.00	1.00	11.7	0.988	0.276	1.39	N/A	N/A	N/A	Non Liq	0.0000	0.00	0.00
B4	7.5	13.5	6.3 to 8.8	2.5	CL			74.3			12.4		120	12	0.80	13.8	900.0	900.0	744.0	1.53	21.2	5.00	1.20	30.4	0.983	0.332	1.39	(N1)60cs >= 30	1.100	3.31	Non Liq	0.0000	0.00	0.00
B4	10	11.0	8.8 to 11.3	2.5	CL			68.8			12.5		120	14	0.85	17.1	1200.0	1200.0	888.0	1.33	22.7	5.00	1.20	32.3	0.977	0.369	1.39	(N1)60cs >= 30	1.100	2.98	Non Liq	0.0000	0.00	0.00
B4	12.5	8.5	11.3 to 13.8	2.5	CL	Wc/LL <= 0.8		81.5	13.8	35.4	20.3	0.57	120	10	0.85	12.2	1500.0	1500.0	1032.0	1.19	14.5	5.00	1.20	22.4	0.971	0.394	1.39	0.248	Non Liq	N/A	Non Liq	0.0000	0.00	0.00
B4	15	6.0	13.8 to 16.3	2.5	CL	Similar to	B1-15'	82.9			21.7		120	9	0.95	12.3	1800.0	1800.0	1176.0	1.08	13.3	5.00	1.20	21.0	0.965	0.413	1.39	0.228	Non Liq	N/A	Non Liq	0.0000	0.00	0.00
B4	17.5	3.5	16.3 to 18.8	2.5	CL	Wc/LL <= 0.8		72.6	15.9	39.4	21.9	0.56	120	11	0.95	15.0	2100.0	2100.0	1320.0	1.00	15.1	5.00	1.20	23.1	0.959	0.426	1.39	0.258	Non Liq	N/A	Non Liq	0.0000	0.00	0.00
B4	20	1.0	18.8 to 21.3	2.5	CL	PI>18 & Insensitive		84.5	20.2	41.2	21.7		120	12	0.95	16.4	2400.0	2400.0	1464.0	0.94	15.4	5.00	1.20	23.5	0.953	0.437	1.39	0.264	Non Liq	N/A	Non Liq	0.0000	0.00	0.00
B4	22.5	-1.5	21.3 to 23.8	2.5	CL	Wc/LL <= 0.8		70.8	16.2	34.3	25.6	0.75	120	7	0.95	9.6	2700.0	2668.8	1608.0	0.89	8.5	5.00	1.20	15.2	0.948	0.445	1.39	0.162	Non Liq	N/A	Non Liq	0.0000	0.00	0.00
B4	25	-4.0	23.8 to 26.3	2.5	SM			37.9			20.4		120	18	0.95	24.6	3000.0	2812.8	1752.0	0.87	21.3	5.00	1.20	30.6	0.942	0.451	1.39	(N1)60cs >= 30	1.100	2.44	Non Liq	0.0000	0.00	0.00
B4	27.5	-6.5	26.3 to 28.8	2.5	SM			29.9			14.9		120	22	0.95	30.0	3300.0	2956.8	1896.0	0.85	25.4	4.70	1.15	34.0	0.936	0.455	1.39	(N1)60cs >= 30	1.100	2.42	Non Liq	0.0000	0.00	0.00
B4	30	-9.0	28.8 to 31.3	2.5	ML			62.2			22.6		120	17	1.00	24.4	3600.0	3100.8	2040.0	0.83	20.2	5.00	1.20	29.2	0.93	0.459	1.39	0.421	0.587	1.28	Non Liq	0.0000	0.00	0.00
B4	32.5	-11.5	31.3 to 33.8	2.5	CL			65.3			25.5		120	19	1.00	27.3	3900.0	3244.8	2184.0	0.81	22.1	5.00	1.20	31.5	0.91	0.454	1.39	(N1)60cs >= 30	1.100	2.42	Non Liq	0.0000	0.00	0.00
B4	35	-14.0	33.8 to 36.3	2.5	CL	Similar to	B1-35'	83.9			24.4		120	8	1.00	11.5	4200.0	3388.8	2328.0	0.79	9.1	5.00	1.20	15.9	0.889	0.448	1.39	0.169	Non Liq	N/A	Non Liq	0.0000	0.00	0.00
B4	37.5	-16.5	36.3 to 38.8	2.5	CL	Wc/LL <= 0.8		87.9	16.3	33.8	25.9	0.77	120	12	1.00	17.3	4500.0	3532.8	2472.0	0.77	13.4	5.00	1.20	21.0	0.869	0.442	1.39	0.229	Non Liq	N/A	Non Liq	0.0000	0.00	0.00
B4	40	-19.0	38.8 to 41.3	2.5	ML			71.8			23.1		120	23	1.00	33.1	4800.0	3676.8	2616.0	0.76	25.1	5.00	1.20	35.1	0.848	0.435	1.39	(N1)60cs >= 30	1.100	2.53	Non Liq	0.0000	0.00	0.00
B4	42.5	-21.5	41.3 to 43.8	2.5	ML	Wc/LL <= 0.8		68.7	13.1	38.9	24.3	0.62	120	15	1.00	21.6	5100.0	3820.8	2760.0	0.74	16.0	5.00	1.20	24.3	0.828	0.428	1.39	0.278	Non Liq	N/A	Non Liq	0.0000	0.00	0.00
B4	45	-24.0	43.8 to 46.3	2.5	SM						15.7		120	41	1.00	58.9	5400.0	3964.8	2904.0	0.73	43.1	0.00	1.00	43.1	0.808	0.420	1.39	(N1)60cs >= 30	1.100	2.62	Non Liq	0.0000	0.00	0.00
B4	47.5	-26.5	46.3 to 48.8	2.5	ML			67.5			19.7		120	21	1.00	30.2	5700.0	4108.8	3048.0	0.72	21.7	5.00	1.20	31.0	0.787	0.411	1.39	(N1)60cs >= 30	1.100	2.67	Non Liq	0.0000	0.00	0.00
B4	50	-29.0	48.8 to 51.3	2.5	SP						21.2		120	34	1.00	48.9	6000.0	4252.8	3192.0	0.71	34.5	0.00	1.00	34.5	0.767	0.403	1.39	(N1)60cs >= 30	1.100	2.73	Non Liq	0.0000	0.00	0.00
B4	52.5	-31.5	51.3 to 53.8	2.5	SW						9.0		120	51	1.00	73.3	6300.0	4396.8	3336.0	0.69	50.9	0.00	1.00	50.9	0.747	0.394	1.39	(N1)60cs >= 30	1.100	2.79	Non Liq	0.0000	0.00	0.00
B4	55	-34.0	53.8 to 57.5	3.7	SW						11.6		120	50	1.00	71.9	6600.0	4540.8	3480.0	0.68	49.1	0.00	1.00	49.1	0.726	0.385	1.39	(N1)60cs >= 30	1.100	2.86	Non Liq	0.0000	0.00	0.00
B4	60	-39.0	57.5 to 61.5	4.0	SW						12.3		120	50	1.00	71.9	7200.0	4828.8	3768.0	0.66	47.6	0.00	1.00	47.6	0.686	0.366	1.39	(N1)60cs >= 30	1.100	3.00	Non Liq	0.0000	0.00	0.00

Liquefaction Susceptibility Analysis: SPT Method (2475-Yr Return)
(Input Data)

Project No.: 22590 Client: 5297 Marina Island, LLC

Project Description.: Proposed Mixed-Use Development

Engineer: RSB/JHP

Boring No.	Top Elevation (ft)	Total Depth (ft)	Existing GW Depth (ft)	Design GW Depth (ft)	Recommended Fill Depth (ft)
B1	19.5	60	21.8	5	0
B4	21	60	22	5	0

Peak Ground Acceleration:	0.64
Earthquake Magnitude:	7.37
Probability of Exceedance in 50 Years:	2%
Borehole Diamter (inches):	8
Delivered Energy Ratio, ERm (%):	75
Energy Ratio Correction Factor, $C_{E:}$	1.25
Borehole Diameter Correction Factor, $C_{B:}$	1.15
Rod Length Correction Factor, $C_{R:}$	1
Sampler Correction with or without Liners, $C_{S:}$	1
Minimum Factor of Safety, FS_{liq}:	1

References: - *Youd, T. L., et. al. (2001), Liquefaction Resistane of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils, ASCE, Journal of Geotechnical and Geoenvironmental Engineering, Vol. 127, No. 10, October 2001.*

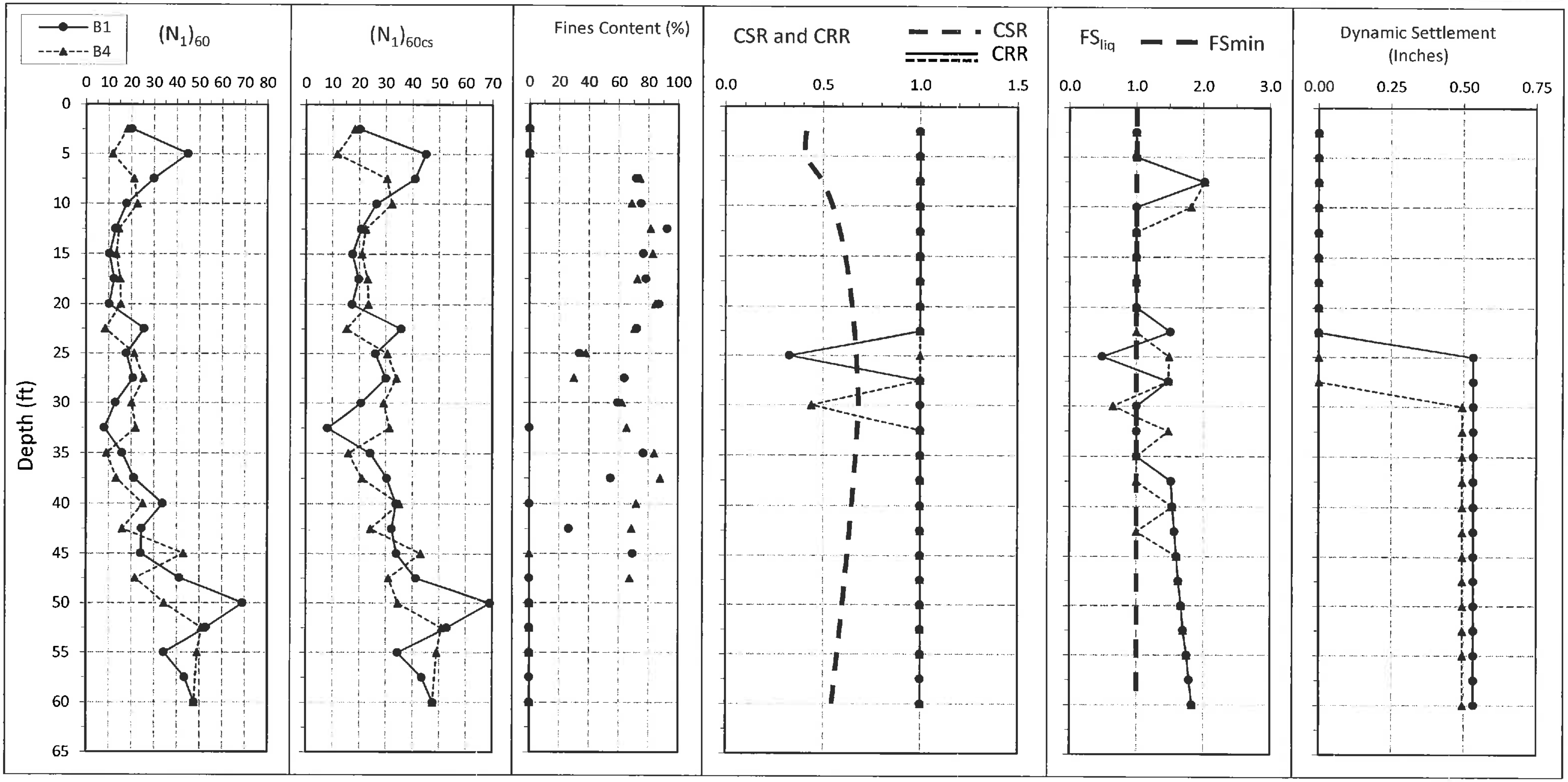
- *Tokimatsu and Seed (1987), Evaluation of Settlements in Sands due to Earthquake Shaking, American Society for Civil Engineers, Journal of Geotechnical Engineering, Vol. 113, No. 8, August, 1987.*

- *California Geological Survey (2008), Special Publication 117A, Guidelines for Evaluating and Mitigating Seismic Hazards in California.*

- *County of Los Angeles, Department of Public Works (2009), Liquefaction/Lateral Spreading, Administrative Manual, Publication No. GS 045-0, May 28, 2009.*

Liquefaction Susceptibility Analysis: SPT Method (2475-Yr Return)

Project No.: 22590
Client: 5297 Marina Island, LLC
Project Description.: Proposed Mixed-Use Development
Engineer: RSB/JHP



Graphical Representation of the SPT Liquefaction Susceptibility Analysis - Borings B1 and B4
(Based on the Methodology of Youd et. al. (2001) and Tokimatsu (1987))

Project No.: 22590 Client: 5297 Marina Island, LLC

Project Description.: Proposed Mixed-Use Development Engineer: RSB/JHP

Liquefaction Susceptibility Analysis: SPT Method (2475-Yr Return)

Energy Ratio Correction Factor, C_E = 1.25

Borehole Diameter Correction Factor, C_B = 1.15

Sampler Correction with or without Liners, C_S = 1 (No Liners)

Boring No.	SPT Depth (ft)	Elev. (ft)	Approximate Layer Depth (ft)	Approx. Layer Thick. (ft)	Soil Type (USCS)	Screening Analysis & Behavior (Based on Laboratory Testing, Existing Conditions, and Project Configuration)		Fines Content FC (%)	Plasticity Index PI (%)	Liquid Limit LL (%)	Moisture Content w_c (%)	w_c / LL	Unit Weight Y_t (pcf)	SPT Blow Count Nm (blows/ft)	C_R	N_{60}	σ_{vc} (psf)	σ'_{vc} (psf) (Current) (GW)	σ'_v (psf) (Hist.) (GW)	C_N (Youd) (2001)	$(N_1)_{60}$	α	β	$(N_1)_{60cs}$ for Clean Sand	Stress Red. Coef. r_d	CSR	MSF	$CRR_{7.5}$	CRR Adjusted with MSF	Factor of Safety FS_{liq} (Liquefiable/ Non Liquefiable) (Min FS = 1.0)		Post-Liquefaction Reconsolidation Settlement: Vol. Strain ε_v	Seismic Settle. (in)	Cum. Settle. (in)
B1	2.5	17.0	0 to 3.8	3.8	CL	Basement					22.0		120	11	0.75	11.9	300.0	300.0	300.0	1.70	20.2	0.00	1.00	20.2	0.994	0.414	1.05	N/A	N/A	N/A	**Non Liq**	0.0000	0.00	0.00
B1	5	14.5	3.8 to 6.3	2.5	CL	Basement					12.0		120	23	0.80	26.5	600.0	600.0	600.0	1.70	45.0	0.00	1.00	45.0	0.988	0.411	1.05	N/A	N/A	N/A	**Non Liq**	0.0000	0.00	0.00
B1	7.5	12.0	6.3 to 8.8	2.5	CL			71.9			13.3		120	17	0.80	19.6	900.0	900.0	744.0	1.53	30.0	5.00	1.20	41.0	0.983	0.495	1.05	(N1)60cs >= 30	1.000	2.02	**Non Liq**	0.0000	0.00	0.00
B1	10	9.5	8.8 to 11.3	2.5	CL	PI>18 & Insensitive		75.0	20.4	44.0	16.5		120	11	0.85	13.4	1200.0	1200.0	888.0	1.33	17.8	5.00	1.20	26.4	0.977	0.549	1.05	0.323	Non Liq	N/A	**Non Liq**	0.0000	0.00	0.00
B1	12.5	7.0	11.3 to 13.8	2.5	CL	PI>18 & Insensitive		92.5	21.5	48.9	18.5		120	9	0.85	11.0	1500.0	1500.0	1032.0	1.19	13.1	5.00	1.20	20.7	0.971	0.587	1.05	0.224	Non Liq	N/A	**Non Liq**	0.0000	0.00	0.00
B1	15	4.5	13.8 to 16.3	2.5	CL	PI>18 & Insensitive		76.6	21.5	44.5	22.6		120	7	0.95	9.6	1800.0	1800.0	1176.0	1.08	10.4	5.00	1.20	17.4	0.965	0.614	1.05	0.186	Non Liq	N/A	**Non Liq**	0.0000	0.00	0.00
B1	17.5	2.0	16.3 to 18.8	2.5	CL	Similar to	B4-17.5'	78.3			27.6		120	9	0.95	12.3	2100.0	2100.0	1320.0	1.00	12.3	5.00	1.20	19.8	0.959	0.635	1.05	0.213	Non Liq	N/A	**Non Liq**	0.0000	0.00	0.00
B1	20	-0.5	18.8 to 21.3	2.5	CL	Similar to	B4-20'	87.2			23.6		120	8	0.95	10.9	2400.0	2400.0	1464.0	0.94	10.3	5.00	1.20	17.3	0.953	0.650	1.05	0.184	Non Liq	N/A	**Non Liq**	0.0000	0.00	0.00
B1	22.5	-3.0	21.3 to 23.8	2.5	CL			72.2			17.2		120	21	0.95	28.7	2700.0	2656.3	1608.0	0.89	25.6	5.00	1.20	35.7	0.948	0.662	1.05	(N1)60cs >= 30	1.000	1.51	**Non Liq**	0.0000	0.00	0.00
B1	25	-5.5	23.8 to 26.3	2.5	SM			33.6			14.8		120	15	0.95	20.5	3000.0	2800.3	1752.0	0.87	17.8	4.91	1.18	26.0	0.942	0.671	1.05	0.313	0.328	0.49	**Liq**	0.0178	0.53	0.53
B1	27.5	-8.0	26.3 to 28.8	2.5	ML			63.9			17.8		120	18	0.95	24.6	3300.0	2944.3	1896.0	0.85	20.8	5.00	1.20	30.0	0.936	0.678	1.05	(N1)60cs >= 30	1.000	1.48	**Non Liq**	0.0000	0.00	0.53
B1	30	-10.5	28.8 to 31.3	2.5	ML	Wc/LL <= 0.8		59.4	14.1	41.2	27.1	0.66	120	11	1.00	15.8	3600.0	3088.3	2040.0	0.83	13.1	5.00	1.20	20.7	0.93	0.683	1.05	0.224	Non Liq	N/A	**Non Liq**	0.0000	0.00	0.53
B1	32.5	-13.0	31.3 to 33.8	2.5	CL	PI>18 & Insensitive			19.9	39.3	24.8		120	7	1.00	10.1	3900.0	3232.3	2184.0	0.81	8.1	0.00	1.00	8.1	0.91	0.676	1.05	0.097	Non Liq	N/A	**Non Liq**	0.0000	0.00	0.53
B1	35	-15.5	33.8 to 36.3	2.5	CL	Wc/LL <= 0.8		76.6	17.3	36.7	23.4	0.64	120	14	1.00	20.1	4200.0	3376.3	2328.0	0.79	15.9	5.00	1.20	24.1	0.889	0.667	1.05	0.275	Non Liq	N/A	**Non Liq**	0.0000	0.00	0.53
B1	37.5	-18.0	36.3 to 38.8	2.5	CL			54.7			27.4		120	19	1.00	27.3	4500.0	3520.3	2472.0	0.78	21.2	5.00	1.20	30.4	0.869	0.658	1.05	(N1)60cs >= 30	1.000	1.52	**Non Liq**	0.0000	0.00	0.53
B1	40	-20.5	38.8 to 41.3	2.5	SP						20.0		120	31	1.00	44.6	4800.0	3664.3	2616.0	0.76	33.9	0.00	1.00	33.9	0.848	0.647	1.05	(N1)60cs >= 30	1.000	1.54	**Non Liq**	0.0000	0.00	0.53
B1	42.5	-23.0	41.3 to 43.8	2.5	SM			26.5			21.8		120	23	1.00	33.1	5100.0	3808.3	2760.0	0.75	24.6	4.43	1.13	32.2	0.828	0.636	1.05	(N1)60cs >= 30	1.000	1.57	**Non Liq**	0.0000	0.00	0.53
B1	45	-25.5	43.8 to 46.3	2.5	ML			69.5			21.8		120	23	1.00	33.1	5400.0	3952.3	2904.0	0.73	24.2	5.00	1.20	34.0	0.808	0.625	1.05	(N1)60cs >= 30	1.000	1.60	**Non Liq**	0.0000	0.00	0.53
B1	47.5	-28.0	46.3 to 48.8	2.5	SW						9.4		120	40	1.00	57.5	5700.0	4096.3	3048.0	0.72	41.3	0.00	1.00	41.3	0.787	0.612	1.05	(N1)60cs >= 30	1.000	1.63	**Non Liq**	0.0000	0.00	0.53
B1	50	-30.5	48.8 to 51.3	2.5	SW						10.4		120	68	1.00	97.8	6000.0	4240.3	3192.0	0.71	69.1	0.00	1.00	69.1	0.767	0.600	1.05	(N1)60cs >= 30	1.000	1.67	**Non Liq**	0.0000	0.00	0.53
B1	52.5	-33.0	51.3 to 53.8	2.5	SW						9.7		120	53	1.00	76.2	6300.0	4384.3	3336.0	0.69	52.9	0.00	1.00	52.9	0.747	0.587	1.05	(N1)60cs >= 30	1.000	1.70	**Non Liq**	0.0000	0.00	0.53
B1	55	-35.5	53.8 to 56.3	2.5	SW						10.2		120	35	1.00	50.3	6600.0	4528.3	3480.0	0.68	34.4	0.00	1.00	34.4	0.726	0.573	1.05	(N1)60cs >= 30	1.000	1.75	**Non Liq**	0.0000	0.00	0.53
B1	57.5	-38.0	56.3 to 58.8	2.5	SW						15.2		120	45	1.00	64.7	6900.0	4672.3	3624.0	0.67	43.5	0.00	1.00	43.5	0.706	0.559	1.05	(N1)60cs >= 30	1.000	1.79	**Non Liq**	0.0000	0.00	0.53
B1	60	-40.5	58.8 to 61.5	2.7	SP						17.6		120	50	1.00	71.9	7200.0	4816.3	3768.0	0.66	47.6	0.00	1.00	47.6	0.686	0.545	1.05	(N1)60cs >= 30	1.000	1.83	**Non Liq**	0.0000	0.00	0.53
B4	2.5	18.5	0 to 3.8	3.8	CL	Basement					17.7		120	10	0.75	10.8	300.0	300.0	300.0	1.70	18.3	0.00	1.00	18.3	0.994	0.414	1.05	N/A	N/A	N/A	**Non Liq**	0.0000	0.00	0.00
B4	5	16.0	3.8 to 6.3	2.5	CL	Basement					15.5		120	6	0.80	6.9	600.0	600.0	600.0	1.70	11.7	0.00	1.00	11.7	0.988	0.411	1.05	N/A	N/A	N/A	**Non Liq**	0.0000	0.00	0.00
B4	7.5	13.5	6.3 to 8.8	2.5	CL			74.3			12.4		120	12	0.80	13.8	900.0	900.0	744.0	1.53	21.2	5.00	1.20	30.4	0.983	0.495	1.05	(N1)60cs >= 30	1.000	2.02	**Non Liq**	0.0000	0.00	0.00
B4	10	11.0	8.8 to 11.3	2.5	CL			68.8			12.5		120	14	0.85	17.1	1200.0	1200.0	888.0	1.33	22.7	5.00	1.20	32.3	0.977	0.549	1.05	(N1)60cs >= 30	1.000	1.82	**Non Liq**	0.0000	0.00	0.00
B4	12.5	8.5	11.3 to 13.8	2.5	CL	Wc/LL <= 0.8		81.5	13.8	35.4	20.3	0.57	120	10	0.85	12.2	1500.0	1500.0	1032.0	1.19	14.5	5.00	1.20	22.4	0.971	0.587	1.05	0.248	Non Liq	N/A	**Non Liq**	0.0000	0.00	0.00
B4	15	6.0	13.8 to 16.3	2.5	CL	Similar to	B1-15'	82.9			21.7		120	9	0.95	12.3	1800.0	1800.0	1176.0	1.08	13.3	5.00	1.20	21.0	0.965	0.614	1.05	0.228	Non Liq	N/A	**Non Liq**	0.0000	0.00	0.00
B4	17.5	3.5	16.3 to 18.8	2.5	CL	Wc/LL <= 0.8		72.6	15.9	39.4	21.9	0.56	120	11	0.95	15.0	2100.0	2100.0	1320.0	1.00	15.1	5.00	1.20	23.1	0.959	0.635	1.05	0.258	Non Liq	N/A	**Non Liq**	0.0000	0.00	0.00
B4	20	1.0	18.8 to 21.3	2.5	CL	PI>18 & Insensitive		84.5	20.2	41.2	21.7		120	12	0.95	16.4	2400.0	2400.0	1464.0	0.94	15.4	5.00	1.20	23.5	0.953	0.650	1.05	0.264	Non Liq	N/A	**Non Liq**	0.0000	0.00	0.00
B4	22.5	-1.5	21.3 to 23.8	2.5	CL	Wc/LL <= 0.8		70.8	16.2	34.3	25.6	0.75	120	7	0.95	9.6	2700.0	2668.8	1608.0	0.89	8.5	5.00	1.20	15.2	0.948	0.662	1.05	0.162	Non Liq	N/A	**Non Liq**	0.0000	0.00	0.00
B4	25	-4.0	23.8 to 26.3	2.5	SM			37.9			20.4		120	18	0.95	24.6	3000.0	2812.8	1752.0	0.87	21.3	5.00	1.20	30.6	0.942	0.671	1.05	(N1)60cs >= 30	1.000	1.49	**Non Liq**	0.0000	0.00	0.00
B4	27.5	-6.5	26.3 to 28.8	2.5	SM			29.9			14.9		120	22	0.95	30.0	3300.0	2956.8	1896.0	0.85	25.4	4.70	1.15	34.0	0.936	0.678	1.05	(N1)60cs >= 30	1.000	1.48	**Non Liq**	0.0000	0.00	0.00
B4	30	-9.0	28.8 to 31.3	2.5	ML			62.2			22.6		120	17	1.00	24.4	3600.0	3100.8	2040.0	0.83	20.2	5.00	1.20	29.2	0.93	0.683	1.05	0.421	0.441	0.65	**Liq**	0.0165	0.49	0.49
B4	32.5	-11.5	31.3 to 33.8	2.5	CL			65.3			25.5		120	19	1.00	27.3	3900.0	3244.8	2184.0	0.81	22.1	5.00	1.20	31.5	0.91	0.676	1.05	(N1)60cs >= 30	1.000	1.48	**Non Liq**	0.0000	0.00	0.49
B4	35	-14.0	33.8 to 36.3	2.5	CL	Similar to	B1-35'	83.9			24.4		120	8	1.00	11.5	4200.0	3388.8	2328.0	0.79	9.1	5.00	1.20	15.9	0.889	0.667	1.05	0.169	Non Liq	N/A	**Non Liq**	0.0000	0.00	0.49
B4	37.5	-16.5	36.3 to 38.8	2.5	CL	Wc/LL <= 0.8		87.9	16.3	33.8	25.9	0.77	120	12	1.00	17.3	4500.0	3532.8	2472.0	0.77	13.4	5.00	1.20	21.0	0.869	0.658	1.05	0.229	Non Liq	N/A	**Non Liq**	0.0000	0.00	0.49
B4	40	-19.0	38.8 to 41.3	2.5	ML			71.8			23.1		120	23	1.00	33.1	4800.0	3676.8	2616.0	0.76	25.1	5.00	1.20	35.1	0.848	0.647	1.05	(N1)60cs >= 30	1.000	1.54	**Non Liq**	0.0000	0.00	0.49
B4	42.5	-21.5	41.3 to 43.8	2.5	ML	Wc/LL <= 0.8		68.7	13.1	38.9	24.3	0.62	120	15	1.00	21.6	5100.0	3820.8	2760.0	0.74	16.0	5.00	1.20	24.3	0.828	0.636	1.05	0.278	Non Liq	N/A	**Non Liq**	0.0000	0.00	0.49
B4	45	-24.0	43.8 to 46.3	2.5	SM						15.7		120	41	1.00	58.9	5400.0	3964.8	2904.0	0.73	43.1	0.00	1.00	43.1	0.808	0.625	1.05	(N1)60cs >= 30	1.000	1.60	**Non Liq**	0.0000	0.00	0.49
B4	47.5	-26.5	46.3 to 48.8	2.5	ML			67.5			19.7		120	21	1.00	30.2	5700.0	4108.8	3048.0	0.72	21.7	5.00	1.20	31.0	0.787	0.612	1.05	(N1)60cs >= 30	1.000	1.63	**Non Liq**	0.0000	0.00	0.49
B4	50	-29.0	48.8 to 51.3	2.5	SP						21.2		120	34	1.00	48.9	6000.0	4252.8	3192.0	0.71	34.5	0.00	1.00	34.5	0.767	0.600	1.05	(N1)60cs >= 30	1.000	1.67	**Non Liq**	0.0000	0.00	0.49
B4	52.5	-31.5	51.3 to 53.8	2.5	SW						9.0		120	51	1.00	73.3	6300.0	4396.8	3336.0	0.69	50.9	0.00	1.00	50.9	0.747	0.587	1.05	(N1)60cs >= 30	1.000	1.70	**Non Liq**	0.0000	0.00	0.49
B4	55	-34.0	53.8 to 57.5	3.7	SW						11.6		120	50	1.00	71.9	6600.0	4540.8	3480.0	0.68	49.1	0.00	1.00	49.1	0.726	0.573	1.05	(N1)60cs >= 30	1.000	1.75	**Non Liq**	0.0000	0.00	0.49
B4	60	-39.0	57.5 to 61.5	4.0	SW						12.3		120	50	1.00	71.9	7200.0	4828.8	3768.0	0.66	47.6	0.00	1.00	47.6	0.686	0.545	1.05	(N1)60cs >= 30	1.000	1.83	**Non Liq**	0.0000	0.00	0.49

Liquefaction Susceptibility Analysis: CPT Method (475-Yr Return)

References: - Robertson, P. K., and Robertson, K. L. (2006), Guide to Cone Penetration Testing and its Application to Geotechnical Engineering, Gregg Drilling & Testing, Inc., July, 2006.
- Zhang, G., Robertson, P. K., and Brachman, R. W. I. (2002), Estimating Liquefaction-Induced Ground Settlements from CPT for Level Ground, Canadian Geotechnical Journal, Vol. 39, pp. 1168-1180.

BG No.: 22590 Client: 5297 Marina Island, LLC
Project Description: Proposed Five-Story Residential Development over Subterranean Parking Level
Engineer: RSB

CPT No.:	2
Ground Surface Elevation (ft):	21
Proposed Finish Grade (ft):	21
Existing Groundwater Depth (ft):	21.5
Design Groundwater Depth (ft):	5
Tip Cone Area (cm^2):	15
Total Unit Weight (pcf):	120
Earthquake Magnitude (Mw):	6.59
Peak Ground Acceleration (g):	0.43
Magnitude Scaling Factor:	1.394
Factor of Safety:	1.1

Total Thickness of Liquefiable Layers =	**0**	**foot**
Liquefaction-Induced Settlement =	**0.00**	**Inches (Saturated Soils - Below GWT)**
Seismically-Induced Settlement =	**0.00**	**Inches (Dry Soils - Above GWT)**
Total Dynamic Settlement =	**0.00**	**Inches**

Notes: - Soils with (Ic) greater than 3.3 are generally not considered susceptible to liquefaction.
- Currently and historically unsaturated soils (i.e. above GW table) are likely not susceptible to liquefaction (Special Publication 117A, 2008).

Depth z_i (ft)	Elevation (ft)	Tip Resitance qc (tsf)	Sleeve Friction fs (tsf)	Average Friction Ratio Rf-ave (%)	SBT No.	Soil Behavior Type	Layer Thickness Δz_i (ft)	Vertical Stress σ_{vo} (tsf)	Effective Vertical Stress σ'_{vo} (tsf)	Friction Ratio F	CPT Penetration Resistance Q	Soil Behavior Type Index I_c	Correction Factor K_c	Clean Sand Cone Penetration Resistance $(q_{c1N})_{cs}$	Cyclic Resistance Ratio (clean sand) $CRR_{7.5}$	Cyclic Resistance Ratio CRR	Remarks	Stress Reduction Factor r_d	Cyclic Stress Ratio CSR	Screening Analysis (Based on Laboratory Test Results and Correlation with SPT Liquefaction Results)	Factor of Safety (Liquefiable / Non Liquefiable) (Min FS = 1.1) FS_{liq}		Vol. Strain ϵ_v (%)	Seismic Settlement S_i (in)	Cumulative Seismic Settlement ΣS_i (in)
1	20	135.1	1.04	0.7700	6	Sand to silty sand	1.5	0.060	0.060	0.770	540.280	1.330	1.000	540.280	Non-Liq	Non-Liq	Unsaturated	0.998	0.279	Basement	N/A	Non-Liq	0.000	0.000	0.000
2	19	111.0	0.94	0.8500	6	Sand to silty sand	1.0	0.120	0.120	0.848	313.644	1.505	1.000	313.644	Non-Liq	Non-Liq	Unsaturated	0.995	0.278	Basement	N/A	Non-Liq	0.000	0.000	0.000
3	18	32.4	1.67	5.1600	3	Clay	1.0	0.180	0.180	5.188	112.024	2.401	2.315	259.285	Non-Liq	Non-Liq	Unsaturated	0.993	0.278	Basement	N/A	Non-Liq	0.000	0.000	0.000
4	17	31.0	1.98	6.4000	3	Clay	1.0	0.240	0.240	6.435	91.437	2.528	2.915	266.540	Non-Liq	Non-Liq	Unsaturated	0.991	0.277	Basement	N/A	Non-Liq	0.000	0.000	0.000
5	16	59.9	3.03	5.0500	4	Clayey silt to silty clay	1.0	0.300	0.300	5.080	138.950	2.339	2.080	288.993	Non-Liq	Non-Liq	(qc1N)cs > 160	0.988	0.276	Basement	N/A	Non-Liq	0.000	0.000	0.000
6	15	35.2	1.57	4.4500	4	Clayey silt to silty clay	1.0	0.360	0.329	4.508	78.903	2.447	2.513	198.256	Non-Liq	Non-Liq	(qc1N)cs > 160	0.986	0.302	Basement	N/A	Non-Liq	0.000	0.000	0.000
7	14	37.0	1.67	4.5200	4	Clayey silt to silty clay	1.0	0.420	0.358	4.569	77.947	2.454	2.549	198.665	Non-Liq	Non-Liq	(qc1N)cs > 160	0.984	0.323	Basement	N/A	Non-Liq	0.000	0.000	0.000
8	13	50.0	1.15	2.3000	5	Silty sand to sandy silt	1.0	0.480	0.386	2.321	92.134	2.187	1.635	150.606	0.398	0.554		0.981	0.341	Basement	N/A	Non-Liq	0.000	0.000	0.000
9	12	43.0	1.88	4.3700	4	Clayey silt to silty clay	1.0	0.540	0.415	4.426	80.553	2.435	2.460	198.126	Non-Liq	Non-Liq	(qc1N)cs > 160	0.979	0.356	Basement	N/A	Non-Liq	0.000	0.000	0.000
10	11	25.7	1.46	5.6900	3	Clay	1.0	0.600	0.444	5.819	48.079	2.671	3.793	182.378	Non-Liq	Non-Liq	(qc1N)cs > 160	0.977	0.369	Basement	N/A	Non-Liq	0.000	0.000	0.000
11	10	106.8	3.24	3.0300	5	Silty sand to sandy silt	1.0	0.660	0.473	3.052	169.240	2.109	1.471	248.921	Non-Liq	Non-Liq	(qc1N)cs > 160	0.974	0.380		N/A	Non-Liq	0.000	0.000	0.000
12	9	36.6	2.19	6.0000	3	Clay	1.0	0.720	0.502	6.112	61.453	2.618	3.437	211.189	Non-Liq	Non-Liq	(qc1N)cs > 160	0.972	0.390		N/A	Non-Liq	0.000	0.000	0.000
13	8	49.0	0.94	1.9200	5	Silty sand to sandy silt	1.0	0.780	0.530	1.950	72.788	2.206	1.681	122.374	0.250	0.349		0.970	0.399	PI>=12 & Wc/LL < 0.8	N/A	Non-Liq	0.000	0.000	0.000
14	7	16.4	0.94	5.7300	3	Clay	1.0	0.840	0.559	6.041	25.540	2.874	5.448	139.132	0.330	0.461		0.967	0.406		1.134	Non-Liq	0.000	0.000	0.000
15	6	15.5	0.84	5.4100	3	Clay	1.0	0.900	0.588	5.769	22.974	2.893	5.634	129.432	0.282	0.393		0.965	0.413	PI>18 & Insensitive	N/A	Non-Liq	0.000	0.000	0.000
16	5	11.8	0.52	4.4300	3	Clay	1.0	0.960	0.617	4.797	16.555	2.946	6.166	102.084	0.179	0.249		0.963	0.419	PI>18 & Insensitive	N/A	Non-Liq	0.000	0.000	0.000
17	4	28.3	1.36	4.8000	3	Clay	1.0	1.020	0.646	4.985	38.513	2.689	3.914	150.731	0.398	0.555		0.960	0.424		1.310	Non-Liq	0.000	0.000	0.000
18	3	25.8	1.15	4.4500	3	Clay	1.0	1.080	0.674	4.654	33.776	2.708	4.054	136.932	0.319	0.444		0.958	0.429	PI>=12 & Wc/LL < 0.8	N/A	Non-Liq	0.000	0.000	0.000
19	2	24.6	1.25	5.0800	3	Clay	1.0	1.140	0.703	5.319	31.303	2.772	4.552	142.495	0.349	0.487		0.956	0.433		1.124	Non-Liq	0.000	0.000	0.000
20	1	13.6	0.63	4.6100	3	Clay	1.0	1.200	0.732	5.089	16.296	2.968	6.397	104.240	0.185	0.258		0.953	0.437	PI>18 & Insensitive	N/A	Non-Liq	0.000	0.000	0.000
21	0	14.1	1.04	7.4000	3	Clay	1.0	1.260	0.761	8.100	16.539	3.098	7.905	130.746	0.288	0.401		0.951	0.440	PI>18 & Insensitive	N/A	Non-Liq	0.000	0.000	0.000
22	-1	9.9	0.84	8.4100	3	Clay	1.0	1.320	0.790	9.767	10.892	3.287	10.512	114.494	0.220	0.306		0.949	0.443	PI>=12 & Wc/LL < 0.8	N/A	Non-Liq	0.000	0.000	0.000
23	-2	9.3	0.52	5.6100	3	Clay	1.0	1.380	0.818	6.574	9.600	3.216	9.472	90.931	0.150	0.209		0.946	0.446	PI>=12 & Wc/LL < 0.8	N/A	Non-Liq	0.000	0.000	0.000
24	-3	8.0	0.10	1.2900	4	Clayey silt to silty clay	1.0	1.440	0.847	1.515	7.613	2.943	6.132	46.679	0.089	0.124		0.944	0.448	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.000
25	-4	20.4	0.63	3.0700	4	Clayey silt to silty clay	1.0	1.500	0.876	3.340	20.925	2.768	4.517	94.511	0.159	0.221		0.942	0.451	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.000
26	-5	89.2	0.84	0.9400	6	Sand to silty sand	1.0	1.560	0.905	0.959	91.287	1.929	1.218	111.181	0.208	0.290		0.939	0.453	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.000
27	-6	86.5	0.73	0.8500	6	Sand to silty sand	1.0	1.620	0.934	0.860	86.785	1.918	1.206	104.692	0.187	0.260		0.937	0.454	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.000
28	-7	99.9	1.04	1.0500	6	Sand to silty sand	1.0	1.680	0.962	1.058	98.790	1.930	1.219	120.392	0.242	0.338		0.935	0.456	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.000
29	-8	98.8	1.15	1.1600	6	Sand to silty sand	1.0	1.740	0.991	1.185	95.974	1.972	1.265	121.375	0.246	0.343		0.932	0.457	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.000
30	-9	47.4	1.25	2.6500	5	Silty sand to sandy silt	1.0	1.800	1.020	2.741	44.478	2.463	2.589	115.174	0.222	0.310		0.930	0.459	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.000
31	-10	14.9	0.84	5.6200	3	Clay	1.0	1.860	1.049	6.427	12.467	3.122	8.211	102.368	0.180	0.251		0.922	0.457	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.000
32	-11	23.8	0.73	3.0800	4	Clayey silt to silty clay	1.0	1.920	1.078	3.335	20.423	2.775	4.580	93.533	0.156	0.218		0.914	0.455	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.000
33	-12	16.8	0.63	3.7400	3	Clay	1.0	1.980	1.106	4.248	13.482	2.982	6.546	88.258	0.144	0.201		0.905	0.453	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.000
34	-13	83.2	0.94	1.1300	6	Sand to silty sand	1.0	2.040	1.135	1.158	73.851	2.053	1.375	101.545	0.177	0.247		0.897	0.451	PI>=12 & Wc/LL < 0.8	N/A	Non-Liq	0.000	0.000	0.000
35	-14	101.9	1.04	1.0300	6	Sand to silty sand	1.0	2.100	1.164	1.042	89.651	1.958	1.249	111.986	0.211	0.294		0.889	0.448	PI>=12 & Wc/LL < 0.8	N/A	Non-Liq	0.000	0.000	0.000
36	-15	27.8	1.15	4.1400	4	Clayey silt to silty clay	1.0	2.160	1.193	4.489	21.889	2.836	5.095	111.526	0.209	0.291		0.881	0.446	PI>=12 & Wc/LL < 0.8	N/A	Non-Liq	0.000	0.000	0.000
37	-16	12.1	0.31	2.6000	3	Clay	1.0	2.220	1.222	3.134	8.183	3.080	7.674	62.794	0.103	0.144		0.873	0.443	PI>=12 & Wc/LL < 0.8	N/A	Non-Liq	0.000	0.000	0.000
38	-17	162.4	0.42	2.9700	3	Clay	1.0	2.280	1.250	0.262	140.300	1.469	1.000	140.300	0.337	0.469		0.865	0.441	PI>=12 & Wc/LL < 0.8	N/A	Non-Liq	0.000	0.000	0.000
39	-18	23.8	1.25	5.2700	3	Clay	1.0	2.340	1.279	5.822	17.107	2.991	6.640	113.599	0.216	0.302		0.857	0.438	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.000
40	-19	97.1	1.36	1.4000	5	Silty sand to sandy silt	1.0	2.400	1.308	1.436	78.537	2.092	1.441	113.139	0.215	0.299		0.848	0.435	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.000
41	-20	99.9	3.45	3.4500	5	Silty sand to sandy silt	1.0	2.460	1.337	3.539	78.099	2.370	2.194	171.363	Non-Liq	Non-Liq	(qc1N)cs > 160	0.840	0.432		N/A	Non-Liq	0.000	0.000	0.000
42	-21	201.1	2.40	1.1900	6	Sand to silty sand	1.0	2.520	1.366	1.208	163.770	1.809	1.113	182.328	Non-Liq	Non-Liq	(qc1N)cs > 160	0.832	0.429		N/A	Non-Liq	0.000	0.000	0.000
43	-22	97.1	3.55	3.6600	5	Silty sand to sandy silt	1.0	2.580	1.394	3.755	73.203	2.408	2.345	171.666	Non-Liq	Non-Liq	(qc1N)cs > 160	0.824	0.426		N/A	Non-Liq	0.000	0.000	0.000
44	-23	96.0	3.55	3.7000	5	Silty sand to sandy silt	1.0	2.640	1.423	3.804	71.093	2.421	2.398	170.506	Non-Liq	Non-Liq	(qc1N)cs > 160	0.816	0.423		N/A	Non-Liq	0.000	0.000	0.000
45	-24	187.0	1.78	0.9500	6	Sand to silty sand	1.0	2.700	1.452	0.966	147.193	1.774	1.088	160.166	Non-Liq	Non-Liq	(qc1N)cs > 160	0.808	0.420		N/A	Non-Liq	0.000	0.000	0.000
46	-25	245.3	1.36	0.5500	6	Sand to silty sand	1.0	2.760	1.481	0.561	195.286	1.526	1.000	195.286	Non-Liq	Non-Liq	(qc1N)cs > 160	0.800	0.417		N/A	Non-Liq	0.000	0.000	0.000

Liquefaction Susceptibility Analysis: CPT Method (475-Yr Return)

References: - Robertson, P. K., and Robertson, K. L. (2006), Guide to Cone Penetration Testing and its Application to Geotechnical Engineering, Gregg Drilling & Testing, Inc., July, 2006.
- Zhang, G., Robertson, P. K., and Brachman, R. W. I. (2002), Estimating Liquefaction-Induced Ground Settlements from CPT for Level Ground, Canadian Geotechnical Journal, Vol. 39, pp. 1168-1180.

BG No.: 22590 Client: 5297 Marina Island, LLC
Project Description: Proposed Five-Story Residential Development over Subterranean Parking Level
Engineer: RSB

CPT No.:	2		
Ground Surface Elevation (ft) :	21	Total Unit Weight (pcf) :	120
Proposed Finish Grade (ft) :	21	Earthquake Magnitude (Mw) :	6.59
Existing Groundwater Depth (ft) :	21.5	Peak Ground Acceleration (g):	0.43
Design Groundwater Depth (ft) :	5	Magnitude Scaling Factor :	1.394
Tip Cone Area (cm^2):	15	Factor of Safety :	1.1

Total Thickness of Liquefiable Layers = 0 foot
Liquefaction-Induced Settlement = 0.00 Inches (Saturated Soils - Below GWT)
Seismically-Induced Settlement = 0.00 Inches (Dry Soils - Above GWT)
Total Dynamic Settlement = 0.00 Inches

Notes: - Soils with (Ic) greater than 3.3 are generally not considered susceptible to liquefaction.
- Currently and historically unsaturated soils (i.e. above GW table) are likely not susceptible to liquefaction (Special Publication 117A, 2008).

Depth z_i (ft)	Elevation (ft)	Tip Resitance qc (tsf)	Sleeve Friction fs (tsf)	Average Friction Ratio Rf-ave (%)	SBT No.	Soil Behavior Type	Layer Thickness Δz_i (ft)	Vertical Stress σ_{vo} (tsf)	Effective Vertical Stress σ'_{vo} (tsf)	Friction Ratio F	CPT Penetration Resistance Q	Soil Behavior Type Index I_c	Correction Factor K_c	Clean Sand Cone Penetration Resistance $(q_{c1N})_{cs}$	Cyclic Resistance Ratio (clean sand) $CRR_{7.5}$	Cyclic Resistance Ratio CRR	Remarks	Stress Reduction Factor r_d	Cyclic Stress Ratio CSR	Screening Analysis (Based on Laboratory Test Results and Correlation with SPT Liquefaction Results)	Factor of Safety (Liquefiable / Non Liquefiable) (Min FS = 1.1) FS_{liq}		Vol. Strain ϵ_v (%)	Seismic Settlement S_i (in)	Cumulative Seismic Settlement ΣS_i (in)
47	-26	123.2	2.40	1.9500	5	Silty sand to sandy silt	1.0	2.820	1.510	1.993	90.375	2.145	1.542	139.392	0.332	0.463		0.792	0.413		1.119	Non-Liq	0.000	0.000	0.000
48	-27	49.5	1.15	2.3200	5	Silty sand to sandy silt	1.0	2.880	1.538	2.467	33.070	2.531	2.928	96.819	0.164	0.229		0.783	0.410	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.000
49	-28	43.6	2.51	5.7600	3	Clay	1.0	2.940	1.567	6.181	27.315	2.860	5.317	145.249	0.365	0.509		0.775	0.406		1.252	Non-Liq	0.000	0.000	0.000
50	-29	69.6	1.57	2.2500	5	Silty sand to sandy silt	1.0	3.000	1.596	2.359	46.584	2.405	2.332	108.643	0.199	0.278		0.767	0.403	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.000
51	-30	270.3	2.09	0.7700	6	Sand to silty sand	1.0	3.060	1.625	0.782	204.379	1.607	1.000	204.379	Non-Liq	Non-Liq	(qc1N)cs > 160	0.759	0.400		N/A	Non-Liq	0.000	0.000	0.000
52	-31	276.8	1.36	0.4900	6	Sand to silty sand	1.0	3.120	1.654	0.497	208.558	1.471	1.000	208.558	Non-Liq	Non-Liq	(qc1N)cs > 160	0.751	0.396		N/A	Non-Liq	0.000	0.000	0.000
53	-32	414.0	2.09	0.5000	7	Gravely sand to dense sand	1.0	3.180	1.682	0.509	310.291	1.347	1.000	310.291	Non-Liq	Non-Liq	(qc1N)cs > 160	0.743	0.392		N/A	Non-Liq	0.000	0.000	0.000
54	-33	598.2	5.01	0.8400	6	Sand to silty sand	1.0	3.240	1.711	0.842	445.599	1.409	1.000	445.599	Non-Liq	Non-Liq	(qc1N)cs > 160	0.735	0.389		N/A	Non-Liq	0.000	0.000	0.000
55	-34	436.2	2.30	0.5300	7	Gravely sand to dense sand	1.0	3.300	1.740	0.531	321.543	1.349	1.000	321.543	Non-Liq	Non-Liq	(qc1N)cs > 160	0.726	0.385		N/A	Non-Liq	0.000	0.000	0.000
56	-35	437.8	2.82	0.6400	6	Sand to silty sand	0.5	3.360	1.769	0.649	320.027	1.413	1.000	320.027	Non-Liq	Non-Liq	(qc1N)cs > 160	0.718	0.381		N/A	Non-Liq	0.000	0.000	0.000

Liquefaction Susceptibility Analysis: CPT Method (475-Yr Return)

References: - Robertson, P. K., and Robertson, K. L. (2006), Guide to Cone Penetration Testing and its Application to Geotechnical Engineering, Gregg Drilling & Testing, Inc., July, 2006.
- Zhang, G., Robertson, P. K., and Brachman, R. W. I. (2002), Estimating Liquefaction-Induced Ground Settlements from CPT for Level Ground, Canadian Geotechnical Journal, Vol. 39, pp. 1168-1180.

BG No.: 22590 Client: 5297 Marina Island, LLC
Project Description: Proposed Five-Story Residential Development over Subterranean Parking Level Engineer: RSB

CPT No.: 3

Ground Surface Elevation (ft) :	19
Proposed Finish Grade (ft) :	19
Existing Groundwater Depth (ft) :	21
Design Groundwater Depth (ft) :	5
Tip Cone Area (cm^2):	15
Total Unit Weight (pcf) :	120
Earthquake Magnitude (Mw) :	6.59
Peak Ground Acceleration (g):	0.43
Magnitude Scaling Factor :	1.394
Factor of Safety :	1.1

Total Thickness of Liquefiable Layers =	2	feet
Liquefaction-Induced Settlement =	0.48	Inches (Saturated Soils - Below GWT)
Seismically-Induced Settlement =	0.00	Inches (Dry Soils - Above GWT)
Total Dynamic Settlement =	0.48	Inches

Notes: - Soils with (Ic) greater than 3.3 are generally not considered susceptible to liquefaction.
- Currently and historically unsaturated soils (i.e. above GW table) are likely not susceptible to liquefaction (Special Publication 117A, 2008).

Depth z_i (ft)	Elevation (ft)	Tip Resistance qc (tsf)	Sleeve Friction fs (tsf)	Average Friction Ratio Rf-ave (%)	SBT No.	Soil Behavior Type	Layer Thickness Δz_i (ft)	Vertical Stress σ_{vo} (tsf)	Effective Vertical Stress σ'_{vo} (tsf)	Friction Ratio F	CPT Penetration Resistance Q	Soil Behavior Type Index I_c	Correction Factor K_c	Clean Sand Cone Penetration Resistance $(q_{c1N})_{cs}$	Cyclic Resistance Ratio (clean sand) $CRR_{7.5}$	Cyclic Resistance Ratio CRR	Remarks	Stress Reduction Factor r_d	Cyclic Stress Ratio CSR	Screening Analysis (Based on Laboratory Test Results and Correlation with SPT Liquefaction Results)	Factor of Safety (Liquefiable / Non Liquefiable) (Min FS = 1.1) FS_{liq}		Vol. Strain ϵ_v (%)	Seismic Settlement S_i (in)	Cumulative Seismic Settlement ΣS_i (in)
1	18	61.5	1.57	2.5500	5	Silty sand to sandy silt	1.5	0.060	0.060	2.555	318.444	1.893	1.182	376.499	Non-Liq	Non-Liq	Unsaturated	0.998	0.279	Basement	N/A	Non-Liq	0.000	0.000	0.000
2	17	25.6	1.57	6.1300	3	Clay	1.0	0.120	0.120	6.167	122.774	2.439	2.477	304.139	Non-Liq	Non-Liq	Unsaturated	0.995	0.278	Basement	N/A	Non-Liq	0.000	0.000	0.000
3	16	14.4	0.63	4.3500	3	Clay	1.0	0.180	0.180	4.427	53.696	2.552	3.043	163.382	Non-Liq	Non-Liq	Unsaturated	0.993	0.278	Basement	N/A	Non-Liq	0.000	0.000	0.000
4	15	39.5	0.42	1.0600	5	Silty sand to sandy silt	1.0	0.240	0.240	1.071	91.578	1.959	1.250	114.431	Non-Liq	Non-Liq	Unsaturated	0.991	0.277	Basement	N/A	Non-Liq	0.000	0.000	0.000
5	14	33.8	0.63	1.8500	5	Silty sand to sandy silt	1.0	0.300	0.300	1.879	74.104	2.189	1.641	121.571	0.247	0.344		0.988	0.276	Basement	N/A	Non-Liq	0.000	0.000	0.000
6	13	57.8	1.25	2.1700	5	Silty sand to sandy silt	1.0	0.360	0.329	2.178	115.484	2.100	1.454	167.931	Non-Liq	Non-Liq	(qc1N)cs > 160	0.986	0.302	Basement	N/A	Non-Liq	0.000	0.000	0.000
7	12	27.5	0.94	3.4200	4	Clayey silt to silty clay	1.0	0.420	0.358	3.476	57.682	2.454	2.547	146.887	0.375	0.522		0.984	0.323	Basement	N/A	Non-Liq	0.000	0.000	0.000
8	11	35.5	1.04	2.9400	4	Clayey silt to silty clay	1.0	0.480	0.386	2.969	68.432	2.353	2.131	145.834	0.368	0.514		0.981	0.341	Basement	N/A	Non-Liq	0.000	0.000	0.000
9	10	46.4	3.24	6.9800	3	Clay	1.0	0.540	0.415	7.070	90.049	2.565	3.119	280.871	Non-Liq	Non-Liq	(qc1N)cs > 160	0.979	0.356	Basement	N/A	Non-Liq	0.000	0.000	0.000
10	9	22.4	1.67	7.4800	3	Clay	1.0	0.600	0.444	7.678	42.995	2.794	4.732	203.432	Non-Liq	Non-Liq	(qc1N)cs > 160	0.977	0.369	Basement	N/A	Non-Liq	0.000	0.000	0.000
11	8	26.8	0.94	3.5000	4	Clayey silt to silty clay	1.0	0.660	0.473	3.591	46.138	2.532	2.937	135.517	0.311	0.434		0.974	0.380	PI>18 & Insensitive	N/A	Non-Liq	0.000	0.000	0.000
12	7	27.7	1.78	6.4100	3	Clay	1.0	0.720	0.502	6.605	47.244	2.718	4.126	194.931	Non-Liq	Non-Liq	(qc1N)cs > 160	0.972	0.390	PI>18 & Insensitive	N/A	Non-Liq	0.000	0.000	0.000
13	6	15.6	1.04	6.7200	3	Clay	1.0	0.780	0.530	7.037	25.631	2.919	5.890	150.974	0.400	0.558		0.970	0.399	PI>18 & Insensitive	N/A	Non-Liq	0.000	0.000	0.000
14	5	14.2	0.73	5.1500	3	Clay	1.0	0.840	0.559	5.464	22.000	2.891	5.612	123.458	0.255	0.355		0.967	0.406	PI>18 & Insensitive	N/A	Non-Liq	0.000	0.000	0.000
15	4	9.7	0.42	4.3100	3	Clay	1.0	0.900	0.588	4.767	14.161	2.997	6.708	94.998	0.160	0.223		0.965	0.413	PI>18 & Insensitive	N/A	Non-Liq	0.000	0.000	0.000
16	3	18.4	0.63	3.4100	3	Clay	1.0	0.960	0.617	3.617	25.635	2.722	4.161	106.668	0.193	0.269		0.963	0.419	PI>18 & Insensitive	N/A	Non-Liq	0.000	0.000	0.000
17	2	16.1	0.73	4.5500	3	Clay	1.0	1.020	0.646	4.847	21.807	2.859	5.308	115.748	0.224	0.313		0.960	0.424	PI>=12 & Wc/LL < 0.8	N/A	Non-Liq	0.000	0.000	0.000
18	1	9.6	0.42	4.3500	3	Clay	1.0	1.080	0.674	4.924	12.222	3.055	7.381	90.207	0.148	0.207		0.958	0.429	PI>=12 & Wc/LL < 0.8	N/A	Non-Liq	0.000	0.000	0.000
19	0	11.3	0.31	2.7800	3	Clay	1.0	1.140	0.703	3.057	13.700	2.890	5.601	76.739	0.122	0.170		0.956	0.433	PI>18 & Insensitive	N/A	Non-Liq	0.000	0.000	0.000
20	-1	10.8	0.42	3.8800	3	Clay	1.0	1.200	0.732	4.393	12.646	3.013	6.889	87.116	0.141	0.197		0.953	0.437	PI>18 & Insensitive	N/A	Non-Liq	0.000	0.000	0.000
21	-2	12.5	0.31	2.5000	3	Clay	1.0	1.260	0.761	2.751	14.170	2.851	5.237	74.206	0.118	0.164		0.951	0.440	PI>18 & Insensitive	N/A	Non-Liq	0.000	0.000	0.000
22	-3	20.4	1.04	5.1300	3	Clay	1.0	1.320	0.790	5.462	23.238	2.874	5.444	126.506	0.268	0.374		0.949	0.443	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.000
23	-4	81.6	0.94	1.1500	6	Sand to silty sand	1.0	1.380	0.818	1.172	88.886	1.994	1.292	114.851	0.221	0.308		0.946	0.446	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.000
24	-5	80.4	2.09	2.6000	5	Silty sand to sandy silt	1.0	1.440	0.847	2.647	87.167	2.245	1.783	155.433	0.429	0.598		0.944	0.448		1.334	Non-Liq	0.000	0.000	0.000
25	-6	75.9	1.36	1.7900	5	Silty sand to sandy silt	1.0	1.500	0.876	1.827	79.948	2.157	1.567	125.311	0.263	0.367		0.942	0.451		0.813	**Liq**	1.462	0.175	0.175
26	-7	67.4	0.63	0.9300	6	Sand to silty sand	1.0	1.560	0.905	0.957	68.838	2.026	1.336	91.979	0.152	0.212		0.939	0.453		0.469	**Liq**	2.503	0.300	0.476
27	-8	14.2	0.52	3.7100	3	Clay	1.0	1.620	0.934	4.134	13.329	2.979	6.509	86.756	0.141	0.196		0.937	0.454	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.476
28	-9	31.4	0.94	3.0000	4	Clayey silt to silty clay	1.0	1.680	0.962	3.160	30.414	2.628	3.501	106.478	0.192	0.268		0.935	0.456	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.476
29	-10	23.8	0.84	3.5300	4	Clayey silt to silty clay	1.0	1.740	0.991	3.806	22.093	2.786	4.665	103.054	0.182	0.253		0.932	0.457	PI>=12 & Wc/LL < 0.8	N/A	Non-Liq	0.000	0.000	0.476
30	-11	38.2	1.04	2.7400	4	Clayey silt to silty clay	1.0	1.800	1.020	2.856	35.535	2.548	3.023	107.407	0.195	0.272		0.930	0.459	PI>=12 & Wc/LL < 0.8	N/A	Non-Liq	0.000	0.000	0.476
31	-12	19.4	1.15	5.9500	3	Clay	1.0	1.860	1.049	6.549	16.752	3.032	7.102	118.973	0.237	0.330		0.922	0.457	PI>=12 & Wc/LL < 0.8	N/A	Non-Liq	0.000	0.000	0.476
32	-13	172.0	1.04	0.6100	6	Sand to silty sand	1.0	1.920	1.078	0.612	160.522	1.616	1.000	160.522	Non-Liq	Non-Liq	(qc1N)cs > 160	0.914	0.455		N/A	Non-Liq	0.000	0.000	0.476
33	-14	20.6	0.52	2.5500	4	Clayey silt to silty clay	1.0	1.980	1.106	2.797	16.958	2.793	4.721	80.065	0.128	0.178		0.905	0.453	PI>18 & Insensitive	N/A	Non-Liq	0.000	0.000	0.476
34	-15	18.3	0.42	2.3000	4	Clayey silt to silty clay	1.0	2.040	1.135	2.588	14.473	2.828	5.031	72.813	0.116	0.162		0.897	0.451	PI>=12 & Wc/LL < 0.8	N/A	Non-Liq	0.000	0.000	0.476
35	-16	27.5	0.42	1.5300	5	Silty sand to sandy silt	1.0	2.100	1.164	1.656	22.327	2.563	3.109	69.419	0.111	0.155		0.889	0.448	PI>=12 & Wc/LL < 0.8	N/A	Non-Liq	0.000	0.000	0.476
36	-17	32.7	2.30	7.0500	3	Clay	1.0	2.160	1.193	7.534	25.979	2.936	6.063	157.499	0.443	0.618		0.881	0.446		1.386	Non-Liq	0.000	0.000	0.476
37	-18	28.4	0.84	2.9500	4	Clayey silt to silty clay	1.0	2.220	1.222	3.209	22.010	2.740	4.294	94.517	0.159	0.221		0.873	0.443	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.476
38	-19	162.4	0.94	4.2700	3	Clay	1.0	2.280	1.250	0.587	139.966	1.652	1.005	140.671	0.339	0.472		0.865	0.441	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.476
39	-20	73.3	1.36	1.8500	5	Silty sand to sandy silt	1.0	2.340	1.279	1.916	59.073	2.268	1.849	109.251	0.201	0.281		0.857	0.438	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.476
40	-21	46.3	1.04	2.2600	5	Silty sand to sandy silt	1.0	2.400	1.308	2.371	35.395	2.497	2.753	97.431	0.166	0.231		0.848	0.435	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.476
41	-22	23.5	0.73	3.1200	4	Clayey silt to silty clay	1.0	2.460	1.337	3.470	16.256	2.864	5.353	87.016	0.141	0.197		0.840	0.432	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.476
42	-23	46.2	0.94	2.0400	5	Silty sand to sandy silt	1.0	2.520	1.366	2.154	34.107	2.483	2.684	91.536	0.151	0.211		0.832	0.429	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.476
43	-24	25.6	0.84	3.2800	4	Clayey silt to silty clay	1.0	2.580	1.394	3.652	17.133	2.860	5.314	91.053	0.150	0.209		0.824	0.426	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.476
44	-25	18.1	0.42	2.3200	4	Clayey silt to silty clay	1.0	2.640	1.423	2.722	11.216	2.932	6.017	67.486	0.109	0.151		0.816	0.423	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.476
45	-26	42.1	1.36	3.2300	4	Clayey silt to silty clay	1.0	2.700	1.452	3.454	28.838	2.671	3.787	109.203	0.201	0.280		0.808	0.420	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.476
46	-27	127.5	1.67	1.3100	6	Sand to silty sand	1.0	2.760	1.481	1.339	96.201	2.006	1.308	125.827	0.265	0.370		0.800	0.417	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.476

Liquefaction Susceptibility Analysis: CPT Method (475-Yr Return)

References: - Robertson, P. K., and Robertson, K. L. (2006), Guide to Cone Penetration Testing and its Application to Geotechnical Engineering, Gregg Drilling & Testing, Inc., July, 2006.
- Zhang, G., Robertson, P. K., and Brachman, R. W. I. (2002), Estimating Liquefaction-Induced Ground Settlements from CPT for Level Ground, Canadian Geotechnical Journal, Vol. 39, pp. 1168-1180.

BG No.: 22590 Client: 5297 Marina Island, LLC
Project Description: Proposed Five-Story Residential Development over Subterranean Parking Level
Engineer: RSB

CPT No.:	3		
Ground Surface Elevation (ft) :	19	Total Unit Weight (pcf) :	120
Proposed Finish Grade (ft) :	19	Earthquake Magnitude (Mw) :	6.59
Existing Groundwater Depth (ft) :	21	Peak Ground Acceleration (g):	0.43
Design Groundwater Depth (ft) :	5	Magnitude Scaling Factor :	1.394
Tip Cone Area (cm^2):	15	Factor of Safety :	1.1

Total Thickness of Liquefiable Layers = 2 feet
Liquefaction-Induced Settlement = 0.48 Inches (Saturated Soils - Below GWT)
Seismically-Induced Settlement = 0.00 Inches (Dry Soils - Above GWT)
Total Dynamic Settlement = 0.48 Inches

Notes: - Soils with (Ic) greater than 3.3 are generally not considered susceptible to liquefaction.
- Currently and historically unsaturated soils (i.e. above GW table) are likely not susceptible to liquefaction (Special Publication 117A, 2008).

Depth z_i (ft)	Elevation (ft)	Tip Resitance qc (tsf)	Sleeve Friction fs (tsf)	Average Friction Ratio Rf-ave (%)	SBT No.	Soil Behavior Type	Layer Thickness Δz_i (ft)	Vertical Stress σ_{vo} (tsf)	Effective Vertical Stress σ'_{vo} (tsf)	Friction Ratio F	CPT Penetration Resistance Q	Soil Behavior Type Index I_c	Correction Factor K_c	Clean Sand Cone Penetration Resistance $(q_{c1N})_{cs}$	Cyclic Resistance Ratio (clean sand) $CRR_{7.5}$	Cyclic Resistance Ratio CRR	Remarks	Stress Reduction Factor r_d	Cyclic Stress Ratio CSR	Screening Analysis (Based on Laboratory Test Results and Correlation with SPT Liquefaction Results)	Factor of Safety (Liquefiable / Non Liquefiable) (Min FS = 1.1) FS_{liq}		Vol. Strain ϵ_v (%)	Seismic Settlement S_i (in)	Cumulative Seismic Settlement ΣS_i (in)
47	-28	63.2	2.09	3.3100	4	Clayey silt to silty clay	1.0	2.820	1.510	3.463	43.419	2.540	2.980	129.404	0.282	0.392		0.792	0.413	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.476
48	-29	233.6	0.84	0.3600	6	Sand to silty sand	1.0	2.880	1.538	0.364	182.258	1.440	1.000	182.258	Non-Liq	Non-Liq	(qc1N)cs > 160	0.783	0.410		N/A	Non-Liq	0.000	0.000	0.476
49	-30	249.3	2.19	0.8800	6	Sand to silty sand	1.0	2.940	1.567	0.889	190.708	1.668	1.016	193.733	Non-Liq	Non-Liq	(qc1N)cs > 160	0.775	0.406		N/A	Non-Liq	0.000	0.000	0.476
50	-31	248.6	1.57	0.6300	6	Sand to silty sand	1.0	3.000	1.596	0.639	190.453	1.571	1.000	190.453	Non-Liq	Non-Liq	(qc1N)cs > 160	0.767	0.403		N/A	Non-Liq	0.000	0.000	0.476
51	-32	328.8	2.09	0.6400	6	Sand to silty sand	1.0	3.060	1.625	0.642	250.415	1.484	1.000	250.415	Non-Liq	Non-Liq	(qc1N)cs > 160	0.759	0.400		N/A	Non-Liq	0.000	0.000	0.476
52	-33	651.4	3.34	0.5100	7	Gravely sand to dense sand	1.0	3.120	1.654	0.515	493.965	1.213	1.000	493.965	Non-Liq	Non-Liq	(qc1N)cs > 160	0.751	0.396		N/A	Non-Liq	0.000	0.000	0.476
53	-34	590.2	5.74	0.9700	6	Sand to silty sand	1.0	3.180	1.682	0.978	443.444	1.464	1.000	443.444	Non-Liq	Non-Liq	(qc1N)cs > 160	0.743	0.392		N/A	Non-Liq	0.000	0.000	0.476
54	-35	441.1	2.61	0.5900	7	Gravely sand to dense sand	1.0	3.240	1.711	0.596	327.960	1.379	1.000	327.960	Non-Liq	Non-Liq	(qc1N)cs > 160	0.735	0.389		N/A	Non-Liq	0.000	0.000	0.476
55	-36	377.8	3.86	1.0200	6	Sand to silty sand	1.0	3.300	1.740	1.031	276.592	1.606	1.000	276.592	Non-Liq	Non-Liq	(qc1N)cs > 160	0.726	0.385		N/A	Non-Liq	0.000	0.000	0.476
56	-37	370.1	4.70	1.2700	6	Sand to silty sand	1.0	3.360	1.769	1.282	265.126	1.691	1.032	273.478	Non-Liq	Non-Liq	(qc1N)cs > 160	0.718	0.381		N/A	Non-Liq	0.000	0.000	0.476
57	-38	475.9	2.82	0.5900	7	Gravely sand to dense sand	1.0	3.420	1.798	0.597	345.259	1.364	1.000	345.259	Non-Liq	Non-Liq	(qc1N)cs > 160	0.710	0.378		N/A	Non-Liq	0.000	0.000	0.476
58	-39	535.6	4.28	0.8000	6	Sand to silty sand	1.0	3.480	1.826	0.804	385.794	1.431	1.000	385.794	Non-Liq	Non-Liq	(qc1N)cs > 160	0.702	0.374		N/A	Non-Liq	0.000	0.000	0.476
59	-40	641.3	3.86	0.6000	7	Gravely sand to dense sand	1.0	3.540	1.855	0.605	458.765	1.287	1.000	458.765	Non-Liq	Non-Liq	(qc1N)cs > 160	0.694	0.370		N/A	Non-Liq	0.000	0.000	0.476
60	-41	444.7	4.70	1.0600	6	Sand to silty sand	1.0	3.600	1.884	1.066	313.512	1.583	1.000	313.512	Non-Liq	Non-Liq	(qc1N)cs > 160	0.686	0.366		N/A	Non-Liq	0.000	0.000	0.476
61	-42	517.1	6.47	1.2500	6	Sand to silty sand	1.0	3.660	1.913	1.260	361.011	1.605	1.000	361.011	Non-Liq	Non-Liq	(qc1N)cs > 160	0.678	0.362		N/A	Non-Liq	0.000	0.000	0.476
62	-43	543.4	8.04	1.4800	6	Sand to silty sand	1.0	3.720	1.942	1.490	373.175	1.657	1.009	376.398	Non-Liq	Non-Liq	(qc1N)cs > 160	0.669	0.358		N/A	Non-Liq	0.000	0.000	0.476
63	-44	563.3	6.68	1.1900	6	Sand to silty sand	1.0	3.780	1.970	1.194	389.936	1.567	1.000	389.936	Non-Liq	Non-Liq	(qc1N)cs > 160	0.661	0.355		N/A	Non-Liq	0.000	0.000	0.476
64	-45	640.1	3.86	0.6000	7	Gravely sand to dense sand	1.0	3.840	1.999	0.607	440.930	1.299	1.000	440.930	Non-Liq	Non-Liq	(qc1N)cs > 160	0.653	0.351		N/A	Non-Liq	0.000	0.000	0.476
65	-46	446.3	5.95	1.3300	6	Sand to silty sand	1.0	3.900	2.028	1.345	297.163	1.677	1.022	303.800	Non-Liq	Non-Liq	(qc1N)cs > 160	0.645	0.347		N/A	Non-Liq	0.000	0.000	0.476
66	-47	353.9	6.79	1.9200	6	Sand to silty sand	1.0	3.960	2.057	1.940	224.337	1.878	1.169	262.163	Non-Liq	Non-Liq	(qc1N)cs > 160	0.637	0.343		N/A	Non-Liq	0.000	0.000	0.476
67	-48	480.0	6.47	1.3500	6	Sand to silty sand	1.0	4.020	2.086	1.359	315.490	1.666	1.014	320.023	Non-Liq	Non-Liq	(qc1N)cs > 160	0.629	0.339		N/A	Non-Liq	0.000	0.000	0.476
68	-49	474.9	6.16	1.3000	6	Sand to silty sand	1.0	4.080	2.114	1.308	310.245	1.656	1.008	312.699	Non-Liq	Non-Liq	(qc1N)cs > 160	0.621	0.335		N/A	Non-Liq	0.000	0.000	0.476
69	-50	423.0	7.83	1.8500	6	Sand to silty sand	0.5	4.140	2.143	1.869	264.936	1.822	1.123	297.603	Non-Liq	Non-Liq	(qc1N)cs > 160	0.612	0.331		N/A	Non-Liq	0.000	0.000	0.476

Liquefaction Susceptibility Analysis: CPT Method (2475-Yr Return)

References: - Robertson, P. K., and Robertson, K. L. (2006), Guide to Cone Penetration Testing and its Application to Geotechnical Engineering, Gregg Drilling & Testing, Inc., July, 2006.
- Zhang, G., Robertson, P. K., and Brachman, R. W. I. (2002), Estimating Liquefaction-Induced Ground Settlements from CPT for Level Ground, Canadian Geotechnical Journal, Vol. 39, pp. 1168-1180.

BG No.: 22590 Client: 5297 Marina Island, LLC
Project Description: Proposed Five-Story Residential Development over Subterranean Parking Level
Engineer: RSB

CPT No.:	2
Ground Surface Elevation (ft) :	21
Proposed Finish Grade (ft) :	21
Existing Groundwater Depth (ft) :	21.5
Design Groundwater Depth (ft) :	5
Tip Cone Area (cm^2):	15

Total Unit Weight (pcf) :	120
Earthquake Magnitude (Mw) :	7.37
Peak Ground Acceleration (g):	0.64
Magnitude Scaling Factor :	1.047
Factor of Safety :	1

Total Thickness of Liquefiable Layers =	5	feet
Liquefaction-Induced Settlement =	1.01	Inches (Saturated Soils - Below GWT)
Seismically-Induced Settlement =	0.00	Inches (Dry Soils - Above GWT)
Total Dynamic Settlement =	1.01	Inches

Notes: - Soils with (Ic) greater than 3.3 are generally not considered susceptible to liquefaction.
- Currently and historically unsaturated soils (i.e. above GW table) are likely not susceptible to liquefaction (Special Publication 117A, 2008).

Depth z_i (ft)	Elevation (ft)	Tip Resistance qc (tsf)	Sleeve Friction fs (tsf)	Average Friction Ratio Rf-ave (%)	SBT No.	Soil Behavior Type	Layer Thickness Δz_i (ft)	Vertical Stress σ_{vo} (tsf)	Effective Vertical Stress σ'_{vo} (tsf)	Friction Ratio F	CPT Penetration Resistance Q	Soil Behavior Type Index I_c	Correction Factor K_c	Clean Sand Cone Penetration Resistance $(q_{c1N})_{cs}$	Cyclic Resistance Ratio (clean sand) $CRR_{7.5}$	Cyclic Resistance Ratio CRR	Remarks	Stress Reduction Factor r_d	Cyclic Stress Ratio CSR	Screening Analysis (Based on Laboratory Test Results and Correlation with SPT Liquefaction Results)	Factor of Safety (Liquefiable / Non Liquefiable) (Min FS = 1.0) FS_{liq}		Vol. Strain ϵ_v (%)	Seismic Settlement S_i (in)	Cumulative Seismic Settlement ΣS_i (in)
1	20	135.1	1.04	0.7700	6	Sand to silty sand	1.5	0.060	0.060	0.770	540.280	1.330	1.000	540.280	Non-Liq	Non-Liq	Unsaturated	0.998	0.415	Basement	N/A	Non-Liq	0.000	0.000	0.000
2	19	111.0	0.94	0.8500	6	Sand to silty sand	1.0	0.120	0.120	0.848	313.644	1.505	1.000	313.644	Non-Liq	Non-Liq	Unsaturated	0.995	0.414	Basement	N/A	Non-Liq	0.000	0.000	0.000
3	18	32.4	1.67	5.1600	3	Clay	1.0	0.180	0.180	5.188	112.024	2.401	2.315	259.285	Non-Liq	Non-Liq	Unsaturated	0.993	0.413	Basement	N/A	Non-Liq	0.000	0.000	0.000
4	17	31.0	1.98	6.4000	3	Clay	1.0	0.240	0.240	6.435	91.437	2.528	2.915	266.540	Non-Liq	Non-Liq	Unsaturated	0.991	0.412	Basement	N/A	Non-Liq	0.000	0.000	0.000
5	16	59.9	3.03	5.0500	4	Clayey silt to silty clay	1.0	0.300	0.300	5.080	138.950	2.339	2.080	288.993	Non-Liq	Non-Liq	(qc1N)cs > 160	0.988	0.411	Basement	N/A	Non-Liq	0.000	0.000	0.000
6	15	35.2	1.57	4.4500	4	Clayey silt to silty clay	1.0	0.360	0.329	4.508	78.903	2.447	2.513	198.256	Non-Liq	Non-Liq	(qc1N)cs > 160	0.986	0.449	Basement	N/A	Non-Liq	0.000	0.000	0.000
7	14	37.0	1.67	4.5200	4	Clayey silt to silty clay	1.0	0.420	0.358	4.569	77.947	2.454	2.549	198.665	Non-Liq	Non-Liq	(qc1N)cs > 160	0.984	0.481	Basement	N/A	Non-Liq	0.000	0.000	0.000
8	13	50.0	1.15	2.3000	5	Silty sand to sandy silt	1.0	0.480	0.386	2.321	92.134	2.187	1.635	150.606	0.398	0.416		0.981	0.507	Basement	N/A	Non-Liq	0.000	0.000	0.000
9	12	43.0	1.88	4.3700	4	Clayey silt to silty clay	1.0	0.540	0.415	4.426	80.553	2.435	2.460	198.126	Non-Liq	Non-Liq	(qc1N)cs > 160	0.979	0.530	Basement	N/A	Non-Liq	0.000	0.000	0.000
10	11	25.7	1.46	5.6900	3	Clay	1.0	0.600	0.444	5.819	48.079	2.671	3.793	182.378	Non-Liq	Non-Liq	(qc1N)cs > 160	0.977	0.549	Basement	N/A	Non-Liq	0.000	0.000	0.000
11	10	106.8	3.24	3.0300	5	Silty sand to sandy silt	1.0	0.660	0.473	3.052	169.240	2.109	1.471	248.921	Non-Liq	Non-Liq	(qc1N)cs > 160	0.974	0.566		N/A	Non-Liq	0.000	0.000	0.000
12	9	36.6	2.19	6.0000	3	Clay	1.0	0.720	0.502	6.112	61.453	2.618	3.437	211.189	Non-Liq	Non-Liq	(qc1N)cs > 160	0.972	0.580		N/A	Non-Liq	0.000	0.000	0.000
13	8	49.0	0.94	1.9200	5	Silty sand to sandy silt	1.0	0.780	0.530	1.950	72.788	2.206	1.681	122.374	0.250	0.262		0.970	0.593	PI>=12 & Wc/LL < 0.8	N/A	Non-Liq	0.000	0.000	0.000
14	7	16.4	0.94	5.7300	3	Clay	1.0	0.840	0.559	6.041	25.540	2.874	5.448	139.132	0.330	0.346		0.967	0.604		0.572	Liq	1.782	0.214	0.214
15	6	15.5	0.84	5.4100	3	Clay	1.0	0.900	0.588	5.769	22.974	2.893	5.634	129.432	0.282	0.295		0.965	0.614	PI>18 & Insensitive	N/A	Non-Liq	0.000	0.000	0.214
16	5	11.8	0.52	4.4300	3	Clay	1.0	0.960	0.617	4.797	16.555	2.946	6.166	102.084	0.179	0.187		0.963	0.623	PI>18 & Insensitive	N/A	Non-Liq	0.000	0.000	0.214
17	4	28.3	1.36	4.8000	3	Clay	1.0	1.020	0.646	4.985	38.513	2.689	3.914	150.731	0.398	0.417		0.960	0.631		0.661	Liq	1.373	0.165	0.379
18	3	25.8	1.15	4.4500	3	Clay	1.0	1.080	0.674	4.654	33.776	2.708	4.054	136.932	0.319	0.334		0.958	0.638	PI>=12 & Wc/LL < 0.8	N/A	Non-Liq	0.000	0.000	0.379
19	2	24.6	1.25	5.0800	3	Clay	1.0	1.140	0.703	5.319	31.303	2.772	4.552	142.495	0.349	0.365		0.956	0.645		0.567	Liq	1.748	0.210	0.588
20	1	13.6	0.63	4.6100	3	Clay	1.0	1.200	0.732	5.089	16.296	2.968	6.397	104.240	0.185	0.194		0.953	0.650	PI>18 & Insensitive	N/A	Non-Liq	0.000	0.000	0.588
21	0	14.1	1.04	7.4000	3	Clay	1.0	1.260	0.761	8.100	16.539	3.098	7.905	130.746	0.288	0.301		0.951	0.655	PI>18 & Insensitive	N/A	Non-Liq	0.000	0.000	0.588
22	-1	9.9	0.84	8.4100	3	Clay	1.0	1.320	0.790	9.767	10.892	3.287	10.512	114.494	0.220	0.230		0.949	0.660	PI>=12 & Wc/LL < 0.8	N/A	Non-Liq	0.000	0.000	0.588
23	-2	9.3	0.52	5.6100	3	Clay	1.0	1.380	0.818	6.574	9.600	3.216	9.472	90.931	0.150	0.157		0.946	0.664	PI>=12 & Wc/LL < 0.8	N/A	Non-Liq	0.000	0.000	0.588
24	-3	8.0	0.10	1.2900	4	Clayey silt to silty clay	1.0	1.440	0.847	1.515	7.613	2.943	6.132	46.679	0.089	0.093		0.944	0.668	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.588
25	-4	20.4	0.63	3.0700	4	Clayey silt to silty clay	1.0	1.500	0.876	3.340	20.925	2.768	4.517	94.511	0.159	0.166		0.942	0.671	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.588
26	-5	89.2	0.84	0.9400	6	Sand to silty sand	1.0	1.560	0.905	0.959	91.287	1.929	1.218	111.181	0.208	0.218		0.939	0.674	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.588
27	-6	86.5	0.73	0.8500	6	Sand to silty sand	1.0	1.620	0.934	0.860	86.785	1.918	1.206	104.692	0.187	0.195		0.937	0.676	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.588
28	-7	99.9	1.04	1.0500	6	Sand to silty sand	1.0	1.680	0.962	1.058	98.790	1.930	1.219	120.392	0.242	0.254		0.935	0.679	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.588
29	-8	98.8	1.15	1.1600	6	Sand to silty sand	1.0	1.740	0.991	1.185	95.974	1.972	1.265	121.375	0.246	0.258		0.932	0.681	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.588
30	-9	47.4	1.25	2.6500	5	Silty sand to sandy silt	1.0	1.800	1.020	2.741	44.478	2.463	2.589	115.174	0.222	0.232		0.930	0.683	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.588
31	-10	14.9	0.84	5.6200	3	Clay	1.0	1.860	1.049	6.427	12.467	3.122	8.211	102.368	0.180	0.188		0.922	0.680	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.588
32	-11	23.8	0.73	3.0800	4	Clayey silt to silty clay	1.0	1.920	1.078	3.335	20.423	2.775	4.580	93.533	0.156	0.163		0.914	0.677	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.588
33	-12	16.8	0.63	3.7400	3	Clay	1.0	1.980	1.106	4.248	13.482	2.982	6.546	88.258	0.144	0.151		0.905	0.674	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.588
34	-13	83.2	0.94	1.1300	6	Sand to silty sand	1.0	2.040	1.135	1.158	73.851	2.053	1.375	101.545	0.177	0.186		0.897	0.671	PI>=12 & Wc/LL < 0.8	N/A	Non-Liq	0.000	0.000	0.588
35	-14	101.9	1.04	1.0300	6	Sand to silty sand	1.0	2.100	1.164	1.042	89.651	1.958	1.249	111.986	0.211	0.220		0.889	0.667	PI>=12 & Wc/LL < 0.8	N/A	Non-Liq	0.000	0.000	0.588
36	-15	27.8	1.15	4.1400	4	Clayey silt to silty clay	1.0	2.160	1.193	4.489	21.889	2.836	5.095	111.526	0.209	0.219		0.881	0.664	PI>=12 & Wc/LL < 0.8	N/A	Non-Liq	0.000	0.000	0.588
37	-16	12.1	0.31	2.6000	3	Clay	1.0	2.220	1.222	3.134	8.183	3.080	7.674	62.794	0.103	0.108		0.873	0.660	PI>=12 & Wc/LL < 0.8	N/A	Non-Liq	0.000	0.000	0.588
38	-17	162.4	0.42	2.9700	3	Clay	1.0	2.280	1.250	0.262	140.300	1.469	1.000	140.300	0.337	0.353		0.865	0.656	PI>=12 & Wc/LL < 0.8	N/A	Non-Liq	0.000	0.000	0.588
39	-18	23.8	1.25	5.2700	3	Clay	1.0	2.340	1.279	5.822	17.107	2.991	6.640	113.599	0.216	0.226		0.857	0.652	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.588
40	-19	97.1	1.36	1.4000	5	Silty sand to sandy silt	1.0	2.400	1.308	1.436	78.537	2.092	1.441	113.139	0.215	0.225		0.848	0.648	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.588
41	-20	99.9	3.45	3.4500	5	Silty sand to sandy silt	1.0	2.460	1.337	3.539	78.099	2.370	2.194	171.363	Non-Liq	Non-Liq	(qc1N)cs > 160	0.840	0.643		N/A	Non-Liq	0.000	0.000	0.588
42	-21	201.1	2.40	1.1900	6	Sand to silty sand	1.0	2.520	1.366	1.208	163.770	1.809	1.113	182.328	Non-Liq	Non-Liq	(qc1N)cs > 160	0.832	0.639		N/A	Non-Liq	0.000	0.000	0.588
43	-22	97.1	3.55	3.6600	5	Silty sand to sandy silt	1.0	2.580	1.394	3.755	73.203	2.408	2.345	171.666	Non-Liq	Non-Liq	(qc1N)cs > 160	0.824	0.634		N/A	Non-Liq	0.000	0.000	0.588
44	-23	96.0	3.55	3.7000	5	Silty sand to sandy silt	1.0	2.640	1.423	3.804	71.093	2.421	2.398	170.506	Non-Liq	Non-Liq	(qc1N)cs > 160	0.816	0.630		N/A	Non-Liq	0.000	0.000	0.588
45	-24	187.0	1.78	0.9500	6	Sand to silty sand	1.0	2.700	1.452	0.966	147.193	1.774	1.088	160.166	Non-Liq	Non-Liq	(qc1N)cs > 160	0.808	0.625		N/A	Non-Liq	0.000	0.000	0.588
46	-25	245.3	1.36	0.5500	6	Sand to silty sand	1.0	2.760	1.481	0.561	195.286	1.526	1.000	195.286	Non-Liq	Non-Liq	(qc1N)cs > 160	0.800	0.620		N/A	Non-Liq	0.000	0.000	0.588

Liquefaction Susceptibility Analysis: CPT Method (2475-Yr Return)

References: - Robertson, P. K., and Robertson, K. L. (2006), Guide to Cone Penetration Testing and its Application to Geotechnical Engineering, Gregg Drilling & Testing, Inc., July, 2006.
- Zhang, G., Robertson, P. K., and Brachman, R. W. I. (2002), Estimating Liquefaction-Induced Ground Settlements from CPT for Level Ground, Canadian Geotechnical Journal, Vol. 39, pp. 1168-1180.

BG No.: 22590 Client: 5297 Marina Island, LLC
Project Description: Proposed Five-Story Residential Development over Subterranean Parking Level
Engineer: RSB

CPT No.:	2		
Ground Surface Elevation (ft) :	21	Total Unit Weight (pcf) :	120
Proposed Finish Grade (ft) :	21	Earthquake Magnitude (Mw) :	7.37
Existing Groundwater Depth (ft) :	21.5	Peak Ground Acceleration (g):	0.64
Design Groundwater Depth (ft) :	5	Magnitude Scaling Factor :	1.047
Tip Cone Area (cm^2):	15	Factor of Safety :	1

Total Thickness of Liquefiable Layers = 5 feet
Liquefaction-Induced Settlement = 1.01 Inches (Saturated Soils - Below GWT)
Seismically-Induced Settlement = 0.00 Inches (Dry Soils - Above GWT)
Total Dynamic Settlement = 1.01 inches

Notes: - Soils with (Ic) greater than 3.3 are generally not considered susceptible to liquefaction.
- Currently and historically unsaturated soils (i.e. above GW table) are likely not susceptible to liquefaction (Special Publication 117A, 2008).

Depth z_i (ft)	Elevation (ft)	Tip Resitance qc (tsf)	Sleeve Friction fs (tsf)	Average Friction Ratio Rf-ave (%)	SBT No.	Soil Behavior Type	Layer Thickness Δz_i (ft)	Vertical Stress σ_{vo} (tsf)	Effective Vertical Stress σ'_{vo} (tsf)	Friction Ratio F	CPT Penetration Resistance Q	Soil Behavior Type Index I_c	Correction Factor K_c	Clean Sand Cone Penetration Resistance $(q_{c1N})_{cs}$	Cyclic Resistance Ratio (clean sand) $CRR_{7.5}$	Cyclic Resistance Ratio CRR	Remarks	Stress Reduction Factor r_d	Cyclic Stress Ratio CSR	Screening Analysis (Based on Laboratory Test Results and Correlation with SPT Liquefaction Results)	Factor of Safety (Liquefiable / Non Liquefiable) (Min FS = 1.0) FS_{liq}		Vol. Strain ϵ_v (%)	Seismic Settlement S_i (in)	Cumulative Seismic Settlement ΣS_i (in)
47	-26	123.2	2.40	1.9500	5	Silty sand to sandy silt	1.0	2.820	1.510	1.993	90.375	2.145	1.542	139.392	0.332	0.347		0.792	0.615		0.565	**Liq**	1.780	0.214	0.802
48	-27	49.5	1.15	2.3200	5	Silty sand to sandy silt	1.0	2.880	1.538	2.467	33.070	2.531	2.928	96.819	0.164	0.172		0.783	0.610	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.802
49	-28	43.6	2.51	5.7600	3	Clay	1.0	2.940	1.567	6.181	27.315	2.860	5.317	145.249	0.365	0.382		0.775	0.605		0.631	**Liq**	1.721	0.206	1.008
50	-29	69.6	1.57	2.2500	5	Silty sand to sandy silt	1.0	3.000	1.596	2.359	46.584	2.405	2.332	108.643	0.199	0.209		0.767	0.600	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	1.008
51	-30	270.3	2.09	0.7700	6	Sand to silty sand	1.0	3.060	1.625	0.782	204.379	1.607	1.000	204.379	Non-Liq	Non-Liq	(qc1N)cs > 160	0.759	0.595		N/A	Non-Liq	0.000	0.000	1.008
52	-31	276.8	1.36	0.4900	6	Sand to silty sand	1.0	3.120	1.654	0.497	208.558	1.471	1.000	208.558	Non-Liq	Non-Liq	(qc1N)cs > 160	0.751	0.589		N/A	Non-Liq	0.000	0.000	1.008
53	-32	414.0	2.09	0.5000	7	Gravely sand to dense sand	1.0	3.180	1.682	0.509	310.291	1.347	1.000	310.291	Non-Liq	Non-Liq	(qc1N)cs > 160	0.743	0.584		N/A	Non-Liq	0.000	0.000	1.008
54	-33	598.2	5.01	0.8400	6	Sand to silty sand	1.0	3.240	1.711	0.842	445.599	1.409	1.000	445.599	Non-Liq	Non-Liq	(qc1N)cs > 160	0.735	0.579		N/A	Non-Liq	0.000	0.000	1.008
55	-34	436.2	2.30	0.5300	7	Gravely sand to dense sand	1.0	3.300	1.740	0.531	321.543	1.349	1.000	321.543	Non-Liq	Non-Liq	(qc1N)cs > 160	0.726	0.573		N/A	Non-Liq	0.000	0.000	1.008
56	-35	437.8	2.82	0.6400	6	Sand to silty sand	0.5	3.360	1.769	0.649	320.027	1.413	1.000	320.027	Non-Liq	Non-Liq	(qc1N)cs > 160	0.718	0.568		N/A	Non-Liq	0.000	0.000	1.008

Liquefaction Susceptibility Analysis: CPT Method (2475-Yr Return)

References: - Robertson, P. K., and Robertson, K. L. (2006), Guide to Cone Penetration Testing and its Application to Geotechnical Engineering, Gregg Drilling & Testing, Inc., July, 2006.
- Zhang, G., Robertson, P. K., and Brachman, R. W. I. (2002), Estimating Liquefaction-Induced Ground Settlements from CPT for Level Ground, Canadian Geotechnical Journal, Vol. 39, pp. 1168-1180.

BG No.: 22590 Client: 5297 Marina Island, LLC
Project Description: Proposed Five-Story Residential Development over Subterranean Parking Level
Engineer: RSB

CPT No.: 3
Ground Surface Elevation (ft): 19
Proposed Finish Grade (ft): 19
Existing Groundwater Depth (ft): 21
Design Groundwater Depth (ft): 5
Tip Cone Area (cm^2): 15

Total Unit Weight (pcf): 120
Earthquake Magnitude (Mw): 7.37
Peak Ground Acceleration (g): 0.64
Magnitude Scaling Factor: 1.047
Factor of Safety: 1

Total Thickness of Liquefiable Layers = 4 feet
Liquefaction-Induced Settlement = 0.85 Inches (Saturated Soils - Below GWT)
Seismically-Induced Settlement = 0.00 Inches (Dry Soils - Above GWT)
Total Dynamic Settlement = 0.85 Inches

Notes: - Soils with (Ic) greater than 3.3 are generally not considered susceptible to liquefaction.
- Currently and historically unsaturated soils (i.e. above GW table) are likely not susceptible to liquefaction (Special Publication 117A, 2008).

Depth z_i (ft)	Elevation (ft)	Tip Resistance qc (tsf)	Sleeve Friction fs (tsf)	Average Friction Ratio Rf-ave (%)	SBT No.	Soil Behavior Type	Layer Thickness Δz_i (ft)	Vertical Stress σ_{vo} (tsf)	Effective Vertical Stress σ'_{vo} (tsf)	Friction Ratio F	CPT Penetration Resistance Q	Soil Behavior Type Index I_c	Correction Factor K_c	Clean Sand Cone Penetration Resistance $(q_{c1N})_{cs}$	Cyclic Resistance Ratio (clean sand) $CRR_{7.5}$	Cyclic Resistance Ratio CRR	Remarks	Stress Reduction Factor r_d	Cyclic Stress Ratio CSR	Screening Analysis (Based on Laboratory Test Results and Correlation with SPT Liquefaction Results)	Factor of Safety (Liquefiable / Non Liquefiable) (Min FS = 1.0) FS_{liq}		Vol. Strain ϵ_v (%)	Seismic Settlement S_i (in)	Cumulative Seismic Settlement ΣS_i (in)
1	18	61.5	1.57	2.5500	5	Silty sand to sandy silt	1.5	0.060	0.060	2.555	318.444	1.893	1.182	376.499	Non-Liq	Non-Liq	Unsaturated	0.998	0.415	Basement	N/A	Non-Liq	0.000	0.000	0.000
2	17	25.6	1.57	6.1300	3	Clay	1.0	0.120	0.120	6.167	122.774	2.439	2.477	304.139	Non-Liq	Non-Liq	Unsaturated	0.995	0.414	Basement	N/A	Non-Liq	0.000	0.000	0.000
3	16	14.4	0.63	4.3500	3	Clay	1.0	0.180	0.180	4.427	53.696	2.552	3.043	163.382	Non-Liq	Non-Liq	Unsaturated	0.993	0.413	Basement	N/A	Non-Liq	0.000	0.000	0.000
4	15	39.5	0.42	1.0600	5	Silty sand to sandy silt	1.0	0.240	0.240	1.071	91.578	1.959	1.250	114.431	Non-Liq	Non-Liq	Unsaturated	0.991	0.412	Basement	N/A	Non-Liq	0.000	0.000	0.000
5	14	33.8	0.63	1.8500	5	Silty sand to sandy silt	1.0	0.300	0.300	1.879	74.104	2.189	1.641	121.571	0.247	0.259		0.988	0.411	Basement	N/A	Non-Liq	0.000	0.000	0.000
6	13	57.8	1.25	2.1700	5	Silty sand to sandy silt	1.0	0.360	0.329	2.178	115.484	2.100	1.454	167.931	Non-Liq	Non-Liq	(qc1N)cs > 160	0.986	0.449	Basement	N/A	Non-Liq	0.000	0.000	0.000
7	12	27.5	0.94	3.4200	4	Clayey silt to silty clay	1.0	0.420	0.358	3.476	57.682	2.454	2.547	146.887	0.375	0.392		0.984	0.481	Basement	N/A	Non-Liq	0.000	0.000	0.000
8	11	35.5	1.04	2.9400	4	Clayey silt to silty clay	1.0	0.480	0.386	2.969	68.432	2.353	2.131	145.834	0.368	0.386		0.981	0.507	Basement	N/A	Non-Liq	0.000	0.000	0.000
9	10	46.4	3.24	6.9800	3	Clay	1.0	0.540	0.415	7.070	90.049	2.565	3.119	280.871	Non-Liq	Non-Liq	(qc1N)cs > 160	0.979	0.530	Basement	N/A	Non-Liq	0.000	0.000	0.000
10	9	22.4	1.67	7.4800	3	Clay	1.0	0.600	0.444	7.678	42.995	2.794	4.732	203.432	Non-Liq	Non-Liq	(qc1N)cs > 160	0.977	0.549	Basement	N/A	Non-Liq	0.000	0.000	0.000
11	8	26.8	0.94	3.5000	4	Clayey silt to silty clay	1.0	0.660	0.473	3.591	46.138	2.532	2.937	135.517	0.311	0.326		0.974	0.566	PI>18 & Insensitive	N/A	Non-Liq	0.000	0.000	0.000
12	7	27.7	1.78	6.4100	3	Clay	1.0	0.720	0.502	6.605	47.244	2.718	4.126	194.931	Non-Liq	Non-Liq	(qc1N)cs > 160	0.972	0.580	PI>18 & Insensitive	N/A	Non-Liq	0.000	0.000	0.000
13	6	15.6	1.04	6.7200	3	Clay	1.0	0.780	0.530	7.037	25.631	2.919	5.890	150.974	0.400	0.419		0.970	0.593	PI>18 & Insensitive	N/A	Non-Liq	0.000	0.000	0.000
14	5	14.2	0.73	5.1500	3	Clay	1.0	0.840	0.559	5.464	22.000	2.891	5.612	123.458	0.255	0.267		0.967	0.604	PI>18 & Insensitive	N/A	Non-Liq	0.000	0.000	0.000
15	4	9.7	0.42	4.3100	3	Clay	1.0	0.900	0.588	4.767	14.161	2.997	6.708	94.998	0.160	0.167		0.965	0.614	PI>18 & Insensitive	N/A	Non-Liq	0.000	0.000	0.000
16	3	18.4	0.63	3.4100	3	Clay	1.0	0.960	0.617	3.617	25.635	2.722	4.161	106.668	0.193	0.202		0.963	0.623	PI>18 & Insensitive	N/A	Non-Liq	0.000	0.000	0.000
17	2	16.1	0.73	4.5500	3	Clay	1.0	1.020	0.646	4.847	21.807	2.859	5.308	115.748	0.224	0.235		0.960	0.631	PI>=12 & Wc/LL < 0.8	N/A	Non-Liq	0.000	0.000	0.000
18	1	9.6	0.42	4.3500	3	Clay	1.0	1.080	0.674	4.924	12.222	3.055	7.381	90.207	0.148	0.155		0.958	0.638	PI>=12 & Wc/LL < 0.8	N/A	Non-Liq	0.000	0.000	0.000
19	0	11.3	0.31	2.7800	3	Clay	1.0	1.140	0.703	3.057	13.700	2.890	5.601	76.739	0.122	0.128		0.956	0.645	PI>18 & Insensitive	N/A	Non-Liq	0.000	0.000	0.000
20	-1	10.8	0.42	3.8800	3	Clay	1.0	1.200	0.732	4.393	12.646	3.013	6.889	87.116	0.141	0.148		0.953	0.650	PI>18 & Insensitive	N/A	Non-Liq	0.000	0.000	0.000
21	-2	12.5	0.31	2.5000	3	Clay	1.0	1.260	0.761	2.751	14.170	2.851	5.237	74.206	0.118	0.124		0.951	0.655	PI>18 & Insensitive	N/A	Non-Liq	0.000	0.000	0.000
22	-3	20.4	1.04	5.1300	3	Clay	1.0	1.320	0.790	5.462	23.238	2.874	5.444	126.506	0.268	0.281		0.949	0.660	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.000
23	-4	81.6	0.94	1.1500	6	Sand to silty sand	1.0	1.380	0.818	1.172	88.886	1.994	1.292	114.851	0.221	0.231		0.946	0.664	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.000
24	-5	80.4	2.09	2.6000	5	Silty sand to sandy silt	1.0	1.440	0.847	2.647	87.167	2.245	1.783	155.433	0.429	0.449		0.944	0.668		0.673	**Liq**	1.314	0.158	0.158
25	-6	75.9	1.36	1.7900	5	Silty sand to sandy silt	1.0	1.500	0.876	1.827	79.948	2.157	1.567	125.311	0.263	0.275		0.942	0.671		0.410	**Liq**	1.942	0.233	0.391
26	-7	67.4	0.63	0.9300	6	Sand to silty sand	1.0	1.560	0.905	0.957	68.838	2.026	1.336	91.979	0.152	0.159		0.939	0.674		0.237	**Liq**	2.503	0.300	0.691
27	-8	14.2	0.52	3.7100	3	Clay	1.0	1.620	0.934	4.134	13.329	2.979	6.509	86.756	0.141	0.147		0.937	0.676	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.691
28	-9	31.4	0.94	3.0000	4	Clayey silt to silty clay	1.0	1.680	0.962	3.160	30.414	2.628	3.501	106.478	0.192	0.201		0.935	0.679	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.691
29	-10	23.8	0.84	3.5300	4	Clayey silt to silty clay	1.0	1.740	0.991	3.806	22.093	2.786	4.665	103.054	0.182	0.190		0.932	0.681	PI>=12 & Wc/LL < 0.8	N/A	Non-Liq	0.000	0.000	0.691
30	-11	38.2	1.04	2.7400	4	Clayey silt to silty clay	1.0	1.800	1.020	2.856	35.535	2.548	3.023	107.407	0.195	0.204		0.930	0.683	PI>=12 & Wc/LL < 0.8	N/A	Non-Liq	0.000	0.000	0.691
31	-12	19.4	1.15	5.9500	3	Clay	1.0	1.860	1.049	6.549	16.752	3.032	7.102	118.973	0.237	0.248		0.922	0.680	PI>=12 & Wc/LL < 0.8	N/A	Non-Liq	0.000	0.000	0.691
32	-13	172.0	1.04	0.6100	6	Sand to silty sand	1.0	1.920	1.078	0.612	160.522	1.616	1.000	160.522	Non-Liq	Non-Liq	(qc1N)cs > 160	0.914	0.677		N/A	Non-Liq	0.000	0.000	0.691
33	-14	20.6	0.52	2.5500	4	Clayey silt to silty clay	1.0	1.980	1.106	2.797	16.958	2.793	4.721	80.065	0.128	0.134		0.905	0.674	PI>18 & Insensitive	N/A	Non-Liq	0.000	0.000	0.691
34	-15	18.3	0.42	2.3000	4	Clayey silt to silty clay	1.0	2.040	1.135	2.588	14.473	2.828	5.031	72.813	0.116	0.121		0.897	0.671	PI>=12 & Wc/LL < 0.8	N/A	Non-Liq	0.000	0.000	0.691
35	-16	27.5	0.42	1.5300	5	Silty sand to sandy silt	1.0	2.100	1.164	1.656	22.327	2.563	3.109	69.419	0.111	0.116		0.889	0.667	PI>=12 & Wc/LL < 0.8	N/A	Non-Liq	0.000	0.000	0.691
36	-17	32.7	2.30	7.0500	3	Clay	1.0	2.160	1.193	7.534	25.979	2.936	6.063	157.499	0.443	0.464		0.881	0.664		0.699	**Liq**	1.290	0.155	0.846
37	-18	28.4	0.84	2.9500	4	Clayey silt to silty clay	1.0	2.220	1.222	3.209	22.010	2.740	4.294	94.517	0.159	0.166		0.873	0.660	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.846
38	-19	162.4	0.94	4.2700	3	Clay	1.0	2.280	1.250	0.587	139.966	1.652	1.005	140.671	0.339	0.355		0.865	0.656	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.846
39	-20	73.3	1.36	1.8500	5	Silty sand to sandy silt	1.0	2.340	1.279	1.916	59.073	2.268	1.849	109.251	0.201	0.211		0.857	0.652	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.846
40	-21	46.3	1.04	2.2600	5	Silty sand to sandy silt	1.0	2.400	1.308	2.371	35.395	2.497	2.753	97.431	0.166	0.174		0.848	0.648	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.846
41	-22	23.5	0.73	3.1200	4	Clayey silt to silty clay	1.0	2.460	1.337	3.470	16.256	2.864	5.353	87.016	0.141	0.148		0.840	0.643	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.846
42	-23	46.2	0.94	2.0400	5	Silty sand to sandy silt	1.0	2.520	1.366	2.154	34.107	2.483	2.684	91.536	0.151	0.158		0.832	0.639	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.846
43	-24	25.6	0.84	3.2800	4	Clayey silt to silty clay	1.0	2.580	1.394	3.652	17.133	2.860	5.314	91.053	0.150	0.157		0.824	0.634	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.846
44	-25	18.1	0.42	2.3200	4	Clayey silt to silty clay	1.0	2.640	1.423	2.722	11.216	2.932	6.017	67.486	0.109	0.114		0.816	0.630	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.846
45	-26	42.1	1.36	3.2300	4	Clayey silt to silty clay	1.0	2.700	1.452	3.454	28.838	2.671	3.787	109.203	0.201	0.211		0.808	0.625	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.846
46	-27	127.5	1.67	1.3100	6	Sand to silty sand	1.0	2.760	1.481	1.339	96.201	2.006	1.308	125.827	0.265	0.278		0.800	0.620	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.846

Liquefaction Susceptibility Analysis: CPT Method (2475-Yr Return)

References: - Robertson, P. K., and Robertson, K. L. (2006), Guide to Cone Penetration Testing and its Application to Geotechnical Engineering, Gregg Drilling & Testing, Inc., July, 2006.
- Zhang, G., Robertson, P. K., and Brachman, R. W. I. (2002), Estimating Liquefaction-Induced Ground Settlements from CPT for Level Ground, Canadian Geotechnical Journal, Vol. 39, pp. 1168-1180.

BG No.: 22590 Client: 5297 Marina Island, LLC
Project Description: Proposed Five-Story Residential Development over Subterranean Parking Level
Engineer: RSB

CPT No.: 3
Ground Surface Elevation (ft) : 19
Proposed Finish Grade (ft) : 19
Existing Groundwater Depth (ft) : 21
Design Groundwater Depth (ft) : 5
Tip Cone Area (cm^2): 15

Total Unit Weight (pcf) : 120
Earthquake Magnitude (Mw) : 7.37
Peak Ground Acceleration (g): 0.64
Magnitude Scaling Factor : 1.047
Factor of Safety : 1

Total Thickness of Liquefiable Layers = 4 **feet**
Liquefaction-Induced Settlement = 0.85 **Inches (Saturated Soils - Below GWT)**
Seismically-Induced Settlement = 0.00 **Inches (Dry Soils - Above GWT)**
Total Dynamic Settlement = 0.85 **Inches**

Notes: - Soils with (Ic) greater than 3.3 are generally not considered susceptible to liquefaction.
- Currently and historically unsaturated soils (i.e. above GW table) are likely not susceptible to liquefaction (Special Publication 117A, 2008).

Depth z_i (ft)	Elevation (ft)	Tip Resitance qc (tsf)	Sleeve Friction fs (tsf)	Average Friction Ratio Rf-ave (%)	SBT No.	Soil Behavior Type	Layer Thickness Δz_i (ft)	Vertical Stress σ_{vo} (tsf)	Effective Vertical Stress σ'_{vo} (tsf)	Friction Ratio F	CPT Penetration Resistance Q	Soil Behavior Type Index I_c	Correction Factor K_c	Clean Sand Cone Penetration Resistance $(q_{c1N})_{cs}$	Cyclic Resistance Ratio (clean sand) $CRR_{7.5}$	Cyclic Resistance Ratio CRR	Remarks	Stress Reduction Factor r_d	Cyclic Stress Ratio CSR	Screening Analysis (Based on Laboratory Test Results and Correlation with SPT Liquefaction Results)	Factor of Safety (Liquefiable / Non Liquefiable) (Min FS = 1.0) FS_{liq}		Vol. Strain ϵ_v (%)	Seismic Settlement S_i (in)	Cumulative Seismic Settlement ΣS_i (in)
47	-28	63.2	2.09	3.3100	4	Clayey silt to silty clay	1.0	2.820	1.510	3.463	43.419	2.540	2.980	129.404	0.282	0.295		0.792	0.615	(CRR > CSR) by SPT	N/A	Non-Liq	0.000	0.000	0.846
48	-29	233.6	0.84	0.3600	6	Sand to silty sand	1.0	2.880	1.538	0.364	182.258	1.440	1.000	182.258	Non-Liq	Non-Liq	(qc1N)cs > 160	0.783	0.610		N/A	Non-Liq	0.000	0.000	0.846
49	-30	249.3	2.19	0.8800	6	Sand to silty sand	1.0	2.940	1.567	0.889	190.708	1.668	1.016	193.733	Non-Liq	Non-Liq	(qc1N)cs > 160	0.775	0.605		N/A	Non-Liq	0.000	0.000	0.846
50	-31	248.6	1.57	0.6300	6	Sand to silty sand	1.0	3.000	1.596	0.639	190.453	1.571	1.000	190.453	Non-Liq	Non-Liq	(qc1N)cs > 160	0.767	0.600		N/A	Non-Liq	0.000	0.000	0.846
51	-32	328.8	2.09	0.6400	6	Sand to silty sand	1.0	3.060	1.625	0.642	250.415	1.484	1.000	250.415	Non-Liq	Non-Liq	(qc1N)cs > 160	0.759	0.595		N/A	Non-Liq	0.000	0.000	0.846
52	-33	651.4	3.34	0.5100	7	Gravely sand to dense sand	1.0	3.120	1.654	0.515	493.965	1.213	1.000	493.965	Non-Liq	Non-Liq	(qc1N)cs > 160	0.751	0.589		N/A	Non-Liq	0.000	0.000	0.846
53	-34	590.2	5.74	0.9700	6	Sand to silty sand	1.0	3.180	1.682	0.978	443.444	1.464	1.000	443.444	Non-Liq	Non-Liq	(qc1N)cs > 160	0.743	0.584		N/A	Non-Liq	0.000	0.000	0.846
54	-35	441.1	2.61	0.5900	7	Gravely sand to dense sand	1.0	3.240	1.711	0.596	327.960	1.379	1.000	327.960	Non-Liq	Non-Liq	(qc1N)cs > 160	0.735	0.579		N/A	Non-Liq	0.000	0.000	0.846
55	-36	377.8	3.86	1.0200	6	Sand to silty sand	1.0	3.300	1.740	1.031	276.592	1.606	1.000	276.592	Non-Liq	Non-Liq	(qc1N)cs > 160	0.726	0.573		N/A	Non-Liq	0.000	0.000	0.846
56	-37	370.1	4.70	1.2700	6	Sand to silty sand	1.0	3.360	1.769	1.282	265.126	1.691	1.032	273.478	Non-Liq	Non-Liq	(qc1N)cs > 160	0.718	0.568		N/A	Non-Liq	0.000	0.000	0.846
57	-38	475.9	2.82	0.5900	7	Gravely sand to dense sand	1.0	3.420	1.798	0.597	345.259	1.364	1.000	345.259	Non-Liq	Non-Liq	(qc1N)cs > 160	0.710	0.562		N/A	Non-Liq	0.000	0.000	0.846
58	-39	535.6	4.28	0.8000	6	Sand to silty sand	1.0	3.480	1.826	0.804	385.794	1.431	1.000	385.794	Non-Liq	Non-Liq	(qc1N)cs > 160	0.702	0.556		N/A	Non-Liq	0.000	0.000	0.846
59	-40	641.3	3.86	0.6000	7	Gravely sand to dense sand	1.0	3.540	1.855	0.605	458.765	1.287	1.000	458.765	Non-Liq	Non-Liq	(qc1N)cs > 160	0.694	0.551		N/A	Non-Liq	0.000	0.000	0.846
60	-41	444.7	4.70	1.0600	6	Sand to silty sand	1.0	3.600	1.884	1.066	313.512	1.583	1.000	313.512	Non-Liq	Non-Liq	(qc1N)cs > 160	0.686	0.545		N/A	Non-Liq	0.000	0.000	0.846
61	-42	517.1	6.47	1.2500	6	Sand to silty sand	1.0	3.660	1.913	1.260	361.011	1.605	1.000	361.011	Non-Liq	Non-Liq	(qc1N)cs > 160	0.678	0.539		N/A	Non-Liq	0.000	0.000	0.846
62	-43	543.4	8.04	1.4800	6	Sand to silty sand	1.0	3.720	1.942	1.490	373.175	1.657	1.009	376.398	Non-Liq	Non-Liq	(qc1N)cs > 160	0.669	0.534		N/A	Non-Liq	0.000	0.000	0.846
63	-44	563.3	6.68	1.1900	6	Sand to silty sand	1.0	3.780	1.970	1.194	389.936	1.567	1.000	389.936	Non-Liq	Non-Liq	(qc1N)cs > 160	0.661	0.528		N/A	Non-Liq	0.000	0.000	0.846
64	-45	640.1	3.86	0.6000	7	Gravely sand to dense sand	1.0	3.840	1.999	0.607	440.930	1.299	1.000	440.930	Non-Liq	Non-Liq	(qc1N)cs > 160	0.653	0.522		N/A	Non-Liq	0.000	0.000	0.846
65	-46	446.3	5.95	1.3300	6	Sand to silty sand	1.0	3.900	2.028	1.345	297.163	1.677	1.022	303.800	Non-Liq	Non-Liq	(qc1N)cs > 160	0.645	0.516		N/A	Non-Liq	0.000	0.000	0.846
66	-47	353.9	6.79	1.9200	6	Sand to silty sand	1.0	3.960	2.057	1.940	224.337	1.878	1.169	262.163	Non-Liq	Non-Liq	(qc1N)cs > 160	0.637	0.510		N/A	Non-Liq	0.000	0.000	0.846
67	-48	480.0	6.47	1.3500	6	Sand to silty sand	1.0	4.020	2.086	1.359	315.490	1.666	1.014	320.023	Non-Liq	Non-Liq	(qc1N)cs > 160	0.629	0.504		N/A	Non-Liq	0.000	0.000	0.846
68	-49	474.9	6.16	1.3000	6	Sand to silty sand	1.0	4.080	2.114	1.308	310.245	1.656	1.008	312.699	Non-Liq	Non-Liq	(qc1N)cs > 160	0.621	0.498		N/A	Non-Liq	0.000	0.000	0.846
69	-50	423.0	7.83	1.8500	6	Sand to silty sand	0.5	4.140	2.143	1.869	264.936	1.822	1.123	297.603	Non-Liq	Non-Liq	(qc1N)cs > 160	0.612	0.492		N/A	Non-Liq	0.000	0.000	0.846

Appendix IV

Calculations and Figures

SEISMIC SOURCES
EZ-FRISK V7.65

DETERMINISTIC CALCULATION
OF PEAK GROUND ACCELERATION BASED ON DIGITIZED FAULT DATA

BG: 22590
CLIENT: 5297 Marina Island, LLC   ENGINEER: RSB
PROJECT DESCRIPTION: Proposed 5-Story Residential Development over Subterranean Parking Level

SITE COORDINATES: LATITUDE: 33.9800
LONGITUDE: -118.4233

SEARCH RADIUS: 100 km

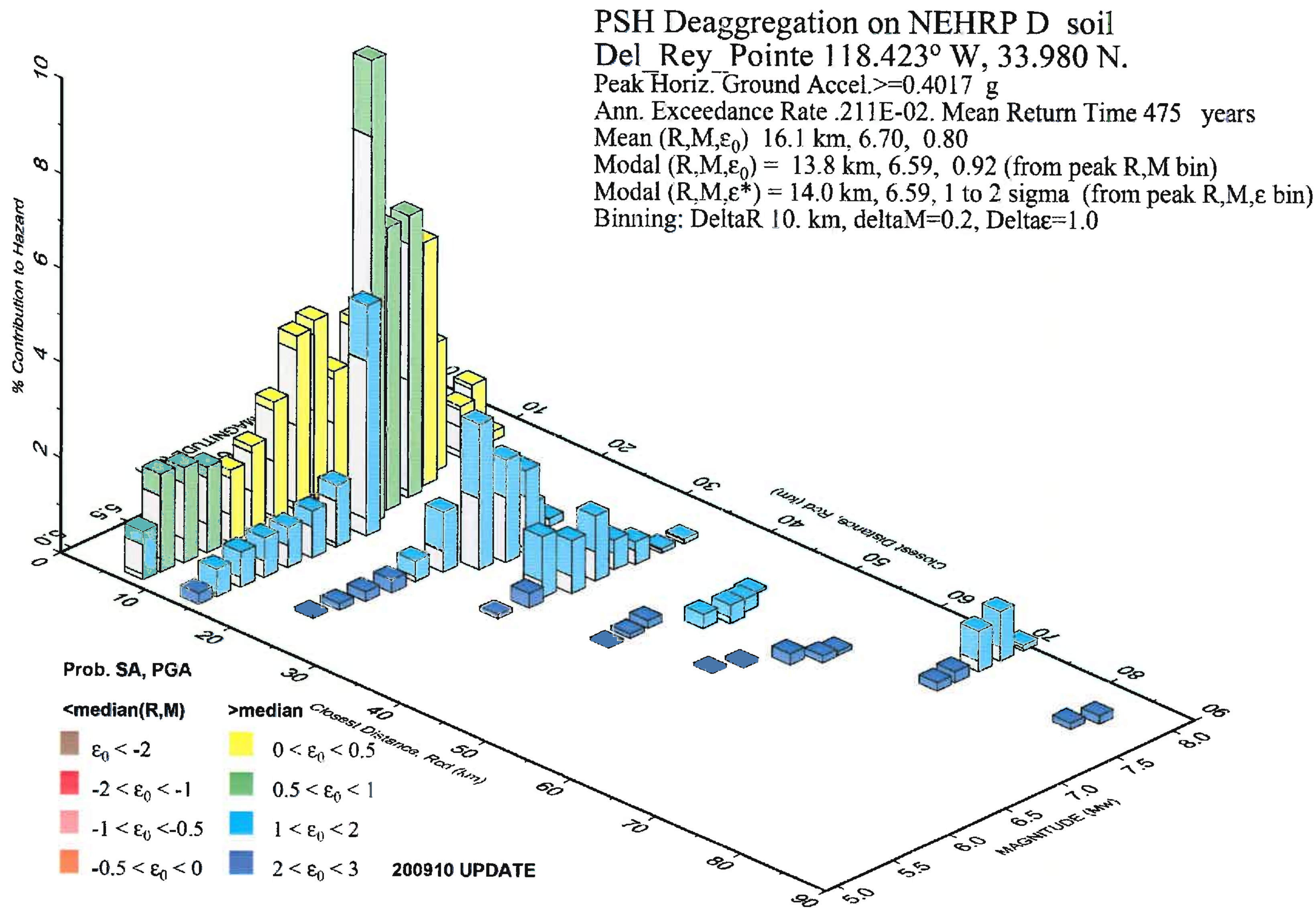
ATTENUATION RELATIONS:
CHIOU-YOUNGS (2007) NGA USGS 2008 MRC
BOORE-ATKINSON (2008) NGA USGS 2008 MRC
CAMPBELL-BOZORGNIA (2008) NGA USGS 2008 MRC

SEISMIC SOURCE SUMMARY
DETERMINISTIC SITE PARAMETERS

FAULT NAME	APPROXIMATE DISTANCE		MAXIMUM EATHQUAKE MAGNITUDE	PEAK GROUND ACCELERATION
	(km)	(mi)	(Mw)	(g)
Newport-Inglewood	5.7	3.6	7.5	0.523
Santa Monica	6.7	4.2	7.4	0.537
Puente Hills (LA)	10.3	6.4	7.0	0.428
Palos Verdes	10.6	6.6	7.3	0.393
Palos Verdes Connected	10.6	6.6	7.7	0.430
Malibu Coast	10.8	6.7	7.0	0.361
Hollywood	11.7	7.3	6.7	0.318
Anacapa-Dume	12.7	7.9	7.2	0.392
Puente Hills	15.4	9.5	7.1	0.368
Elysian Park (Upper)	19.0	11.8	6.7	0.267
Raymond	24.3	15.1	6.8	0.204
Puente Hills (Santa Fe Springs)	25.9	16.1	6.7	0.220
Verdugo	26.4	16.4	6.9	0.198
Northridge	29.9	18.6	6.9	0.238
Sierra Madre	33.4	20.8	7.2	0.187
Sierra Madre Connected	33.4	20.8	7.3	0.195

FAULT NAME	APPROXIMATE DISTANCE		MAXIMUM EATHQUAKE MAGNITUDE	PEAK GROUND ACCELERATION
	(km)	(mi)	(Mw)	(g)
Sierra Madre (San Fernando)	34.1	21.2	6.7	0.147
Elsinore	34.6	21.5	7.9	0.231
Puente Hills (Coyote Hills)	36.5	22.7	6.9	0.172
Santa Susana, alt 1	37.3	23.2	6.9	0.150
San Gabriel	39.8	24.7	7.3	0.166
Simi-Santa Rosa	43.9	27.3	6.9	0.129
Clamshell-Sawpit	44.8	27.8	6.7	0.116
Holser, alt 1	45.1	28.0	6.8	0.129
Oak Ridge Connected	48.0	29.9	7.4	0.167
San Jose	50.3	31.3	6.7	0.103
Oak Ridge (Onshore)	51.0	31.7	7.2	0.152
San Joaquin Hills	55.3	34.4	7.1	0.130
Chino	56.4	35.0	6.8	0.094
San Cayetano	59.5	37.0	7.2	0.115
Cucamonga	65.6	40.8	6.7	0.080
Southern San Andreas	69.6	43.3	8.2	0.164
Santa Ynez (East)	76.9	47.8	7.2	0.088
Oak Ridge (Offshore)	77.1	47.9	7.0	0.080
Santa Cruz Island	77.2	48.0	7.2	0.087
Santa Ynez Connected	77.2	48.0	7.4	0.152
Ventura-Pitas Point	77.4	48.1	7.0	0.087
Pitas Point Connected	77.4	48.1	7.3	0.104
Channel Islands Thrust	77.7	48.3	7.3	0.110
Mission Ridge-Arroyo Parida-Santa Ana	85.1	52.9	6.9	0.067
San Jacinto	86.4	53.7	7.9	0.114
Red Mountain	90.3	56.1	7.4	0.085
Coronado Bank	90.9	56.5	7.4	0.082

43 Faults found within a 100 km Search Radius.
Closest Fault to the Site: Newport-Inglewood Distance = 5.73 km (3.56mi)
Largest Peak Ground Acceleration: 0.537 g
The San Andreas Fault is Located Aproximately 69.6 km (43.3 mi) from the Site.



REFERENCE: USGS, 2009, Deaggregation of Seismic Hazard at One Period of Spectral Acceleration, Data from USGS National Seismic Hazards Mapping Project, https://geohazards.usgs.gov/deaggint/2008/.

GMT 2017 Feb 7 04:12:38 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 330. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

BYER GEOTECHNICAL INC.
1461 E. CHEVY CHASE DRIVE, #200, GLENDALE, CA 91206
tel 818.549.9959 fax 818.543.3747

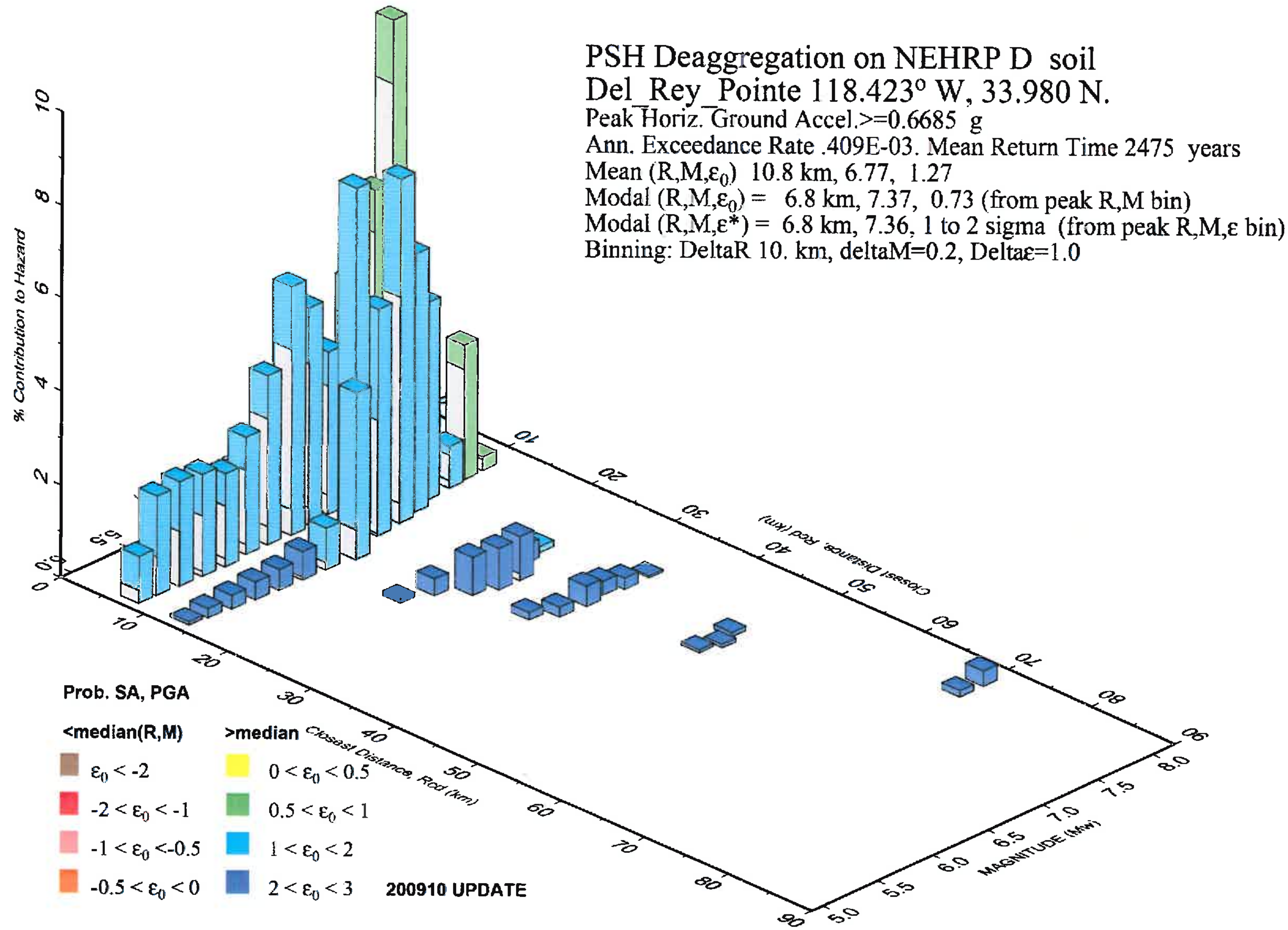
SEISMIC HAZARD DEAGGREGATION CHART 1

(Probability of Exceedance: 10% in 50 years)

BG: 22590

CLIENT: 5297 MARINA ISLAND, LLC

ENGINEER: RSB



REFERENCE: USGS, 2009, Deaggregation of Seismic Hazard at One Period of Spectral Acceleration, Data from USGS National Seismic Hazards Mapping Project, https://geohazards.usgs.gov/deaggint/2008/.

GMT 2017 Feb 7 04:11:57 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 330. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

BYER GEOTECHNICAL INC.
1461 E. CHEVY CHASE DRIVE, #200, GLENDALE, CA 91206
tel 818.549.9959 fax 818.543.3747

SEISMIC HAZARD DEAGGREGATION CHART 2

(Probability of Exceedance: 2% in 50 years)

BG: 22590

CLIENT: 5297 MARINA ISLAND, LLC

ENGINEER: RSB

Static Settlement Calculations

Reference: Das, B. M., 1990, Principles of Foundation Engineering, 2nd Edition, Chapter 3, P. 167-169.

Calculation Sheet #: 1

Project No.: 22590 Client: 5297 Marina Island, LLC Engineer: RSB
Project Description: Proposed 5-Story Building over Subterranean Parking Level

Applied Load, Q =	200	kips	Footing Width, B =	10	ft
Applied Pressure, q =	2000	psf	Footing Length, L =	10	ft
Preconsolidation, σ'_p =	3500	psf	**Embedment Depth, D =**	12	ft
			Depth to Groundwater =	21	ft
			Depth of Compressible Layer below Footing =	0	ft
			Unit Weight above Compressible Layer =	120	pcf

Geotechnical Properties of Soil Layers

Depth		Unit Wt.	Sat.	Consol. Parameters		
From	To	γ_t, (pcf)	γ_{sat}, (pcf)	e_0	C_c	C_s
0	10	120	130	0.83	0.055	0.023
10	30	120	130	0.59	0.057	0.016
30	40	120	130	0.57	0.063	0.018

Total Settlement = 0.31"

Depth (ft)	γ_t (pcf)	γ_{sat} (pcf)	σ_o (psf)	γ_w (pcf)	u (psf)	σ'_o (psf)	*Ave. Δq* (psf)	$\sigma'_o + \Delta q$ (psf)	σ'_p (psf)	*OCR*	e_o	C_c	C_s	Comp. Strain	Recomp. Strain	ϵ_v	Settlement (in)
0.5	120	130	60.0	0.0	0.0	60.0	0.0	60.0	3500	58.3	0.83	0.055	0.023	0.0000	0.0000	0.0000	0.0000
1	120	130	120.0	0.0	0.0	120.0	0.0	120.0	3500	29.2	0.83	0.055	0.023	0.0000	0.0000	0.0000	0.0000
1.5	120	130	180.0	0.0	0.0	180.0	0.0	180.0	3500	19.4	0.83	0.055	0.023	0.0000	0.0000	0.0000	0.0000
2	120	130	240.0	0.0	0.0	240.0	0.0	240.0	3500	14.6	0.83	0.055	0.023	0.0000	0.0000	0.0000	0.0000
2.5	120	130	300.0	0.0	0.0	300.0	0.0	300.0	3500	11.7	0.83	0.055	0.023	0.0000	0.0000	0.0000	0.0000
3	120	130	360.0	0.0	0.0	360.0	0.0	360.0	3500	9.7	0.83	0.055	0.023	0.0000	0.0000	0.0000	0.0000
3.5	120	130	420.0	0.0	0.0	420.0	0.0	420.0	3500	8.3	0.83	0.055	0.023	0.0000	0.0000	0.0000	0.0000
4	120	130	480.0	0.0	0.0	480.0	0.0	480.0	3500	7.3	0.83	0.055	0.023	0.0000	0.0000	0.0000	0.0000
4.5	120	130	540.0	0.0	0.0	540.0	0.0	540.0	3500	6.5	0.83	0.055	0.023	0.0000	0.0000	0.0000	0.0000
5	120	130	600.0	0.0	0.0	600.0	0.0	600.0	3500	5.8	0.83	0.055	0.023	0.0000	0.0000	0.0000	0.0000
5.5	120	130	660.0	0.0	0.0	660.0	0.0	660.0	3500	5.3	0.83	0.055	0.023	0.0000	0.0000	0.0000	0.0000
6	120	130	720.0	0.0	0.0	720.0	0.0	720.0	3500	4.9	0.83	0.055	0.023	0.0000	0.0000	0.0000	0.0000
6.5	120	130	780.0	0.0	0.0	780.0	0.0	780.0	3500	4.5	0.83	0.055	0.023	0.0000	0.0000	0.0000	0.0000
7	120	130	840.0	0.0	0.0	840.0	0.0	840.0	3500	4.2	0.83	0.055	0.023	0.0000	0.0000	0.0000	0.0000
7.5	120	130	900.0	0.0	0.0	900.0	0.0	900.0	3500	3.9	0.83	0.055	0.023	0.0000	0.0000	0.0000	0.0000
8	120	130	960.0	0.0	0.0	960.0	0.0	960.0	3500	3.6	0.83	0.055	0.023	0.0000	0.0000	0.0000	0.0000
8.5	120	130	1020.0	0.0	0.0	1020.0	0.0	1020.0	3500	3.4	0.83	0.055	0.023	0.0000	0.0000	0.0000	0.0000
9	120	130	1080.0	0.0	0.0	1080.0	0.0	1080.0	3500	3.2	0.83	0.055	0.023	0.0000	0.0000	0.0000	0.0000
9.5	120	130	1140.0	0.0	0.0	1140.0	0.0	1140.0	3500	3.1	0.83	0.055	0.023	0.0000	0.0000	0.0000	0.0000
10	120	130	1200.0	0.0	0.0	1200.0	0.0	1200.0	3500	2.9	0.83	0.055	0.023	0.0000	0.0000	0.0000	0.0000
10.5	120	130	1260.0	0.0	0.0	1260.0	0.0	1260.0	3500	2.8	0.59	0.057	0.016	0.0000	0.0000	0.0000	0.0000
11	120	130	1320.0	0.0	0.0	1320.0	0.0	1320.0	3500	2.7	0.59	0.057	0.016	0.0000	0.0000	0.0000	0.0000
11.5	120	130	1380.0	0.0	0.0	1380.0	0.0	1380.0	3500	2.5	0.59	0.057	0.016	0.0000	0.0000	0.0000	0.0000
12	120	130	1440.0	0.0	0.0	1440.0	2000.0	3440.0	3500	2.4	0.59	0.057	0.016	0.0000	0.0038	0.0038	0.0114
12.5	120	130	1500.0	0.0	0.0	1500.0	1815.1	3315.1	3500	2.3	0.59	0.057	0.016	0.0000	0.0035	0.0035	0.0218
13	120	130	1560.0	0.0	0.0	1560.0	1653.7	3213.7	3500	2.2	0.59	0.057	0.016	0.0000	0.0032	0.0032	0.0199
13.5	120	130	1620.0	0.0	0.0	1620.0	1513.0	3133.0	3500	2.2	0.59	0.057	0.016	0.0000	0.0029	0.0029	0.0181
14	120	130	1680.0	0.0	0.0	1680.0	1389.5	3069.5	3500	2.1	0.59	0.057	0.016	0.0000	0.0026	0.0026	0.0165
14.5	120	130	1740.0	0.0	0.0	1740.0	1280.5	3020.5	3500	2.0	0.59	0.057	0.016	0.0000	0.0024	0.0024	0.0151
15	120	130	1800.0	0.0	0.0	1800.0	1183.9	2983.9	3500	1.9	0.59	0.057	0.016	0.0000	0.0022	0.0022	0.0139
15.5	120	130	1860.0	0.0	0.0	1860.0	1097.8	2957.8	3500	1.9	0.59	0.057	0.016	0.0000	0.0020	0.0020	0.0127
16	120	130	1920.0	0.0	0.0	1920.0	1020.7	2940.7	3500	1.8	0.59	0.057	0.016	0.0000	0.0019	0.0019	0.0117
16.5	120	130	1980.0	0.0	0.0	1980.0	951.5	2931.5	3500	1.8	0.59	0.057	0.016	0.0000	0.0017	0.0017	0.0107
17	120	130	2040.0	0.0	0.0	2040.0	889.1	2929.1	3500	1.7	0.59	0.057	0.016	0.0000	0.0016	0.0016	0.0099
17.5	120	130	2100.0	0.0	0.0	2100.0	832.7	2932.7	3500	1.7	0.59	0.057	0.016	0.0000	0.0015	0.0015	0.0091
18	120	130	2160.0	0.0	0.0	2160.0	781.4	2941.4	3500	1.6	0.59	0.057	0.016	0.0000	0.0013	0.0013	0.0084
18.5	120	130	2220.0	0.0	0.0	2220.0	734.8	2954.8	3500	1.6	0.59	0.057	0.016	0.0000	0.0012	0.0012	0.0078
19	120	130	2280.0	0.0	0.0	2280.0	692.2	2972.2	3500	1.5	0.59	0.057	0.016	0.0000	0.0012	0.0012	0.0072
19.5	120	130	2340.0	0.0	0.0	2340.0	653.2	2993.2	3500	1.5	0.59	0.057	0.016	0.0000	0.0011	0.0011	0.0067
20	120	130	2400.0	0.0	0.0	2400.0	617.4	3017.4	3500	1.5	0.59	0.057	0.016	0.0000	0.0010	0.0010	0.0062
20.5	120	130	2460.0	0.0	0.0	2460.0	584.5	3044.5	3500	1.4	0.59	0.057	0.016	0.0000	0.0009	0.0009	0.0058
21	120	130	2520.0	0.0	0.0	2520.0	554.1	3074.1	3500	1.4	0.59	0.057	0.016	0.0000	0.0009	0.0009	0.0054
21.5	120	130	2585.0	62.4	31.2	2553.8	526.1	3079.9	3500	1.4	0.59	0.057	0.016	0.0000	0.0008	0.0008	0.0051
22	120	130	2650.0	62.4	62.4	2587.6	500.1	3087.7	3500	1.4	0.59	0.057	0.016	0.0000	0.0008	0.0008	0.0048
22.5	120	130	2715.0	62.4	93.6	2621.4	476.0	3097.4	3500	1.3	0.59	0.057	0.016	0.0000	0.0007	0.0007	0.0045
23	120	130	2780.0	62.4	124.8	2655.2	453.6	3108.8	3500	1.3	0.59	0.057	0.016	0.0000	0.0007	0.0007	0.0043
23.5	120	130	2845.0	62.4	156.0	2689.0	432.7	3121.7	3500	1.3	0.59	0.057	0.016	0.0000	0.0007	0.0007	0.0040
24	120	130	2910.0	62.4	187.2	2722.8	413.3	3136.1	3500	1.3	0.59	0.057	0.016	0.0000	0.0006	0.0006	0.0038
24.5	120	130	2975.0	62.4	218.4	2756.6	395.1	3151.7	3500	1.3	0.59	0.057	0.016	0.0000	0.0006	0.0006	0.0036
25	120	130	3040.0	62.4	249.6	2790.4	378.1	3168.5	3500	1.3	0.59	0.057	0.016	0.0000	0.0006	0.0006	0.0034
25.5	120	130	3105.0	62.4	280.8	2824.2	362.2	3186.4	3500	1.2	0.59	0.057	0.016	0.0000	0.0005	0.0005	0.0032
26	120	130	3170.0	62.4	312.0	2858.0	347.3	3205.3	3500	1.2	0.59	0.057	0.016	0.0000	0.0005	0.0005	0.0031
26.5	120	130	3235.0	62.4	343.2	2891.8	333.2	3225.0	3500	1.2	0.59	0.057	0.016	0.0000	0.0005	0.0005	0.0029
27	120	130	3300.0	62.4	374.4	2925.6	320.0	3245.6	3500	1.2	0.59	0.057	0.016	0.0000	0.0005	0.0005	0.0028
27.5	120	130	3365.0	62.4	405.6	2959.4	307.6	3267.0	3500	1.2	0.59	0.057	0.016	0.0000	0.0004	0.0004	0.0027

Static Settlement Calculations

Reference: Das, B. M., 1990, Principles of Foundation Engineering, 2nd Edition, Chapter 3, P. 167-169.

Calculation Sheet #: 1

Project No.: 22590 Client: 5297 Marina Island, LLC Engineer: RSB

Project Description: Proposed 5-Story Building over Subterranean Parking Level

Applied Load, Q =	200	kips
Applied Pressure, q =	2000	psf
Preconsolidation, σ'_p =	3500	psf
Footing Width, B =	10	ft
Footing Length, L =	10	ft
Embedment Depth, D =	12	ft
Depth to Groundwater =	21	ft
Depth of Compressible Layer below Footing =	0	ft
Unit Weight above Compressible Layer =	120	pcf

Geotechnical Properties of Soil Layers

Depth		Unit Wt.	Sat.	Consol. Parameters		
From	To	γ_t, (pcf)	γ_{sat}, (pcf)	e_0	C_c	C_s
0	10	120	130	0.83	0.055	0.023
10	30	120	130	0.59	0.057	0.016
30	40	120	130	0.57	0.063	0.018

Total Settlement = 0.31"

Depth (ft)	γ_t (pcf)	γ_{sat} (pcf)	σ_o (psf)	γ_w (pcf)	u (psf)	σ'_o (psf)	Ave. Δq (psf)	$\sigma'_o + \Delta q$ (psf)	σ'_p (psf)	OCR	e_0	C_c	C_s	Comp. Strain	Recomp. Strain	ϵ_v	Settlement (in)
28	120	130	3430.0	62.4	436.8	2993.2	295.9	3289.1	3500	1.2	0.59	0.057	0.016	0.0000	0.0004	0.0004	0.0025
28.5	120	130	3495.0	62.4	468.0	3027.0	284.8	3311.8	3500	1.2	0.59	0.057	0.016	0.0000	0.0004	0.0004	0.0024
29	120	130	3560.0	62.4	499.2	3060.8	274.4	3335.2	3500	1.1	0.59	0.057	0.016	0.0000	0.0004	0.0004	0.0023
29.5	120	130	3625.0	62.4	530.4	3094.6	264.5	3359.1	3500	1.1	0.59	0.057	0.016	0.0000	0.0004	0.0004	0.0022
30	120	130	3690.0	62.4	561.6	3128.4	255.1	3383.5	3500	1.1	0.59	0.057	0.016	0.0000	0.0003	0.0003	0.0021
30.5	120	130	3755.0	62.4	592.8	3162.2	246.2	3408.4	3500	1.1	0.57	0.063	0.018	0.0000	0.0004	0.0004	0.0021
31	120	130	3820.0	62.4	624.0	3196.0	237.8	3433.8	3500	1.1	0.57	0.063	0.018	0.0000	0.0004	0.0004	0.0022
31.5	120	130	3885.0	62.4	655.2	3229.8	229.8	3459.6	3500	1.1	0.57	0.063	0.018	0.0000	0.0003	0.0003	0.0021
32	120	130	3950.0	62.4	686.4	3263.6	222.2	3485.8	3500	1.1	0.57	0.063	0.018	0.0000	0.0003	0.0003	0.0020
32.5	120	130	4015.0	62.4	717.6	3297.4	215.0	3512.4	3500	1.1	0.57	0.063	0.018	0.0001	0.0003	0.0004	0.0021
33	120	130	4080.0	62.4	748.8	3331.2	208.1	3539.3	3500	1.1	0.57	0.063	0.018	0.0002	0.0002	0.0004	0.0024
33.5	120	130	4145.0	62.4	780.0	3365.0	201.6	3566.6	3500	1.0	0.57	0.063	0.018	0.0003	0.0002	0.0005	0.0029
34	120	130	4210.0	62.4	811.2	3398.8	195.3	3594.1	3500	1.0	0.57	0.063	0.018	0.0005	0.0001	0.0006	0.0034
34.5	120	130	4275.0	62.4	842.4	3432.6	189.4	3622.0	3500	1.0	0.57	0.063	0.018	0.0006	0.0001	0.0007	0.0039
35	120	130	4340.0	62.4	873.6	3466.4	183.7	3650.1	3500	1.0	0.57	0.063	0.018	0.0007	0.0000	0.0008	0.0044
35.5	120	130	4405.0	62.4	904.8	3500.2	178.2	3678.4	3500	1.0	0.57	0.063	0.018	0.0000	0.0000	0.0000	0.0023
36	120	130	4470.0	62.4	936.0	3534.0	173.0	3707.0	3500	1.0	0.57	0.063	0.018	0.0000	0.0000	0.0000	0.0000
36.5	120	130	4535.0	62.4	967.2	3567.8	168.0	3735.8	3500	1.0	0.57	0.063	0.018	0.0000	0.0000	0.0000	0.0000
37	120	130	4600.0	62.4	998.4	3601.6	163.3	3764.9	3500	1.0	0.57	0.063	0.018	0.0000	0.0000	0.0000	0.0000
37.5	120	130	4665.0	62.4	1029.6	3635.4	158.7	3794.1	3500	1.0	0.57	0.063	0.018	0.0000	0.0000	0.0000	0.0000
38	120	130	4730.0	62.4	1060.8	3669.2	154.3	3823.5	3500	1.0	0.57	0.063	0.018	0.0000	0.0000	0.0000	0.0000
38.5	120	130	4795.0	62.4	1092.0	3703.0	150.1	3853.1	3500	0.9	0.57	0.063	0.018	0.0000	0.0000	0.0000	0.0000
39	120	130	4860.0	62.4	1123.2	3736.8	146.1	3882.9	3500	0.9	0.57	0.063	0.018	0.0000	0.0000	0.0000	0.0000
39.5	120	130	4925.0	62.4	1154.4	3770.6	142.2	3912.8	3500	0.9	0.57	0.063	0.018	0.0000	0.0000	0.0000	0.0000
40	120	130	4990.0	62.4	1185.6	3804.4	138.5	3942.9	3500	0.9	0.57	0.063	0.018	0.0000	0.0000	0.0000	0.0000

Static Settlement Calculations

Reference: Das, B. M., 1990, Principles of Foundation Engineering, 2nd Edition, Chapter 3, P. 167-169.

Calculation Sheet #: 2

Project No.: 22590 Client: 5297 Marina Island, LLC Engineer: RSB
Project Description: Proposed 5-Story Building over Subterranean Parking Level

Applied Load, Q =	400	kips
Applied Pressure, q =	4000	psf
Preconsolidation, σ'_p =	3500	psf
Footing Width, B =	10	ft
Footing Length, L =	10	ft
Embedment Depth, D =	12	ft
Depth to Groundwater =	21	ft
Depth of Compressible Layer below Footing =	0	ft
Unit Weight above Compressible Layer =	120	pcf

Geotechnical Properties of Soil Layers

Depth		Unit Wt.	Sat.	Consol. Parameters		
From	To	γ_t (pcf)	γ_{sat} (pcf)	e_0	C_c	C_s
0	10	120	130	0.83	0.055	0.023
10	30	120	130	0.59	0.057	0.016
30	40	120	130	0.57	0.063	0.018

Total Settlement = 0.78"

Depth (ft)	γ_t (pcf)	γ_{sat} (pcf)	σ_o (psf)	γ_w (pcf)	u (psf)	σ'_o (psf)	Ave. Δq (psf)	$\sigma'_o + \Delta q$ (psf)	σ'_p (psf)	OCR	e_0	C_c	C_s	Comp. Strain	Recomp. Strain	ϵ_v	Settlement (in)
0.5	120	130	60.0	0.0	0.0	60.0	0.0	60.0	3500	58.3	0.83	0.055	0.023	0.0000	0.0000	0.0000	0.0000
1	120	130	120.0	0.0	0.0	120.0	0.0	120.0	3500	29.2	0.83	0.055	0.023	0.0000	0.0000	0.0000	0.0000
1.5	120	130	180.0	0.0	0.0	180.0	0.0	180.0	3500	19.4	0.83	0.055	0.023	0.0000	0.0000	0.0000	0.0000
2	120	130	240.0	0.0	0.0	240.0	0.0	240.0	3500	14.6	0.83	0.055	0.023	0.0000	0.0000	0.0000	0.0000
2.5	120	130	300.0	0.0	0.0	300.0	0.0	300.0	3500	11.7	0.83	0.055	0.023	0.0000	0.0000	0.0000	0.0000
3	120	130	360.0	0.0	0.0	360.0	0.0	360.0	3500	9.7	0.83	0.055	0.023	0.0000	0.0000	0.0000	0.0000
3.5	120	130	420.0	0.0	0.0	420.0	0.0	420.0	3500	8.3	0.83	0.055	0.023	0.0000	0.0000	0.0000	0.0000
4	120	130	480.0	0.0	0.0	480.0	0.0	480.0	3500	7.3	0.83	0.055	0.023	0.0000	0.0000	0.0000	0.0000
4.5	120	130	540.0	0.0	0.0	540.0	0.0	540.0	3500	6.5	0.83	0.055	0.023	0.0000	0.0000	0.0000	0.0000
5	120	130	600.0	0.0	0.0	600.0	0.0	600.0	3500	5.8	0.83	0.055	0.023	0.0000	0.0000	0.0000	0.0000
5.5	120	130	660.0	0.0	0.0	660.0	0.0	660.0	3500	5.3	0.83	0.055	0.023	0.0000	0.0000	0.0000	0.0000
6	120	130	720.0	0.0	0.0	720.0	0.0	720.0	3500	4.9	0.83	0.055	0.023	0.0000	0.0000	0.0000	0.0000
6.5	120	130	780.0	0.0	0.0	780.0	0.0	780.0	3500	4.5	0.83	0.055	0.023	0.0000	0.0000	0.0000	0.0000
7	120	130	840.0	0.0	0.0	840.0	0.0	840.0	3500	4.2	0.83	0.055	0.023	0.0000	0.0000	0.0000	0.0000
7.5	120	130	900.0	0.0	0.0	900.0	0.0	900.0	3500	3.9	0.83	0.055	0.023	0.0000	0.0000	0.0000	0.0000
8	120	130	960.0	0.0	0.0	960.0	0.0	960.0	3500	3.6	0.83	0.055	0.023	0.0000	0.0000	0.0000	0.0000
8.5	120	130	1020.0	0.0	0.0	1020.0	0.0	1020.0	3500	3.4	0.83	0.055	0.023	0.0000	0.0000	0.0000	0.0000
9	120	130	1080.0	0.0	0.0	1080.0	0.0	1080.0	3500	3.2	0.83	0.055	0.023	0.0000	0.0000	0.0000	0.0000
9.5	120	130	1140.0	0.0	0.0	1140.0	0.0	1140.0	3500	3.1	0.83	0.055	0.023	0.0000	0.0000	0.0000	0.0000
10	120	130	1200.0	0.0	0.0	1200.0	0.0	1200.0	3500	2.9	0.83	0.055	0.023	0.0000	0.0000	0.0000	0.0000
10.5	120	130	1260.0	0.0	0.0	1260.0	0.0	1260.0	3500	2.8	0.59	0.057	0.016	0.0000	0.0000	0.0000	0.0000
11	120	130	1320.0	0.0	0.0	1320.0	0.0	1320.0	3500	2.7	0.59	0.057	0.016	0.0000	0.0000	0.0000	0.0000
11.5	120	130	1380.0	0.0	0.0	1380.0	0.0	1380.0	3500	2.5	0.59	0.057	0.016	0.0000	0.0000	0.0000	0.0000
12	120	130	1440.0	0.0	0.0	1440.0	4000.0	5440.0	3500	2.4	0.59	0.057	0.016	0.0069	0.0039	0.0107	0.0322
12.5	120	130	1500.0	0.0	0.0	1500.0	3630.2	5130.2	3500	2.3	0.59	0.057	0.016	0.0060	0.0037	0.0097	0.0612
13	120	130	1560.0	0.0	0.0	1560.0	3307.5	4867.5	3500	2.2	0.59	0.057	0.016	0.0051	0.0035	0.0087	0.0550
13.5	120	130	1620.0	0.0	0.0	1620.0	3026.0	4646.0	3500	2.2	0.59	0.057	0.016	0.0044	0.0034	0.0078	0.0493
14	120	130	1680.0	0.0	0.0	1680.0	2779.0	4459.0	3500	2.1	0.59	0.057	0.016	0.0038	0.0032	0.0070	0.0443
14.5	120	130	1740.0	0.0	0.0	1740.0	2561.0	4301.0	3500	2.0	0.59	0.057	0.016	0.0032	0.0031	0.0063	0.0397
15	120	130	1800.0	0.0	0.0	1800.0	2367.7	4167.7	3500	1.9	0.59	0.057	0.016	0.0027	0.0029	0.0056	0.0357
15.5	120	130	1860.0	0.0	0.0	1860.0	2195.5	4055.5	3500	1.9	0.59	0.057	0.016	0.0023	0.0028	0.0051	0.0320
16	120	130	1920.0	0.0	0.0	1920.0	2041.5	3961.5	3500	1.8	0.59	0.057	0.016	0.0019	0.0026	0.0046	0.0288
16.5	120	130	1980.0	0.0	0.0	1980.0	1903.1	3883.1	3500	1.8	0.59	0.057	0.016	0.0016	0.0025	0.0041	0.0260
17	120	130	2040.0	0.0	0.0	2040.0	1778.3	3818.3	3500	1.7	0.59	0.057	0.016	0.0014	0.0024	0.0037	0.0235
17.5	120	130	2100.0	0.0	0.0	2100.0	1665.4	3765.4	3500	1.7	0.59	0.057	0.016	0.0011	0.0022	0.0034	0.0213
18	120	130	2160.0	0.0	0.0	2160.0	1562.9	3722.9	3500	1.6	0.59	0.057	0.016	0.0010	0.0021	0.0031	0.0193
18.5	120	130	2220.0	0.0	0.0	2220.0	1469.6	3689.6	3500	1.6	0.59	0.057	0.016	0.0008	0.0020	0.0028	0.0176
19	120	130	2280.0	0.0	0.0	2280.0	1384.4	3664.4	3500	1.5	0.59	0.057	0.016	0.0007	0.0019	0.0026	0.0162
19.5	120	130	2340.0	0.0	0.0	2340.0	1306.4	3646.4	3500	1.5	0.59	0.057	0.016	0.0006	0.0018	0.0024	0.0150
20	120	130	2400.0	0.0	0.0	2400.0	1234.8	3634.8	3500	1.5	0.59	0.057	0.016	0.0006	0.0016	0.0022	0.0139
20.5	120	130	2460.0	0.0	0.0	2460.0	1168.9	3628.9	3500	1.4	0.59	0.057	0.016	0.0006	0.0015	0.0021	0.0130
21	120	130	2520.0	0.0	0.0	2520.0	1108.2	3628.2	3500	1.4	0.59	0.057	0.016	0.0006	0.0014	0.0020	0.0123
21.5	120	130	2585.0	62.4	31.2	2553.8	1052.1	3605.9	3500	1.4	0.59	0.057	0.016	0.0005	0.0014	0.0018	0.0115
22	120	130	2650.0	62.4	62.4	2587.6	1000.2	3587.8	3500	1.4	0.59	0.057	0.016	0.0004	0.0013	0.0017	0.0106
22.5	120	130	2715.0	62.4	93.6	2621.4	952.0	3573.4	3500	1.3	0.59	0.057	0.016	0.0003	0.0013	0.0016	0.0099
23	120	130	2780.0	62.4	124.8	2655.2	907.2	3562.4	3500	1.3	0.59	0.057	0.016	0.0003	0.0012	0.0015	0.0092
23.5	120	130	2845.0	62.4	156.0	2689.0	865.4	3554.4	3500	1.3	0.59	0.057	0.016	0.0002	0.0012	0.0014	0.0086
24	120	130	2910.0	62.4	187.2	2722.8	826.6	3549.4	3500	1.3	0.59	0.057	0.016	0.0002	0.0011	0.0013	0.0081
24.5	120	130	2975.0	62.4	218.4	2756.6	790.2	3546.8	3500	1.3	0.59	0.057	0.016	0.0002	0.0010	0.0013	0.0077
25	120	130	3040.0	62.4	249.6	2790.4	756.2	3546.6	3500	1.3	0.59	0.057	0.016	0.0002	0.0010	0.0012	0.0073
25.5	120	130	3105.0	62.4	280.8	2824.2	724.4	3548.6	3500	1.2	0.59	0.057	0.016	0.0002	0.0009	0.0012	0.0070
26	120	130	3170.0	62.4	312.0	2858.0	694.5	3552.5	3500	1.2	0.59	0.057	0.016	0.0002	0.0009	0.0011	0.0068
26.5	120	130	3235.0	62.4	343.2	2891.8	666.5	3558.3	3500	1.2	0.59	0.057	0.016	0.0003	0.0008	0.0011	0.0066
27	120	130	3300.0	62.4	374.4	2925.6	640.1	3565.7	3500	1.2	0.59	0.057	0.016	0.0003	0.0008	0.0011	0.0065
27.5	120	130	3365.0	62.4	405.6	2959.4	615.2	3574.6	3500	1.2	0.59	0.057	0.016	0.0003	0.0007	0.0011	0.0064

Static Settlement Calculations

Reference: Das, B. M., 1990, Principles of Foundation Engineering, 2nd Edition, Chapter 3, P. 167-169.

Calculation Sheet #: 2

Project No.: 22590 Client: 5297 Marina Island, LLC Engineer: RSB

Project Description: Proposed 5-Story Building over Subterranean Parking Level

Applied Load, Q =	400	kips	Footing Width, B =	10	ft
Applied Pressure, q =	4000	psf	Footing Length, L =	10	ft
Preconsolidation, σ'_p =	3500	psf	Embedment Depth, D =	12	ft
			Depth to Groundwater =	21	ft
			Depth of Compressible Layer below Footing =	0	ft
			Unit Weight above Compressible Layer =	120	pcf

Geotechnical Properties of Soil Layers

Depth		Unit Wt.	Sat.	Consol. Parameters		
From	To	γ_t, (pcf)	γ_{sat}, (pcf)	e_0	C_c	C_s
0	10	120	130	0.83	0.055	0.023
10	30	120	130	0.59	0.057	0.016
30	40	120	130	0.57	0.063	0.018

Total Settlement = 0.78"

Depth (ft)	γ_t (pcf)	γ_{sat} (pcf)	σ_o (psf)	γ_w (pcf)	u (psf)	σ'_o (psf)	Ave. Δq (psf)	$\sigma'_o + \Delta q$ (psf)	σ'_p (psf)	OCR	e_0	C_c	C_s	Comp. Strain	Recomp. Strain	ϵ_v	Settlement (in)
28	120	130	3430.0	62.4	436.8	2993.2	591.8	3585.0	3500	1.2	0.59	0.057	0.016	0.0004	0.0007	0.0011	0.0064
28.5	120	130	3495.0	62.4	468.0	3027.0	569.6	3596.6	3500	1.2	0.59	0.057	0.016	0.0004	0.0006	0.0011	0.0063
29	120	130	3560.0	62.4	499.2	3060.8	548.7	3609.5	3500	1.1	0.59	0.057	0.016	0.0005	0.0006	0.0011	0.0064
29.5	120	130	3625.0	62.4	530.4	3094.6	529.0	3623.6	3500	1.1	0.59	0.057	0.016	0.0005	0.0005	0.0011	0.0064
30	120	130	3690.0	62.4	561.6	3128.4	510.2	3638.6	3500	1.1	0.59	0.057	0.016	0.0006	0.0005	0.0011	0.0065
30.5	120	130	3755.0	62.4	592.8	3162.2	492.5	3654.7	3500	1.1	0.57	0.063	0.018	0.0008	0.0005	0.0013	0.0071
31	120	130	3820.0	62.4	624.0	3196.0	475.7	3671.7	3500	1.1	0.57	0.063	0.018	0.0008	0.0005	0.0013	0.0076
31.5	120	130	3885.0	62.4	655.2	3229.8	459.7	3689.5	3500	1.1	0.57	0.063	0.018	0.0009	0.0004	0.0013	0.0078
32	120	130	3950.0	62.4	686.4	3263.6	444.5	3708.1	3500	1.1	0.57	0.063	0.018	0.0010	0.0003	0.0014	0.0080
32.5	120	130	4015.0	62.4	717.6	3297.4	430.0	3727.4	3500	1.1	0.57	0.063	0.018	0.0011	0.0003	0.0014	0.0082
33	120	130	4080.0	62.4	748.8	3331.2	416.3	3747.5	3500	1.1	0.57	0.063	0.018	0.0012	0.0002	0.0014	0.0085
33.5	120	130	4145.0	62.4	780.0	3365.0	403.1	3768.1	3500	1.0	0.57	0.063	0.018	0.0013	0.0002	0.0015	0.0088
34	120	130	4210.0	62.4	811.2	3398.8	390.6	3789.4	3500	1.0	0.57	0.063	0.018	0.0014	0.0001	0.0015	0.0090
34.5	120	130	4275.0	62.4	842.4	3432.6	378.7	3811.3	3500	1.0	0.57	0.063	0.018	0.0015	0.0001	0.0016	0.0093
35	120	130	4340.0	62.4	873.6	3466.4	367.3	3833.7	3500	1.0	0.57	0.063	0.018	0.0016	0.0000	0.0016	0.0097
35.5	120	130	4405.0	62.4	904.8	3500.2	356.4	3856.6	3500	1.0	0.57	0.063	0.018	0.0000	0.0000	0.0000	0.0049
36	120	130	4470.0	62.4	936.0	3534.0	346.0	3880.0	3500	1.0	0.57	0.063	0.018	0.0000	0.0000	0.0000	0.0000
36.5	120	130	4535.0	62.4	967.2	3567.8	336.1	3903.9	3500	1.0	0.57	0.063	0.018	0.0000	0.0000	0.0000	0.0000
37	120	130	4600.0	62.4	998.4	3601.6	326.5	3928.1	3500	1.0	0.57	0.063	0.018	0.0000	0.0000	0.0000	0.0000
37.5	120	130	4665.0	62.4	1029.6	3635.4	317.4	3952.8	3500	1.0	0.57	0.063	0.018	0.0000	0.0000	0.0000	0.0000
38	120	130	4730.0	62.4	1060.8	3669.2	308.7	3977.9	3500	1.0	0.57	0.063	0.018	0.0000	0.0000	0.0000	0.0000
38.5	120	130	4795.0	62.4	1092.0	3703.0	300.3	4003.3	3500	0.9	0.57	0.063	0.018	0.0000	0.0000	0.0000	0.0000
39	120	130	4860.0	62.4	1123.2	3736.8	292.2	4029.0	3500	0.9	0.57	0.063	0.018	0.0000	0.0000	0.0000	0.0000
39.5	120	130	4925.0	62.4	1154.4	3770.6	284.5	4055.1	3500	0.9	0.57	0.063	0.018	0.0000	0.0000	0.0000	0.0000
40	120	130	4990.0	62.4	1185.6	3804.4	277.0	4081.4	3500	0.9	0.57	0.063	0.018	0.0000	0.0000	0.0000	0.0000

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RETAINING WALL

BG: **22590** ENGINEER: **RSB**
CLIENT: **5297 Marina Island, LLC**

CALCULATION SHEET # **3**

CALCULATE THE DESIGN ACTIVE EQUIVALENT FLUID PRESSURE (EFP) FOR THE PROPOSED RETAINING WALL. ASSUME BACKFILL IS SATURATED AND THERE IS NO HYDROSTATIC PRESSURE THE RETAINED HEIGHT AND BACKSLOPE AND SURCHARGE CONDITIONS ARE LISTED BELOW. USE THE MONONOBE-OKABE METHOD FOR SEISMIC FORCES.

CALCULATION PARAMETERS

EARTH MATERIAL:	Alluvium	WALL HEIGHT	12 feet
SHEAR DIAGRAM:	1	BACKSLOPE ANGLE:	0 degrees
COHESION:	480 psf	SURCHARGE:	300 pounds
PHI ANGLE:	26 degrees	SURCHARGE TYPE:	U Uniform
DENSITY	120 pcf	INITIAL FAILURE ANGLE:	20 degrees
SAFETY FACTOR:	1.5	FINAL FAILURE ANGLE:	70 degrees
WALL FRICTION	0 degrees	INITIAL TENSION CRACK:	1 feet
CD (C/FS):	320.0 psf	FINAL TENSION CRACK:	20 feet

PHID = ATAN(TAN(PHI)/FS) = 18.0 degrees

HORIZONTAL PSEUDO STATIC SEISMIC COEFFICIENT (k_h) 0 g

VERTICAL PSEUDO STATIC SEISMIC COEFFICIENT (k_v) 0 g

CALCULATED RESULTS

CRITICAL FAILURE ANGLE	54 degrees
AREA OF TRIAL FAILURE WEDGE	42.8 square feet
TOTAL EXTERNAL SURCHARGE	1200.0 pounds
WEIGHT OF TRIAL FAILURE WEDGE	6335.4 pounds
NUMBER OF TRIAL WEDGES ANALYZED	1020 trials
LENGTH OF FAILURE PLANE	8.5 feet
DEPTH OF TENSION CRACK	5.1 feet
HORIZONTAL DISTANCE TO UPSLOPE TENSION CRACK	5.0 feet
CALCULATED HORIZONTAL THRUST ON WALL	**1401.6 pounds**
CALCULATED EQUIVALENT FLUID PRESSURE	**19.5 pcf**
DESIGN EQUIVALENT FLUID PRESSURE	**43.0 pcf**

CONCLUSION:

THE CALCULATION INDICATES THAT CANTILEVER RETAINING WALLS UP TO 6 FEET HIGH, WITH LEVEL BACKSLOPE AND SURCHARGE, MAY BE DESIGNED FOR AN ACTIVE EQUIVALENT FLUID PRESSURE OF 43 POUNDS-PER-CUBIC-FOOT.

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RETAINING WALL

BG: **22590** ENGINEER: **RSB**
CLIENT: **5297 Marina Island, LLC**

CALCULATION SHEET # **4**

CALCULATE THE DESIGN SEISMIC FORCE FOR THE PROPOSED RETAINING WALL. ASSUME BACKFILL IS SATURATED AND THERE IS NO HYDROSTATIC PRESSURE THE RETAINED HEIGHT AND BACKSLOPE AND SURCHARGE CONDITIONS ARE LISTED BELOW. USE THE MONONOBE-OKABE METHOD FOR SEISMIC FORCES.

CALCULATION PARAMETERS

EARTH MATERIAL:	Alluvium	WALL HEIGHT	12 feet
SHEAR DIAGRAM:	1	BACKSLOPE ANGLE:	0 degrees
COHESION:	480 psf	SURCHARGE:	300 pounds
PHI ANGLE:	26 degrees	SURCHARGE TYPE:	U Uniform
DENSITY	120 pcf	INITIAL FAILURE ANGLE:	20 degrees
SAFETY FACTOR:	1	FINAL FAILURE ANGLE:	70 degrees
WALL FRICTION	0 degrees	INITIAL TENSION CRACK:	1 feet
CD (C/FS):	480.0 psf	FINAL TENSION CRACK:	20 feet

PHID = ATAN(TAN(PHI)/FS) = 26.0 degrees

HORIZONTAL PSEUDO STATIC SEISMIC COEFFICIENT (k_h) 0.21 g

VERTICAL PSEUDO STATIC SEISMIC COEFFICIENT (k_v) 0 g

CALCULATED RESULTS

CRITICAL FAILURE ANGLE	51 degrees
AREA OF TRIAL FAILURE WEDGE	38.1 square feet
TOTAL EXTERNAL SURCHARGE	900.0 pounds
WEIGHT OF TRIAL FAILURE WEDGE	5474.5 pounds
NUMBER OF TRIAL WEDGES ANALYZED	1020 trials
LENGTH OF FAILURE PLANE	6.4 feet
DEPTH OF TENSION CRACK	7.1 feet
HORIZONTAL DISTANCE TO UPSLOPE TENSION CRACK	4.0 feet
CALCULATED HORIZONTAL THRUST ON WALL	**676.8 pounds**

CONCLUSIONS:

THE CALCULATION INDICATES THAT NO ADDITIONAL SEISMIC LOADING IS REQUIRED FOR CANTILEVER AND RESTRAINED RETAINING WALLS UP TO 14 FEET HIGH (CALCULATED SEISMIC THRUST IS LESS THAN THE ACTIVE THRUST OF 3,096 POUNDS AND AT-REST THRUST OF 5,068.8 POUNDS).

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818.549.9959 TEL
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SHORING PILE

BG: **22590** ENGINEER: **RSB**
CLIENT: **5297 Marina Island, LLC**
CALCULATION SHEET # **5**

CALCULATE THE DESIGN MINIMUM EQUIVALENT FLUID PRESSURE (EFP) FOR PROPOSED SHORING PILE. ASSUME BACKFILL IS SATURATED AND THERE IS NO HYDROSTATIC PRESSURE THE RETAINED HEIGHT AND BACKSLOPE AND SURCHARGE CONDITIONS ARE LISTED BELOW. USE THE MONONOBE-OKABE METHOD FOR SEISMIC FORCES.

CALCULATION PARAMETERS

EARTH MATERIAL:	Alluvium	RETAINED LENGTH	14 feet
SHEAR DIAGRAM:	1	BACKSLOPE ANGLE:	0 degrees
COHESION:	480 psf	SURCHARGE:	300 pounds
PHI ANGLE:	26 degrees	SURCHARGE TYPE:	u Uniform
DENSITY	120 pcf	INITIAL FAILURE ANGLE:	20 degrees
SAFETY FACTOR:	1.25	FINAL FAILURE ANGLE:	70 degrees
PILE FRICTION	0 degrees	INITIAL TENSION CRACK:	1 feet
CD (C/FS):	384.0 psf	FINAL TENSION CRACK:	20 feet

PHID = ATAN(TAN(PHI)/FS) = 21.3 degrees

HORIZONTAL PSEUDO STATIC SEISMIC COEFFICIENT (k_h) 0 g

VERTICAL PSEUDO STATIC SEISMIC COEFFICIENT (k_v) 0 g

CALCULATED RESULTS

CRITICAL FAILURE ANGLE	55 degrees
AREA OF TRIAL FAILURE WEDGE	52.1 square feet
TOTAL EXTERNAL SURCHARGE	1200.0 pounds
WEIGHT OF TRIAL FAILURE WEDGE	7457.8 pounds
NUMBER OF TRIAL WEDGES ANALYZED	1020 trials
LENGTH OF FAILURE PLANE	8.7 feet
DEPTH OF TENSION CRACK	6.9 feet
HORIZONTAL DISTANCE TO UPSLOPE TENSION CRACK	5.0 feet
CALCULATED THRUST ON PILE	**1223.2 pounds**
CALCULATED EQUIVALENT FLUID PRESSURE	**12.5 pcf**
DESIGN EQUIVALENT FLUID PRESSURE	**30.0 pcf**

CONCLUSIONS:

THE PROPOSED TEMPORARY SHORING UP TO 14 FEET HIGH, WITH LEVEL BACKSLOPE AND VEHICULAR SURCHARGE, MAY BE DESIGNED FOR AN ACTIVE EQUIVALENT FLUID PRESSURE OF 30 POUNDS-PER-CUBIC-FOOT. IF PILES ARE USED, THE FLUID PRESSURE SHOULD BE MULTIPLIED BY THE PILE SPACING.

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1461 E. CHEVY CHASE DR., SUITE 200
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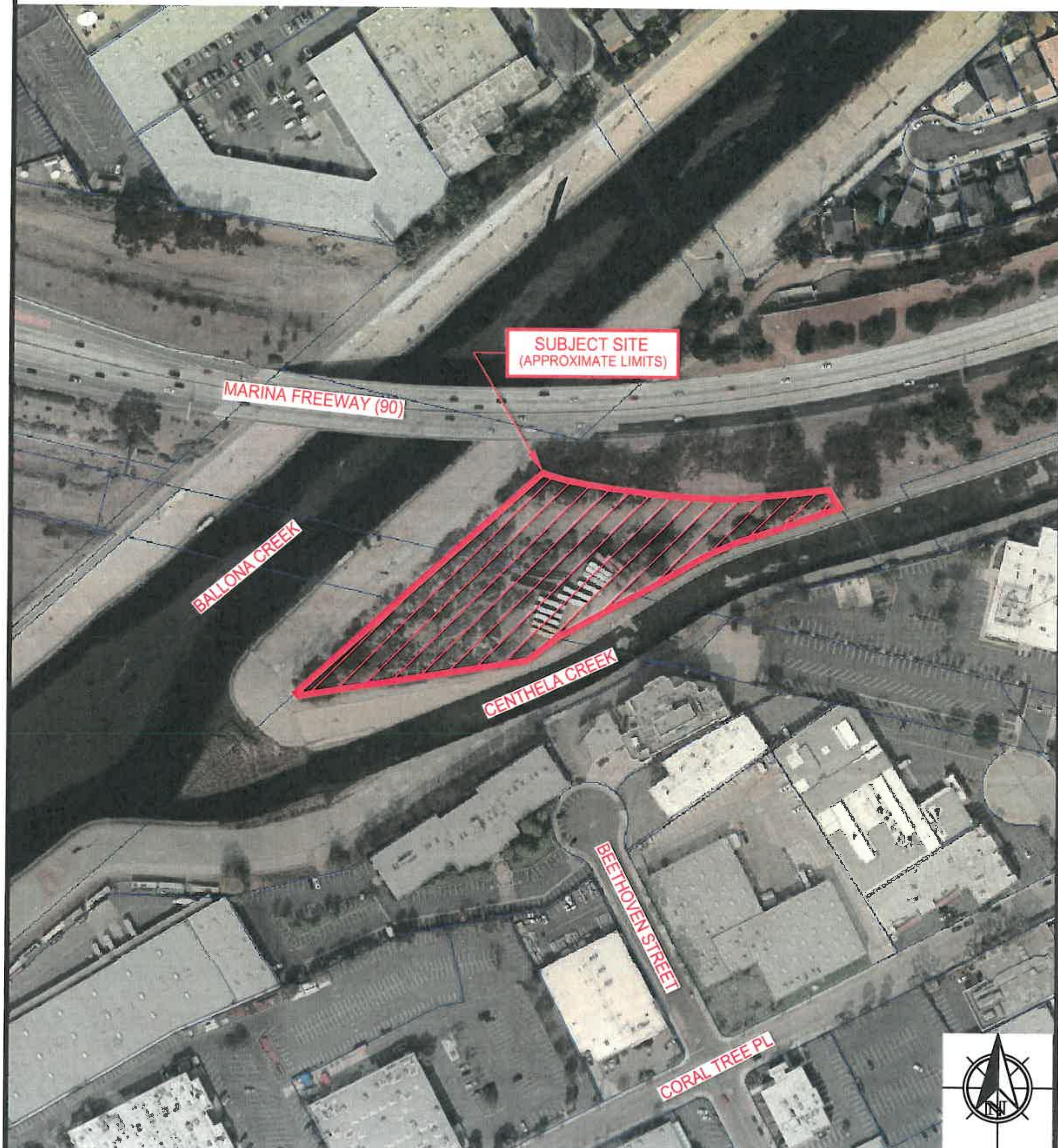
818.549.9959 TEL
818.543.3747 FAX

AERIAL VICINITY MAP

BG:22590	5297 MARINA ISLAND, LLC	
CONSULTANT: RSB		SCALE: 1" = 200'

REFERENCE: LOS ANGELES COUNTY DEPARTMENT OF REGIONAL PLANNING, GIS-NET, 2013, http://gis.planning.lacounty.gov/GIS-NET_Public/Viewer.html



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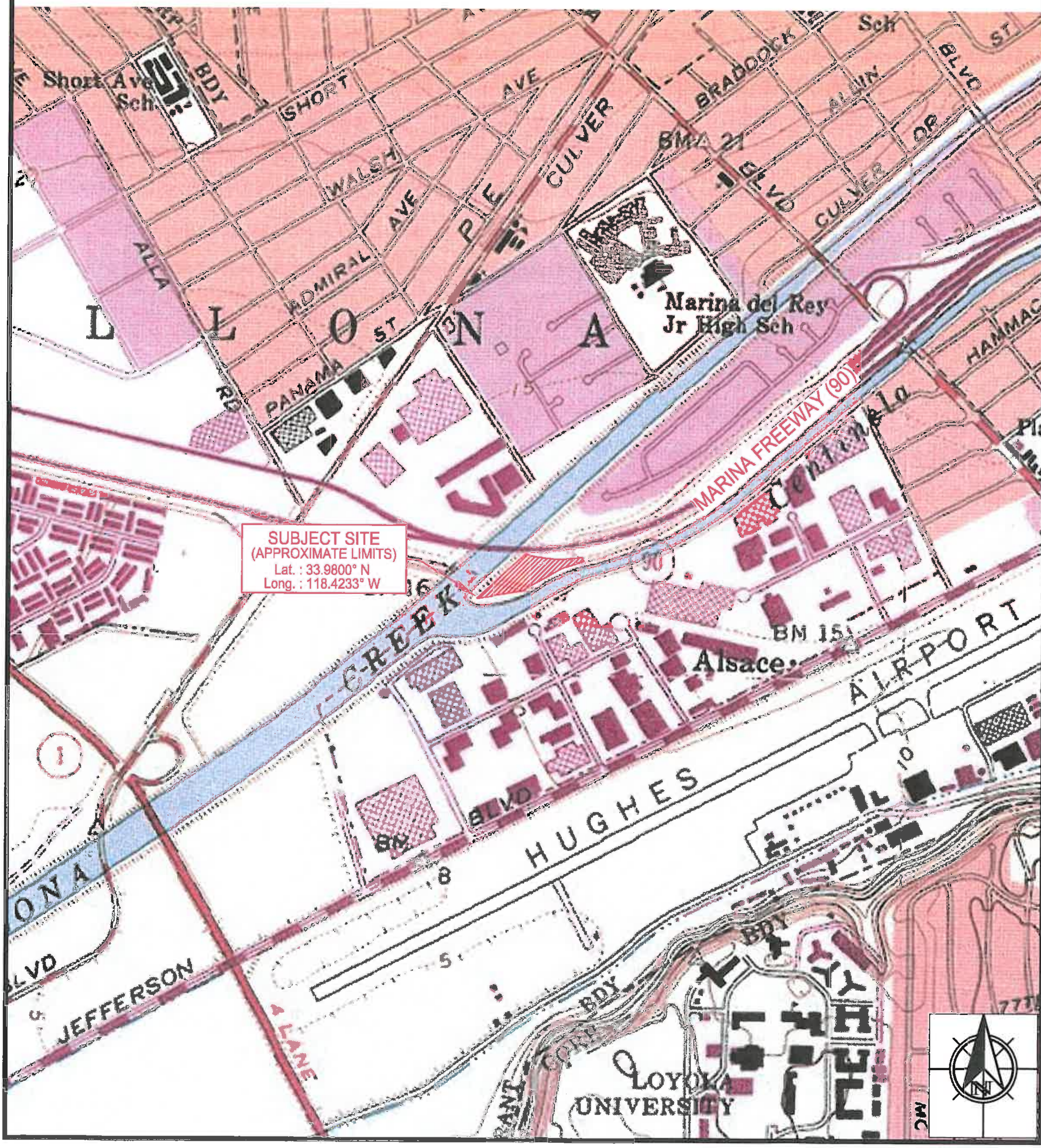
REGIONAL TOPOGRAPHIC MAP

BG:22590 5297 MARINA ISLAND, LLC

CONSULTANT: RSB

SCALE: 1" = 1000'

REFERENCE: USGS TOPOGRAPHIC MAP, VENICE 7.5-MINUTE SERIES QUADRANGLE, LOS ANGELES COUNTY, CALIFORNIA CREATED 1964.



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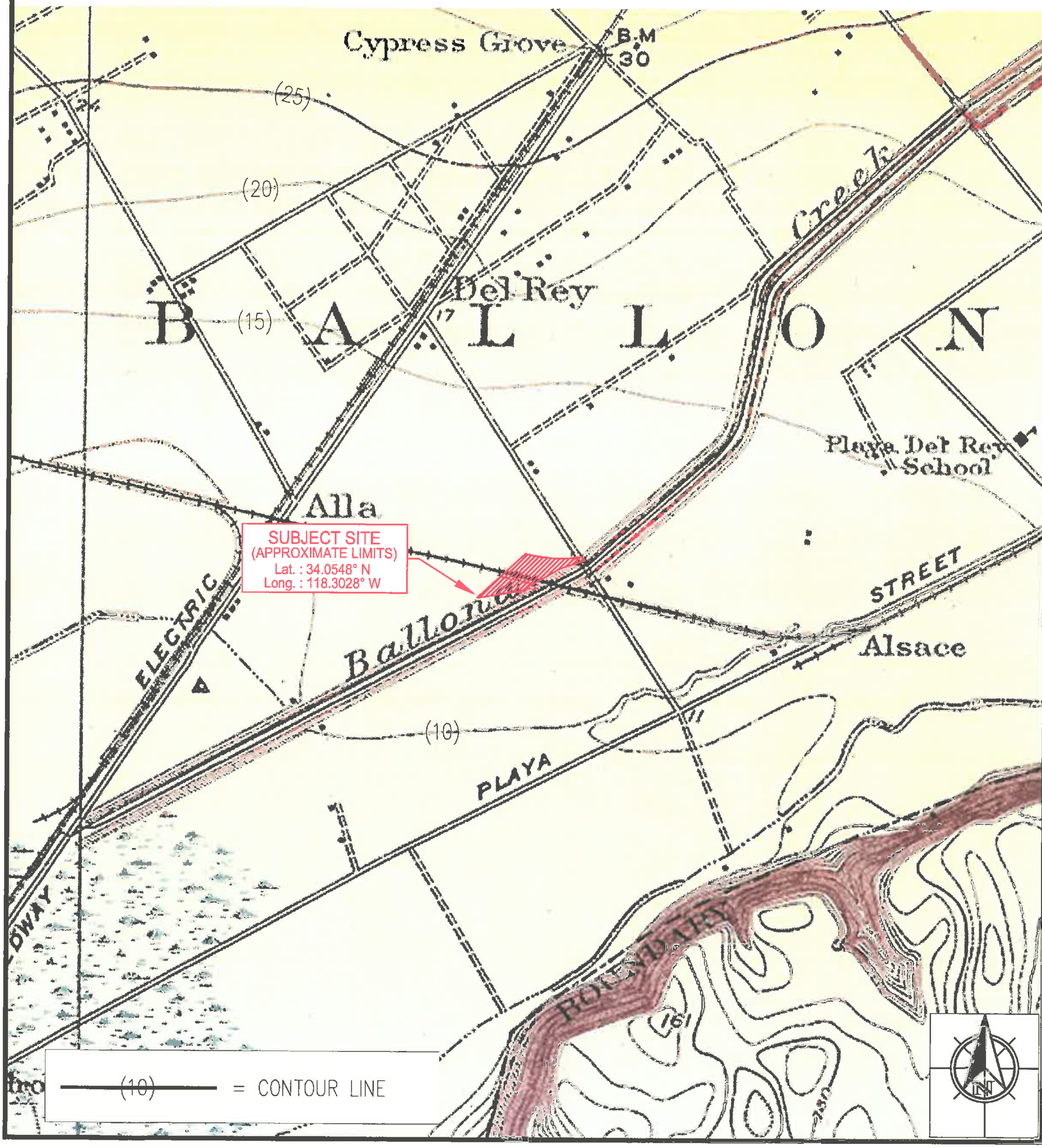
HISTORIC TOPOGRAPHIC MAP

BG:22590 5297 MARINA ISLAND, LLC

CONSULTANT: RSB SCALE: 1" = 1000'

REFERENCE: USGS TOPOGRAPHIC MAP, VENICE 6-MINUTE SERIES QUADRANGLE, LOS ANGELES COUNTY, CALIFORNIA CREATED 1924.



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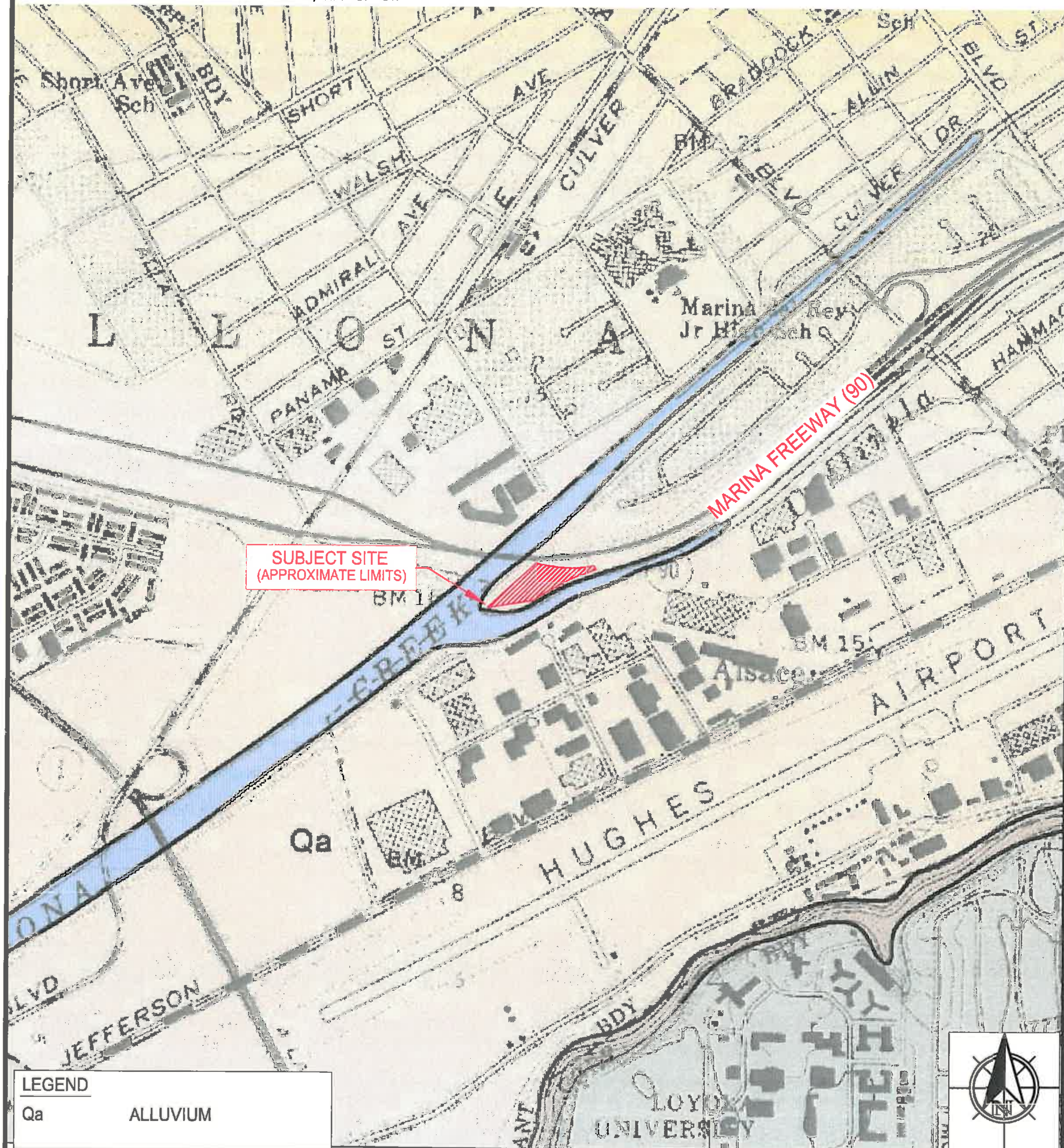
REGIONAL GEOLOGIC MAP #1

BG:22590	5297 MARINA ISLAND, LLC		
CONSULTANT:	RSB	SCALE:	1" = 1000'

REFERENCE: DIBBLEE, T.W. (1991), GEOLOGIC MAP OF THE BEVERLY HILLS AND VAN NUYS (SOUTH 1/2) QUADRANGLES, LOS ANGELES, CALIFORNIA DIBBLEE GEOLOGICAL FOUNDATION, MAP DF-31.



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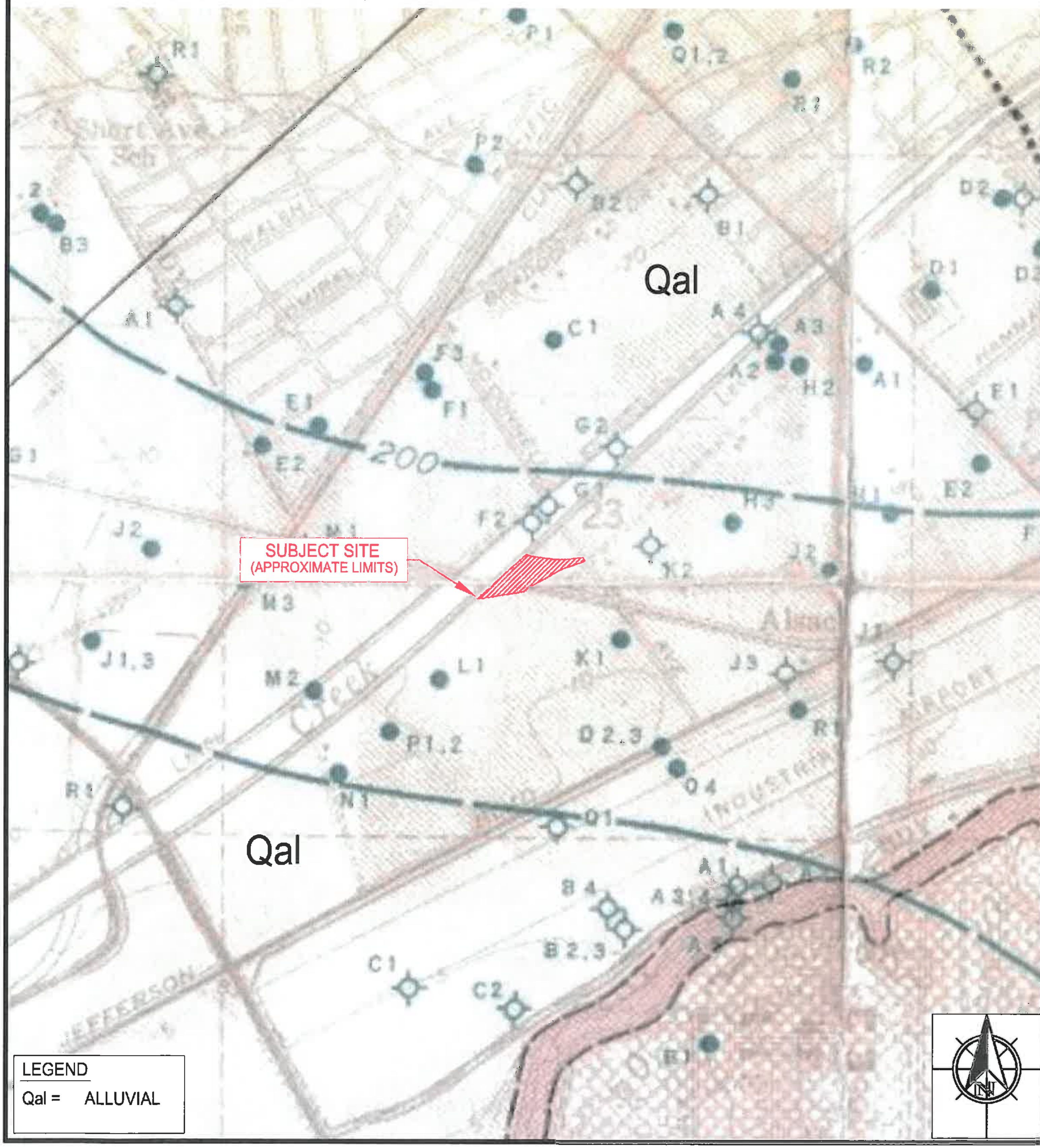
REGIONAL GEOLOGIC MAP #2

BG:22590 5297 MARINA ISLAND, LLC

CONSULTANT: RSB | SCALE: 1" = 1000'

REFERENCE: GEOLOGIC MAP OF THE TORRANCE-SANTA MONICA AREA, CALIFORNIA, SHOWING ALTITUDE OF BASE OF WATER-BEARING ZONES OF PLEISTOCENE AGE AND LOCATION OF WELLS (NORTHERN HALF) - POLAND 1959.



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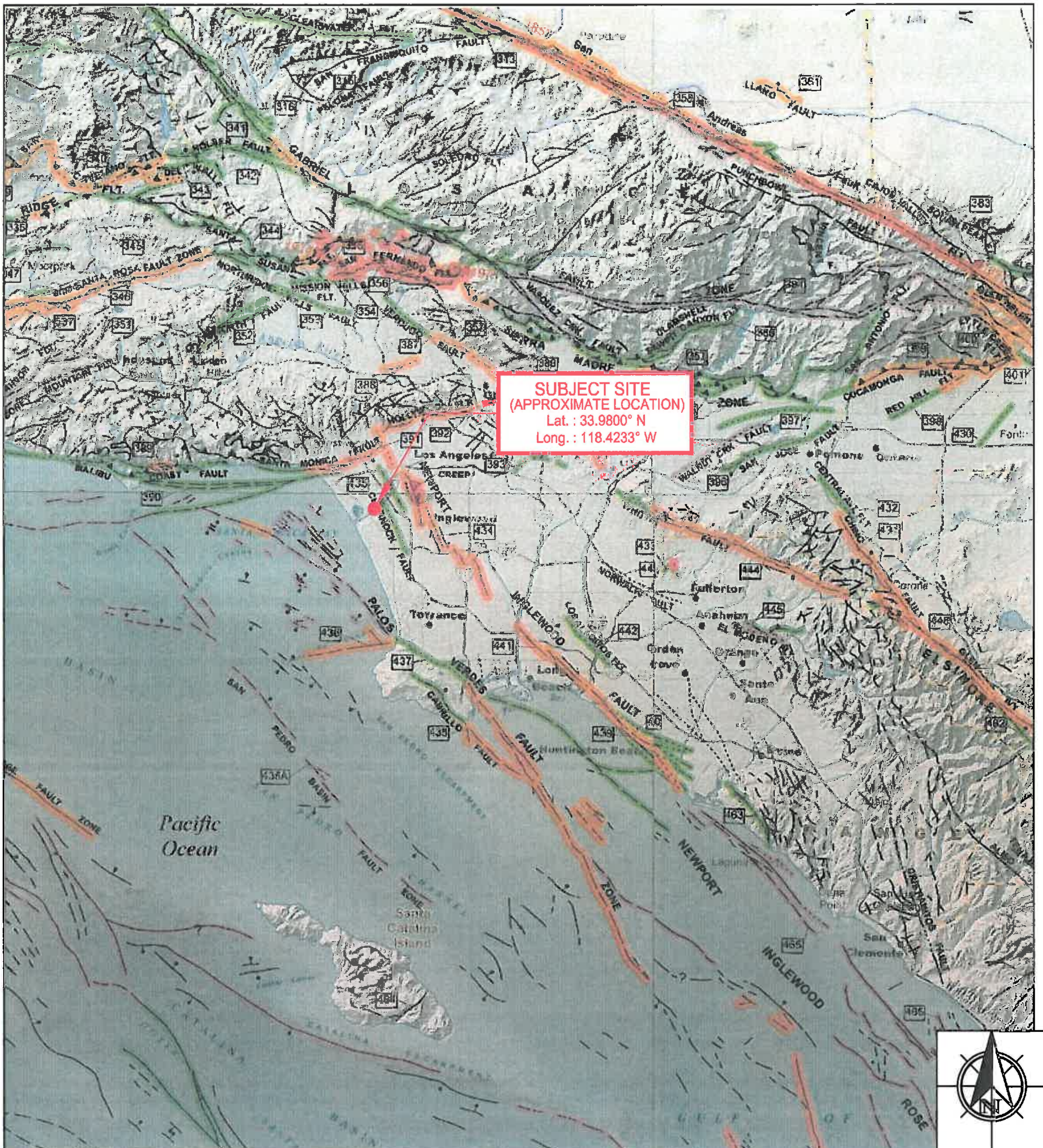
REGIONAL FAULT MAP

BG:22590	5297 MARINA ISLAND, LLC	
CONSULTANT: RSB		SCALE: 1" = 12 MILES

REFERENCE: JENNINGS, C.W., AND BRYANT, W.A.,2010, FAULT ACTIVITY MAP OF CALIFORNIA GEOLOGICAL SURVEY, 150th ANNIVERSARY, MAP No 6.



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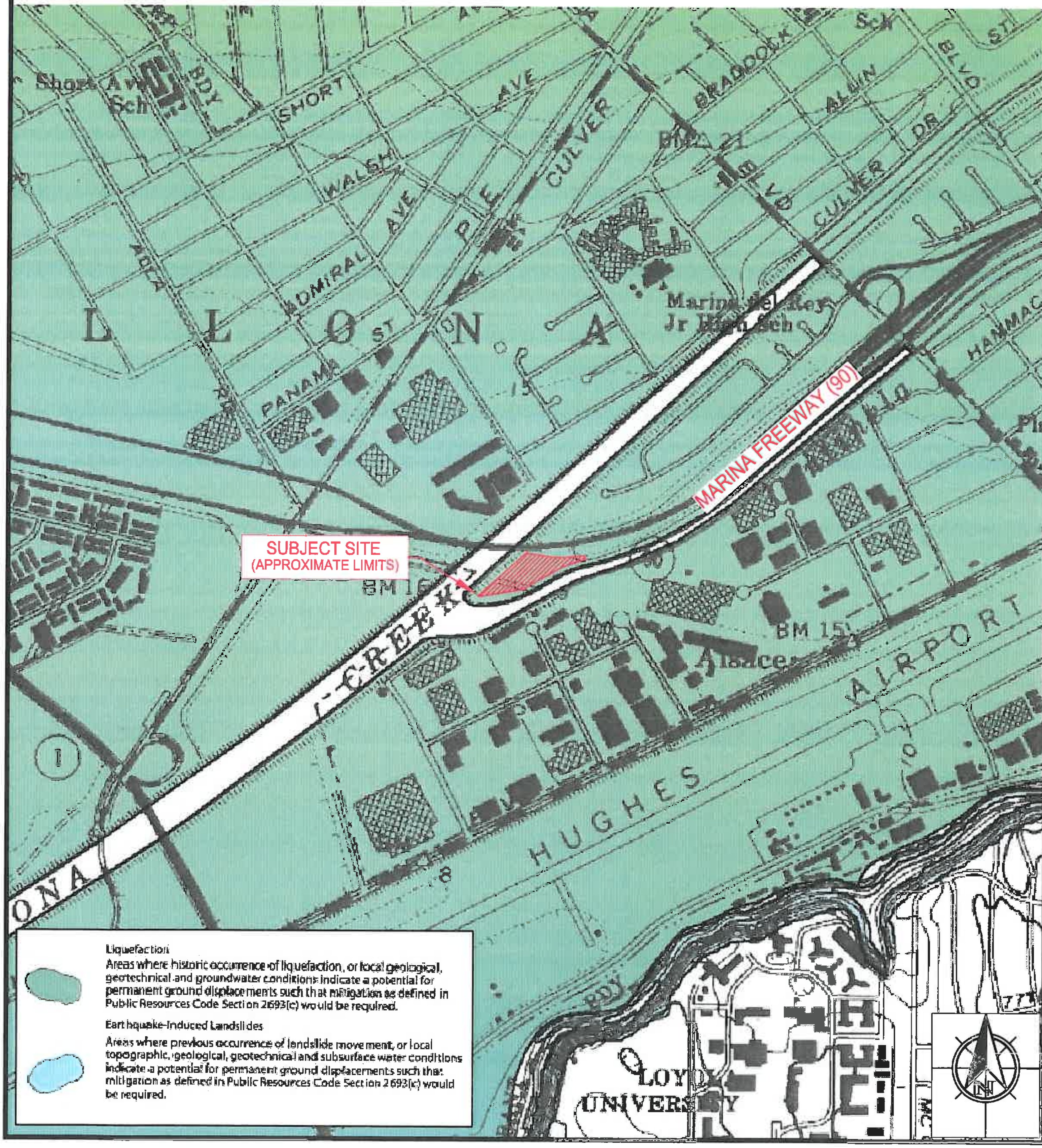
SEISMIC HAZARD ZONES MAP

BG:22590	5297 MARINA ISLAND, LLC
CONSULTANT: RSB	SCALE: 1" = 1000'

REFERENCE: STATE OF CALIFORNIA SEISMIC HAZARD ZONES, VENICE QUADRANGLE OFFICIAL MAP, CALIFORNIA GEOLOGICAL SURVEY, DATED MARCH 25, 1999.



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HISTORIC-HIGH GROUNDWATER MAP

BG:22590	5297 MARINA ISLAND, LLC
CONSULTANT: RSB	SCALE: 1" = 4000'

REFERENCE: CGS, 1998, Seismic Hazard Zone Report for the Venice 7.5-Minute Quadrangle, Los Angeles County, California, Seismic Hazard Zone Report 036.

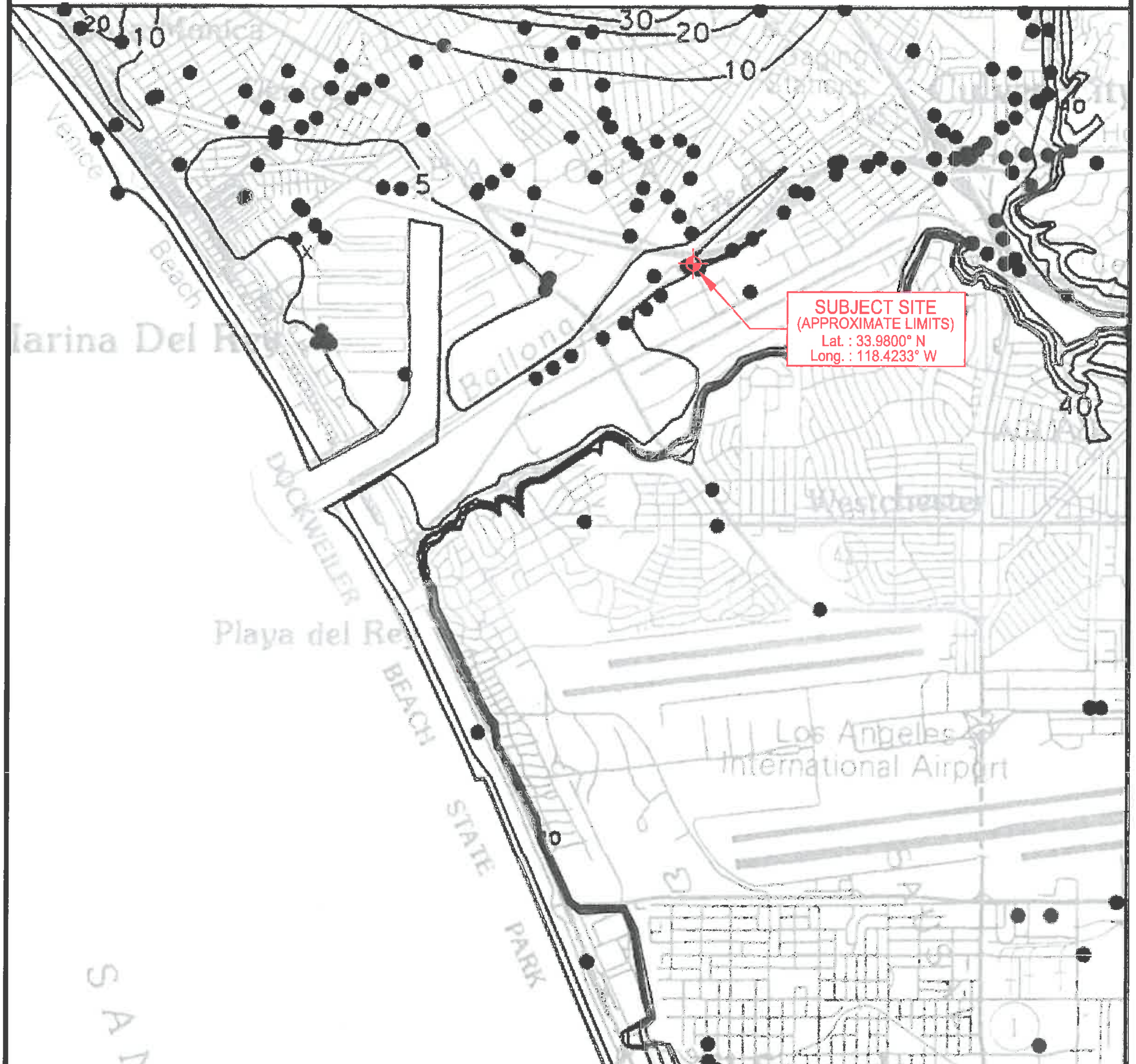

Plate 1.2 Historically Highest Ground Water Contours and Borehole Log Data Locations, Venice Quadrangle.

● Borehole Site

30 Depth to ground water in feet

X Site of historical earthquake–generated liquefaction. See "Areas of Past Liquefaction" discussion in text.

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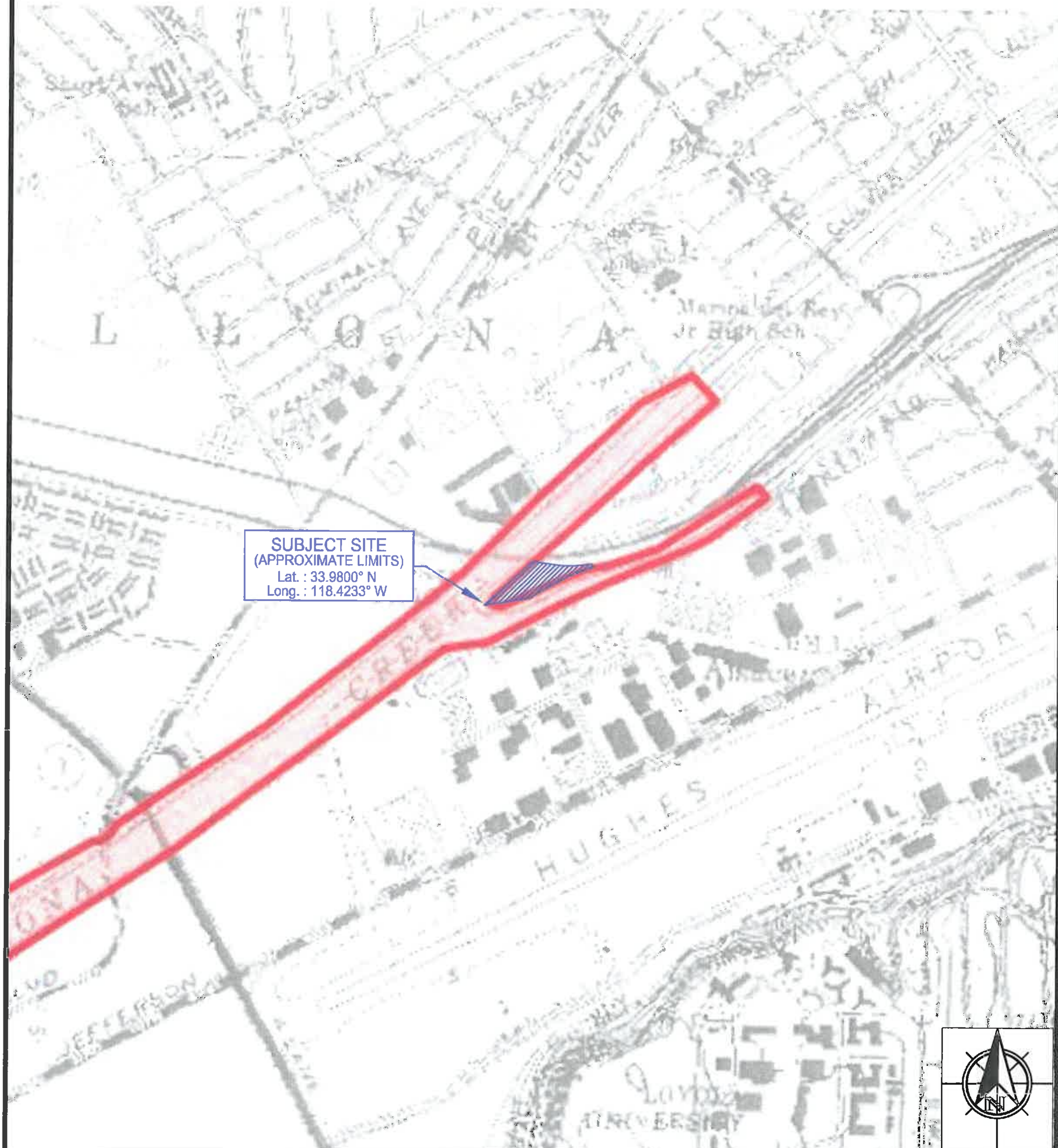
TSUNAMI INUNDATION MAP

BG:22590	5297 MARINA ISLAND, LLC
CONSULTANT: RSB	SCALE: 1" = 1000'

REFERENCE: TSUNAMI INUNDATION MAP FOR EMERGENCY PLANNING, STATE OF CALIFORNIA ~ COUNTY OF LOS ANGELES, VENICE QUADRANGLE, DATED MARCH 1, 2009.



FEBRUARY 10, 2017

REFERENCE: TOPOGRAPHIC SURVEY PREPARED BY MOLLENHAUER GROUP, DATED 10/12/2005 AND PLANS BY THE ALBERT GROUP ARCHITECTS.

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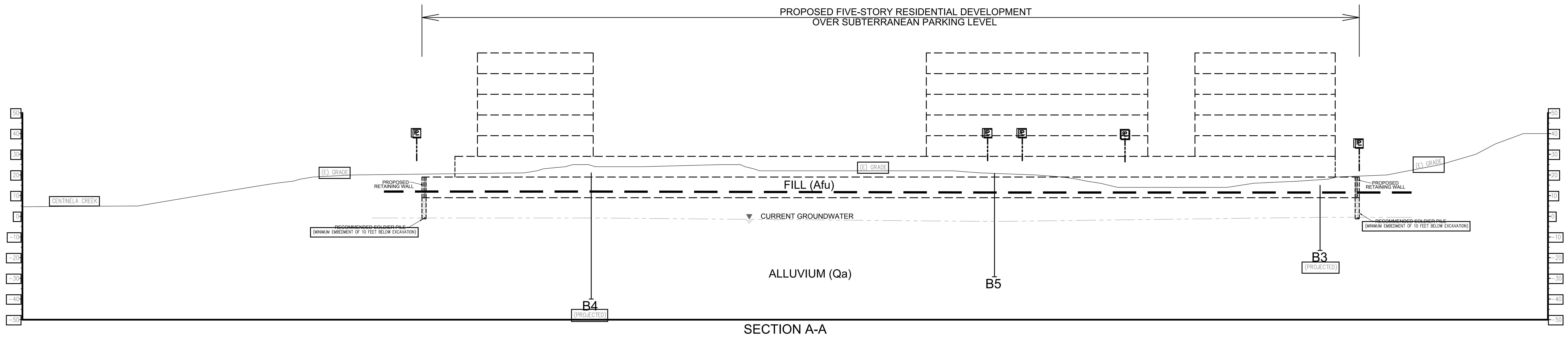
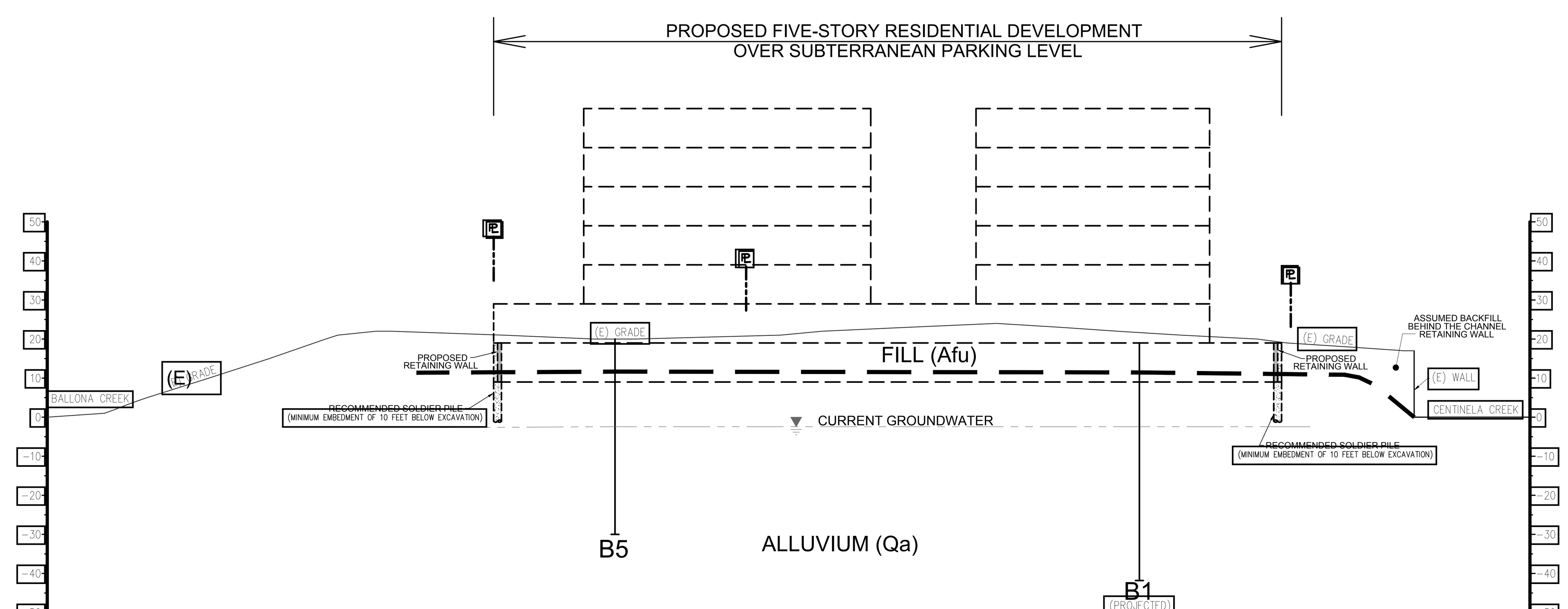
SITE PLAN

BG: 22590 5297 MARINA ISLAND, LLC

CONSULTANT: RSB SCALE: 1" = 30'



SECTION A-A



SECTION B-B

FEBRUARY 10, 2017

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GLENDALE, CA 91206
818.549.9959 TEL
818.543.3747 FAX

SECTIONS A & B

BG:22590 5297 MARINA ISLAND, LLC

CONSULTANT: RSB SCALE: 1" = 30'