Appendix E:
Geotechnical Report and Paleontological Resources Record Check

Part 1: Geotechnical Report

October 18, 2019
J.N. 18-322
(Revision 1)

THE BOUQUET CANYON PROJECT OWNER, LLC
888 San Clemente Dr., Suite 110
Newport Beach, California 92660

Attention: Mr. Scott Covington, Vice President

Subject: **Updated Geotechnical EIR-Level Assessment, *Bouquet Canyon Project*, Tentative Tract Map 82126, Southerly Adjacent to Bouquet Canyon Road at Copper Hill Drive, City of Santa Clarita, Los Angeles County, California**

References: See Appendix

Dear Mr. Covington:

Petra Geosciences, Inc. (Petra) is presenting herein our Updated Geotechnical EIR-level assessment for development of the proposed residential dwellings at the Bouquet Canyon project located in Santa Clarita, California. The purposes of our study are to evaluate the proposed project from a geotechnical engineering standpoint and to determine what geotechnical constraints are inherent to the site that may influence the proposed development as depicted on the current site plan. This updated report supersedes the EIR-Level Assessment report dated January 22, 2019 (___, 2019a) and includes additional analyses and recommendations as outlined in Peer Review Comments from R.T. Frankian and Associates (___, 2019a,b) and subsequent Response Reports by Petra (___, 2019b,c)

Should you have any questions regarding the contents of this report, or should you require additional information, please do not hesitate to contact us.

Respectfully submitted,

PETRA GEOSCIENCES, INC.

Theodore M. Wolfe
Senior Associate Geologist
CEG 1626

EXECUTIVE SUMMARY

Site Description

The study area is located on the east/south side of Bouquet Canyon Road at the easterly terminus of Copper Hill Drive. The frontage along Bouquet Canyon Road is approximately 0.7 miles. The accompanying Site Location Map (Figure 1) depicts the areal limits of the site. The site comprises approximately 90 acres and is characterized by a prominent north/south trending ridgeline on the western portion of the site and the broad, flat plain of Bouquet Canyon in the central and northeastern portions. The active stream channel of Bouquet Canyon crosses the northern portion of the site. Topographically, the central and northern portions of the site are relatively flat with a slight gradient toward the active stream channel. The slopes that descend from the main ridgeline vary in gradient from approximately 3:1 horizontal to vertical (h:v) to 1½:1. The highest natural slope is approximately 150± feet and overall site topographic relief is on the order of 200± feet.

An existing homestead consisting of a one-story dwelling and several secondary structures/sheds is located in the northwest portion of the site. Access to the homestead, which is not a legal part of the subject tract, is via a dirt/asphalt road off of Bouquet Canyon Road.

CEQA Guidelines

According to Appendix G of the California Environmental Quality Act Statutes and Guidelines (CEQA, 2018), geological/geotechnical impacts are deemed significant if the project results in any of the following:

1. Exposure of people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:

    a. Surface rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault. (Refer to Division of Mines and Geology Special Publication 42).

    b. Strong seismic ground shaking.

    c. Seismic-related ground failure including liquefaction or landslides.

2. Substantial soil erosion or the loss of topsoil.

3. Location of structures on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse.

4. Location of structures on expansive soils, as defined in Table 18-1-B of the 1994 Uniform Building Code (CBC), creating substantial risks to life or property.

5. Soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater.

In addition, if the project substantially alters a topographic feature, or a unique natural physical feature (i.e., significant ridgelines or rock outcroppings) were to be damaged or destroyed by project related activities, project impacts could also be considered significant.

Potentially Significant Geological/Geotechnical Impacts

On the basis of our study, the project activities and geologic hazards that have been identified which may potentially affect the proposed development of the site include the following:

- The potential for strong ground motions associated with major earthquakes on one of several nearby active earthquake faults.
- Secondary effects associated with seismic activity, including liquefaction, lateral spread, landslide and related ground deformation.
- Pre- and post-construction soil erosion.
- The presence of potentially compressible native soils within the foundation influence zone of the proposed structures.
- Potential hazards related to the inherent engineering characteristics of onsite soils (i.e. expansion potential).
- Unfavorable bedding plane orientation that adversely affects slope stability.

The possible impacts of each of these conditions on the proposed development are summarized in the following paragraphs. A more detailed discussion of each of these issues and their potential impact on site development is provided in the "Site-Specific Geologic Impacts and Mitigation Measures" section of this report.

Seismically-Related Ground Shaking and Secondary Seismic Effects

As is the case for most locations in southern California, the subject property is susceptible to strong ground shaking as a result of future earthquakes along any of the numerous faults that traverse the region. For this reason, the State and local building codes that govern construction in the area require that the maximum anticipated level of earthquake shaking be taken into consideration in the design of human occupancy structures. Through proper application of the current California Building Code (CBC) regulations for

seismic design, it is expected that the potential for life-threatening damage to the proposed structures as a result of seismically-related ground shaking can be mitigated to a less than significant level. Potential secondary effects of strong seismic shaking at the site include liquefaction and associated settlement, lateral spreading, surface manifestation of liquefaction (including localized bearing failure, ground fissuring and sand boils), as well as landslide movement. According to data reviewed of the published Seismic Hazard Zone Report for the Mint Canyon 7.5-minute quadrangle (CDMG, 1999), the flatter areas in the north/central portions of the site lie within a designated Liquefaction Hazard Zone and much of the remaining portions of ridgeling and slope areas of the site are within a designated Earthquake-induced Landslide Hazard Zone.

Soil Erosion

Based on the current topography of the site, rainfall runoff is presently controlled by sheet flow from the dominant high points along the southern and western property limits to the active drainage channel of Bouquet Canyon. This drainage debauches offsite through a culvert/bridge which crosses Bouquet Canyon Road. Secondary runoff from the western flank of the main site ridgeline is directed to storm drain systems along Bouquet Canyon Road. The lack of permanent surface drainage and erosion controls across the site is likely to impact the adjacent areas and possibly the municipal storm drain system prior to and during the construction phase of the project until such time as the permanent Water Quality Management Plan is implemented.

Concentrated surface water flow can, over time, cause rilling and possible washouts of graded slope areas. The project design is expected to incorporate protective landscaping, positive drainage away from slopes on building pad areas, and an extensive network of area drains as means to prevent erosion and loss of topsoil. Such measures will ultimately be shown on the civil engineer's project plans.

Settlement Due to Consolidation of Native Soils

The results of our field investigation indicate that undocumented artificial fill and native soils existing within the foundation influence zone of proposed structures may be subject to compression under the loads imposed by newly-placed compacted fills and proposed building foundations. For this reason, the design-phase geotechnical report should include recommendations for excavation and recompaction of existing fill and native soils that are intended to reduce the amount of expected post-construction settlement to within typical construction tolerances for well-designed foundations.

Expansive Soils

Expansive soils are soils that experience volumetric changes in response increases or decreases in moisture content. Relatively thin, rigid structural elements such as building floor slabs and exterior concrete flatwork may experience uplift, shifting, or cracking as a result of swelling or contraction of expansive soils. In recognition of these issues, Section 1808 of the CBC contains provisions for design of building foundations and floor slabs to reduce the potential detrimental effects of expansive soils.

The site soils are anticipated to have Expansion Indices (EIs) ranging from less or equal to 20 for sandy soils derived from active alluvial deposits to possibly on the order of 100 or so for soils derived from fine-grained portion of the Castaic Formation. Soils with Expansion Indices greater than 20 are considered expansive in accordance with the 2016 CBC. Recommendations intended to reduce the potential detrimental effects of expansive soils should be provided during the design phase. Additional testing should be performed during and after grading to evaluate the expansion potential soils present at/near finish grade so that additional recommendations can be provided by the geotechnical consultant, if necessary.

Slope Instability and Landslides

Portions of the site slope areas are located within a State of California designated seismically-induced landslide hazard zone. Also, subsurface exploration revealed adversely oriented bedding conditions for westerly facing slopes and some relatively shallow existing landslides within the site. These occurrences could create potentially unstable slopes if mitigative measures are not performed. Such measures would typically involve grading to remove potentially unstable geologic features and replacement with engineered fill. Recommendations intended to mitigate the potential effects of the adverse bedding conditions and landslides should be presented in the design phase geotechnical report.

Geotechnical Feasibility

This firm concludes the development of the subject project site is feasible from a geotechnical engineering and engineering geology standpoint and that the potential for substantial risk to life or property can be mitigated to an acceptable level for this project. These conclusions are based on our understanding of the project scope, our review of the referenced literature, the results of our subsurface investigation and is contingent upon the project geotechnical consultant's recommendations being implemented into the design and construction of the project and compliance with applicable grading and building codes.

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BOUQUET CANYON PROJECT, TENTATIVE TRACT MAP 82126
SOUTHERLY ADJACENT TO BOUQUET CANYON ROAD AT COPPER HILL DRIVE
CITY OF SANTA CLARITA, LOS ANGELES COUNTY, CALIFORNIA

INTRODUCTION

The following EIR-level geotechnical assessment report presents our findings and opinions with respect to the geotechnical feasibility of the proposed project and geotechnical constraints that may have an impact on the development of the subject property. This evaluation is based on our review of published geotechnical maps and literature pertinent to the area of the subject site, subsurface investigation, and our previous experience with similar projects in the area. The proposed project included under the purview of this report is based on the 120-scale Preliminary Grading Exhibit, Tentative Tract 82126 prepared Sikand Engineering Associates, Inc. (Sikand) and dated April 5, 2019

PURPOSE AND SCOPE OF SERVICES

The purpose of this study is to collect the required regional and site-specific geotechnical data in order to provide an assessment of potential geologic and seismic-related constraints that may affect the development as currently proposed. The results of our assessment, as well as preliminary mitigation measures intended to reduce the impact of the identified geologic constraints, are provided in this report.

This study has been performed in general accordance with relevant provisions of the California Environmental Quality Act (CEQA) of 1970, and the statute and guidelines for implementation of CEQA (AEP, 2018) as amended. In preparing this report, our scope of services has included the following:

1. Review of readily available published and unpublished literature and maps pertaining to regional faulting, seismic hazards and soil and geologic conditions within and adjacent to the site that could have an impact on the proposed development.

2. Reconnaissance of the subject site and surrounding areas.

3. Excavating and logging 16 backhoe test pits (TP-1 through TP-16) to depths ranging from roughly 3 to 16 feet at the base of natural slopes that are superjacent to proposed pads. These pits were used to evaluate the thickness of soil and weathered bedrock.

4. Drilling, sampling and logging of 15 hollow stem borings (HS-1 through HS-15) to depths ranging from roughly 20½ to 66½ feet below existing grades. These borings generated subsurface information so that project unsuitable material removal recommendations could be evaluated.

5. Drilling 15 flight auger borings (FA-1 through FA-15) to depths of roughly 16 to 80 feet below existing grade. The borings were sampled and downhole logged by an engineering geologist. Information from the flight auger borings has been utilized to aid in modeling site geologic structure.

6. Advancement of 7 CPT soundings (CPT-1 through CPT-7) to depths of approximately 21 to 46 feet below existing grades. The CPT soundings have been utilized to evaluate liquefaction potential and provide soils engineering data to help formulate removal recommendations.
7. Performing laboratory analysis on soil samples, typically including determination of in-situ dry density and optimum moisture content; shear strength, consolidation characteristics, expansion potential; soluble sulfate and chloride content, and general soil corrosivity (pH and minimum resistivity).
8. Engineering and geologic analyses of the collated data as they pertain to the proposed construction.
9. Evaluation of faulting and seismicity of the region and the possible impact of regional seismicity on the site and the proposed construction.
10. Analysis of settlement/consolidation characteristics of near surface materials and the potential impact on the site and proposed construction.
11. Evaluation of the global and surficial stability of both natural and proposed slopes and the potential impact on the site and proposed construction.
12. Preparation of this report presenting our findings, conclusions and recommendations.

LOCATION AND SITE DESCRIPTION

The study area is located on the east/south side of Bouquet Canyon Road at the easterly terminus of Copper Hill Drive. The frontage along Bouquet Canyon Road is approximately 0.7 miles. The accompanying Site Location Map (Figure 1) depicts the areal limits of the site. The Joseph Scott Detention School is located on the northeast property limits and open space/undeveloped land abuts the eastern and southern property limits. The southernmost portion of the site is superjacent to a commercial center/parking lot. The site comprises approximately 90± acres and is characterized by a prominent north/south trending ridgeline on the western portion of the site and the broad, flat plain of Bouquet Canyon in the central and northeastern portions. The active stream channel of Bouquet Canyon crosses the northern portion of the site. Spur ridges and intervening tributary drainages are located along the southern boundary. The majority of the site is covered with low height grass and shrubs. Numerous large trees and shrubs are located in the northern portion of the site along the existing stream channel. Topographically, the central and northern portions of the site are relatively flat with a slight gradient toward the active stream channel. The slopes that descend from the main ridgeline vary in gradient from approximately 3:1 horizontal to vertical (h:v) to 1½:1. The highest natural slope is approximately 150± feet and overall site topographic relief is on the order of 200± feet.

An existing residence consisting of a one-story dwelling and several secondary structures/sheds is located in the northwest portion of the site. Access to this residence, which is not a legal part of the subject tract, is via a dirt/asphalt road from Bouquet Canyon Road.

REGULATORY ENVIRONMENT

The proposed project considered in this report is regulated by the local permitting agency, the Department of Building and Safety of the City of Santa Clarita. Prior to issuing grading and building permits, the City is tasked with ensuring that that grading and structural design is in compliance with applicable provisions of the state and local regulatory standards listed below.

California Building Code (CBC)

The California Building Code (Title 24 of the California Code of Regulations) provides the regulatory framework for building code enforcement within the City of Santa Clarita. The various requirements contained within the CBC are based on the International Building Code and are intended to provide minimum standards to protect public property and welfare by regulating the design and construction of excavations, structural foundations and building framing systems to mitigate the effects of strong ground shaking and adverse soil conditions. By order of the California legislature, the CBC is published by the California Building Standards Commission every three years. The regulations contained in each revision take effect 180 days after the publication date. As of the date of this report, the current revision of the CBC (2016) that is being enforced by the City of Santa Clarita was adopted on January 1, 2017.

California Alquist-Priolo Earthquake Fault Zoning Act

In December 1972, the State legislature enacted the Alquist-Priolo Earthquake Fault Zoning Act which directed the State Geologist to begin compiling maps of known surface traces of active faults within the urbanized areas of California. The intent of this law was to improve earthquake safety by prohibiting the construction of buildings intended for human occupancy across the traces of known active earthquake faults. The term "Earthquake Fault Zones" refers to areas established by the California Geologic Survey (CGS) wherein comprehensive geologic investigations are required in order to demonstrate that locations designated for new construction are not traversed by active fault traces. The Alquist-Priolo Earthquake Fault Zoning Act also requires property owners or their representatives to disclose whether or not their property is situated within an established Earthquake Fault Zone prior to selling the property. Local regulatory agencies (such as city- or county-level building departments) are responsible for local implementation of the Act and must regulate development projects within the zones.

California Seismic Hazards Mapping Act

As a further means to protect public safety and property from seismic hazards, the California legislature adopted the Seismic Hazards Mapping Act in 1990. In contrast to the Alquist Priolo Act, the Seismic

Hazards Mapping Act specifically addresses potential hazards posed by secondary effects of seismic activity including strong ground shaking, soil liquefaction and associated ground failure, and seismically-induced landslides. Maps showing zones of required investigation for one or more of these hazards are prepared and published by the California Geologic Survey and, like the Alquist-Priolo maps, are available to the public via an online resource. Inclusion within a designated seismic hazard zone does not necessarily indicate that such hazards have been confirmed within the zone, but only that the prevalent soil and groundwater conditions within the zone render the area susceptible to the hazard. The local jurisdictional (i.e., the city or county permitting agency) is responsible for ensuring that the required site-specific geotechnical investigations have been performed for construction projects proposed within these seismic hazard zones.

PROPOSED CONSTRUCTION AND GRADING

Project Design

Based on the grading exhibit provided by Sikand it is our understanding that the proposed development will consist of 375 residential dwellings with 200 being single-family, detached units and the remainder 175 being attached residential dwellings. The project will include two recreation centers, a tot lot and three water quality detention basins. Associated exterior improvements are expected to include asphalt-paved access streets, concrete driveways and pedestrian sidewalks, surface drainage controls, perimeter fencing, common landscaped areas, extensive underground infrastructure, and required storm water quality devices.

Proposed Grading

Standard cut and fill grading techniques will be used to accommodate the proposed development. Both cut and fill slopes are designed to slope ratios of 2:1(horizontal:vertical) or flatter. The highest proposed 2:1 cut and fill slopes are approximately 170± feet and 50± feet, respectively. The maximum depth of planned cut is roughly 120± feet, while the maximum depth of planned fill is on the order of 50± feet.

Structural details for the proposed structures have not, as yet, been provided to this firm. It is anticipated that the detached and attached single-family residences will be one-, two-, and possibly three-story wood frame structures with slabs constructed on grade. For this type of construction, it is anticipated that relatively light foundation loads will be imposed on the subgrade soils.

INVESTIGATION PROGRAM

Petra's scope of geotechnical services included performing a subsurface exploration program intended to characterize subsurface conditions within the project site. Details pertaining to our field methodology are presented in the following sections.

Subsurface Exploration

In October and November of 2018, 15 flight auger borings (FA-1 through FA-15), 16 backhoe test pits (TP-1 through TP-16), 15 hollow-stem borings (HS-1 through HS-15), and 7 Cone Penetrometer Test (CPT) soundings (CPT-1 through CPT-7) were excavated/advanced across the site. In addition, two borings (P-1 and P-2) were advanced for use in percolation testing that was performed to evaluate the permeability of the underlying soils for two of the water quality basins. Boring, test pit and CPT locations are shown on the accompanying Geotechnical Map (Plate 1). The excavations were visually logged by an engineering geologist with this firm and material samples were taken of representative site soils and bedrock. Earth materials were classified and logged in accordance with Unified Soil Classification System procedures. Descriptive boring and test pit logs are presented in the appendix of this report.

FINDINGS

Regional and Local Geologic Setting

Regional Physiographic Setting

The site is located in the Soledad basin which is a northeast trending alluvium filled valley in the Transverse Range Geomorphic Province. The basin is bound on the north, east and west by mountainous ridgelines that are composed of sedimentary rocks underlain by a crystalline core. The sedimentary rocks are thousands of feet in thickness and have been uplifted and folded into a synform whose axis is subparallel to the basins northeasterly trend. The San Gabriel fault zone forms the southwest boundary of the Soledad basin and at its closest is about 3.5 miles southwest of the site.

Local Geology and Subsurface Conditions

The distribution, thicknesses and characteristics of near-surface soils in the Santa Clarita area have been previously mapped by other investigators at a scale of 1:48,000 for purposes of seismic zonation. Based on our review of published maps, the local area is underlain by sedimentary bedrock consisting sandstone, siltstone and to a lesser extent claystone. These rocks are exposed in several locations in the general site locale. The bedrock is mantled by varying thicknesses of soil and alluvial deposits and to a lesser extent landslide debris.

Based on the log of test pits and borings, bedrock underlies the site and is mantled by soil/alluvial materials in the valley/tributary areas. Soils are generally less than 2 to 3 feet in thickness while alluvium varies in thickness from a few feet to greater than the depths explored (66½± feet). These materials are generally described as silty, fine- to medium-grained sands that are gray to brown, dry to moist, and loose to dense. Varying amounts of clay and gravel were also noted within the sandy portions of the alluvium. Landslide debris/deposits have been mapped on lower portions of natural slopes. These features are relatively minor and localized. Depths ranged from 5 to 10 feet to as much as 21± feet. Landslide material is derived from the bedrock materials and consists of loose/broken sandstone and siltstone layers. Bedrock on site consists of the Castaic and Saugus Formations. The Castaic underlies the majority of the site and is exposed on the northern and central portions of the main ridgeline. This unit typically consists of silty to fine-grained sandstone, calcareous sandstone, siltstone, shale and mudstone. Bedding ranges from well-developed to massive. These rocks are poorly to very well cemented. These materials were deposited in a relatively shallow marine environment as turbidities and inter-channel sediments, and often exhibit fold strata, rip-up clasts and scour/fill features. The Saugus Formation underlies the southern portion of the site and is exposed on the steeper natural slopes of the main ridgeline. This unit typically consists of fine- to coarse-grained sandstone, pebble to cobble conglomerate and conglomeratic sandstone. Occasional beds of well-indurated to well-consolidated reddish brown to greenish gray siltstones and claystones (mudstones) are present. Bedding is moderately to poorly developed to discontinuous or indistinct with some cross-bedding and scour/fill features. These rocks are generally poorly to moderately cemented, with some beds near the lower contact with the underlying Castaic Formation being very well cemented. The Saugus Formation is considered to be a portion of a large ancient alluvial fan complex.

Local Groundwater Conditions

The site is located on the periphery of the East Sub Basin of the Upper Santa Clara River Groundwater Basin. Information pertaining to the occurrence of groundwater within the local area has primarily been obtained from borehole logs prepared during installation of the water wells throughout the area. In general, ground water occurs in at least two distinct bodies; in downward succession. These are: 1) a body of semi-perched water that occurs within the lowermost portion of the recent alluvium; and 2) in nearly all deposits of Pleistocene age and some Pliocene rocks. Of interest with respect to development of the site is the body of semi-perched groundwater occurring within the upper portions of Holocene-age alluvial sediments.

The extent of shallow semi-perched groundwater in the area of the subject site is described in general terms in the referenced Seismic Hazard Zone report for the Mint Canyon quadrangle published by the California Division of Mines and Geology (CDMG, 1998). Based on information provided in that report, the subject

property is located where shallow groundwater (i.e., groundwater existing at a depth of 40 feet or less below the ground surface) would typically be expected to occur. The figures included in the Seismic Hazard Zone report indicate that the historical high groundwater depth for the site varies from approximately 40 to 10 feet below the surface. The shallow depths are indicated in isolated areas of the active drainage channel of Bouquet Canyon. The recent field investigation, which included 15 borings within the alluvial sediments, indicates that groundwater levels are significantly lower than reported in the literature. Shallow, near surface groundwater was not encountered in/near the active drainage channel. Two water levels were measured at depths of 45 and 50 feet below ground surface. These levels indicate that groundwater, when extant, is located at or near the bedrock contact (i.e. at the base of the alluvial section). Given these conditions, groundwater is not anticipated to affect the proposed development. It should be noted that the depth of groundwater is representative of the date and time that our investigation was performed, and that this level is likely to fluctuate in response to seasonal changes.

Tectonic Setting

Regional Surface Fault Systems

The geologic structure of Southern California is dominated by northwest-trending faults associated with the San Andreas system. Faults such as the Newport-Inglewood, the Whittier-Elsinore, the San Jacinto, and various segments of the San Andreas Fault itself are all major faults associated with this system. They are all known to be seismically active, and most are known to have ruptured the ground surface in historic time. Also within the southern California region are a number of west-trending, low-angle reverse (thrust) faults that are similarly active. The majority of these faults occur as north-dipping planes which trend along the south-facing flanks of the Transverse Ranges. Among the known active thrust faults in the region include the Cucamonga, Sierra Madre, Santa Monica, and Hollywood faults.

Concealed Faults

Another category of fault known as the "blind thrust" became recognized as a significant seismic hazard as a result of the 1987 moment magnitude (Mw) 6.0 Whittier Narrows earthquake. Blind thrusts are concealed beneath the earth's surface and are defined as dip-slip faults that tend to fold and/or uplift the near surface sediments during moderate to large magnitude earthquakes (Shaw and Suppe, 1996). In 1994 the Mw 6.7 Northridge earthquake occurred along what researchers have interpreted as a south-dipping thrust ramp beneath the San Fernando Valley. Together, these events caused more than $25 billion in property damage and clearly demonstrate the risks that blind thrusts pose to the greater Los Angeles metropolitan area.

Recent structural models of the Los Angeles basin suggest that deep-seated, blind thrust sheets underlie portions of Orange and Los Angeles Counties. These structures are apparently accommodating north-south compression with slip rates of several millimeters per year (Hauksson, 1992; Petersen and Wesnouski, 1994). The Puente Hills and Upper Elysian Park blind thrust systems represent two such blind thrusts that are reported in the general vicinity of the site (Dolan et al, 2003, Shaw et al, 2002, and Oskin et al 2000). Structural models and seismicity values for these three blind thrust systems and the Northridge blind thrust have been incorporated into the California Geological Survey seismic model, which was updated in April 2003 (Cao, et al., 2003).

Nearby Seismic Sources

Published geologic maps and literature indicate that the site lies within 50 kilometers of a number of significant active and potentially active faults that are considered capable of generating strong ground motion at the subject site. The names and locations of these faults relative to the subject property are provided in Table 1. The locations of these faults are graphically depicted on Figure 5.

TABLE 1

Significant Nearby Seismic Sources

Fault Name	Approximate Distance/ Direction From Site	Source Type[1]	Slip Rate (mm/yr)[2]	Maximum Magnitude[3,4]
San Gabriel	5.75 kilometers southwest	B	1.0	7.4
Holser, alt 1	7.02 kilometers southwest	B	0.4	6.8
Holser, alt 2	8.40 kilometers southwest	B	-	7.6
Santa Susan, alt 2	11.70 kilometers southwest	B	5.0	7.1
Northridge Hills	11.79 kilometers southwest	B	-	7.7
Northridge	12.38 kilometers southwest	B	1.5	6.9
Santa Susana, alt 1	14.93 kilometers southwest	B	5.0	6.9
Sierra Madre Connected	17.36 kilometers southwest	B	2.0	7.3
Sierra Madre (San Fernando)	17.36 kilometers south	B	2.0	6.7
Oak Ridge Connected	22.38 kilometers west	B	3.6	7.4
Oak Ridge (Onshore)	22.38 kilometers west	B	4.0	7.2
Verdugo	22.85 kilometers southwest	B	0.5	6.9
San Andreas – Mojave	23.65 kilometers northeast	A	>5.0	8.0
S. San Andreas; SM	23.58 kilometers northeast	A	29.0	7.3
San Cayetano	25.07 kilometers south	B	6.0	7.2

Fault Name	Approximate Distance/ Direction From Site	Source Type[1]	Slip Rate (mm/yr)[2]	Maximum Magnitude[3,4]
Simi – Santa Rosa	25.54 kilometers southwest	B	1.0	6.9
S. San Andreas; NM	36.63 kilometers northeast	A	27.0	7.0

Notes: 1) As classified according to 2001 California Bu ilding Code Table 16-U.
2) Per CGS 2002 fault data file (Cao et al, 2003).
3) Moment Magnitude (Mw).
4) 2008 USGS fault file (EZ-FRISK 2010)

Based on a review of published geotechnical maps and literature pertaining to regional faulting, the closest known fault considered capable of causing strong ground motion at the subject site is the San Gabriel fault. Located approximately 3½ miles southwest of the subject site, the San Gabriel fault is a right-lateral strike slip fault which trends to the northwest from the San Gabriel Mountains to the Ridge Basin near the Sierra Pelona - San Emigdio Mountains. Published investigations reveal that this fault offsets Holocene stratigraphy. For this reason, this fault is considered active and is included within the boundaries of an Alquist-Priolo Earthquake Fault zone.

Historical Seismicity

As is the case with most locations in Southern California, the subject site is located in a region that is characterized by moderate to high seismic activity. The project site and vicinity have experienced strong ground shaking due to earthquakes on a number of occasions in historic time. Some of the more significant historic seismic events for which ground motion data are available are listed in Table 2, along with the corresponding approximate epicentral distances to the subject site.This data is obtained from the USGS Earthquake Hazards website page, https://earthquake.usgs.gov/hazards/interactive/. The locations of selected earthquake epicenters with respect to the subject site are shown graphically on Figure 5.

TABLE 2

Notable Historical Earthquakes (M>5.5) within 100 kilometers of Project

Date	Location	Magnitude
1994	7km NNE of Simi Valley	5.6
1994	1km ENE of Granada Hills	5.9
1994	1km NNW of Reseda	6.7
1992	12km NW of California City	5.7
1991	13km NNE of Sierra Madre	5.8
1990	6km NNE of Claremont	5.5
1987	2km SSW of Rosemead	5.9
1971	10km SSW of Agua Dulce	5.8
1971	10km SSW of Agua Dulce	5.8
1971	10km SSW of Agua Dulce	6.6
1952	14km NNW of Tehachapi	5.6
1952	19km N of Tehachapi	5.6
1952	22km N of Tehachapi	5.6
1952	6km SSE of Arvin	5.5
1952	13km ENE of Grapevine	5.6
1952	13km WNW of Grapevine	5.8
1952	6km WNW of Grapevine	7.5
1926	Southern California	5.5
1916	Southern California	5.5
1916	Central California	6.0
1899	Southern California	6.4
1894	Southern California	5.9
1893	Santa Barbara Channel	5.5
1855	Greater Los Angeles area	6.0

Notes: [1] Maximum free-field site accelerations based on published accelerogram data for USGS CSMIP Station No. 707, located approximately 2.8 kilometers southwest of the subject site.

[2] Maximum site acceleration based on the published accelerogram data for CGS CSMIP Station No. 13079, located approximately 5.6 kilometers north of the subject site.

[3] Maximum site acceleration based on the published accelerogram data for CGS CSMIP Station No. 13326, located approximately 2 kilometers southwest of the subject site.

[4] Site acceleration was estimated based on the results of a computerized database search using a software application developed by T.F. Blake (Eqsearch V3.0, 2000). For purposes of the computerized site acceleration estimates, the attenuation relationship developed by Bozorgnia, Campbell and Niazi (1999) for hard rock sites was considered appropriate.

[5] Based on Wald et. al, 1999.

Active Fault Zonation

No portion of the area of proposed construction is located within the boundaries of an "Earthquake Fault Zone" as defined by the State of California in the Alquist-Priolo Earthquake Fault Zoning Act (Hart and Bryant, 1997). The nearest "active" fault is the San Gabriel Fault which is located approximately 3½ miles to the southwest of the site. On the basis of our review of the current revision of the Local Hazard Mitigation Plan of the City of Santa Clarita, no active faults have been identified onsite.

Secondary Seismic Hazard Zonation

Based on our review of the published Seismic Hazard Zone Report for the USGS Mint Canyon 7.5-minute quadrangle (CDMG, 1998), portions of the site lie within a designated Liquefaction Hazard Zone and also within an Earthquake Induced Landslide Hazard Zone.

Seismically-Induced Flooding

The types of seismically induced flooding which may be considered as potential hazards to a particular site normally include flooding due to a tsunami (seismic sea wave), a seiche, or failure of a major reservoir or other water retention structure upstream of the site. Since the site is more than 50 kilometers inland from the Pacific Ocean the probability of flooding from a tsunami is considered nil.

Bouquet Reservoir is located approximately 15 kilometers north of the site. As per the City of Santa Clarita Local Hazard Mitigation Plan, the site is located in a Dam Inundation Zone. A seismically-induced failure when the dam basin is filled to capacity could impact the project. In recognition of this possibility, the City has adopted measures which govern development in Flood Inundation Zones which are addressed in the Local Hazard Mitigation Plan.

Flooding Not Related to Seismicity

As part of this investigation, we conducted an independent review of the applicable FEMA flood insurance rate map for the area of the subject site (FEMA, 2008). This map indicates that portions of the project site are located within an area that is designated as having one or more of the following conditions:

- Located within an area having a 1 percent annual chance of flooding. (FEMA Zone A).
- Located within an area having a 1 percent annual chance of flooding with an average floodwater depth between 1 and 3 feet. (FEMA Zone AO).
- Located within an area of undetermined, but possible flood hazard. (FEMA Zone D).

DEFINITION AND USE OF SIGNIFICANCE CRITERIA

This section provides an evaluation of the potential impacts of the proposed project with regard to geologic and geotechnical features and processes. The guidelines provided in the following three publications served as a basis for identifying potential impacts.

1. California Environmental Quality Act Appendix G (Environmental Checklist Form), Section VI (Geology and Soils).
2. City of Santa Clarita Local Hazard Mitigation Plan.
3. California Division of Mines and Geology Note 46, "Guidelines for Geologic/Seismic Considerations in Environmental Impact Reports" (currently in revision).
4. Criteria established by the National Environmental Protection Act and the California Environmental Quality Act were also used to evaluate potential geologic impacts.

Generally speaking, geological and seismological impacts occur as two basic categories: natural events which may occur whether or not the project advances to the construction phase, and impacts that occur as a direct result of construction of the project. Examples of the former include fault displacement, earthquake shaking, liquefaction, and landslides. These can often be reduced to a level of insignificance through avoidance or by proper engineering design. Examples of potential geological impacts that can occur as a result of project construction are typically related to disturbance of surficial geologic formations and include induced hydroconsolidation of collapsible soils, induced slope instability, and increased soil erosion. Regardless of whether the impact is due to a natural event or a direct result of the proposed development, Appendix G of the CEQA Guidelines states that implementation of the project would result in a significant impact if one or more of the following conditions is anticipated:

1. The project will expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:
    a. Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area, or based on other substantial evidence from a known fault;
    b. Strong seismic ground shaking;
    c. Seismically-induced ground failure, including liquefaction; and
    d. Landslides.
2. The project results in substantial soil erosion or the loss of topsoil.

3. The project is located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in an on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse.

4. The project is located on expansive soil as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life and property.

5. The project is underlain by soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water.

SITE-SPECIFIC GEOLOGIC IMPACTS AND MITIGATION MEASURES

The following paragraphs provide our assessment of the potential geologic impacts of the proposed project in consideration of the significance thresholds described above. This assessment is based on our review of available geologic literature and maps, as well as our subsurface investigation, laboratory testing and engineering analysis completed to date. Specific impacts are ranked as less than significant and potentially significant. Proposed mitigation measures are provided where appropriate that, in the opinion of this firm, would reduce the effect of potentially significant impacts to a less than significant level.

Impact No. 1(a) - Surface Fault Rupture

Level of Significance: Less than Significant

Discussion:

No portion of the area of proposed construction is located within the boundaries of an "Earthquake Fault Zone" as defined by the State of California in the Alquist-Priolo Earthquake Fault Zoning Act (Hart and Bryant, 1997). The site is, however, located approximately 3½ miles to the northeast of the earthquake fault zone that has been established around the active traces of the San Gabriel fault.

A fault feature has been described in Boring FA-10. Given the existing database, it is not possible to definitively characterize the activity level of this feature. The likelihood that structure setbacks would be required is considered low and therefore the project design from an EIR perspective will not be impacted. For planning purposes, the general locale surrounding Boring FA-10 has been designated as a Restricted Use Area (See Plate 1). This RUA should be further evaluated at the Tentative Map stage.

Impact No. 1(b) - Strong Ground Motion

Level of Significance: Potentially Significant

Discussion:

The subject site is located in seismically active southern California. The type and magnitude of seismic hazards that may affect the site are dependent on both the distance to causative faults and the intensity and duration of the seismic event. Although the probability of primary surface rupture is considered very low, ground shaking hazards posed by earthquakes occurring along regional active faults do exist and should be considered in the design and construction of the proposed structures within the subject site.
Given its proximity to the site, the San Gabriel Fault (approximately 3½ miles to the southwest) would be considered the causative fault and is expected to generate the most significant ground motions at the site.

Proposed Mitigation:

The proposed structures within the site should be designed and constructed to resist the effects of seismic ground motions as provided in the applicable portions of the 2016 CBC. Earthquake loads on earth and super-structures are a function of the ground acceleration, which may be determined from the site-specific acceleration response spectrum. Seismic parameters to construct acceleration response spectrum for analysis and design of structures may be determined in accordance with the provisions of Section 1613 of the 2016 CBC, which incorporates the 2010 version of the American Society of Civil Engineers (ASCE) document, "Minimum Design Loads for Buildings and Other Structures", (ASCE/SEI 7-10).

Provided that the structures proposed within the site are designed and constructed in accordance with the current edition of the CBC and the Building Code of the City of Santa Clarita, it is expected that the impacts posed by seismically-induced strong ground shaking at the site will be reduced to a less than significant level.

Impact No. 1(c) – Seismically-Induced Ground Failure

Level of Significance: Potentially Significant

Discussion:

Secondary effects of seismic activity that are typically considered as possible hazards to a particular site include several types of ground failure as well as induced flooding. The general types of ground failure that can occur as a consequence of severe ground shaking include landsliding, ground subsidence, ground lurching, shallow ground rupture, lateral spreading, liquefaction, and soil strength loss. The probability of occurrence of each type of ground failure depends on the severity of the earthquake, distance from the causative fault, topography, soil and groundwater conditions, in addition to other factors.

Of the seismically induced ground failure modes listed above, liquefaction and landsliding are considered to be the primary concerns with respect to the subject site. Proposed mitigation measures for liquefaction, as well as induced flooding resulting from failure or overtopping of Bouquet Reservoir are discussed below. Proposed mitigation for landsliding is discussed later in this report in conjunction with slope stability.

Proposed Mitigation (Liquefaction):

The potential detrimental effects of liquefaction can be reduced to a less than significant level by grading/earthwork that removes and replaces potentially liquefiable soils with non-liquefiable fill soils, utilizing in-situ ground improvement methods that reduce liquefaction potential, designing structural foundations in recognition of potential liquefaction-induced settlement or by performing a combination of the preceding strategies.

The resultant dynamic settlements from our preliminary liquefaction analyses are summarized in the table below. The results indicate that given the proposed grading design, removal of the upper 10 to 25 feet of alluvial soils is sufficient to reduce the potential impacts less than significant. The analyses were performed using the computer program CLiq (v. 3.0.2.1) and assumed a groundwater level at 10 feet below existing ground, except for CPT-3 which is located in the bottom of the new channel and where groundwater was assumed to be at the new ground surface. The liquefaction analyses utilized a magnitude (Mw) 6.85 earthquake and a peak ground acceleration of 0.63g. These magnitude acceleration values correspond to a seismic event with a probability of exceedance of 10 percent in 50 years and were obtained from the USGS Uniform Hazards website page, https://earthquake.usgs.gov/hazards/interactive/. A 10 percent probability of exceedance in 50 years is acceptable for liquefaction analyses per Appendix GS 045.0 of the *Manual for Preparation of Geotechnical* Reports published by the County of Los Angeles, Department of Public Works, Geotechnical and Materials Engineering Division (dated July 1, 2013). A summary report of the liquefaction analyses is included in Appendix B. It should be noted that the dynamic settlement results in Appendix B do not account for the recommended depths of removals as presented on the accompanying Geotechnical Map (Plate 1).

Summary of Liquefaction-Induced Potential Settlement

CPT ID	Design Fill Depth (ft)	Design Cut Depth (ft)	Approximate Unsuitable Soil Removal Depth (ft)	Estimated Liquefaction Induced Settlement Considering Removals (in)
CPT-1	43	--	10	0.2

CPT-2	54	--	20	0
CPT-3	--	5	0	0.7*
CPT-4	33	--	10	<0.1
CPT-5	30	--	10	0.3
CPT-5A	37	--	10	<0.1
CPT-6	34	--	15	0.2
CPT-7	30	--	15	0.5
CPT-P1	4	--	25	1.2
CPT-P2	9	--	15	0.3
CPT-P3	6	--	15	<0.1
CPT-P3B	6	--	15	0.4
CPT-P4	10	--	25	<0.1
* - In new channel bottom, no removals assumed for liquefaction analyses.				

Proposed Mitigation (Induced Flooding from Dam Failure):

The potential detrimental effects of flooding as a result of the failure of Bouquet Reservoir or overtopping from a seismic event can be reduced to a less than significant level by incorporating elements of the City of Santa Clarita Local Hazard Mitigation Plan and FEMA policies and guidelines for areas at risk of flooding into the project design.

Impact No. 1(d) – Slope Instability and Landslides

Level of Significance: Potentially Significant

Discussion:

Portions of the site slope areas are located within a State of California designated seismically-induced landslide hazard zone. Also, subsurface exploration revealed adversely oriented bedding conditions for westerly facing slopes and some relatively shallow existing landslides within the site.

Proposed Mitigation:

Remedial grading should be performed in slope areas where adversely oriented bedding planes exist. The remedial grading would remove the adversely oriented bedrock and replace it with engineered fill materials. Proposed cut grading will likely remove some, if not all, of the existing landslide materials. If the landslide materials are not removed by cut grading, then they should be overexcavated and replaced with engineered fill materials. Provided that remedial and design grading within the site are performed in accordance with local grading ordinances, current standards of practice in the area, and the site-specific recommendations

to be provided by the project geotechnical professional, the potential for gross or surficial slope instability will be reduced to a less than significant level.

Slope stability calculations for the highest proposed cut slope (Section 2-2') and stabilization fill slope (Section 1-1') are presented in Appendix C. The results indicate factors-of-safety in excess of 1.5 and 1.1 for static and pseudo-static conditions, respectively. The following table indicates the shear strengths utilized in the analyses. The values are based on the results of Petra's field investigation and laboratory testing program for the project. Peak values were used for some of the materials in the pseudo-static analyses as indicated in the table below.

Shear Strength Summary

Unit	Ultimate		Peak	
	Friction Angle (deg.)	Cohesion (psf)	Friction Angle (deg.)	Cohesion (psf)
Engineered Fill	27	275	28	325
Saugus Formation – Across Bedding	31	200	--	--
Castaic Formation – Across Bedding	31	200	--	--
-- indicates value not used in analysis.				

Estimated dimensions and geometries for stabilization fills for the westerly facing slopes are depicted on the Geotechnical Map. Additional borings, and laboratory testing will be conducted during the Tentative Map study to further evaluate and refine slope stability recommendations

Impact No. 2 – Soil Erosion

Level of Significance: Potentially Significant

Discussion:

There are proposed slopes of moderate to significant height within the project site; therefore, the potential for erosion and downslope transport of soil material is considered significant. Additionally, under conditions where runoff from precipitation or uncontrolled irrigation is concentrated over an extended period of time, some localized erosion of graded areas could occur that would result in offsite transport of the non-cohesive (sandy) near-surface soils within the site. This would be particularly problematic during the rough grading phase of the project when permanent storm water controls have not yet been constructed.

Proposed Mitigation:

It is expected that the potential impact of localized minor soil erosion will be mitigated to a less than significant level through the implementation of proper storm water Best Management Practices (BMP's) prior to commencement of earthwork operations within the site, as well as diligent maintenance of erosion control devices throughout the early phases of construction until such time as the permanent storm water conveyance system has been constructed and activated. During the post-construction and occupancy period, the less than significant impact of soil erosion would be maintained through permanent storm water conveyance devices and proper maintenance of engineered grades and irrigation systems.

Impact No. 3 – Compressible Near-Surface Soil Units

Level of Significance: Potentially Significant

Discussion:

Our exploratory excavations revealed that the site is mantled by a relatively thin soil/fill layer which is underlain by alluvial soils to approximate maximum depths of roughly 66½± feet or bedrock materials. The upper few feet of the bedrock is weathered/loose. The fill, soil, upper portions of alluvium and weathered bedrock are considered unsuitable for support of the proposed buildings and appurtenant site improvements. These unsuitable materials will require excavation and recompaction in areas where new engineered fills or structures are proposed.

Proposed Mitigation:

In order to support the proposed new engineered fills, structural foundations and exterior site improvements the unsuitable material should be overexcavated and the resultant void should be replaced with engineered fill.

Petra performed consolidation and hydroconsolidation testing as part of the field investigation and laboratory testing program for the proposed development. Based on these test results and considering the proposed fill depths along with the recommended unsuitable material removals, Petra has estimated that the remaining alluvial soils could settle/consolidate up to approximately 4.2 inches under a fill depth of 34 feet in the area of boring HS-12, while settlement of up to roughly 3.6 inches could occur in the area of boring HS-10. Considering the granular nature of the majority of the soil, Petra estimates that approximately 80 percent of this settlement could occur during grading as the fill is placed. This yields a post-grading static consolidation settlement of roughly 0.7 to 0.8 inches for the areas of borings HS-10 and HS-12, respectively.

The hydro-consolidation potential of the soils has also been evaluated. The laboratory test results indicated hydro-consolidation potentials ranging from roughly 0.2 to 1.0 percent with an average of approximately 0.5 percent. The 0.2 and the 1.0 percent hydro-consolidation occurred in samples from HS-10 at depths of 20 and 30 feet, respectively. These values yielded a potential hydroconsolidation settlement on the order of 1.3 inches when the recommended remedial grading was considered. Similar evaluation of the hydro-consolidation test data for the site along with the anticipated remaining alluvial soil in the area of HS-12 indicated a potential hydro-consolidation settlement of 0.7 inches.

The following table summarizes the potential total estimated consolidation, hydro-consolidation, and liquefaction-induced settlements in the area of borings HS-10 and H-12 which are anticipated to have the largest settlements from the combined effects of the aforementioned three phenomena. Estimated differential settlement is also presented.

Summary of Total and Differential Settlements

Location	Design Fill Depth (ft)	Unsuitable Soil Removal Depth (ft)	Post-Grading Consolidation Settlement (in)	Hydro-Consolidation Potential (in)	Liquefaction Induced Settlement (in)	Total Settlement (in)	Differential Settlement Over 30' (in)
HS-10	50	20	0.7	1.3	0.0	2.0	1.0
HS-12	34	15	0.8	0.7	0.2	1.7	0.9

Provided that remedial and design grading within the site are performed in accordance with local grading ordinances, current standards of practice in the area, and the site-specific recommendations to be provided by the project geotechnical professional, it is expected that excessive settlement resulting from compression of unsuitable fill, soil, alluvium and weathered bedrock will be reduced to a less than significant level.

Impact No. 4 – Expansive Soils

Level of Significance: Potentially Significant

Discussion:

The site soils are anticipated to have Expansion Indices (EIs) ranging from less or equal to 20 for sandy soils derived from active alluvial deposits to possibly on the order of 100 or so for soils derived from fine-grained portion of the Castaic Formation. Soils with Expansion Indices greater than 20 are considered expansive in accordance with the 2016 CBC.

Proposed Mitigation:

Recommendations intended to reduce the potential detrimental effects of expansive soils should be provided during the design phase. Testing should be performed during and after grading to evaluate the expansion potential soils present at/near finish grade so that appropriate recommendations can be provided by the geotechnical consultant. Design of building foundations, floor slabs and exterior improvements in consideration of the potential uplift forces that can develop due to expansive soils and incorporation of practices intended to reduce the soil moisture content variations should mitigate the potential detrimental impacts to a less than significant level.

The potential for rock heaving as the result of the chemical reaction and transformation of sulfites to sulfates may be mitigated by overexcavating "at grade" bedrock materials and replacing the void with compacted fill materials. Preliminarily, it is recommended that building pad areas and street rights-of-way, which

expose bedrock materials, be overexcavated a minimum of 5 feet and replaced with compacted fill. Recommendations for structural improvements may also need to be designed for high sulfate conditions. Post grading testing of all structural building pads should be conducted to assess this condition.

Impact No. 5 – Suitability of Site to Support Waste Water Disposal Systems

Level of Significance: Less than Significant

Discussion:

Current development plans for the subject site indicate that the proposed residential dwellings will be served by the local municipal sewer system. Therefore, the use of private on-site septic systems or alternative wastewater disposal systems is not anticipated.

FINAL ANALYSIS AND CONCLUSIONS

Geotechnical Feasibility

This firm concludes the development of the subject project site is feasible from a geotechnical engineering and engineering geology standpoint. This conclusion is based on our understanding of the project scope, our review of the referenced literature, the results of our subsurface investigation and is contingent upon the project geotechnical consultant's recommendations being implemented into the design and construction of the project and compliance with applicable grading and building codes.

Level of Significance of Impacts Following Mitigation

Assuming that the mitigation measures described in this report and the design-phase geotechnical recommendation are fully implemented during the project planning and construction phases, it is the opinion of this firm that the potentially significant geologic and seismic impacts described herein can be reduced to a less than significant level.

REPORT LIMITATIONS

This report is based on the proposed project and geotechnical data as described herein. The materials encountered on the project site and described in other literature are believed representative of the project area, and the conclusions and recommendations contained in this report are presented on that basis. However, soil materials can vary in characteristics between points of exploration, both laterally and vertically, and those variations could affect the conclusions and recommendations contained herein. As

such, observation and testing by a geotechnical consultant during the grading and construction phases of the project are essential to confirming the basis of this report.

This report has been prepared consistent with that level of care being provided by other professionals providing similar services at the same locale and time period. The contents of this report are professional opinions and as such, are not to be considered a guarantee or warranty. This report should be reviewed and updated after a period of one year or if the project concept changes from that described herein.

It should be noted that this geotechnical evaluation does not address possible soil contamination or other environmental issues that may affect the property. Such issues should be addressed by the project environmental consultant.

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

Should you have any questions, please do not hesitate to call.

Respectfully submitted,
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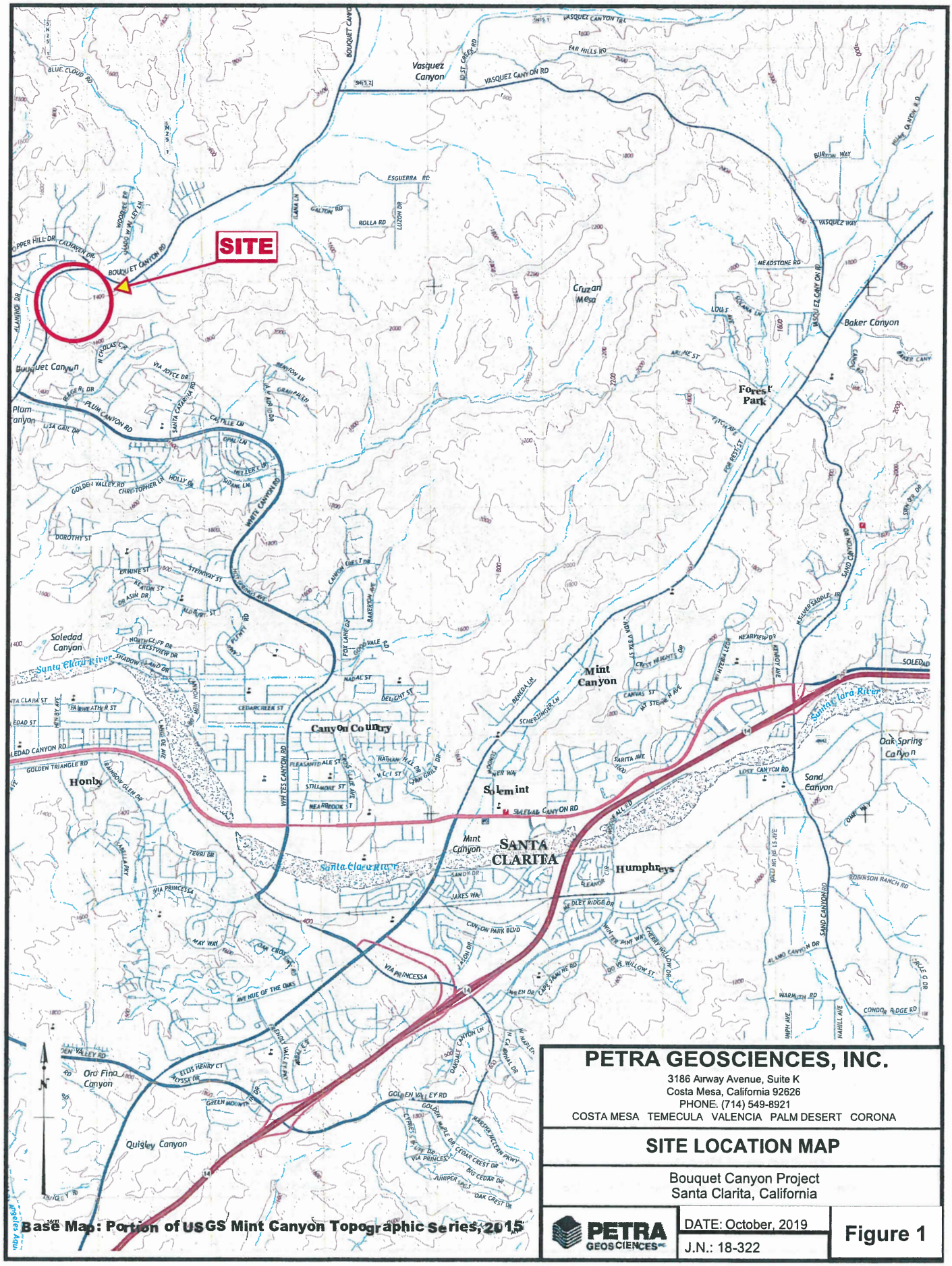

Base Map: Portion of USGS Mint Canyon Topographic Series, 2015

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SITE LOCATION MAP

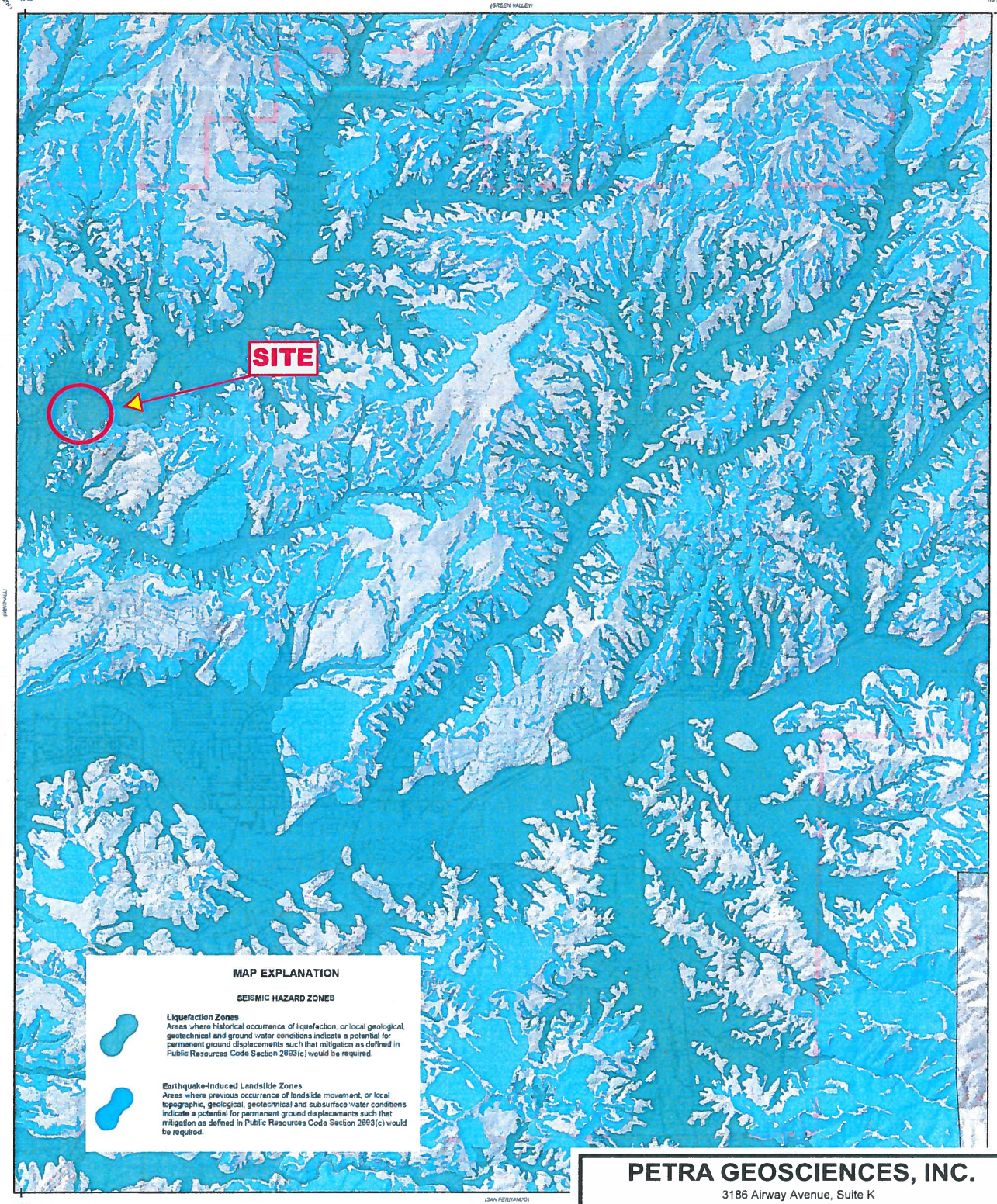
Bouquet Canyon Project
Santa Clarita, California

PETRA GEOSCIENCES

DATE: October, 2019

J.N.: 18-322

Figure 1



Base Map: Portion of Mint Canyon 7.5 Minute Quadrangle
Seismic Hazard Zones, Released March 25, 1999

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SEISMIC HAZARDS MAP

Bouquet Canyon Project
Santa Clarita, California

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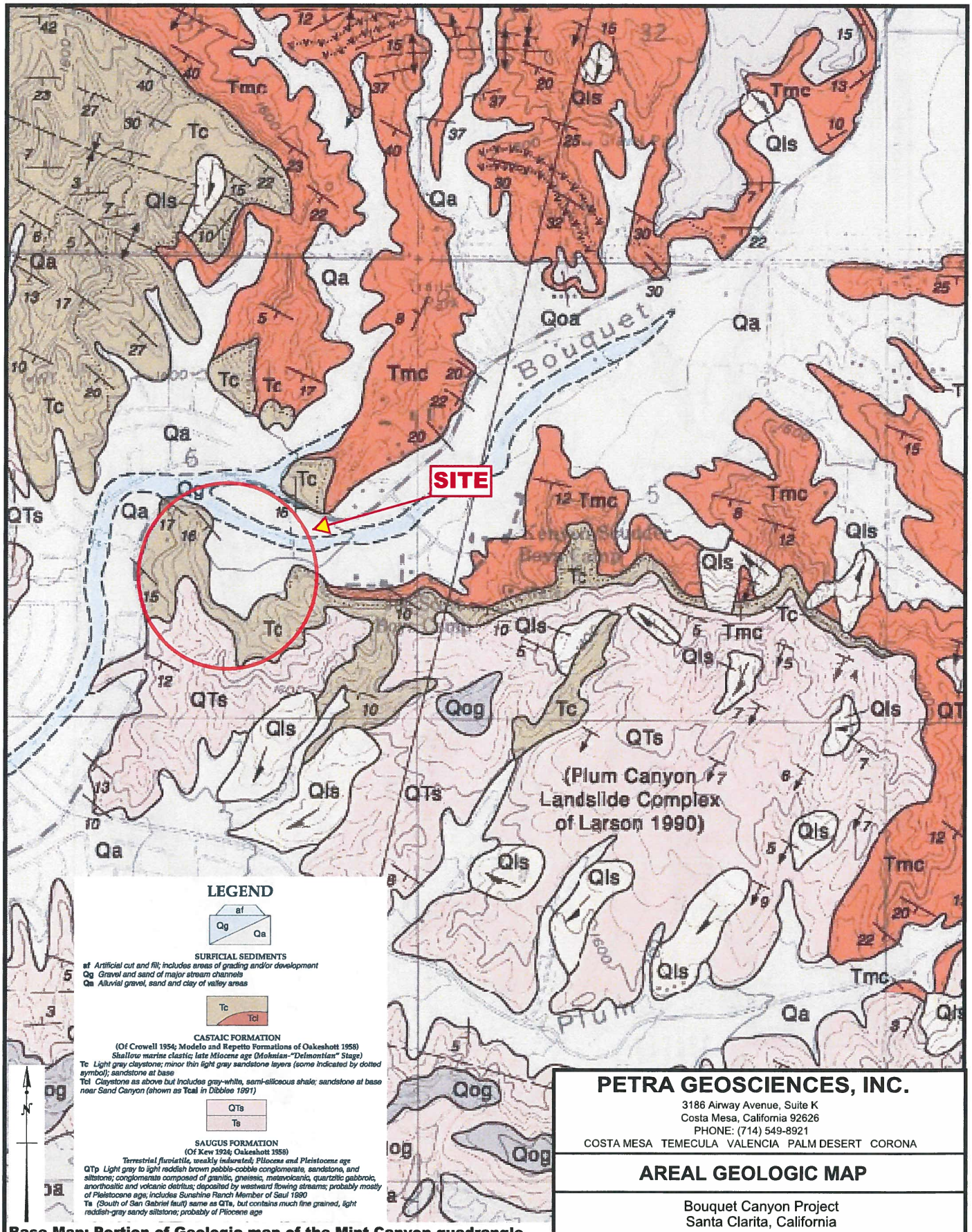
DATE: January, 2019
J.N.: 18-322

Figure 2



Base Map: Portion of Geologic map of the Mint Canyon quadrangle
Dibblee, T.W., and Ehrenspeck, H.E., 1996
From National Geologic Map Database

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AREAL GEOLOGIC MAP

Bouquet Canyon Project
Santa Clarita, California

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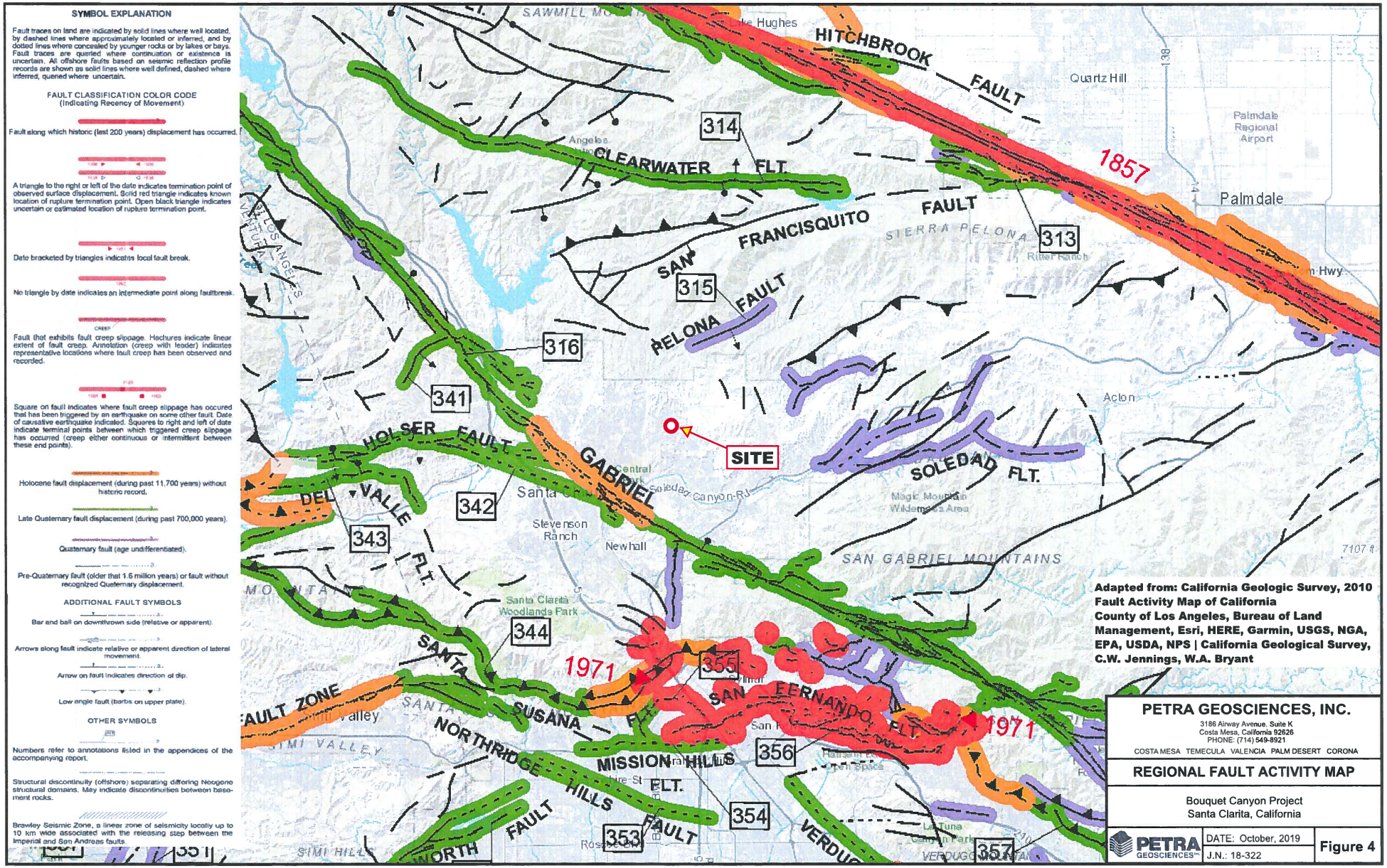
DATE: October, 2019
J.N.: 18-322

Figure 3


SYMBOL EXPLANATION
Fault traces on land are indicated by solid lines where well located, by dashed lines where approximately located or inferred, and by dotted lines where concealed by younger rocks or by lakes or bays. Fault traces are queried where continuation or existence is uncertain. All offshore faults based on seismic reflection profile records are shown as solid lines where well defined, dashed where inferred, queried where uncertain.
FAULT CLASSIFICATION COLOR CODE
(Indicating Recency of Movement)
Fault along which historic (last 200 years) displacement has occurred.
A triangle to the right or left of the date indicates termination point of observed surface displacement. Solid red triangle indicates known location of rupture termination point. Open black triangle indicates uncertain or estimated location of rupture termination point.
Date bracketed by triangles indicates local fault break.
No triangle by date indicates an intermediate point along faultbreak.
Fault that exhibits fault creep slippage. Hachures indicate linear extent of fault creep. Annotation (creep with leader) indicates representative locations where fault creep has been observed and recorded.
Square on fault indicates where fault creep slippage has occured that has been triggered by an earthquake on some other fault. Date of causative earthquake indicated. Squares to right and left of date indicate terminal points between which triggered creep slippage has occurred (creep either continuous or intermittent between these end points).
Holocene fault displacement (during past 11,700 years) without historic record.
Late Quaternary fault displacement (during past 700,000 years).
Quaternary fault (age undifferentiated).
Pre-Quaternary fault (older that 1.6 million years) or fault without recognized Quaternary displacement.
ADDITIONAL FAULT SYMBOLS
Bar and ball on downthrown side (relative or apparent).
Arrows along fault indicate relative or apparent direction of lateral movement.
Arrow on fault indicates direction of dip.
Low angle fault (barbs on upper plate).
OTHER SYMBOLS
Numbers refer to annotations listed in the appendices of the accompanying report.
Structural discontinuity (offshore) separating differing Neogene structural domains. May indicate discontinuities between basement rocks.
Brawley Seismic Zone, a linear zone of seismicity locally up to 10 km wide associated with the releasing step between the Imperial and San Andreas faults.
HITCHBROOK FAULT
CLEARWATER FLT.
SAN FRANCISQUITO FAULT
PELONA FAULT
HOLSER FAULT
GABRIEL
DEL VALLE FLT.
SOLEDAD FLT.
SAN GABRIEL MOUNTAINS
SANTA SUSANA FLT.
SAN FERNANDO FLT.
NORTHRIDGE HILLS FAULT
MISSION HILLS FLT.
VERDUGO
SITE
1857
1971
1971
314
315
316
313
341
342
343
344
355
356
354
353
357
Quartz Hill
Palmdale
Palmdale Regional Airport
Acton
Santa Clarita
Stevenson Ranch
Newhall
Santa Clarita Woodlands Park
Magic Mountain Wilderness Area
7107 ft
Adapted from: California Geologic Survey, 2010 Fault Activity Map of California
County of Los Angeles, Bureau of Land Management, Esri, HERE, Garmin, USGS, NGA, EPA, USDA, NPS | California Geological Survey, C.W. Jennings, W.A. Bryant
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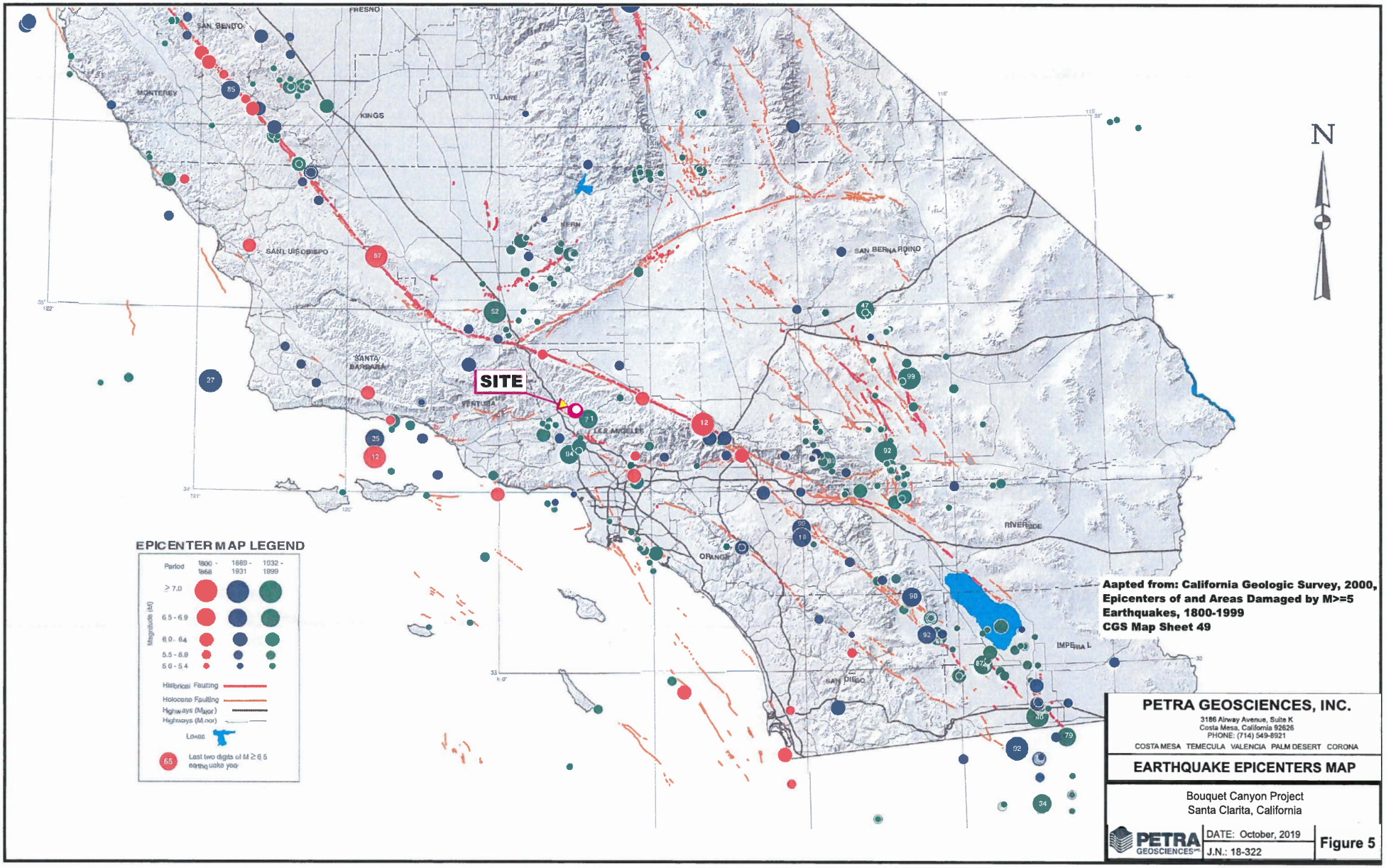
REGIONAL FAULT ACTIVITY MAP
Bouquet Canyon Project
Santa Clarita, California
DATE: October, 2019
J.N.: 18-322
Figure 4



Aapted from: California Geologic Survey, 2000, Epicenters of and Areas Damaged by M>=5 Earthquakes, 1800-1999
CGS Map Sheet 49

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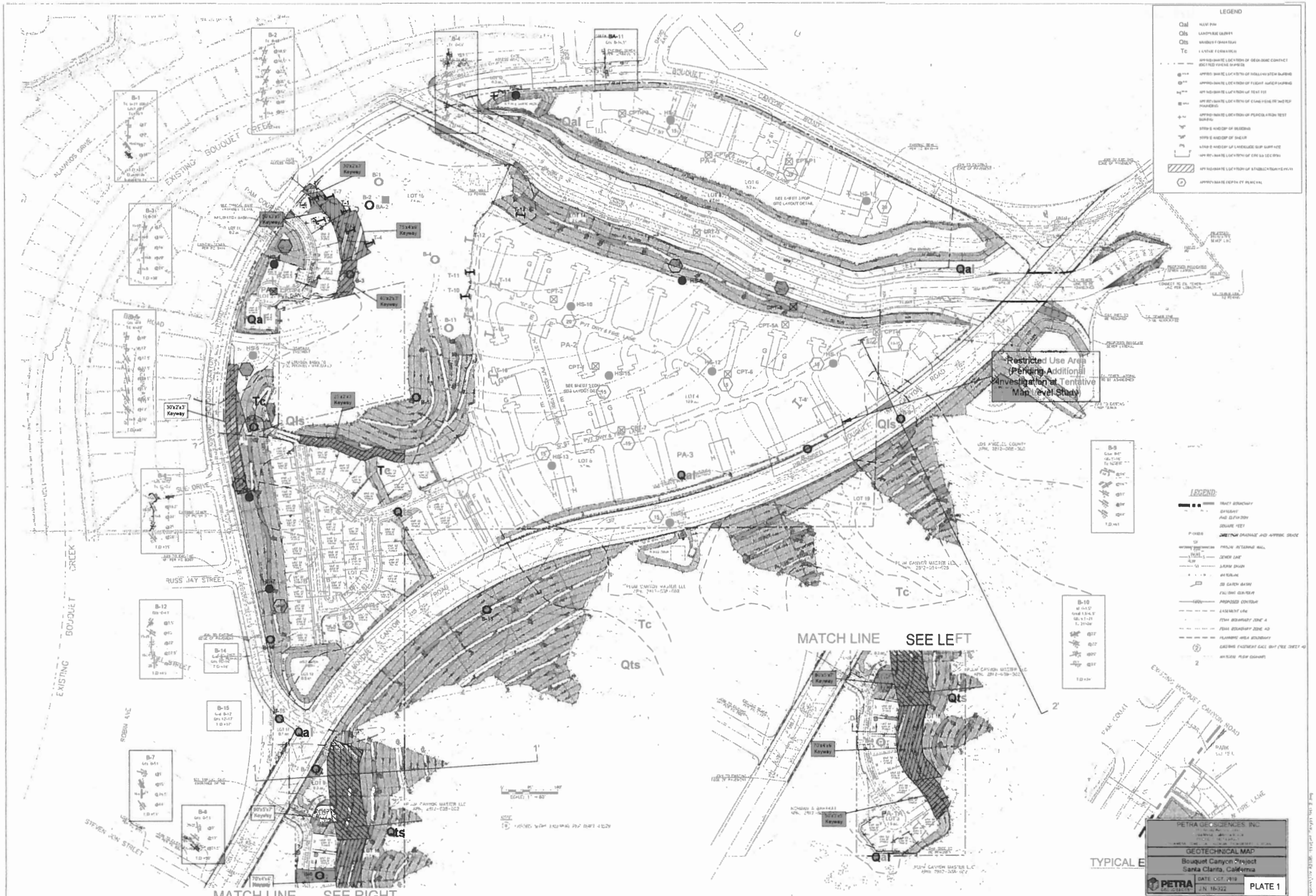
EARTHQUAKE EPICENTERS MAP

Bouquet Canyon Project
Santa Clarita, California

PETRA GEOSCIENCES INC. | DATE: October, 2019 | J.N.: 18-322 | **Figure 5**



PREPARED FOR

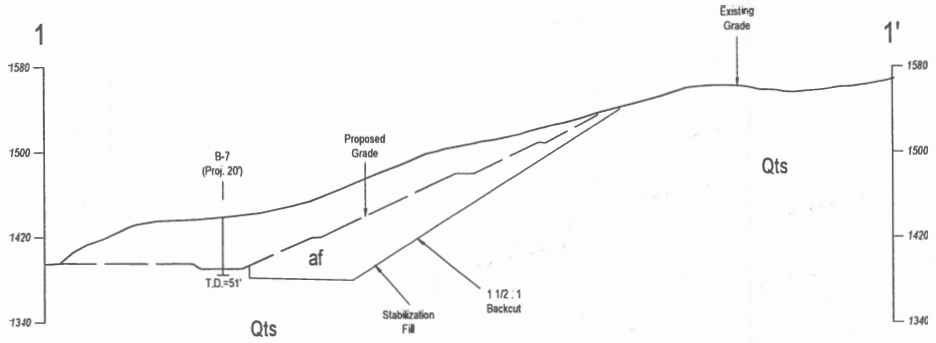
INTEGRAL PARTNERS FUNDING, LLC
888 SAN CLEMENTE DRIVE, SUITE 100
NEWPORT BEACH, CA 92660

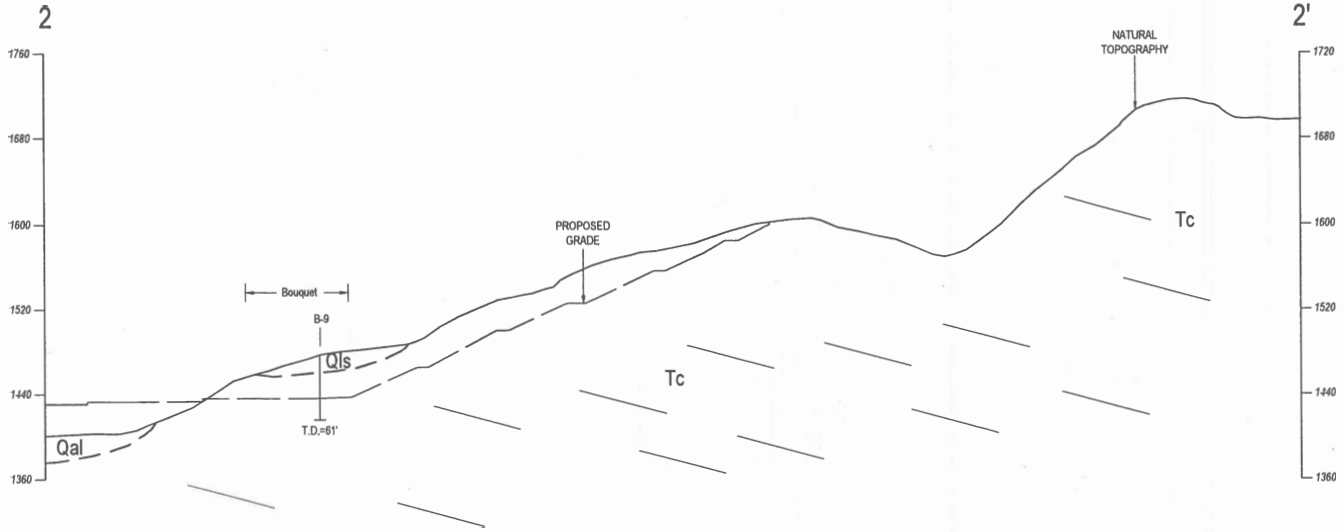
LEGAL DESCRIPTION:

A PORTION OF SECTION 6, TOWNSHIP 4 NORTH RANGE 15 WEST, SAN BERNARDINO MERIDIAN

SIKAND
Engineering | Planning | Surveying
15230 Burbank Blvd.
Van Nuys, CA 91411
Tel: (818) 787-8550
Fax: (818) 901-7451
info@sikand.com

VESTING TENTATIVE TRACT MAP NO. 82126





SCALE: 1"=80'

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CROSS SECTIONS 1-1' and 2-2'

Bouquet Canyon Project
Santa Clarita, California

PETRA GEOSCIENCES

DATE Oct. 2019

J.N: 18-322

PLATE 2

APPENDIX A

EXPLORATION LOGS
HS-1 through HS-15
FA-1 through FA-15

TEST PIT LOGS
TP-1 through TP-16

CONE PENETROMETER SOUNDINGS
CPT-1 through CPT-7

EXPLORATION LOG

Project: **Bouquet Canyon**		Boring No.:	**HS-1**
Location: **Santa Clarita**		Elevation:	**±1400**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**	Date:	**9/12/18**
Drill Method: **Hollow Stem Auger**	Driving Weight: **140lbs/30"**	Logged By:	**AM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**ALLUVIUM (Qal)** Silty Sand (SM): Grayish-brown, dry, loose to medium dense, very fine- to fine-grained sand.							
5		becomes brown, slightly moist, medium dense, fine-grained sand, trace fine-grained gravel, few pores, with roots.		13 16 18	■				
10		becomes gray, dense, few fine-grained gravel (to 0.5").		15 17 20	■	■			
15		Sandy Silt to Silty Sand (SM-ML): Brown, moist, medium dense, fine-grained sand, abundant of pores, rootlets, weakly cemented.		6 7 10	■				
20		with mottled black, less pores.		12 12 15	■				
25		Silty Sand (SM): Light brown, to brown, moist, very dense, fine- to coarse-grained sand, poorly graded, with some fine- to coarse-grained gravell (0.3" to 2"), rock fragments.		20 32 45	■				
30		Sand with Silt and Gravel (SP): Brown, moist, very dense, fine- to coarse-grained sand, poorly graded, with some fine- to coarse-grained gravell (to 1.2"), with few cemented olive brown layer.		28 50/6"	■				
35		Silty Clayey Sand (SM): Gray, to olive gray, moist, very dense, fine- to		40	■				

PLATE

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EXPLORATION LOG

Project: **Bouquet Canyon**		Boring No.:	**HS-1**
Location: **Santa Clarita**		Elevation:	**±1400**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**	Date:	**9/12/18**
Drill Method: **Hollow Stem Auger**	Driving Weight: **140lbs/30"**	Logged By:	**AM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		medium-grained sand, with numerous cemented olive brown layers.		50/6"	■				
40		**BEDROCK - Castaic Formation (Tcs)** Sandstone: Gray, moist, moderately hard, massive, fractured.		50/6"	■				
45		becomes hard, with slight iron oxide staining on fractures.		50/5"	■				
50				50/5"	■				
		Total Depth 50.5 feet No groundwater Boring Backfilled with cuttings.							
55									
60									
65									
70									

PLATE

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EXPLORATION LOG

Project: **Bouquet Canyon**		Boring No.:	**HS-2**
Location: **Santa Clarita**		Elevation:	**±1394**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**	Date:	**9/12/18**
Drill Method: **Hollow Stem Auger**	Driving Weight: **140lbs/30"**	Logged By:	**AM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**ALLUVIUM (Qal)** silty sand (SM): Grayish-brown, dry, loose to medium dense, very fine- to fine-grained sand.							
5		Sand with Silt (SP-SM): Gray, dry, very dense, fine- to coarse-grained sand, poorly graded, with few fine- to coarse-grained gravel (to 0.6").		20 30 36	■				
10		becomes yellowish brown, slightly moist, medium dense.		12 15 20	■	■			
15		Silty Sand (SM): Brown, moist, very dense, fine- to medium-grained sand, with few coarse-grained gravel (0.5" to 1.2"). Abundant of coarse-grained gravel.		25 50/6"	■	■			
20		No Recovery (Too Sandy).		39 50/6"	■				
25		Sand with Silt (SP-SM): Gray, to yellowish-brown, moist, dense, fine- to coarse-grained sand, poorly graded, with fine- to coarse-grained gravel (to 1.5"), subangular.		16 23 32	■				
30		becomes very dense.		32 50/6"	■				
35				35	■				

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**		Boring No.:	**HS-2**
Location: **Santa Clarita**		Elevation:	**±1394**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**	Date:	**9/12/18**
Drill Method: **Hollow Stem Auger**	Driving Weight: **140lbs/30"**	Logged By:	**AM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
				50/6"	■				
40		Silty Sand (SM): Yellowish-brown, moist, very dense, fine- to medium-grained sand, with few fine- to coarse-grained gravel (0.3" to 1.5").		40 50/5"	■				
45		becomes very moist.		42 50/3"	■				
50		Sand with Silt (SP-SM): Yellowish-brown, wet, very dense, fine- to coarse-grained sand, poorly graded.	▽	50/6"	■				
55		Gravel with Silt and Sand (GP): Brown, wet, very dense, coarse-grained sand, poorly graded.		50/5"	■				
60		Sandy Silt (SM): Dark brown, wet, very dense, fine-grained sand.		38 50/3"	■				
65				18 25 38	■				
		Total Depth 66.5 feet Groundwater @ 50 feet Boring Backfilled with cuttings.							
70									

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**		Boring No.:	**HS-3**
Location: **Santa Clarita**		Elevation:	**±1386**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**	Date:	**9/12/18**
Drill Method: **Hollow Stem Auger**	Driving Weight: **140lbs/30"**	Logged By:	**AM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**ALLUVIUM (Qal)** Silty Sand (SM): Brown, to brownish-gray, dry, loose to medium dense, very fine- to fine-grained sand.							
5		Sand with Silt (SP-SM): Gray, dry to slightly moist, dense, fine- to coarse-grained sand, poorly graded, trace of gravel.		15 18 30	■				
10		becomes moist, with rock fragments (to 2"), some gravel.		19 28 40	■				
15		Silty Sand (SM): Brown, moist, very dense, fine- to medium-grained sand.		28 50/6"	■				
20		Sand with Silt (SP-SM): Yellowish-brown, moist, very dense, fine- to coarse-grained sand, poorly graded, with some fine- to coarse-grained gravel.		20 35 42	■				
		Total Depth 21.5 feet No groundwaterBoring Backfilled with cuttings.							
25									
30									
35									

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**		Boring No.:	**HS-4**
Location: **Santa Clarita**		Elevation:	**±1370**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**	Date:	**9/13/18**
Drill Method: **Hollow Stem Auger**	Driving Weight: **140lbs/30"**	Logged By:	**AM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**ALLUVIUM (Qal)** Sandy Silt to Silty Sand (SM-ML): Grayish-brown, dry, loose, very fine- to fine-grained sand, with few fine-grained gravel.							
5		becomes brown, dry to slightly moist, loose, with roots.		3 3 3	■				
10		becomes moist, with trace fine-grained gravel, subangular, with few clay, slightly plastic and with iron oxide stainingsome gravel.		3 6 10	■				
15		with trace pores (1mm).		5 6 9	■				
20		becomes weakly cemented, few roots, more plastic.		6 8 11	■				
25				5 10 13	■				
		Total Depth 26.5 feet No groundwater Boring Backfilled with cuttings.							
30									
35									

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**		Boring No.:	**HS-5**
Location: **Santa Clarita**		Elevation:	**±1366**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**	Date:	**9/13/18**
Drill Method: **Hollow Stem Auger**	Driving Weight: **140lbs/30"**	Logged By:	**AM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**ALLUVIUM (Qal)** Sandy Silt to Silty Sand (SM-ML): Grayish-brown, dry, soft, very fine- to fine-grained sand, with few fine-grained gravel.							
5		becomes brown, moist, medium dense, with trace of tiny roots, without gravel.		8 9 12	■				
10		with 1-2 mm pores, iron & manganese oxide staining stainingsome gravel.		8 9 10	■				
15		more pores and less staining.		5 6 8	■				
20		becomes dense, weakly cemented, without pores, trace of fine-grained gravel.		13 18 25	■				
25				15 18 26	■				
30		**BEDROCK - Castaic Formation (Tcs)** Silty Sandstone: Grayish-brown, moist, moderately hard, thickly bedded to massive, slightly fractured, highly weathered, slightly cemented.		13 16 28	■				
35		with few iron oxide staining.		12	■				

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**		Boring No.:	**HS-5**
Location: **Santa Clarita**		Elevation:	**±1366**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**	Date:	**9/13/18**
Drill Method: **Hollow Stem Auger**	Driving Weight: **140lbs/30"**	Logged By:	**AM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
				18 26	■				
40		Cla e Sandstone: Dark brown, moist, soft, massive, highly weathered, slightly cemented.		13 19 23	■				
45		with trace of rock fragments.		21 24 31	■				
50				19 21 32	■				
55		Silty Sandstone: Olive gray, moist, moderately hard, massive, moderately fractured, with slight iron oxide staining on fractures, slightly cemented.		22 28 39	■				
60		becomes moderately to intensely fractured, with numerous iron oxide staining on fractures.		39 47 50/5"	■				
		Total Depth 61.5 feet No groundwater Boring Backfilled with cuttings.							
65									
70									

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**		Boring No.:	**HS-6**
Location: **Santa Clarita**		Elevation:	**±1370**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**	Date:	**9/13/18**
Drill Method: **Hollow Stem Auger**	Driving Weight: **140lbs/30"**	Logged By:	**AM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**ALLUVIUM (Qal)** Sandy Silt to Silty Sand (SM-ML): Brown, dry, medium dense, fine-grained sand.							
5		becomes moist, rootlet.		3 5 8	■				
		BEDROCK - Castaic Formation (Tcs) Sandstone: Gray, moist, soft to moderately hard, massive, slightly fractured, moderately weathered.							
10		with trace pores (1mm).		36 50/2"	■				
15		Becomes olive gray, hard.		50/3"	■				
20		Becomes yellowish-brown.		50/2"	■				
		Total Depth 20.5 feet No groundwater Boring Backfilled with cuttings.							
25									
30									
35									

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**		Boring No.:	**HS-7**
Location: **Santa Clarita**		Elevation:	**±1375**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**	Date:	**9/12/18**
Drill Method: **Hollow Stem Auger**	Driving Weight: **140lbs/30"**	Logged By:	**AM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**ALLUVIUM (Qal)** Silty Sand (SM): Grayish-brown, to brown, dry, loose, fine-grained sand, poorly graded.							
5		Sandy Silt to Silty Sand (SM-ML): Brown, slightly moist, loose, very fine- to fine-grained sand, with trace of fine-grained gravel.		4 4 6	■				
10		Becomes moist, weakly cemented, rootlet.		8 10 15	■	■			
15		with trace of coarse-grained gravel and rock fragments.		8 12 40	■				
20		Becomes yellowish-brown.		8 9 11	■				
25		with iron oxide staining.		9 12 16	■				
30		without gravel.		7 9 12	■				
		BEDROCK - Castaic Formation (Tcs) Sandstone: Gray, moist, soft to moderately hard, massive, slightly fractured, moderately weathered.							
35		with iron oxide staining on fractures.		27	■				

PLATE

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EXPLORATION LOG

Project: **Bouquet Canyon**		Boring No.:	**HS-7**
Location: **Santa Clarita**		Elevation:	**±1375**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**	Date:	**9/12/18**
Drill Method: **Hollow Stem Auger**	Driving Weight: **140lbs/30"**	Logged By:	**AM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
40		increase in iron oxide staining, black mottled.		40 50/6"	■				
				50/6"	■				
45				50/6"	■				
		Total Depth 45.5 feet No groundwater Boring Backfilled with cuttings.							
50									
55									
60									
65									
70									

PLATE

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EXPLORATION LOG

Project: **Bouquet Canyon**		Boring No.:	**HS-8**
Location: **Santa Clarita**		Elevation:	**±1397**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**	Date:	**9/18/18**
Drill Method: **Hollow Stem Auger**	Driving Weight: **140lbs/30"**	Logged By:	**AM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**ALLUVIUM (Qal)** Silty Sand (SM): Light brown, dry, loose to medium dense, fine-grained sand, with few gravel.							
5		Sand with Silt (SP-SM): Grayish-brown, slightly moist, very dense, fine- to medium-grained sand, poorly graded, with fine-grained gravel.		20 25 37	■				
10		Becomes moist.		22 28 36	■				
15		Sand with Silt and Gravel (SP): Grayish-brown, moist, dense to very dense, fine- to coarse-grained sand, with some fine- to coarse-grained gravel.		18 26 34	■				
20				20 28 37	■				
25		becomes medium- to coarse-grained sand.		23 40 45	■				
30		Sandy Gravel to Gravelly Sand (SP/GP): Grayish-brown, to yellowish-brown, moist, very dense, fine- to coarse-grained sand, poorly graded, with fine- to coarse-grained gravel, few silt.		20 28 35	■				
35		Sand with Silt and Gravel (SP): Grayish-brown, moist, very dense, fine- to		37	■				

PLATE

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EXPLORATION LOG

Project: **Bouquet Canyon**		Boring No.:	**HS-8**
Location: **Santa Clarita**		Elevation:	**±1397**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**	Date:	**9/18/18**
Drill Method: **Hollow Stem Auger**	Driving Weight: **140lbs/30"**	Logged By:	**AM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		coarse-grained sand, poorly graded, with fine-grained gravel.		50/6"	■				
40		Becomes very moist, with fine- to coarse-grained gravel and trace of clay.		38 50/5"	■				
45		Becomes wet.	▽	50/6"	■				
50		Sand (SP/SW): Yellowish-brown, wet, very dense, fine- to coarse-grained sand, moderately graded, with fine- to coarse-grained gravel and silt.		40 50/5"	■				
55				39 50/5"	■				
60		**BEDROCK - Castaic Formation (Tcs)** Sandstone: Brown, to grayish-brown, wet, soft to moderately hard, massive, slightly fractured, highly weathered, with iron oxide staining on fractures.		7 12 12	■				
65		Becomes dark brown.		8 10 15	■				
		Total Depth 66.5 feet Groundwater @ 45 feet Boring Backfilled with cuttings.							
70									

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**		Boring No.:	**HS-9**
Location: **Santa Clarita**		Elevation:	**±1395**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**	Date:	**9/18/18**
Drill Method: **Hollow Stem Auger**	Driving Weight: **140lbs/30"**	Logged By:	**AM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**ALLUVIUM (Qal)** Silty Sand (SM): Light brown, dry, loose, fine-grained sand, with some fine-grained gravel (0.4" to 0.7"), subrounded.							
		Sand with Silt (SP-SM): Yellowish-brown, slightly moist, medium dense, fine- to coarse-grained sand, poorly graded, with fine-grained gravel.		12 11 11	■	■			
5		Becomes moist, with fine- to coarse-grained gravel.		10 16	■				
10		Sand with Silt and Gravel (SP): Yellowish-brown, moist, dense, fine- to coarse-grained sand, few silt.		19 32 14	■				
15		Gravelly Sand to Sandy Gravel (SP/GP): Grayish-brown, to yellowish-brown, moist, very dense, fine- to coarse-grained sand, poorly graded, with fine- to coarse-grained gravel.		15 26 36	■				
20				30 50/6"	■				
25		Sand with Silt (SP-SM): Grayish-brown, moist, very dense, very fine- to medium-grained sand, poorly graded, with some fine- to coarse-grained gravel (to 1.1"), few rock fragments, subangular.		37 50/6"	■				
30		Sand with Silt and Gravel (SP): Yellowish-brown, moist, very dense, fine- to coarse-grained sand, poorly graded, with few coarse-grained gravel.		40 50/5"	■				
35									

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**		Boring No.:	**HS-9**
Location: **Santa Clarita**		Elevation:	**±1395**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**	Date:	**9/18/18**
Drill Method: **Hollow Stem Auger**	Driving Weight: **140lbs/30"**	Logged By:	**AM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
40		**BEDROCK - Castaic Formation (Tcs)** Silty Sandstone: Grayish-brown, moist, moderately hard, massive, slightly to moderately fractured, highly weathered, with iron oxide staining on fractures.		50/6"	■				
		Becomes gray, to olive gray, moderately hard to hard.		50/6"	■				
45		Total Depth 43.5 feet No groundwater Boring Backfilled with cuttings.							
50									
55									
60									
65									
70									

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**		Boring No.:	**HS-10**
Location: **Santa Clarita**		Elevation:	**±1396**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**	Date:	**9/18/18**
Drill Method: **Hollow Stem Auger**	Driving Weight: **140lbs/30"**	Logged By:	**AM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**ALLUVIUM (Qal)** Silty Sand (SM): Light brown, dry, loose, fine-grained sand, with few fine-grained gravel.							
5		Sandy Silt to Silty Sand (SM-ML): Brown, slightly moist, medium dense, very fine- to fine-grained sand.		5 7 12	■	■			
10		Becomes dark brown, moist, medium dense, fine- to medium-grained sand, poorly graded, trace of fine-grained gravel, slightly plastic.		5 8 12	■				
15		Becomes rootlet, with trace of clay.		6 8 11	■				
20		Silty Sand (SM): Light brown, moist, medium dense, fine- to coarse-grained sand, trace of fine- to coarse-grained Gravel (up to 1.1"), with few pores (1mm).		8 11 13	■				
25		with trace of fine-grained gravel, without pores.		10 15 18	■				
30		without gravel.		8 12 16	■				
35		**BEDROCK - Castaic Formation (Tcs)**		6	■				

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**		Boring No.:	**HS-10**
Location: **Santa Clarita**		Elevation:	**±1396**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**	Date:	**9/18/18**
Drill Method: **Hollow Stem Auger**	Driving Weight: **140lbs/30"**	Logged By:	**AM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		Silty Sandstone: Brown, moist, soft, massive, slightly fractured, highly weathered, Slightly cemented.		10 15	■				
40		Becomes moderately hard.		50/6"	■				
45		Becomes brown, to olive brown, with iron oxide staining.		50/5"	■				
50		Becomes moderately weathered.		50/5"	■				
55		Clayey Sandstone: Becomes dark brown, to black.		50/5"	■				
		Total Depth 55.5 feet No groundwater Boring Backfilled with cuttings.							
60									
65									
70									

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**		Boring No.:	**HS-11**
Location: **Santa Clarita**		Elevation:	**±1405**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**	Date:	**9/18/18**
Drill Method: **Hollow Stem Auger**	Driving Weight: **140lbs/30"**	Logged By:	**AM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**ALLUVIUM (Qal)** Sandy Silt to Silty Sand (SM-ML): Brown, dry, loose, very fine- to fine-grained sand.							
5		becomes slightly moist, medium dense.		5 6 12	■				
10		Becomes grayish-brown, moist, with iron oxide staining.		7 8 12	■				
15		Sandy Silt (ML): Dark brown, moist, medium dense, very fine- to fine-grained sand, With trace of clay.		12 15 18	■				
20		Becomes brown, dense.		16 23 13	■				
25		**BEDROCK - Castaic Formation (Tcs)** Silty Sandstone: Gray, moist, moderately hard to hard, thickly bedded to massive, slightly to moderately fractured, moderately weathered, with iron oxide staining on fractures.		29 50/6"	■				
30		Total Depth 26 feet No groundwater Boring Backfilled with cuttings.							
35									

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**		Boring No.:	**HS-12**
Location: **Santa Clarita**		Elevation:	**±1404**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**	Date:	**9/19/18**
Drill Method: **Hollow Stem Auger**	Driving Weight: **140lbs/30"**	Logged By:	**AM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		Sandy Silt to Silty Sand (SM-ML): Brown, dry, loose, very fine- to fine-grained sand, with few fine-grained gravel, subrounded.							
		Becomes moist, medium dense, weakly cemented, rootlet, with few rock fragments.		13 10 8					
5									
		Silty Sand (SM): Brown, slightly moist, medium dense to dense, fine- to medium-grained sand, with few rock fragments.		10 16 20					
10									
		Sand with Silt (SP-SM): Yellowish-brown, to brown, moist, dense, fine- to coarse-grained sand, poorly graded, with fine-grained gravel (to 0.4").		13 17 19					
15									
		Silty Sand (SM): Brown, moist, dense, fine-grained sand, weakly cemented, trace of coarse-grained sand.		15 18 20					
20									
		Clayey Silty Sand (CL-ML): Dark brown, moist, dense, fine-grained sand, moderately plastic.		9 15 26					
25									
		Becomes medium dense.		6 7 8					
30									
		with iron oxide staining (probable weathered bedrock).		13 18 21					
35									

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**			Boring No.: **HS-12**
Location: **Santa Clarita**			Elevation: **±1404**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**		Date: **9/19/18**
Drill Method: **Hollow Stem Auger**	Driving Weight: **140lbs/30"**		Logged By: **AM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
40				9 12 13					
45		**BEDROCK - Castaic Formation (Tcs)** Clayey Sandstone: Brown, to grayish-brown, moist, moderately hard to hard, massive, slightly fractured, highly weathered, with iron oxide staining on fractures.		50/6"					
50		No recovery, (Per driller, hit a rock layer and then a soft one), 2 rock fragments (2") are attached to sampler shoe..		52/5"					
55		Becomes dark brown, slightly weathered, with gray mottled.		50/4"					
		Total Depth 55.5 feet No groundwater Boring Backfilled with cuttings.							
60									
65									
70									

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**		Boring No.:	**HS-13**
Location: **Santa Clarita**		Elevation:	**±1417**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**	Date:	**9/19/18**
Drill Method: **Hollow Stem Auger**	Driving Weight: **140lbs/30"**	Logged By:	**AM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**ALLUVIUM (Qal)** Sandy Silt to Silty Sand (SM-ML): Light brown, dry, loose, very fine- to fine-grained sand, with few fine-grained gravel.							
5		Becomes dark brown, moist, medium dense, more silty, weakly cemented.		6 9 13	■				
10		With trace of fine-grained gravel, rootlet.		8 12 16	■				
15		**BEDROCK - Castaic Formation (Tcs)** Silty Sandstone: Yellowish-brown, moist, soft to moderately hard, massive, highly weathered.		12 15 18	■				
20		Becomes brown.		8 10 14	■				
25		Becomes light brown, moderately hard to hard, slightly fractured, with iron oxide staining on fractures.		7 9 13	■				
30		Becomes olive brown, to brown, hard.		12 20 27	■				
35		Total Depth 31.5 feet No groundwater Boring Backfilled with cuttings.							

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**		Boring No.:	**HS-14**
Location: **Santa Clarita**		Elevation:	**±1425**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**	Date:	**9/19/18**
Drill Method: **Hollow Stem Auger**	Driving Weight: **140lbs/30"**	Logged By:	**AM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**ALLUVIUM (Qal)** Sandy Silt to Silty Sand (SM-ML): Brown, dry, loose, very fine- to fine-grained sand.							
		Silty Sand: Becomes grayish-brown, slightly moist, medium dense, fine-grained sand, with numerous rock fragments.		11 14 16	■				
5		Becomes brwon.		9 12 18	■				
10		Becomes grayish-brown, moist, massive, few coarse-grained sand, with iron oxide staining, probable weathered bedrock.		10 13 16	■				
15		**BEDROCK - Castaic Formation (Tcs)** Silty Sandstone: Yellowish-brown, moist, moderately hard to hard, massive, slightly fractured, highly weathered, with iron oxide staining on fractures, gray mottled.		18 26 40	■				
20				16 16 25	■				
		Total Depth 21.5 feet No groundwater Boring Backfilled with cuttings.							
25									
30									
35									

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**		Boring No.:	**HS-15**
Location: **Santa Clarita**		Elevation:	**±1402**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**	Date:	**9/19/18**
Drill Method: **Hollow Stem Auger**	Driving Weight: **140lbs/30"**	Logged By:	**AM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**ALLUVIUM (Qal)** Sandy Silt to Silty Sand (SM-ML): Brown, dry, loose, very fine- to fine-grained sand, trace of fine-grained gravel.							
5		Becomes slightly moist, medium dense, few pores (1mm), rootlet.		10 13 15	■				
10		Silty Sand (SM): Brown, moist, dense, fine- to coarse-grained sand, fine-grained gravel, slightly cemented.		14 16 28	■				
15		Sandy Silt to Silty Sand (SM-ML): Dark brown, moist, medium dense, fine-grained sand, fine-grained gravel, cemented.		12 14 19	■				
20		Becomes brwon, with iron oxide staining.		9 11 13	■				
25		Becomes dark brown, (probable weathered bedrock).		8 10 12	■				
30		**BEDROCK - Castaic Formation (Tcs)** Silty Sandstone: Grayish-brown, moist, moderately hard to hard, massive, with iron oxide staining, well cemented.		11 14 19	■				
35		Becomes gray, hard.		29	■				

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**		Boring No.:	**HS-15**
Location: **Santa Clarita**		Elevation:	**±1402**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**	Date:	**9/19/18**
Drill Method: **Hollow Stem Auger**	Driving Weight: **140lbs/30"**	Logged By:	**AM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
40		Becomes hard to very hard, slightly fractured, with iron oxide staining on fractures.		50/6"	■				
				50/4"	■				
		Total Depth 40.5 feet No groundwater Boring Backfilled with cuttings.							
45									
50									
55									
60									
65									
70									

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**			Boring No.: **FA-1**
Location: **Santa Clarita**			Elevation: **±1452'**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**		Date: **9/24/18**
Drill Method: **Lo-Dril w/24" Auger**	Driving Weight: **See end of log**		Logged By: **EBP**

Depth (Feet)	Becker Data: Measured Blow Count, Blows / foot	Becker Data: Bounce Chamber Pressure, psi	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0				**SOIL** Clayey Silt (ML): olive-brown, dry to slightly moist, firm, few gravel sized shale clasts, pinhole porosity, rootlets throughout.							
				LANDSLIDE DEBRIS (Qls) Clayey Siltstone and Sandy Siltstone: Light olive-brown, fine-grained sand, moderately hard, thinly to thickly bedded, intensely fractured, highly weathered, moderately indurated, sections with disoriented bedding, interbedded with a scouring and infilling sequence, rootlets to 3.5'. @2.2': B: N5°E,12°N. @4.2': Becomes light yellowish brown and olive brown, hard, moderately weathered, slightly to moderately fractured, FeO banding. @6.8': Bedding: N5°E,12°N. @6.9': Fault: N30°-40°W,80°S; offset at 12.8' by another fault, reappears in hole at 14.7'. @10.1': Fault: N45°W, 65°N; brown sandy clay gouge up to 1/4-inch thick, hanging wall highly fractured and blocky with voids up to 12 inches in size, 2 foot offset with reverse movement, offsets above fault at 12.8'. @13-16': Caving of sidewalls due to voids and intensely fractured bedrock (very blocky).		11	■				
20						11	■				
				BEDROCK - Castaic Formation (Tcs) @ 23': Siltstone: Brown, olive-brown, hard, laminated to thinly bedded, moderately indurated.							
30						11	■				
				Total Depth = 31' Downhole logged to 16' due to caving sidewalls No groundwater encountered during drilling Borehole backfilled with cuttings Kelly Bar Weights							
35											

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**			Boring No.: **FA-1**
Location: **Santa Clarita**			Elevation: **±1452'**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**		Date: **9/24/18**
Drill Method: **Lo-Dril w/24" Auger**	Driving Weight: **See end of log**		Logged By: **EBP**

Depth (Feet)	Becker Data: Measured Blow Count, Blows / foot	Becker Data: Bounce Chamber Pressure, psi	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
40				0-15': 1,767 lbs. 15-30': 1,182 lbs. 30-45': 757 lbs. 45-60': 489 lbs. 5' Stem: 288 lbs. 12' Stem: 580 lbs..							
45											
50											
55											
60											
65											
70											

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**			Boring No.: **FA-2**
Location: **Santa Clarita**			Elevation: **±1430'**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**		Date: **9/21/18**
Drill Method: **Lo-Dril w/24" Auger**	Driving Weight: **See end of log**		Logged By: **TW**

Depth (Feet)	Becker Data: Measured Blow Count, Blows / foot	Becker Data: Bounce Chamber Pressure, psi	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0				**SOIL** Sandy Silt to Silty Sand (SM-ML): Brown, dry, loose, very fine- to fine-grained sand, with rock fragments. @2' : very fine- to fine-grained sand, grayish brown, dry to slightly moist.							
5				**BEDROCK - Castaic Formation (Tcs)** Silty Sandstone: Grayish-brown, moist, fine-grained sand, fractured, blocky.							
10				Becomes gray, to yellowish-brown, fine- to medium-grained sand, with iron oxide staining on fractures, well cemented. @ 10.5': Bedding : N20°E, 20°N; 1-2" cemented sandstone bed medium- to coarse-grained sandstone, buff, dry, hard, cemented.		13	■				
15				@14.5': Bedding: N15°E, 15-20°N.							
20				Occasional iron stained silty sandstone layers.		16	■				
25				@22': Contact N30°E, 20°N; iron stained bed Coarsens to fine- to medium-grained sandstone, buff, dry, hard to very hard. @25': N30°E, 15-20°N; thin iron stained bed.							
30				@32': Contact N10°E, 10°N below tan, fine-grained sandstone fining and coarsening sequences.		20	■				
35											

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**			Boring No.: **FA-2**
Location: **Santa Clarita**			Elevation: **±1430'**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**		Date: **9/21/18**
Drill Method: **Lo-Dril w/24" Auger**	Driving Weight: **See end of log**		Logged By: **TW**

Depth (Feet)	Becker Data: Measured Blow Count, Blows / foot	Becker Data: Bounce Chamber Pressure, psi	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
40				@37': 6" very hard, cemented bed. @39': Bedding N20°E, 15-20°N becomes very fine- to fine-grained sandstone, tan to buff, very hard, massive. @42': Bedding NS, 15°W.		26					
45				@45': Silty very fine-grained sandstone, brown to gray, very hard, massive.							
50				Total Depth = 49' Downhole logged No groundwater or caving encountered during drilling Borehole backfilled with cuttings <u>Kelly Bar Weights</u> 0-15': 1,767 lbs. 15-30': 1,182 lbs. 30-45': 757 lbs. 45-60': 489 lbs. 5' Stem: 288 lbs. 12' Stem: 580 lbs..							
55											
60											
65											
70											

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**			Boring No.: **FA-3**
Location: **Santa Clarita**			Elevation: **±1394'**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**		Date: **9/21/18**
Drill Method: **Lo-Dril w/24" Auger**	Driving Weight: **See end of log**		Logged By: **TW**

Depth (Feet)	Becker Data: Measured Blow Count, Blows / foot	Becker Data: Bounce Chamber Pressure, psi	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0				**SOIL** Sandy Silt to Silty Sand (SM-ML): Brown, dry, loose to medium dense, very fine- to fine-grained sand, with rock fragments.							
				BEDROCK - Castaic Formation (Tcs) Sandy Siltstone: Gray, dry to slightly moist, massive.							
5				@5': 6" clayey Siltstone, brown, slightly moist, moderately hard.							
				@7': Bedding: N10°E, 10-15°N.							
10				@ 10': Bedding: NS, 15-20°W Very fine-grained sandstone, yellowish brown, moist, fractured, iron stained, moderately hard to hard.		7	■				
15											
				@18': Contact N10°E, 20°N; 3" gravel layer very fine- to fine-grained sandstone, tan, hard to very hard, massive.							
20						10	■				
				@22': 6" hard, cemented bed.							
				@24': Bedding: NS, 10°W fining and coarsening sequences.							
25											
30						15	■				
				Total Depth = 31' Downhole logged No groundwater or caving encountered during drilling Borehole backfilled with cuttings							
				Kelly Bar Weights							
35											

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**			Boring No.: **FA-3**
Location: **Santa Clarita**			Elevation: **±1394'**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**		Date: **9/21/18**
Drill Method: **Lo-Dril w/24" Auger**	Driving Weight: **See end of log**		Logged By: **TW**

Depth (Feet)	Becker Data: Measured Blow Count, Blows / foot	Becker Data: Bounce Chamber Pressure, psi	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
				0-15': 1,767 lbs. 15-30': 1,182 lbs. 30-45': 757 lbs. 45-60': 489 lbs. 5' Stem: 288 lbs. 12' Stem: 580 lbs..						
40											
45											
50											
55											
60											
65											
70											

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**			Boring No.: **FA-4**
Location: **Santa Clarita**			Elevation: **±1502'**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**		Date: **9/18/18**
Drill Method: **Lo-Dril w/24" Auger**	Driving Weight: **See end of log**		Logged By: **EBP**

Depth (Feet)	Becker Data: Measured Blow Count, Blows / foot	Becker Data: Bounce Chamber Pressure, psi	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0				**BEDROCK - Castaic Formation (Tcs)** Clayey Siltstone: Light tan, to light yellowish-brown, dry, hard, laminated to thinly bedded, intensely fractured, highly weathered, moderately to well indurated, iron oxide staining along fractures, few sandy siltstone lenses throughout.							
5				@5.5': Becomes light olive gray, moderately weathered, MnO staining along fractures. @7.0': Bivalve fossils in sandy siltstone bed.							
10				@8.5': Becomes moderately fractured with a moderately defined fracture set: Fracture: N10°W,80°N; N30°E,80°S; N55°E, 55°S. @10.5': Becomes slightly fractured, slightly moist, faintly laminated; Bedding: N10°E,18°N. @11.0': Becomes very hard.		11	■				
15				@14.8': Becomes white to light tan, slightly weathered. @16.8': Becomes yellowish brown, fractures infilled with gypsum. @17.5': concretion approximately 2'-diameter, very hard.							
20				@19.0': Fracture: N55°E,60°S; MnO stained with partial gypsum infilling. @19.9': Clay bed: N55°,60°S; brown, moderately hard, moderately plastic, approximately 1/4" thick, no signs of shearing or slicks, some mineralization directly above.		14	■				
25				Interbedded Clayey Siltstone and Silty Claystone: Light brown, to olive gray, hard, laminated to thinly bedded, slightly fractured, slightly weathered, well defined and slightly undulating laminations, well indurated. Sandstone: Light Gray, fine-grained sand, hard, massive, moderately cemented, slightly undulating. @24.9': Bedding: N15°E,15°N. Fining and coarsening sequences from siltstone to coarse-grained sandstone; sandstone highly oxidized.							
30				Sandstone: Light yellowish brown, fine-grained sand, massive, moderately cemented, few coarse-grained sand lenses. Interbedded Clayey Siltstone and Silty Claystone: Light brown to olive gray, hard, laminated to thinly bedded, slightly fractured, slightly weathered, well indurated. Siltstone: Olive gray, hard, massive, well indurated.		13	■				
35											

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**			Boring No.: **FA-4**
Location: **Santa Clarita**			Elevation: **±1502'**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**		Date: **9/18/18**
Drill Method: **Lo-Dril w/24" Auger**	Driving Weight: **See end of log**		Logged By: **EBP**

Depth (Feet)	Becker Data: Measured Blow Count, Blows / foot	Becker Data: Bounce Chamber Pressure, psi	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
40				Interbedded Clayey Siltstone and Silty Claystone: Light brown, to olive gray, hard, laminated to thinly bedded, slightly fractured, slightly weathered, well indurated, gypsum seams approximately 1/4" thick @36.6': Bedding: N10°E, 10°N.							
				Sandstone: Bluish-gray, to very pale brown, fine-grained sand, hard, massive, few coarse grain lenses, moderately cemented.		14					
				Interbedded Clayey Siltstone and Silty Claystone: Light brown, to olive gray, hard, laminated to thinly bedded, slightly fractured, slightly weathered, well defined and slightly undulating laminations, well indurated.							
45				Sandstone: Bluish-gray, to very pale brown, fine-grained sand, hard, massive, coarsening sequence with depth, moderately cemented.							
				Interbedded Clayey Siltstone and Silty Claystone: Light brown, to olive gray, hard, laminated to thinly bedded, slightly fractured, slightly weathered, well defined and slightly undulating laminations, poorly defined bedding, well indurated.							
50				Sandstone: Light bluish-gray, fine-grained sand, hard, massive, moderately cemented. @44.9': Becomes reddish brown, to yellowish brown, medium- to coarse- grained sandstone with many gravel. @48.2': Bedding N20°E,20°N; becomes yellowish brown, fine- grained sandstone, few interbedded silt sandstone beds approximately 1.5' thick.		20					
55				@55.3': Interbedded Claystone and siltstone bed: N10°E, 12°N; reddish brown and olive brown, approximately 4-inches thick. @57.0': Becomes coarse- grained sand with few gravel.							
				Silty Sandstone: Reddish-brown, fine- to coarse-grained sand, hard, massive, few very pale brown coarse- grained sand lenses.							
60						22					
				Interbedded Clayey Siltstone and Silty Claystone: Light brown, to olive gray, hard, laminated to thinly bedded, slightly fractured, slightly weathered, well defined and slightly undulating laminations, poorly defined bedding, well indurated @61.0': Bedding: N15°E, 13°N.							
65				Sandstone: Bluish-gray, fine- to medium-grained sand, hard, massive, moderately cemented.							
						22					
70				Total Depth = 69.0' Downhole logged to 66.5' No Groundwater Encountered During Drilling							

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**			Boring No.: **FA-4**
Location: **Santa Clarita**			Elevation: **±1502'**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**		Date: **9/18/18**
Drill Method: **Lo-Dril w/24" Auger**	Driving Weight: **See end of log**		Logged By: **EBP**

Depth (Feet)	Becker Data: Measured Blow Count, Blows / foot	Becker Data: Bounce Chamber Pressure, psi	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
				No Caving Backfilled with Cuttings <u>Kelly Bar Weights</u> 0-15': 1,767 lbs. 15-30': 1,182 lbs. 30-45': 757 lbs. 45-60': 489 lbs. 5' Stem: 288 lbs. 12' Stem: 580 lbs..						
75											
80											
85											
90											
95											
100											
105											

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**		Boring No.:	**FA-5**
Location: **Santa Clarita**		Elevation:	**±1516'**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**	Date:	**9/19-9/20/18**
Drill Method: **Lo-Dril with 24" auger**	Driving Weight: **See End of Log**	Logged By:	**EBP**

Depth (Feet)	Becker Data: Measured Blow Count, Blows / foot	Becker Data: Bounce Chamber Pressure, psi	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0				**BEDROCK - Saugus Formation (QTs)** Sandstone: Light yellowish brown, dry to slightly moist, fine- to coarse-grained sand, very hard, very thinly to thickly bedded, slightly fractured, moderately weathered, many fine gravel, moderately to well cemented, iron oxide staining along bedding, interbedded with thin Siltstone: light tan, very hard, moderately indurated, moderately weathered, some fine sand; undulating bedding and partially discouninuous and cross bedded.							
5											
10				**BEDROCK - Castaic Formation (Tcs)** Interbedded Clayey Sandstone, Claystone, and Siltstone: light gray to reddish brown to yellowish brown to blueish gray, slightly moist, moderately indurated/cemented, fine-grained sand, laminated to thickly bedded, slightly fractured, slightly weathered, undulating laminations and bedding, fining and coarsening sequences generally capped with well cemented coarse- grained sandstone with highly iron oxide stained laminations. @9.9': Bedding: N10°E,18°N. @13.3': Bedding: N5°E,12°N; white, well cemented, fine-grained sandstone bed, approximately 3-inches thick.		9					
15											
20						11					
25				@22.1': Bedding: N5°W,22°S; white, well cemented, fine-grained sandstone bed, approximately 7-inches thick.							
30						19					
35				@31.5': Bedding: N10°W,10°S.							

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**		Boring No.:	**FA-5**
Location: **Santa Clarita**		Elevation:	**±1516'**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**	Date:	**9/19-9/20/18**
Drill Method: **Lo-Dril with 24" auger**	Driving Weight: **See End of Log**	Logged By:	**EBP**

Depth (Feet)	Becker Data: Measured Blow Count, Blows / foot	Becker Data: Bounce Chamber Pressure, psi	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
40				@38.5': Bedding: N15°W,10°S.		19					
45				@43.8': Sandstone bed, reddish brown, fine- to coarse-grained, 1.3' thick.							
50						17					
55				Sandstone bed with cobbles up to 12-inches in diameter, approximately 1.2' thick. @53.2': Bedding: N10°W,17°S.							
60				Sandstone: reddish brown, moist, fine- grained, massive, weakly cemented, few gravel and cobbles up to 4-inch diameter.							
65				@65.0': Becomes fine- to coarse- grained.							
70				Interbedded Claystone and Siltstone: Dark gray to dark reddish brown, hard, bedding 1- to 6-inches thick, some gypsum veins along bedding @37.7': Bedding/contact: N35°W,15°S. Interbedded Clayey Sandstone, Claystone, and Siltstone:		7					

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**			Boring No.: **FA-5**
Location: **Santa Clarita**			Elevation: **±1516'**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**		Date: **9/19-9/20/18**
Drill Method: **Lo-Dril with 24" auger**	Driving Weight: **See End of Log**		Logged By: **EBP**

Depth (Feet)	Becker Data: Measured Blow Count, Blows / foot	Becker Data: Bounce Chamber Pressure, psi	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
75				light gray to reddish brown to yellowish brown to blueish gray, moderately indurated/cemented, fine-grained sand, laminated to thinly bedded, undulating laminations and bedding.							
				Interbedded Claystone and Siltstone: Dark gray to dark reddish brown, hard, bedding 1- to 6-inches thick, some gypsum veins along bedding @73.0': Bedding: N35°W,12°S.							
				Sandstone: Gray, fine- to coarse-grained sand, massive, moderately to well cemented.							
				Clayey Sandstone: Yellowish-brown to light gray, fine-grained sand, hard, laminated.							
80				Interbedded Claystone and Siltstone: Dark gray to dark reddish brown, hard, bedding 1- to 6-inches thick, some gypsum veins along bedding @76.0': Bedding: N-S,20°W.							
				Total Depth = 80.0'							
				Downhole logged to 77.0'							
				No Groundwater Encountered During Drilling							
				No Caving							
85				Backfilled with Cuttings							
				Kelly Bar Weights							
				0-15': 1,767 lbs.							
				15-30': 1,182 lbs.							
				30-45': 757 lbs.							
				45-60': 489 lbs.							
90				5' Stem: 288 lbs.							
				12' Stem: 580 lbs.							
95											
100											
105											

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**			Boring No.: **FA-6**
Location: **Santa Clarita**			Elevation: **±1395**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**		Date: **9/24/18**
Drill Method: **Lo-Dril with 24" Auger**	Driving Weight: **See End of Log**		Logged By: **EBP**

Depth (Feet)	Becker Data: Measured Blow Count, Blows / foot	Becker Data: Bounce Chamber Pressure, psi	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0				**SLOPEWASH (Qsw)** Clayey Silt (ML): Olive brown, dry to slightly moist, firm, few gravel sized bedrock clasts, pinhole porosity, rootlets throughout.							
5				**LANDSLIDE DEBRIS (Qls)** Clayey Siltstone: Light gray, dry, soft to moderately hard, laminated to thinly bedded, intensely fractured, highly weathered, blocky, disoriented bedding.							
10						11					
				@11.6': Highly fractured brown siltstone beds, approximately 6-inches thick. @12.0': Basal landslide surface: N35°W,25°S; Claystone: brown, ½- to 1-inch thick, well defined bed, low plasticity.						
15				**BEDROCK - Castaic Formation (Tcs)** Sandstone: Light bluish-gray, fine- to coarse-grained sand, hard, massive, slightly fractured, slightly weathered, weakly cemented, few fine gravel, highly iron oxide stained near contact above Sandy Siltstone: Light olive brown, fine-grained sand, moderately hard, massive, slightly fractured, slightly weathered, weakly indurated Interbedded Clayey Siltstone and Silty Claystone: Dark brown, to olive brown, hard, laminated to thinly bedded, moderately indurated.							
20						11					
				Sandstone: Light bluish-gray, fine- to coarse-grained sand, hard, massive, slightly fractured, slightly weathered, weakly cemented, few fine gravel Sandy Siltstone: Light olive brown, moderately hard, massive, unfractured to slightly fractured, slightly weathered, weakly indurated.						
25				Interbedded Clayey Siltstone and Silty Claystone: Dark brown, to olive brown, hard, laminated to thinly bedded, moderately indurated Silty Sandstone: Light bluish-gray, fine-grained sand, hard, massive, slightly weathered, weakly cemented. Interbedded Clayey Siltstone and Silty Claystone: Dark brown, to olive brown, hard, laminated to thinly bedded, moderately indurated.							
30						15					
				Sandy Siltstone: Light olive brown, fine-grained sand, moderately hard, massive, unfractured to slightly fractured, slightly weathered, weakly indurated. Silty Sandstone: Light bluish-gray, fine-grained sand, hard, thinly bedded, slightly weathered, weakly cemented. Sandstone: Light bluish-gray, fine- to coarse-grained sand, hard, massive, slightly fractured, slightly weathered, weakly cemented, few fine gravel, coarsens with depth.						
35											

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**			Boring No.: **FA-6**
Location: **Santa Clarita**			Elevation: **±1395**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**		Date: **9/24/18**
Drill Method: **Lo-Dril with 24" Auger**	Driving Weight: **See End of Log**		Logged By: **EBP**

Depth (Feet)	Becker Data: Measured Blow Count, Blows / foot	Becker Data: Bounce Chamber Pressure, psi	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
40				@29.2': Bedding: N40°W,22°S. Total Depth = 35.0' Downhole logged to 32.0' No Groundwater Encountered During Drilling No Caving Backfilled with Cuttings Kelly Bar Weights 0-15': 1,767 lbs. 15-30': 1,182 lbs. 30-45': 757 lbs. 45-60': 489 lbs. 5' Stem: 288 lbs. 12' Stem: 580 lbs.						
45											
50											
55											
60											
65											
70											

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**			Boring No.: **FA-7**
Location: **Santa Clarita**			Elevation: **±1442'**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**		Date: **9/27/18**
Drill Method: **Lo-Dril with 24" Auger**	Driving Weight: **See End of Log**		Logged By: **EBP**

Depth (Feet)	Becker Data: Measured Blow Count, Blows / foot	Becker Data: Bounce Chamber Pressure, psi	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0				**SOIL** Sandy Silt with Clay (ML): Dark brown.							
				BEDROCK - Saugus Formation (QTs) Sandstone: Yellowish-brown, fine- to coarse-grained sand, hard, massive, slightly fractured, highly weathered, many gravel and cobbles, lenses with varying grain-sizes, moderately cemented. @2.5': 18-inch-diameter cobble. @3': Decrease in grain size, fine- to coarse-grained sand with trace gravel. @5.1': Bedding: N75°W,27°S on faint lamination.						
5											
10						13	■				
				BEDROCK - Castaic Formation (Tcs) Clayey Sandstone: Olive brown, very fine- to medium-grained sand, hard, massive, slightly fractured, moderately weathered, moderately cemented.							
15				Silty Sandstone: Yellowish-brown, fine- to medium-grained sand, hard, massive, moderately cemented @15.4': Fault: N30°W,73°N; ½ to 1" thick, infilled with white mineral, out of hole at 21.9'.							
20						22	■				
				Clayey Sandstone: Yellowish-brown, fine- to coarse-grained sand, hard, massive, moderately cemented.							
				Sandy Claystone: Dark reddish-brown to dark olive gray, hard, weakly indurated, low plasticity, undulating bedding and contact.							
25				Clayey Sandstone: Olive gray, fine-grained sand, hard, massive. @25.6': Becomes dark yellowish brown.							
30				Silty Sandstone: Yellowish-brown, fine-grained sand, hard, moderately cemented, trace cobbles, mixed pockets and interbeds of clayey sand.		20	■				
35											

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**			Boring No.: **FA-7**
Location: **Santa Clarita**			Elevation: **±1442'**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**		Date: **9/27/18**
Drill Method: **Lo-Dril with 24" Auger**	Driving Weight: **See End of Log**		Logged By: **EBP**

Depth (Feet)	Becker Data: Measured Blow Count, Blows / foot	Becker Data: Bounce Chamber Pressure, psi	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
40				Sandy Claystone: Reddish-brown, to olive gray, hard, moderately indurated, highly scoured contact, interbeds of clayey sandstone. @36.7': Fault: N-S,75°E; 1/8" thick, FeO stained, out of hole at 49'.							
				@40.4': White, highly cemented concretion, approximately 3" thick by 20" wide.		24	■				
45				@44.2': Bedding: N35°W,12°S.							
				@46.3': Gravel bed, approximately 2" thick, undulating, discontinuous around hole.							
50						20	■				
55				Total Depth = 51' Downhole logged to 47.5' No groundwater encountered during drilling No caving Borehole backfilled with cuttings Kelly Bar Weights 0-15': 1,767 lbs. 15-30': 1,182 lbs. 30-45': 757 lbs. 45-60': 489 lbs. 5' Stem: 288 lbs. 12' Stem: 580 lbs..							
60											
65											
70											

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**		Boring No.:	**FA-8**
Location: **Santa Clarita**		Elevation:	**±1450'**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**	Date:	**9/25/18**
Drill Method: **Lo-Dril w/24" Auger**	Driving Weight: **See end of log**	Logged By:	**TW**

Depth (Feet)	Becker Data: Measured Blow Count, Blows / foot	Becker Data: Bounce Chamber Pressure, psi	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0				**BEDROCK - Castaic Formation (Tcs)** Coarse-grained sandstone: Tan, dry, soft to moderately hard, weathered to 6", with rootlets.							
				@3': Approximate bedding; N70°W, 20-25°S 6" pebble bed.							
5				fine- to coarse-grained sandstone, occasional cemented lenses 6-8", tan, dry, hard, massive.							
10						10	■				
				@13': 1-2" reddish-brown siltstone layers Bedding: N50°W, 15-20°S.							
15											
				@18': Pebbly coarse-grained sandstone; light tan, dry, hard to very hard, massive.							
20						23	■				
25											
				@27': fine- to medium-grained sandstone; brown, dry, hard to very hard, massive.							
30				Coarsens to coarse-grained sandstone.		24	■				
				@31.5': 2-3" silty Sand Stone over a medium-grained sandstone. Bedding: N50°W, 25-30°S. Erosional/undulatory contact.							
35											

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**			Boring No.: **FA-8**
Location: **Santa Clarita**			Elevation: **±1450'**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**		Date: **9/25/18**
Drill Method: **Lo-Dril w/24" Auger**	Driving Weight: **See end of log**		Logged By: **TW**

Depth (Feet)	Becker Data: Measured Blow Count, Blows / foot	Becker Data: Bounce Chamber Pressure, psi	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
40				@38': 2' cemented bed, very hard. Fine- to medium-grained sandstone, Brown, dry, hard to very hard, massive.		21	■				
45				Slight fining and coarsening sequences.							
50						21	■				
				Total Depth = 50' Downhole logged No groundwater or caving encountered during drilling Borehole backfilled with cuttings <u>Kelly Bar Weights</u> 0-15': 1,767 lbs. 15-30': 1,182 lbs. 30-45': 757 lbs. 45-60': 489 lbs. 5' Stem: 288 lbs. 12' Stem: 580 lbs..						
55											
60											
65											
70											

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**		Boring No.:	**FA-9**
Location: **Santa Clarita**		Elevation:	**±1482**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**	Date:	**9/25/18**
Drill Method: **Lo-Dril w/ 24" Auger**	Driving Weight: **See End of Log**	Logged By:	**EBP**

Depth (Feet)	Becker Data: Measured Blow Count, Blows / foot	Becker Data: Bounce Chamber Pressure, psi	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0				**SLOPEWASH (Qsw)** Sandy Silt with Clay (ML): Light olive brown, dry, firm, fine- to coarse-grained sand, gravel sized bedrock clasts, rootlets throughout.							
5				**LANDSLIDE DEBRIS (Qls)** CLayey Siltstone and Silty Claystone: Brown to light olive brown, moderately hard, intensely fractured, highly weathered, significant FeO and MnO staining and gypsum infilling along fractures, discontinuous, and folded bedding,. @7.1': Becomes bluish gray to olive brown Bedding on north side of hole: N70°E,65°N; Bedding on south side of hole: N30°W, 25°N.		12	■				
10											
15				@14': Highly fractured zone with fractures 1/4" to 1" apart. **@15.9': Rupture Surface:** N60°-80°W,18°S; 1-2" thick, brown to olive gray, polished surfaces with microshears throughout, flakey shears with slickensides, moderate to high plasticity, fractures above terminate on surface.							
20				**BEDROCK - Castaic Formation (Tcs)** Clayey Siltstone: Dark reddish-brown to olive gray, very hard, thinly to thicky bedded, moderately indurated. Fault: N60°E,75°N to Vert; MnO stained with fractures 6" to 16" wide, begins at rupture surface and out of the hole at 34'. @19': Becomes dark browm, massive, fault fracture becomes tighter.		17	■				
25											
30				@31.1': Fault offsets sand beds, 1/4" opening of fault Bedding: N60°W,5°S.		15	■				
35				@34.0': Fault out of hole.							

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**			Boring No.: **FA-9**
Location: **Santa Clarita**			Elevation: **±1482**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**		Date: **9/25/18**
Drill Method: **Lo-Dril w/ 24" Auger**	Driving Weight: **See End of Log**		Logged By: **EBP**

Depth (Feet)	Becker Data: Measured Blow Count, Blows / foot	Becker Data: Bounce Chamber Pressure, psi	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
40				Interbedded Silty Sandstone: yellowish brown, fine-grained, very hard, modereately cemented; Clayey Siltstone: olive green, moderately indurated; low plasticity; and Silty Claystone: dark reddish brown, moderately indurated, moderate plasticity; thinly to thickly bedded. @37.9': Bedding: N55°W,11°S; sand lens, slightly undulating, 1 to 6" thick.		17	■				
45				@44.0': Bedding: N45°W,13°S; gypsum seam along bedding; few unoxidized, dark gray spotting. Sandy Siltstone: Yellowish-brown, fine-grained sand, hard, massive, moderetely indurated.							
50						20	■				
55				Clayey Siltstone: Reddish-brown, with dark grey spotting, very hard, massive, weakly indurated. @52': Becomes dark gray.							
60						22	■				
65				Total Depth = 61' Downhole logged to 56.0' No groundwater encountered during drilling No caving Borehole backfilled with cuttings Kelly Bar Weights 0-15': 1,767 lbs. 15-30': 1,182 lbs. 30-45': 757 lbs. 45-60': 489 lbs. 5' Stem: 288 lbs. 12' Stem: 580 lbs..							
70											

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**			Boring No.: **FA-10**
Location: **Santa Clarita**			Elevation: **±1435'**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**		Date: **9/26/18**
Drill Method: **Lo-Dril w/ 24" aguer**	Driving Weight: **See End of Log**		Logged By: **EBP**

Depth (Feet)	Becker Data: Measured Blow Count, Blows / foot	Becker Data: Bounce Chamber Pressure, psi	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0				**ARTIFICIAL FILL, undocumented (afu)** Clayey Sand with Gravel (SC): Brown, dry, loose, fine- to coarse-grained sand, few cobbles, desiccated.							
				ALLUVIUM (Qal) Silty Sand (SM): White, to pale yellow, slightly moist, medium dense, faint laminations, lenses with brown clayey sand to clay with many having varying amounts of charcoal throughout, few undulating beds with coarse sand that are cross bedded or discontinuous, krotovina throughout.							
5											
				LANDSLIDE DEBRIS (Qls) Clayey Siltstone: erosional and highly scoured contact with above, soft to moderately hard, intensely fractured, intensely weathered, disoriented and discountinuous bedding, Iron oxide and MnO staining throughout, areas with silt and sand matrix, occasional clumps of topsoil and alluvium with roots up to 6-inch-diameter, few shale cobbles.		8					
10											
15											
				@18.4': Rupture Surface: non-planar- at 18.4' on SW side of hole and 20.7' on NE side: silty clay, yellowish brown to dark brown, low placticity, approximately 1/4" thick.		14					
20				**ALLUVIUM (Qal)** Silty Sand (SM): Light gray, to light yellowish-brown, slightly moist, medium dense, faint laminations, lenses with brown clayey sand to clay with many having high quantities of charcoal, few beds with coarse sand that are cross bedded, channelized, or discontinuous. @18.5': Fault: N65°E,65°N; Approximately 1/4" to 1/8" thick with MnO and gypsum infilling, Fault in 3 main splays through hole, t2' offset of bedrock below, normal movement, terminated by rupture surface above, out of hole at 23'.							
25				**BEDROCK - Castaic Formation (Tcs)** Clayey Siltstone: Olive gray, hard, thinly bedded to massive, slightly fractured, slightly weathered, moderately indurated, contact offset 2' by fault above.. @21.9': Bedding: N70°W,19°S; Silty Sandstone bed approximately 0.9' thick. @24.8': Bedding: N75°E,28°S.							
30				@32.8': Clay seam: E-W, 15°S; dark brown, soft, high plasticity, no shears or slicks, 1/2 to 1/4" thick.		14					
35											

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**			Boring No.: **FA-10**
Location: **Santa Clarita**			Elevation: **±1435'**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**		Date: **9/26/18**
Drill Method: **Lo-Dril w/ 24" aguer**	Driving Weight: **See End of Log**		Logged By: **EBP**

Depth (Feet)	Becker Data: Measured Blow Count, Blows / foot	Becker Data: Bounce Chamber Pressure, psi	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
				Total Depth = 38.0'							
				Downhole logged to 35.0'							
				No groundwater encountered during drilling							
40				No caving							
				Borehole backfilled with cuttings							
				Kelly Bar Weights							
				0-15': 1,767 lbs.							
				15-30': 1,182 lbs.							
45				30-45': 757 lbs.							
				45-60': 489 lbs.							
				5' Stem: 288 lbs.							
				12' Stem: 580 lbs..							
50											
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65											
70											

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**		Boring No.:	**FA-11**
Location: **Santa Clarita**		Elevation:	**±1475**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**	Date:	**9/26-9/27/18**
Drill Method: **Lo-Dril w/ 24" auger**	Driving Weight: **See End of Log**	Logged By:	**EBP**

Depth (Feet)	Becker Data: Measured Blow Count, Blows / foot	Becker Data: Bounce Chamber Pressure, psi	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0				**BEDROCK - Saugus Formation (QTs)** Gravelly Sandstone with cobbles: Light yellowish brown, , fine- to coarse-grained sand, hard, fining and coarsening, cross bedding, moderately cemented with few well cemented lenses. @3.1': Bedding: N5°W,21°S; silty sandstone bed.							
5				@7': Becomes fine- to medium- grained sand with trace gravel and cobbles.							
10						11	■				
				Silty Sandstone: Light olive brown, fine-grained sand, hard, massive, trace gravel and cobbles, @11.8': Bedding: N5°W,20°S.							
15											
20				@19.0': Cobble bed with brown coarse- grained sand matrix, approximately 9-inches thick. @19.8': Becomes fine- to medium- grained.		16	■				
				@21.8': Clayey Sandstone bed: N10°W,22°S; reddish brown, fine- grained sand, high quantities of charcoal, approximately 4-inches thick.							
25				Gravelly Sandstone with cobbles: White, coarse-grained sand, very hard, massive, well cemented.							
				Silty Sandstone: Olive gray, fine- to medium-grained sand, hard, massive, moderately cemented.							
30				@29.2': Clayey Sandstone bed: N10°W,20°S; reddish brown, fine- grained sand, high quantities of charcoal, approximately 4-inches thick.		12	■				
35											

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**			Boring No.: **FA-11**
Location: **Santa Clarita**			Elevation: **±1475**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**		Date: **9/26-9/27/18**
Drill Method: **Lo-Dril w/ 24" auger**	Driving Weight: **See End of Log**		Logged By: **EBP**

Depth (Feet)	Becker Data: Measured Blow Count, Blows / foot	Becker Data: Bounce Chamber Pressure, psi	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
				Total Depth = 36.5' Downhole logged to 33.5' No groundwater encountered during drilling No caving Borehole backfilled with cuttings <u>Kelly Bar Weights</u> 0-15': 1,767 lbs. 15-30': 1,182 lbs. 30-45': 757 lbs. 45-60': 489 lbs. 5' Stem: 288 lbs. 12' Stem: 580 lbs..						
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60											
65											
70											

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**			Boring No.: **FA-12**
Location: **Santa Clarita**			Elevation: **±1405'**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**		Date: **9/28/18**
Drill Method: **Lo-Dril w/24" Auger**	Driving Weight: **See end of log**		Logged By: **TW**

Depth (Feet)	Becker Data: Measured Blow Count, Blows / foot	Becker Data: Bounce Chamber Pressure, psi	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0				**SOIL** Silty Sand (SM): Light brown, dry to slightly moist, loose to medium dense, with few gravel.							
				BEDROCK - Castaic Formation (Tcs) Medium grain Sandstone: Buff, dry, Medium-grain, weathered, blocky. @3.5': Bedding; N35°E, 25°N.							
5				@6': 6" hard, cemented layer Massive with slight fining and coarsening sequences.							
10						11	■				
				@13': 3-6" Silty sandstone, iron stained Bedding: N55°W, 15-20°S.		7	■				
15				@17': Bedding: N35°W, 10-15°S; iron stained layer.							
				Sandy Siltstone: White to yellowish-brown, slightly moist, fine- to medium-grain.							
20				Siltstone: Gray with white (marbled), orange oxidized, fine-grain, hard, laminated.		14	■				
				@22': Bedding: NS, 15°W.							
25				Silty Sandstone: Yellowish-brown, slightly moist, fine- to medium-grained sand with gravel. Becomes gray with cobbles							
				@27.5': N10°W, 15-20°S; very thin clayey sandstone, gray.							
30				Siltstone/Silty Sandstone: Gray and white, orange oxidized, fine- to medium-grain, moderately hard. @30.5': NS, 20°W; 3" coarse-grained sandstone, white gray, iron stained.		18	■				
35				Silty Sandstone: Olive brown, to brownish-yellow, slightly							

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**			Boring No.: **FA-12**
Location: **Santa Clarita**			Elevation: **±1405'**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**		Date: **9/28/18**
Drill Method: **Lo-Dril w/24" Auger**	Driving Weight: **See end of log**		Logged By: **TW**

Depth (Feet)	Becker Data: Measured Blow Count, Blows / foot	Becker Data: Bounce Chamber Pressure, psi	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
40				moist, hard, massive to depth.		22	■				
45				Total Depth = 41' Downhole logged No groundwater or caving encountered during drilling Borehole backfilled with cuttings <u>Kelly Bar Weights</u> 0-15': 1,767 lbs. 15-30': 1,182 lbs. 30-45': 757 lbs. 45-60': 489 lbs. 5' Stem: 288 lbs. 12' Stem: 580 lbs..						
50											
55											
60											
65											
70											

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**			Boring No.: **FA-13**
Location: **Santa Clarita**			Elevation: **±1560'**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**		Date: **11/02/18**
Drill Method: **Lo-Dril w/24" Auger**	Driving Weight: **See end of log**		Logged By: **TW**

Depth (Feet)	Becker Data: Measured Blow Count, Blows / foot	Becker Data: Bounce Chamber Pressure, psi	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0				**SOIL** Silty Sand (SM): Brown, to reddish-brown, dry, medium dense to dense, medium- to coarse-grained sand, Pebbles.							
5				**BEDROCK - Castaic Formation (Tcs)** Siltstone/Silty Sandstone: Brownish-gray, dry, very fine-grained sandstone, moderately hard, weathered.							
10				@10': 6" cobble bed.		12	■				
				Clayey Siltstone/Silty Claystone: Reddish-brown, dry, hard. @13.5': Approximate bedding: N40°E, 5-10°N.							
15				Silty Sandstone: Gray, dry, medium- to coarse-grain, hard, occasional gravel Coarsens.							
20				Gravelly Sandstone: Gray, dry, coarse-grain, moderately hard, occasional pebbles to 2".		15	■				
25				@24': Undulated contact: N45°W, 10-15°S Hard drilling. @25.5': Medium- to coarse-grained sandstone, White, moderately hard, occasional gravel. @27': Bedding: N30°W, 10°S; siltstone/ clayey siltstone, reddish brown, hard.							
30				Sandstone: Yellowish-brown, dry, fine- to medium-grain, moderately hard to hard, massive. Coarsens to medium- to coarse-grained sandstone with occasional gravel.		16	■				
35											

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**			Boring No.: **FA-13**
Location: **Santa Clarita**			Elevation: **±1560'**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**		Date: **11/02/18**
Drill Method: **Lo-Dril w/24" Auger**	Driving Weight: **See end of log**		Logged By: **TW**

Depth (Feet)	Becker Data: Measured Blow Count, Blows / foot	Becker Data: Bounce Chamber Pressure, psi	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
40				@37': Indistinct contact: 6-8" silty claystone. @40': Silty fine-grained sandstone.		19	■				
45				@42': 0.5-1' clayey siltstone, reddish brown. @47.5': Approximate bedding: N15°E, 5N; 6" clayey siltstone.							
50				: @48': Fine-grained sandstone, brown, dry, hard, cemented, massive, occasional gravel/cobbles. Fining and coarsening sequences.		20	■				
55											
60				@59': N30°W, 5-10°S: slightly iron stained layer.		20	■				
65				@62': 6" Cobble Layer. @63': Approximate bedding: NS, 10-15°W; iron stained bed. Silty Sandstone/Siltstone: Gray, dry to slightly moist, very fine-grain, hard, massive.							
70						21	■				

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**			Boring No.: **FA-13**
Location: **Santa Clarita**			Elevation: **±1560'**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**		Date: **11/02/18**
Drill Method: **Lo-Dril w/24" Auger**	Driving Weight: **See end of log**		Logged By: **TW**

Depth (Feet)	Becker Data: Measured Blow Count, Blows / foot	Becker Data: Bounce Chamber Pressure, psi	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
75				Total Depth = 71' Downhole logged No groundwater or caving encountered during drilling Borehole backfilled with cuttings Kelly Bar Weights 0-15': 1,767 lbs. 15-30': 1,182 lbs. 30-45': 757 lbs. 45-60': 489 lbs. 5' Stem: 288 lbs. 12' Stem: 580 lbs..						
80											
85											
90											
95											
100											
105											

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**		Boring No.:	**FA-14**
Location: **Santa Clarita**		Elevation:	**±1380**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**	Date:	**11/01/18**
Drill Method: **Bucket Auger**	Driving Weight:	Logged By:	**AM**

Depth (Feet)	Becker Data: Measured Blow Count, Blows / foot	Becker Data: Bounce Chamber Pressure, psi	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0				**ALLUVIUM (Qal)** Sandy Silt to Silty Sand (SM-ML): Brown, to grayish-brown, dry to slightly moist, loose to medium dense, very fine- to fine-grained sand.							
5				becomes moist, with rock fragments.		9	■				
10				**BEDROCK - Castaic Formation (Tcs)** Sandstone: Tan, to light gray, moist, fine-grained sand, soft to moderately hard, massive, moderately weathered.							
15				Becomes fine- to medium-grained sand, with iron oxide staining.		11	■				
				Total Depth 16 feet No groundwater Boring Backfilled with cuttings.							
20											
25											
30											
35											

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Bouquet Canyon**			Boring No.: **FA-15**
Location: **Santa Clarita**			Elevation: **±1397**
Job No.: **18-322**	Client: **The Bouquet Canyon Project Owner, LLC**		Date: **11/01/18**
Drill Method: **Bucket Auger**	Driving Weight:		Logged By: **AM**

Depth (Feet)	Becker Data: Measured Blow Count, Blows / foot	Becker Data: Bounce Chamber Pressure, psi	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0				**ALLUVIUM (Qal)** Sandy Silt to Silty Sand (SM-ML): Brown to grayish-brown, dry to slightly moist, loose to medium dense, very fine- to medium-grained sand, with abundant cobbles and rock fragments..							
5				becomes moist.		11	■				
10				**BEDROCK - Castaic Formation (Tcs)** Sandstone: Tan, to light gray, moist, fine-grained sand, soft to moderately hard, massive, moderately weathered.							
15				Becomes fine- to coarse-grained sand.		17	■				
				Total Depth 17 feet No groundwater Boring Backfilled with cuttings.							
20											
25											
30											
35											

PLATE

Petra Geosciences, Inc.

LOGS OF TEST PITS

J.N. 18-322

TEST PIT TP-1

0 to 5 ½ feet – Soil/colluvium- very fine-grained sandy silt- grey, dry loose, occasional coarse grain/gravel size pieces

@ 1 foot – heavy root zone/rootlets

@ 5 ½ to 7 feet – Bedrock - silty very fine to fine grain sandstone- brown/light tan, dry, loose, moderately hard, iron stained layers ½ to 1-inch

Total Depth – 7 feet
No Water/No Caving

Drive sample- 2 ½ feet

TEST PIT TP-2

0 to 6 feet - Soil/colluvium- very fine-grained sandy silt- grey, dry loose, occasional gravel size pieces, roots to 3 feet

@ 6 to 8 feet – Bedrock - silty very fine to fine grain sandstone, light tan, dry, loose to moderately hard

Total Depth – 8 feet
No Water/No Caving

Bulk sample- 2 to 5 feet

TEST PIT TP-3

0 to 1 ½ feet – Soil - sandy silt/silty sand- grey, dry, loose, rootlets

@ 1 ½ to 5 ½ feet - Bedrock- well bedded sandstone/siltstone, ½ to 1 inch layers, sand layers are iron stained, dry, blocky with rootlets.
@ 2-1/2'- light grey sandstone- dry, moderately hard, moderately indurated

@3' Attitude- N40E, 14NW Bedding ~

Total Depth – 5 ½ feet
NoWater/No Caving

Drive sample at surface. No recovery – very loose

TEST PIT TP-4

0 to 3 ½ feet – Soil - sandy silt, light grey, dry, loose, rootlets/burrows

@ 3 ½ to 5 feet – Bedrock - silty, very fine grained sandstone-buff, dry, moderately hard

@ 5 feet – 1-foot, well bedded siltstone

@5'- Attitude N5W, 25S bedding

@6 to 7 ½ feet – very fine grained sandstone-buff, dry, moderately hard

Total Depth – 7 ½ feet
No Water/No Caving

Drive sample- 2 feet

TEST PIT TP-5

0 to 10 ½ feet – Alluvium - fine grained sandy silt- light grey, dry, loose, occasional gravel, pinhole porosity

@ 6 feet- becomes medium dense

@ 10 ½ feet – Bedrock- medium grained sandstone- buff, dry, moderately hard

Total Depth – 11 feet
No Water/No Caving

TEST PIT TP-6

0 to 4 ½ feet – Soil/colluvium - sandy silty, grey, dry, loose, rootlets

@ 4 ½ feet – Bedrock- siltstone, blocky/fractured, grey, dry, fractured/blocky

@ 5 feet – Attitude N20E, 40N - bedding, creep affected.

Total Depth – 7 feet
No Water/No Caving

TEST PIT TP-7

0 to 4 feet – Soil - sandy silt with abundant pebbles and cobbles, light grey, dry, loose

@ 4 to 6 ½ feet – Bedrock- sandy siltstone- grey, dry, weathered, blocky/fractured

Total Depth – 6 ½ feet
No Water/No Caving

TEST PIT TP-8

0 to 8 feet – Fill- silt/clayey sand, brown, dry, slightly moist, medium dense, rootlets

@ 8 to 10 ½ feet – brown sand, dry, loose with sandstone pieces

@ 10 ½ to 14 ½ feet – possible weathered bedrock- sandstone/siltstone- grey, loose

Total Depth – 14 ½ feet
No Water/No Caving

TEST PIT TP-9

0 to 6 inches –Soil - silty, fine medium grain sand- brown, dry, medium dense, rootlets, pinhole porosity, occasional gravel cobbles

@ 6 inches to 5 feet – Bedrock- fine to coarse grained sandstone, buff white, dry, hard, iron staining, occasional gravel, sporadic cobbles, blocky in upper 6 inches to 1 foot.

3 ½ feet- Attitude N45W, 10-15S, 3-4" coarse grained/gravel bed

Total Depth – 5 feet
No Water/No Caving

TEST PIT TP-10

0 to 6 inches – Soil- silty, fine to medium grain sand- brown, dry, medium dense, rootlets, occasional gravel and cobbles

@ 6 inches to 3 feet – Bedrock- fine to coarse grained sandstone- buff white, dry, becoming a pebble/cobble conglomerate, hard

Total Depth – 3 feet
No Water/No Caving

TEST PIT TP-11

@ 0 to 6 inches – Soil- silty, fine to medium grain sand- brown, dry, medium dense, rootlets, occasional gravel cobbles

@ 6 inches to 4 ½ feet – Bedrock- medium to coarse grain silty sandstone- buff, dry, hard, some iron staining, slightly blocky

@ 3 feet- Attitude: Bedding N40W, 20S iron stained bed

Total Depth – 4 ½ feet
No Water/No Caving

TEST PIT TP-12

0 to 6 inches - Soil - silty, fine medium grain sand, brown, dry, medium dense, rootlets, occasional gravel and cobbles

@6 inches to 6 feet – Bedrock- medium to coarse grain silty sandstone- buff, dry, hard

@2 feet– finer grained, occasional 1 to 2-inch beds

@4 feet- Attitude: Bedding NS, 10-15W- top of fine-grained bed

@ 5 ½ feet – Attitude: Bedding N5W, 25S- iron stained bed

Total Depth – 6 feet
No Water/No Caving

TEST PIT TP-13

0 to 6 inches – Soil - silty, fine medium grain sand, brown, dry, medium dense, rootlets, occasional gravel

@ 6 inches to 7 feet- Bedrock- medium grained sandstone- buff/tan, dry, hard, iron staining, some bedding

@ 3 feet to 5 feet – fine grained silty sandstone- buff, dry, hard,

@3 feet- Attitude: Bedding N10W, 10-15S- top of fine-grained bed

@ 5 feet to 7 feet – medium to coarse grain silty sandstone- buff, dry, hard, thin iron stained layers

@ 5 ½ feet – Attitude: Bedding N20E, 10N- coarse grained bed

Total Depth – 7 feet
No Water/No Caving

TEST PIT TP-14

0 to 12 feet – Colluvium/alluvium – silty sand- brown, dry, dense to very dense, occasional pebbles/cobbles

@ 10 ½ feet to 12 feet – medium to coarse grain silty sand- buff, dry, hard

Total Depth – 12 feet
No Water/No Caving

TEST PIT TP-15

0 to 16 feet – Colluvium/alluvium – silty sand to fine grain sand- grey, dry, medium dense to dense, occasional cobbles

@14 feet to 16 feet – medium to coarse grained sandy silt with cobbles, buff, dry

Total Depth – 16 feet
No Water/No Caving

TEST PIT TP-16

0 to 2 feet – Soil – silty clayey sand- dark brown, dry, dense, rootlets

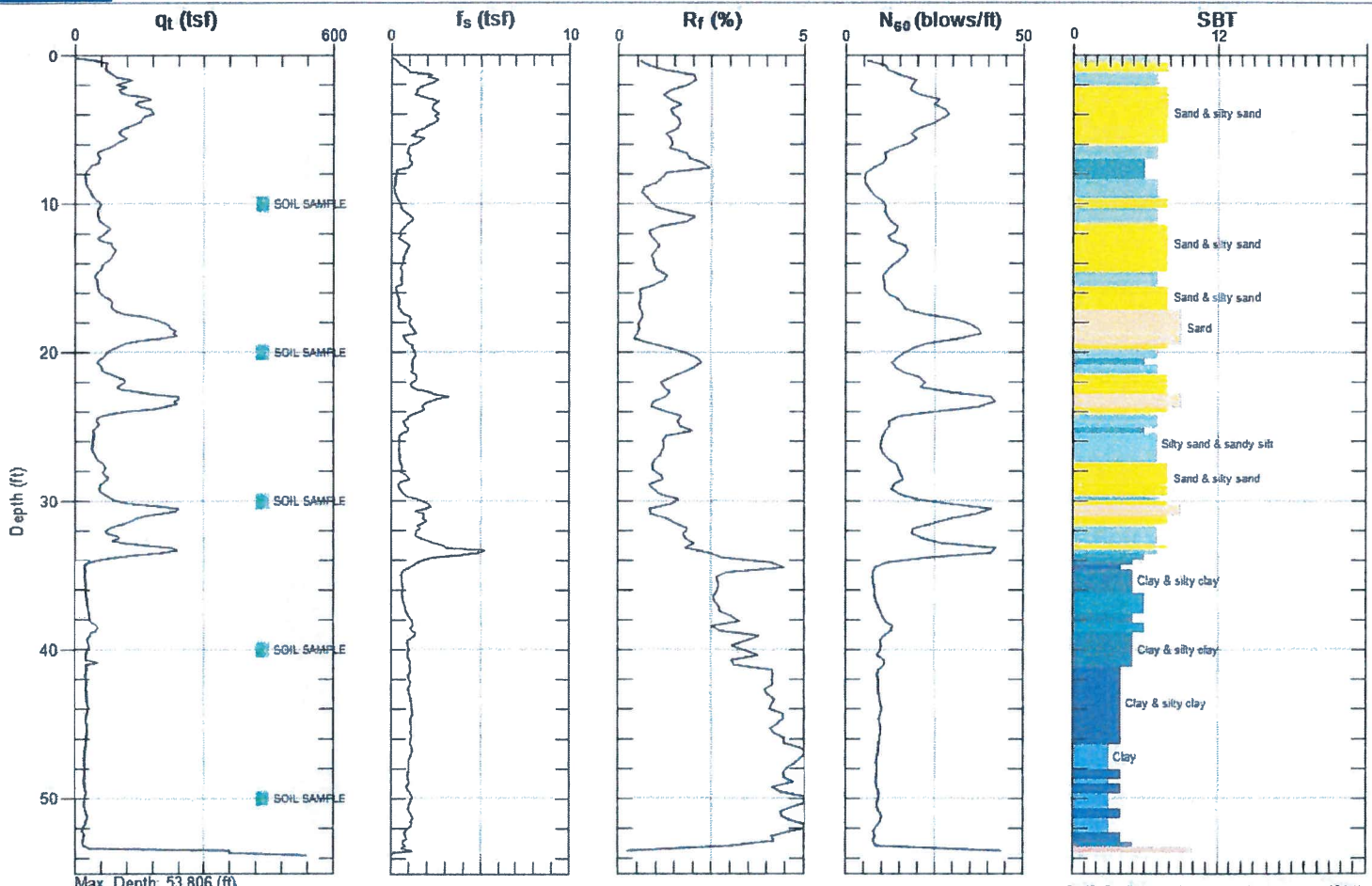
@ 2 feet – Alluvium – silty sand- brown/grey, dry, loose to medium dense, porosity, occasional pebbles/cobbles

@6 feet – medium to coarse grained sand- grey, dry, occasional gravel and cobbles

Total Depth – 12 ½ feet
No Water/No Caving

PETRA GEOSCIENCES, INC.

Site: RESID. PROJ AT BANQ.
Sounding: CPT-1
Engineer: T.WOLFE
Date: 6/23/2017 11:59



Max. Depth: 53.806 (ft)
Avg. Interval: 0.328 (ft)

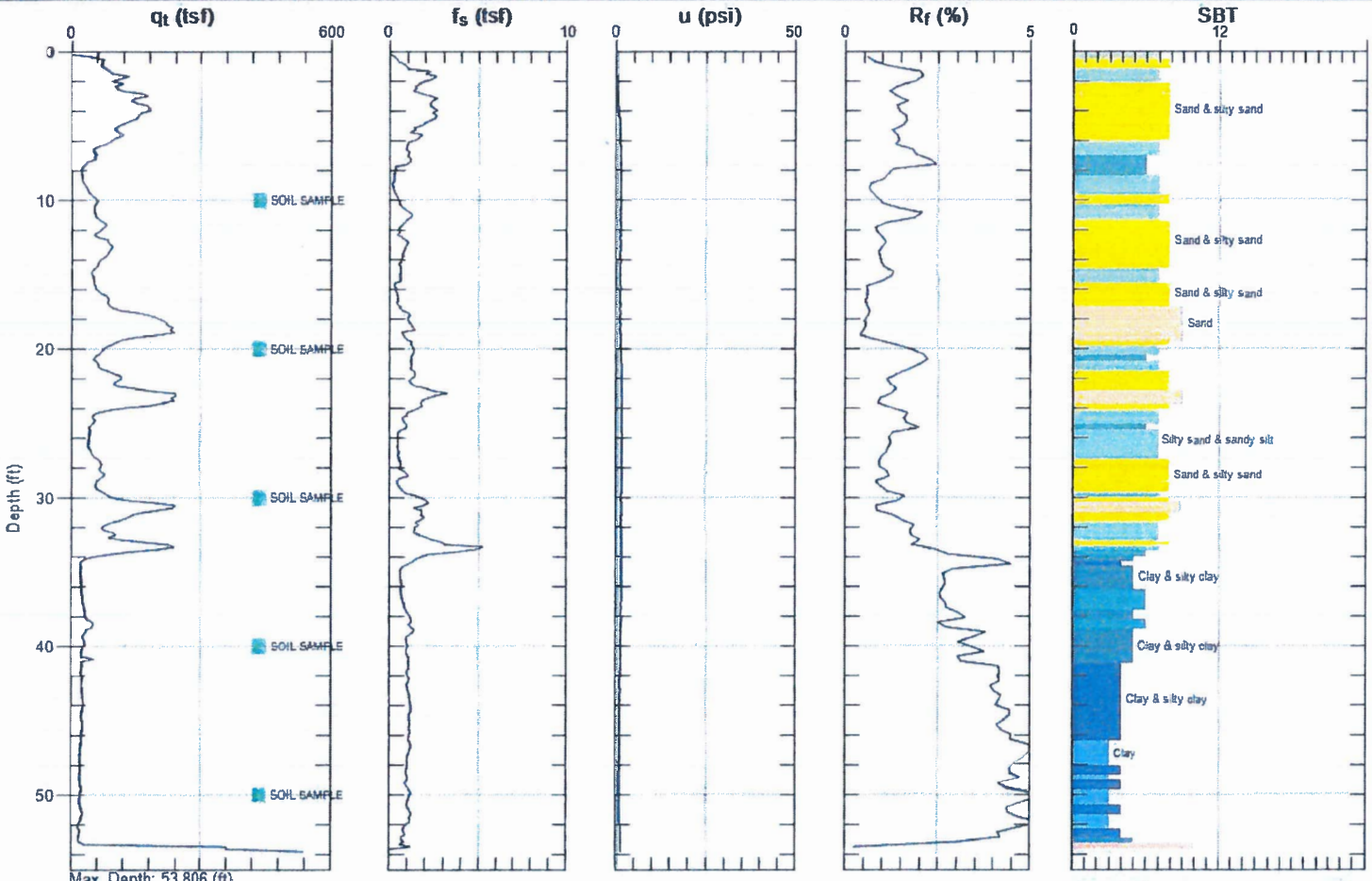
SBT: Soil Behavior Type (Robertson 1990)

GREGG

PETRA GEOSCIENCES, INC.

Site: RESID. PROJ AT BANQ. Engineer: T.WOLFE

Sounding: CPT-1 Date: 6/23/2017 11:59



Max. Depth: 53.806 (ft)
Avg. Interval: 0.328 (ft)

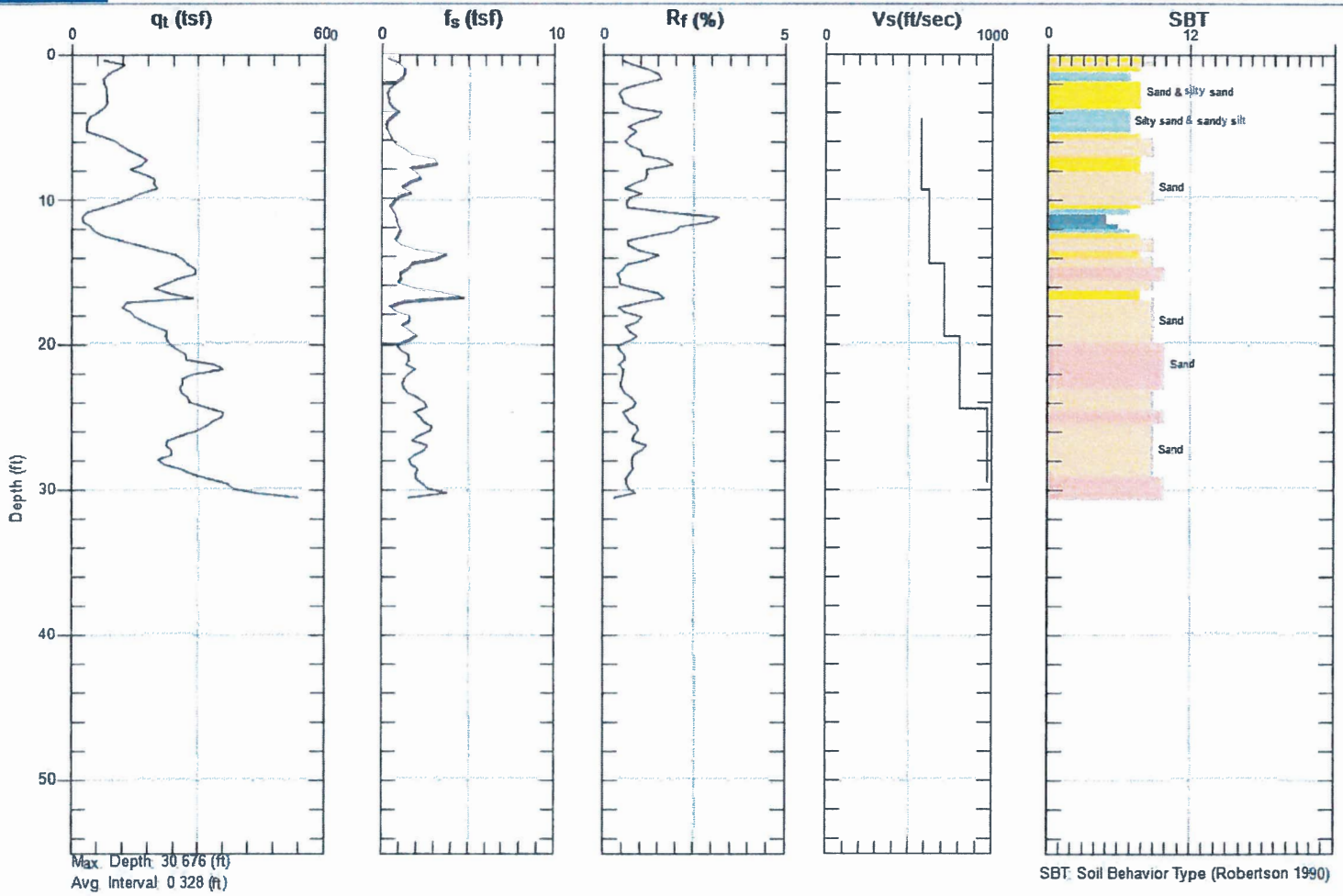
SBT: Soil Behavior Type (Robertson 1990)

GREGG

PETRA GEOSCIENCES, INC.

Site: RESID. PROJ AT BANQ. Engineer: T.WOLFE

Sounding: CPT-2 Date: 6/23/2017 10:37



Max. Depth: 30.676 (ft)
Avg. Interval: 0.328 (ft)

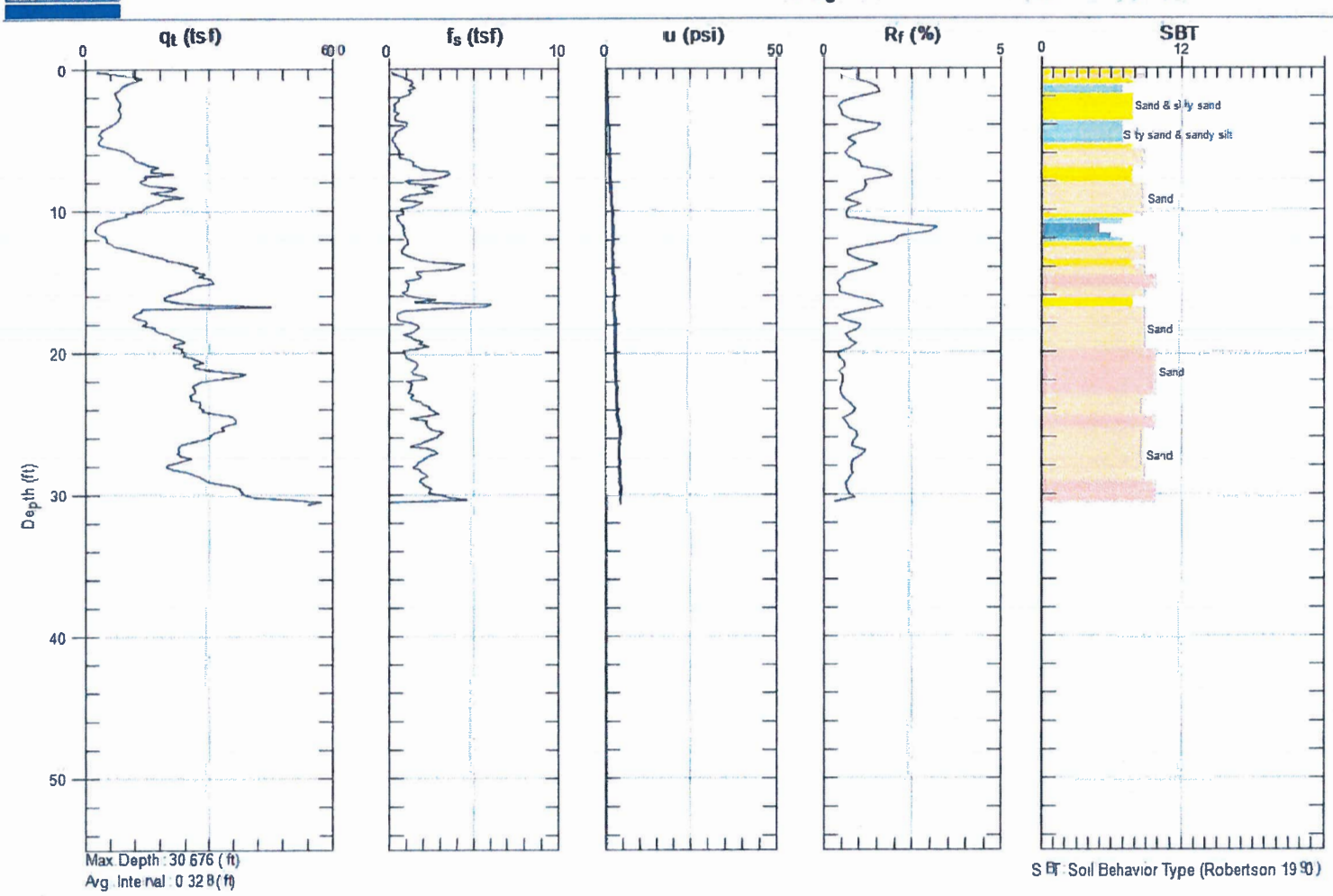
SBT: Soil Behavior Type (Robertson 1990)

GREGG

PETRA GEOSCIENCES, INC.

Site: RESID. PROJ AT BANQ. Engineer: T.WOLFE

Sounding: CPT-2 Date: 6/23/2017 10:37



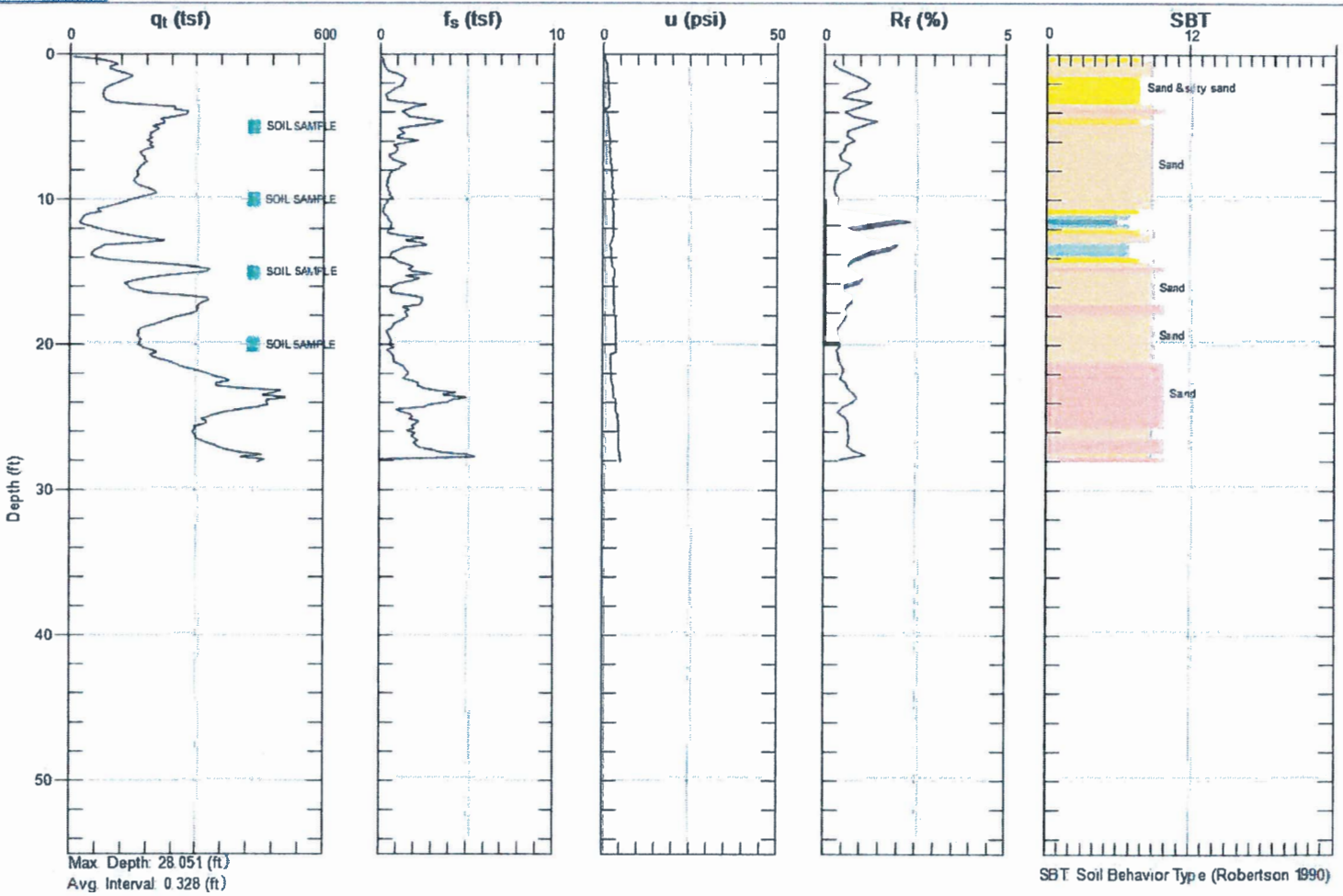
Max Depth : 30.676 (ft)
Avg. Interval : 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

PETRA GEOSCIENCES, INC.

Site: RESID. PROJ AT BANQ. Engineer: T.WOLFE

Sounding: CPT-3B Date: 6/23/2017 08:58



Max. Depth: 28.051 (ft)
Avg. Interval: 0.328 (ft)

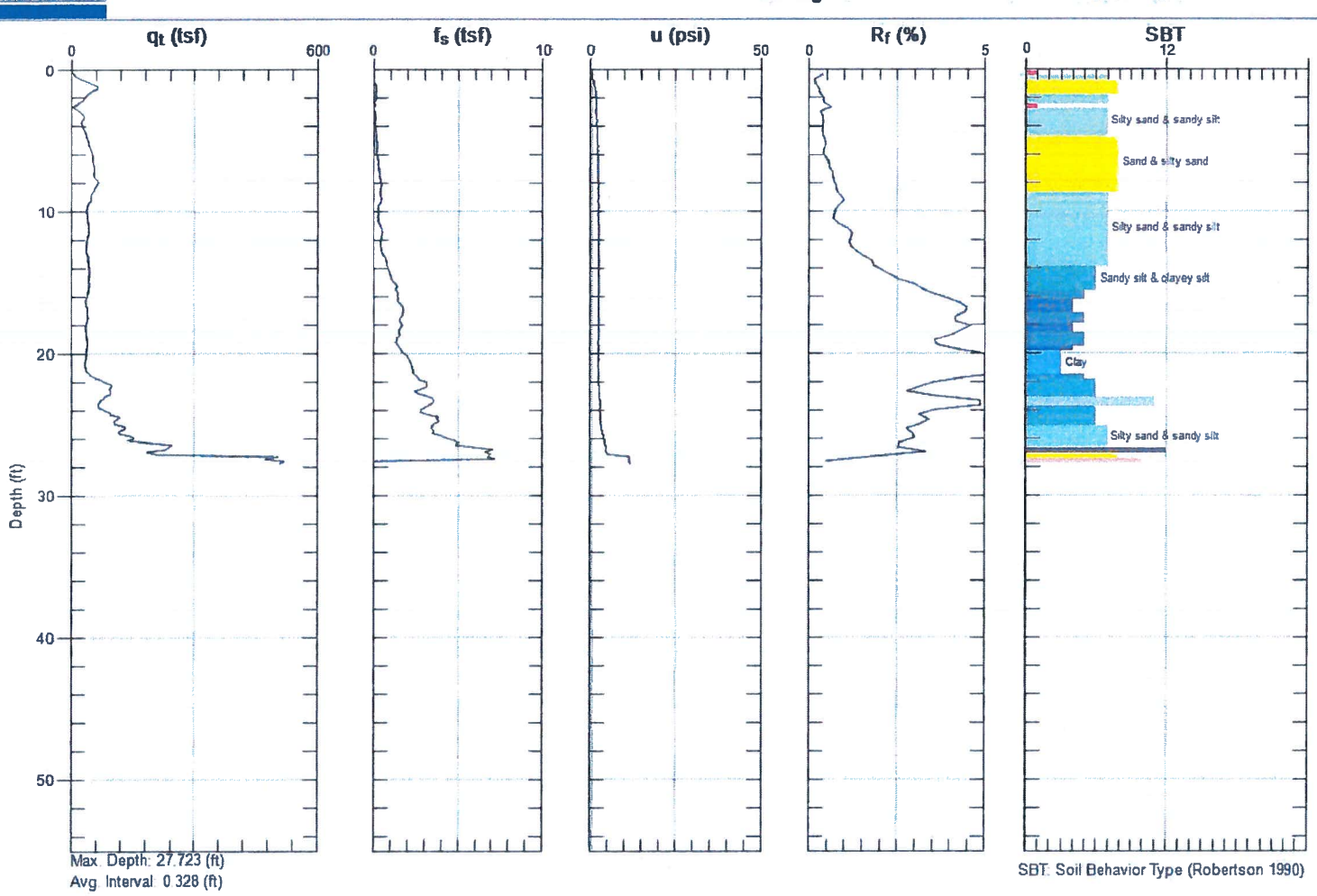
SBT: Soil Behavior Type (Robertson 1990)

GREGG

PETRA GEOSCIENCES, INC.

Site: RESID. PROJ AT BANQ. Engineer: T.WOLFE

Sounding: CPT-4 Date: 6/23/2017 01:42



Max. Depth: 27.723 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

GREGG DRILLING, INC.
www.greggdrilling.com

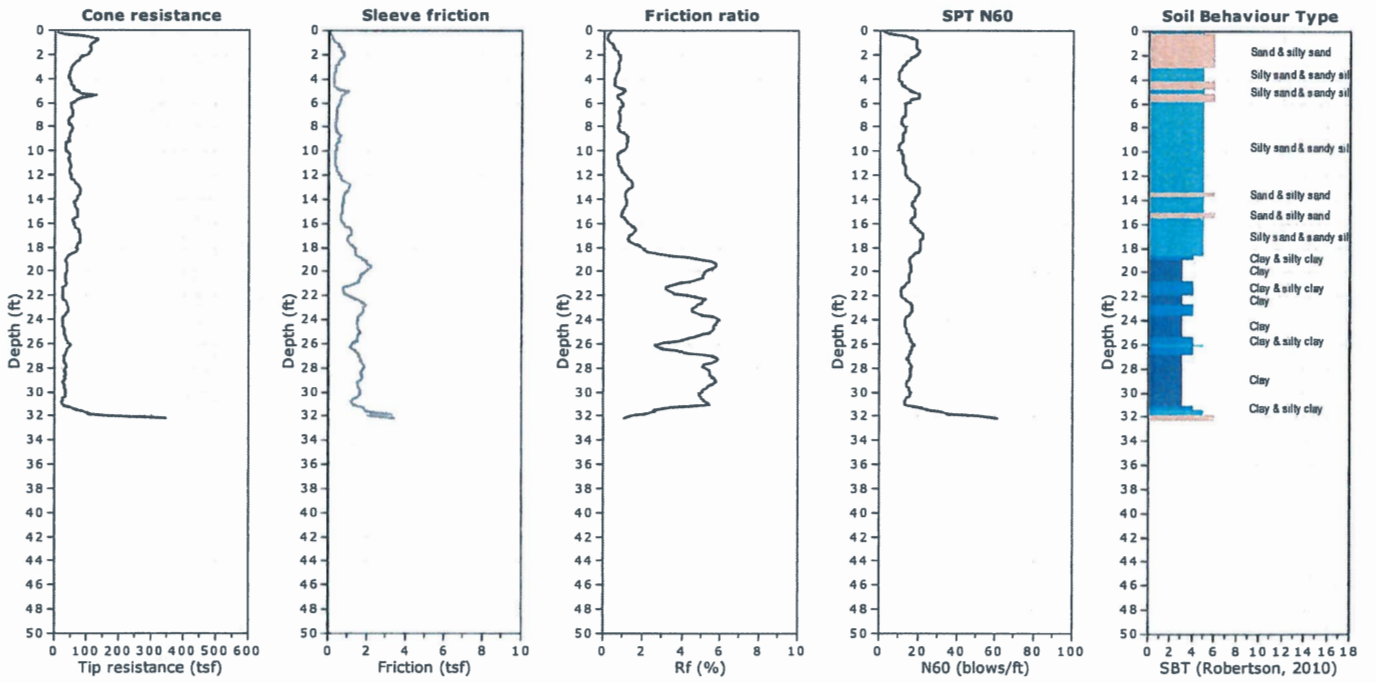
CPT: CPT-1

CLIENT: PETRA GEOSCIENCES, INC.

SITE: BOUQUET CANYON - 20605 SUE DRIVE, SANTA CLARITA, CA

Field Rep: ALI

Total depth: 32.15 ft, Date: 10/1/2018



SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

GREGG DRILLING, INC.
www.greggdrilling.com

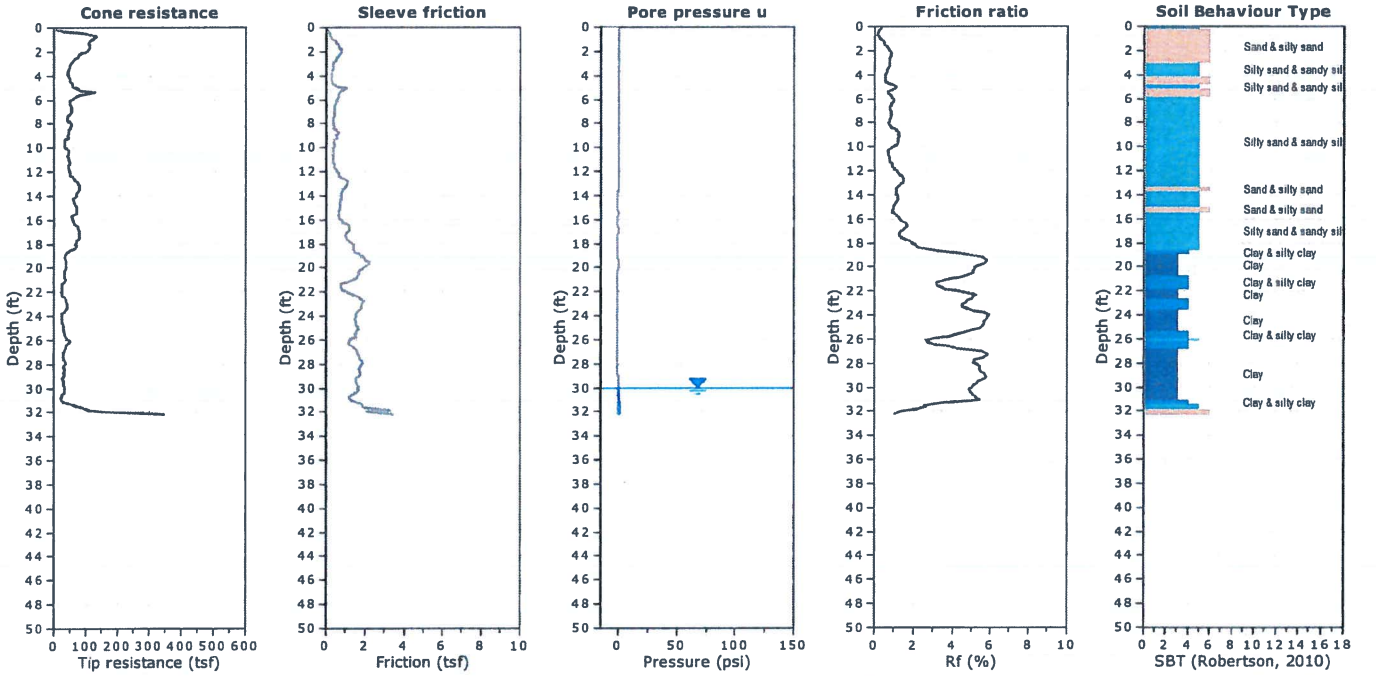
CPT: CPT-1

CLIENT: PETRA GEOSCIENCES, INC.

SITE: BOUQUET CANYON - 20605 SUE DRIVE, SANTA CLARITA, CA

Field Rep: ALI

Total depth: 32.15 ft, Date: 10/1/2018



SBTn legend

1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

WATER TABLE FOR ESTIMATING PURPOSES ONLY

GREGG DRILLING, INC.
www.greggdrilling.com

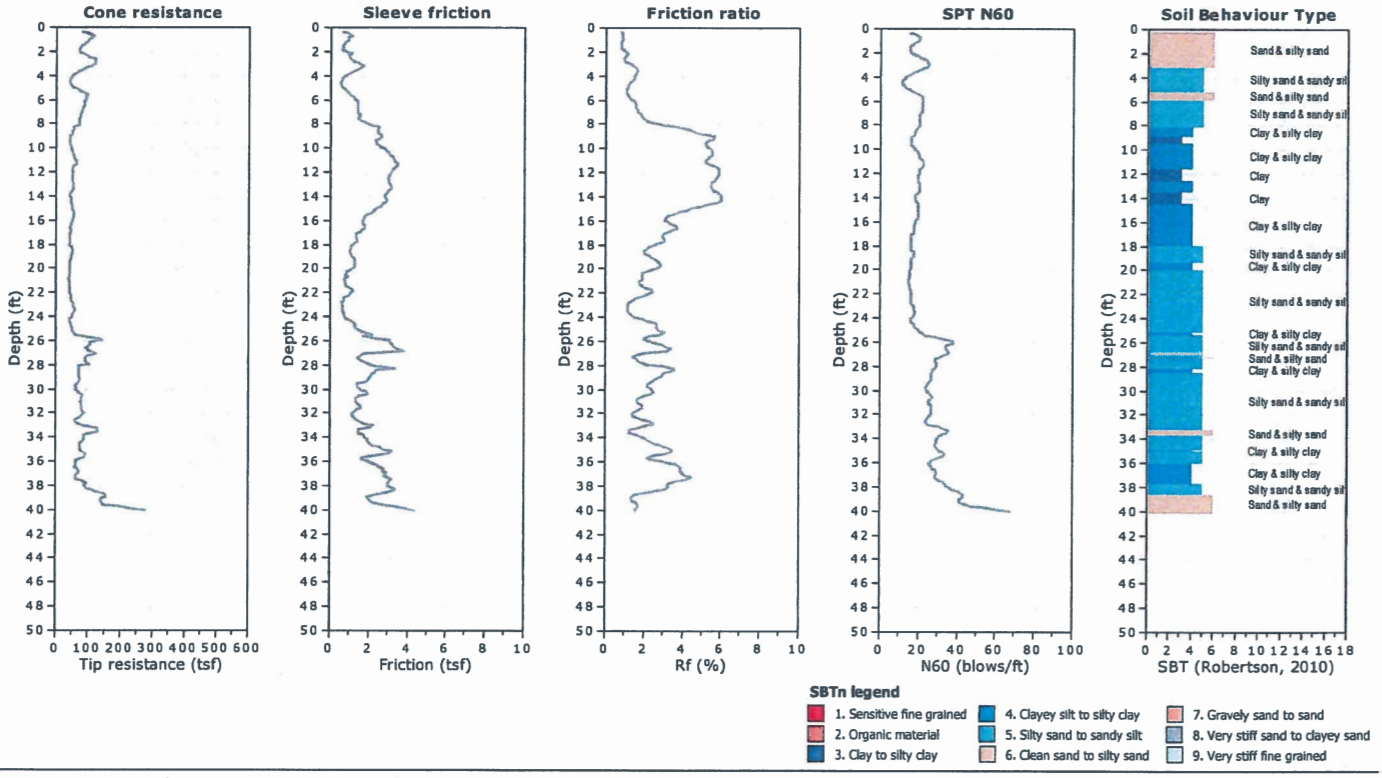
CPT: CPT-2

CLIENT: PETRA GEOSCIENCES, INC.

SITE: BOUQUET CANYON - 20605 SUE DRIVE, SANTA CLARITA, CA

Field Rep: ALI

Total depth: 40.03 ft, Date: 10/1/2018



GREGG DRILLING, INC.
www.greggdrilling.com

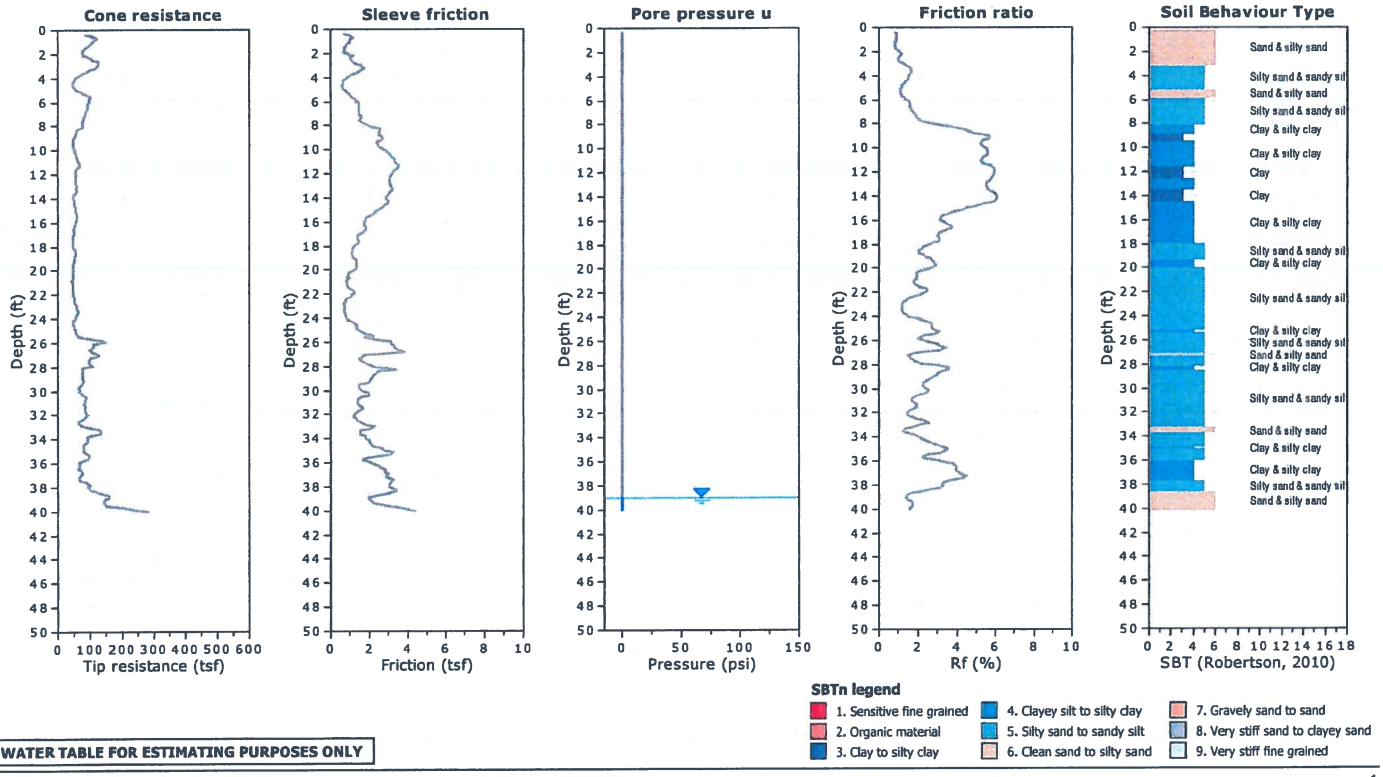
CPT: CPT-2

CLIENT: PETRA GEOSCIENCES, INC.

SITE: BOUQUET CANYON - 20605 SUE DRIVE, SANTA CLARITA, CA

Field Rep: ALI

Total depth: 40.03 ft, Date: 10/1/2018



WATER TABLE FOR ESTIMATING PURPOSES ONLY

GREGG DRILLING, INC.
www.greggdrilling.com

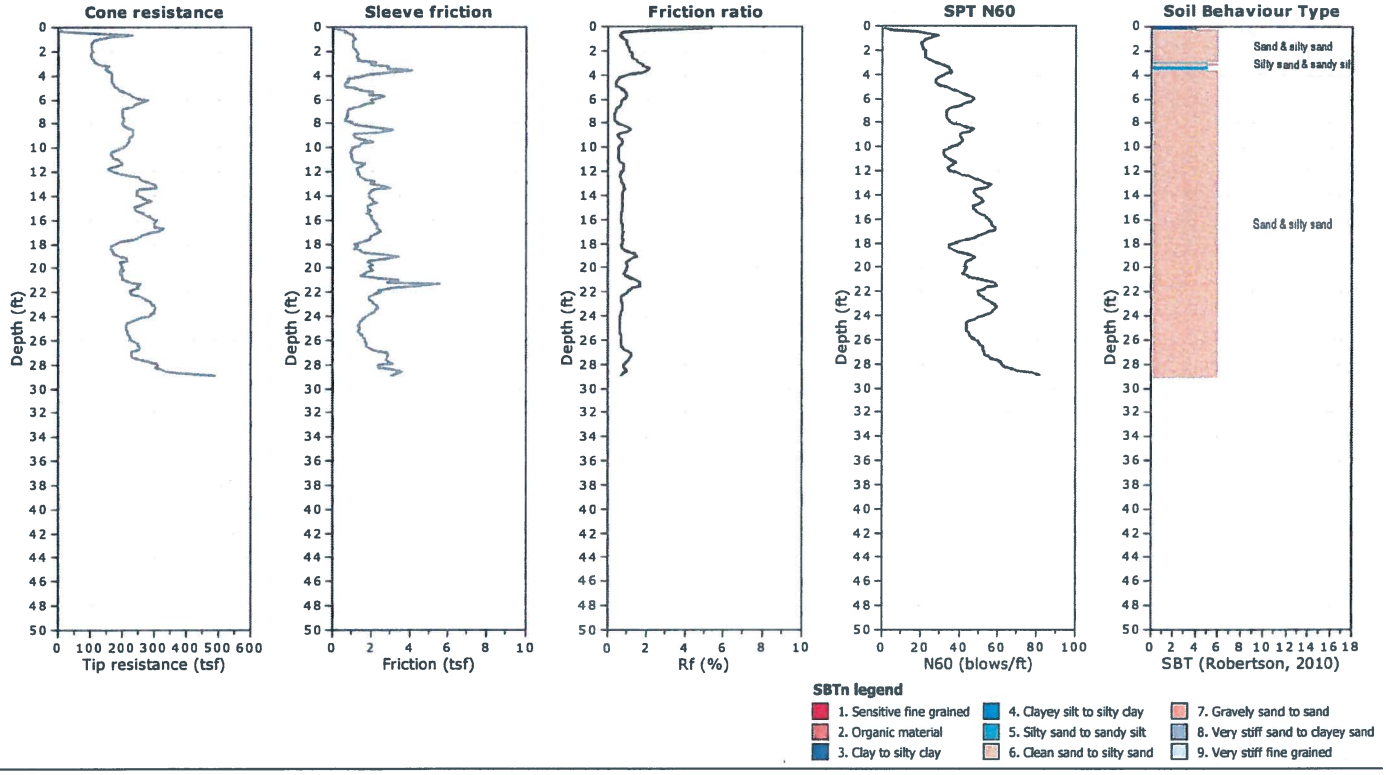
CPT: CPT-4

CLIENT: PETRA GEOSCIENCES, INC.

Field Rep: ALI

SITE: BOUQUET CANYON - 20605 SUE DRIVE, SANTA CLARITA, CA

Total depth: 28.87 ft, Date: 10/1/2018



GREGG DRILLING, INC.
www.greggdrilling.com

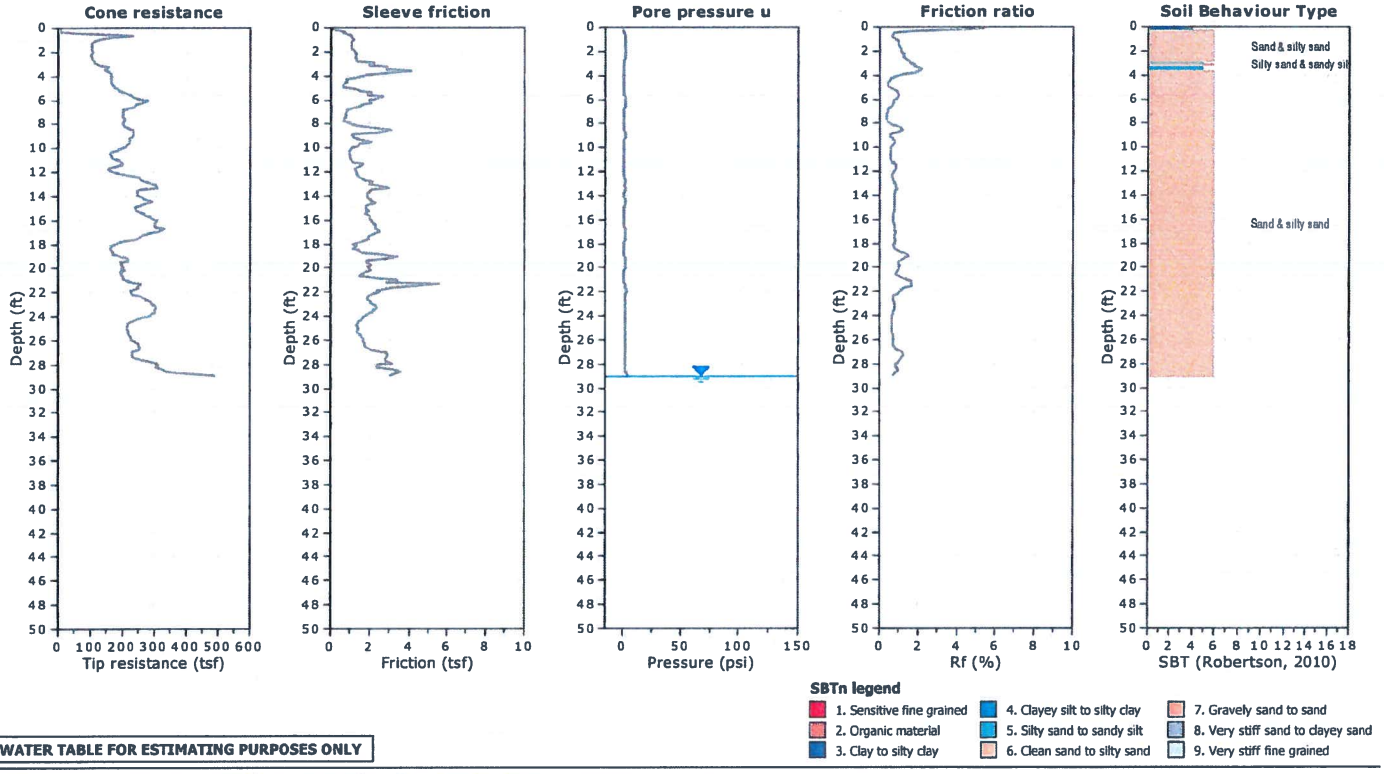
CPT: CPT-4

CLIENT: PETRA GEOSCIENCES, INC.

SITE: BOUQUET CANYON - 20605 SUE DRIVE, SANTA CLARITA, CA

Field Rep: ALI

Total depth: 28.87 ft, Date: 10/1/2018



WATER TABLE FOR ESTIMATING PURPOSES ONLY

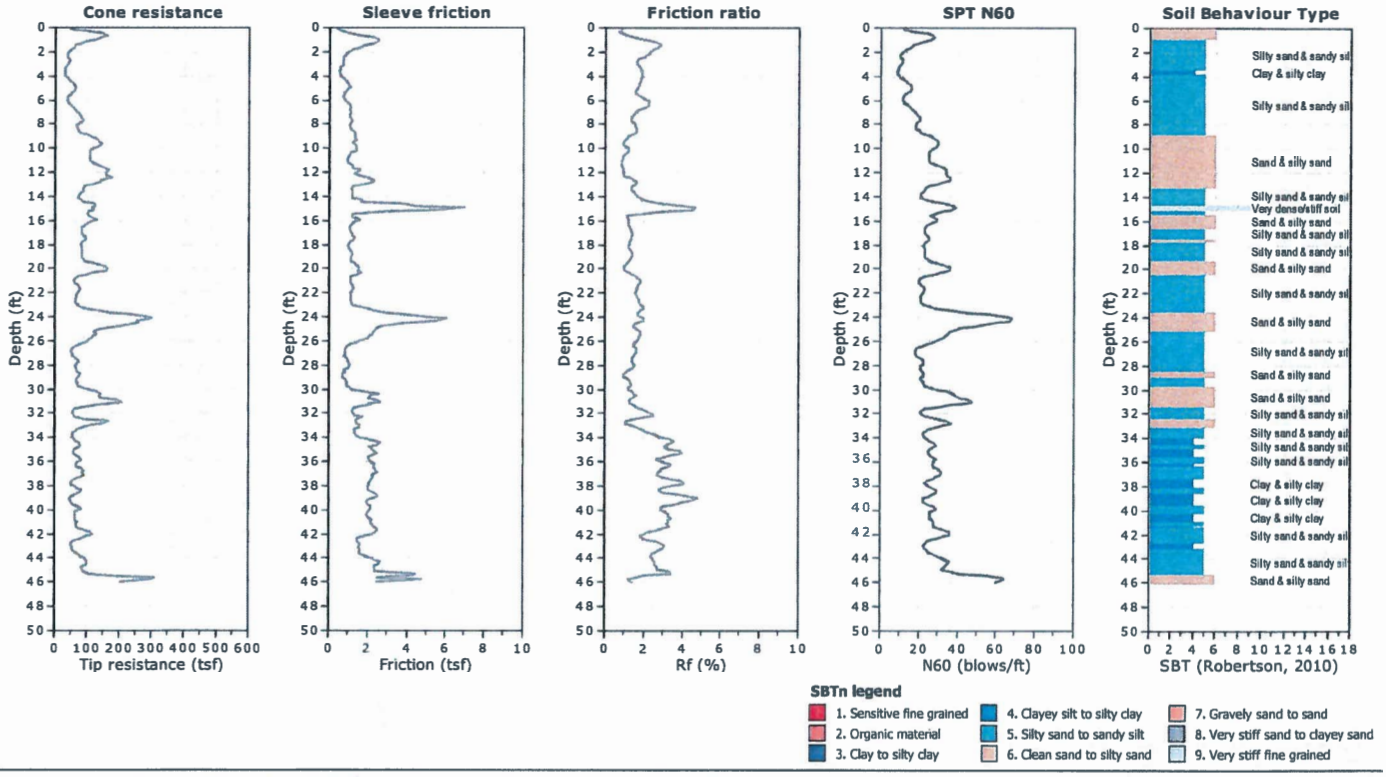
CPT: CPT-7

CLIENT: PETRA GEOSCIENCES, INC.

SITE: BOUQUET CANYON - 20605 SUE DRIVE, SANTA CLARITA, CA

Field Rep: ALI

Total depth: 45.93 ft, Date: 10/1/2018



SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravelly sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

GREGG DRILLING, INC.
www.greggdrilling.com

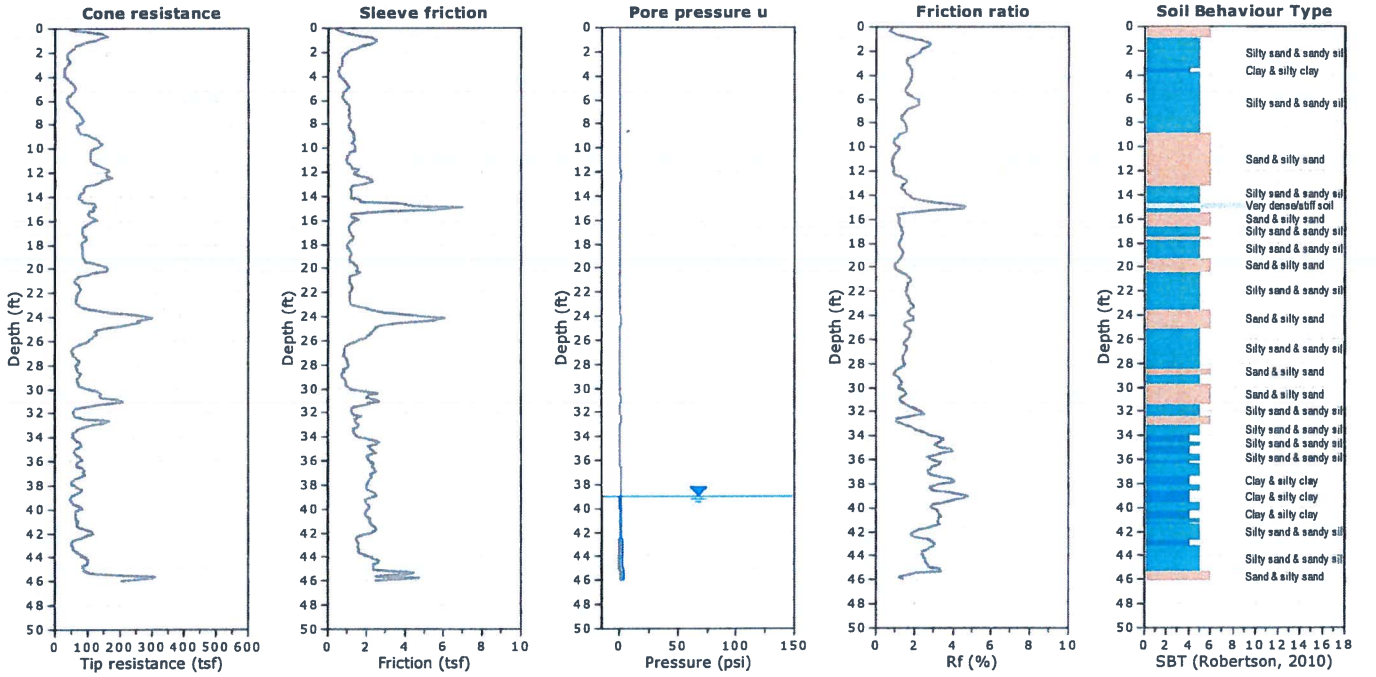
CPT: CPT-7

CLIENT: PETRA GEOSCIENCES, INC.

SITE: BOUQUET CANYON - 20605 SUE DRIVE, SANTA CLARITA, CA

Field Rep: ALI

Total depth: 45.93 ft, Date: 10/1/2018



WATER TABLE FOR ESTIMATING PURPOSES ONLY

GREGG DRILLING, INC.
www.greggdrilling.com

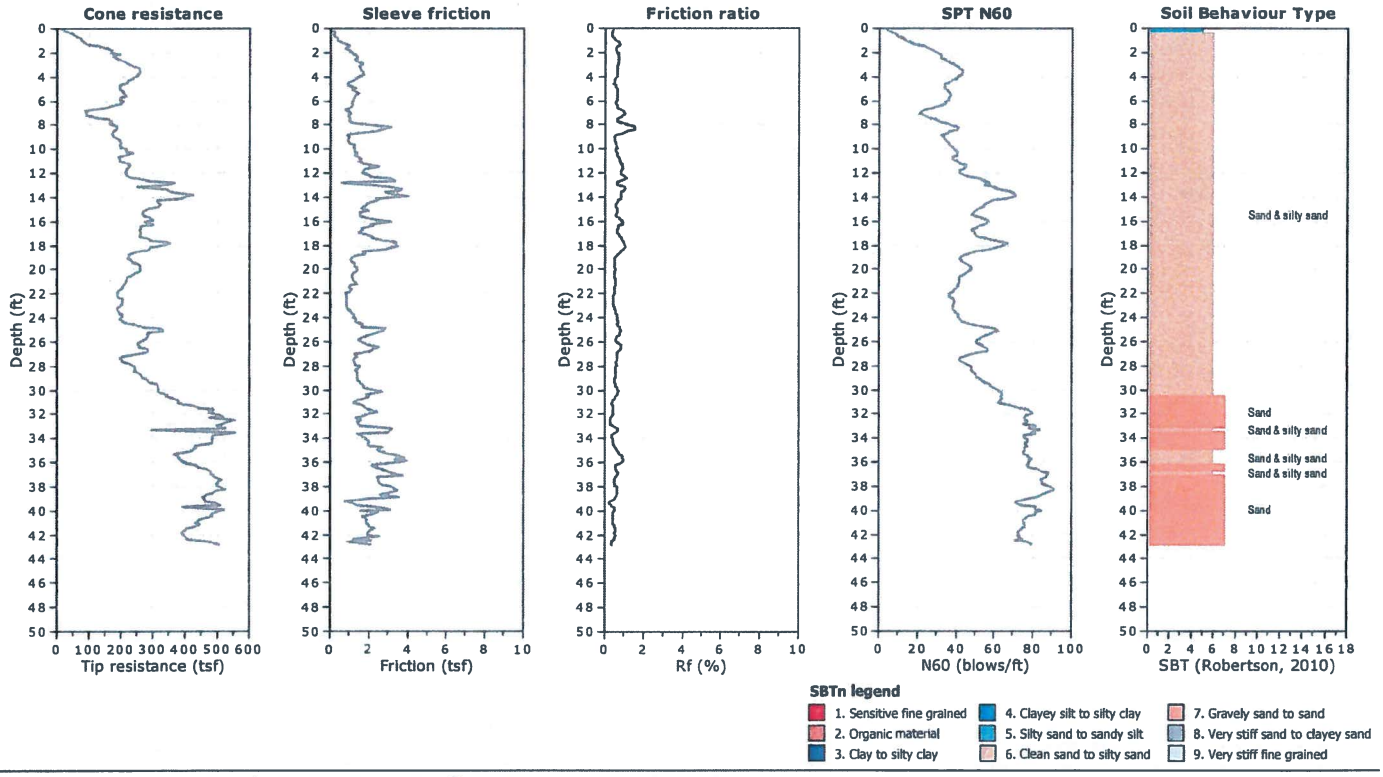
CPT: SCPT-3

CLIENT: PETRA GEOSCIENCES, INC.

SITE: BOUQUET CANYON - 20605 SUE DRIVE, SANTA CLARITA, CA

Field Rep: ALI

Total depth: 42.81 ft, Date: 10/1/2018



GREGG DRILLING, INC.
www.greggdrilling.com

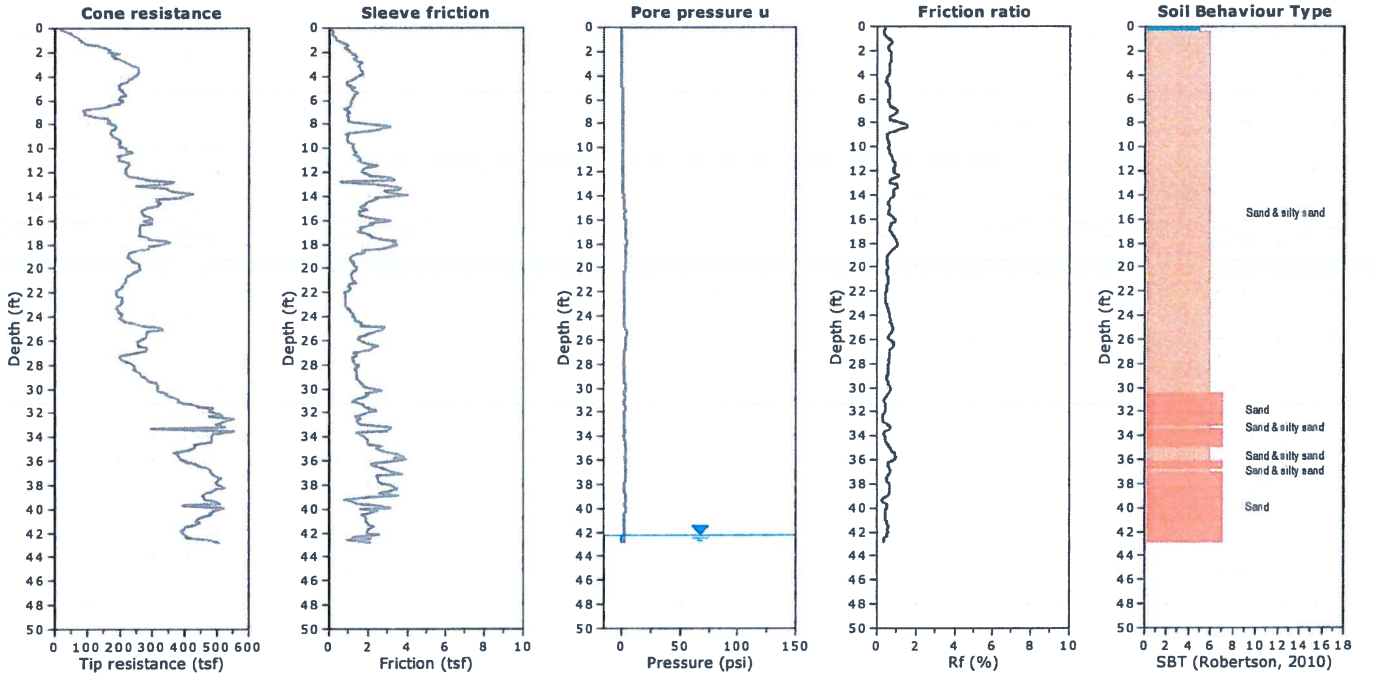
CPT: SCPT-3

CLIENT: PETRA GEOSCIENCES, INC.

SITE: BOUQUET CANYON - 20605 SUE DRIVE, SANTA CLARITA, CA

Field Rep: ALI

Total depth: 42.81 ft, Date: 10/1/2018



WATER TABLE FOR ESTIMATING PURPOSES ONLY

GREGG DRILLING, INC.
www.greggdrilling.com

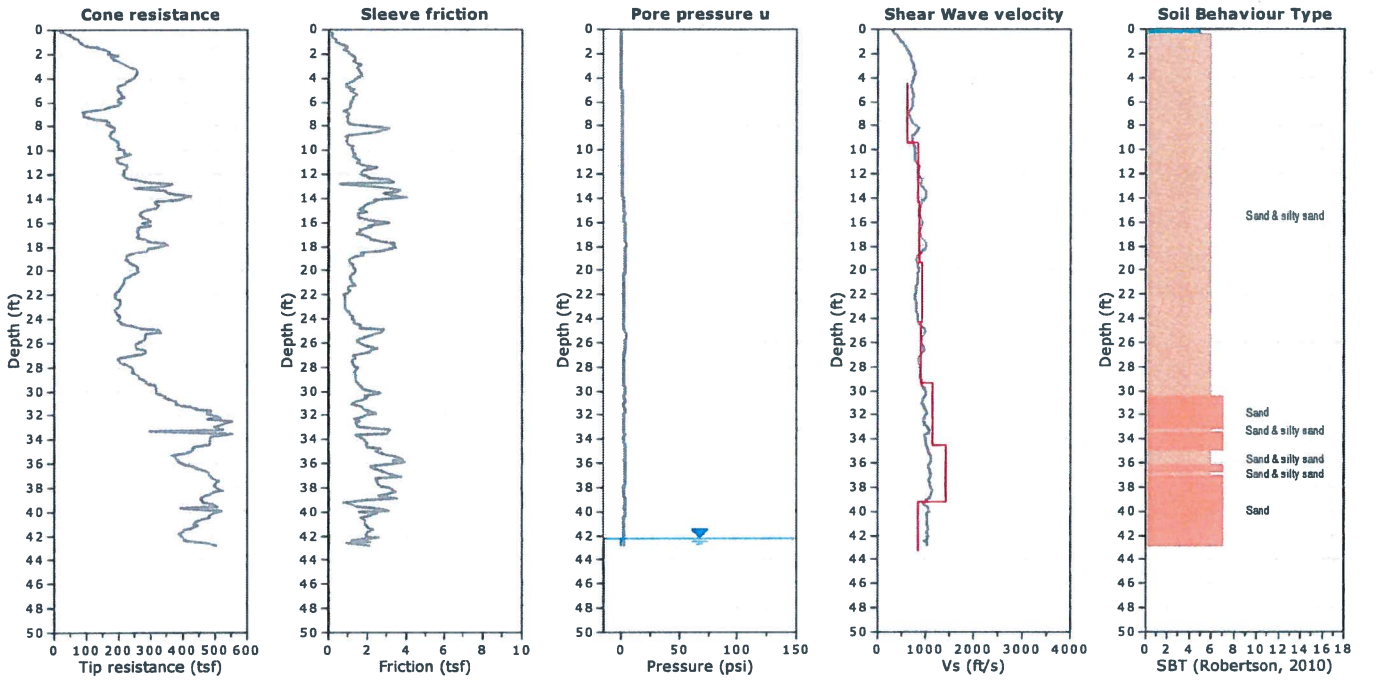
CPT: SCPT-3

CLIENT: PETRA GEOSCIENCES, INC.

Field Rep: ALI

SITE: BOUQUET CANYON - 20605 SUE DRIVE, SANTA CLARITA, CA

Total depth: 42.81 ft, Date: 10/1/2018



WATER TABLE FOR ESTIMATING PURPOSES ONLY

GREGG DRILLING, INC.
www.greggdrilling.com

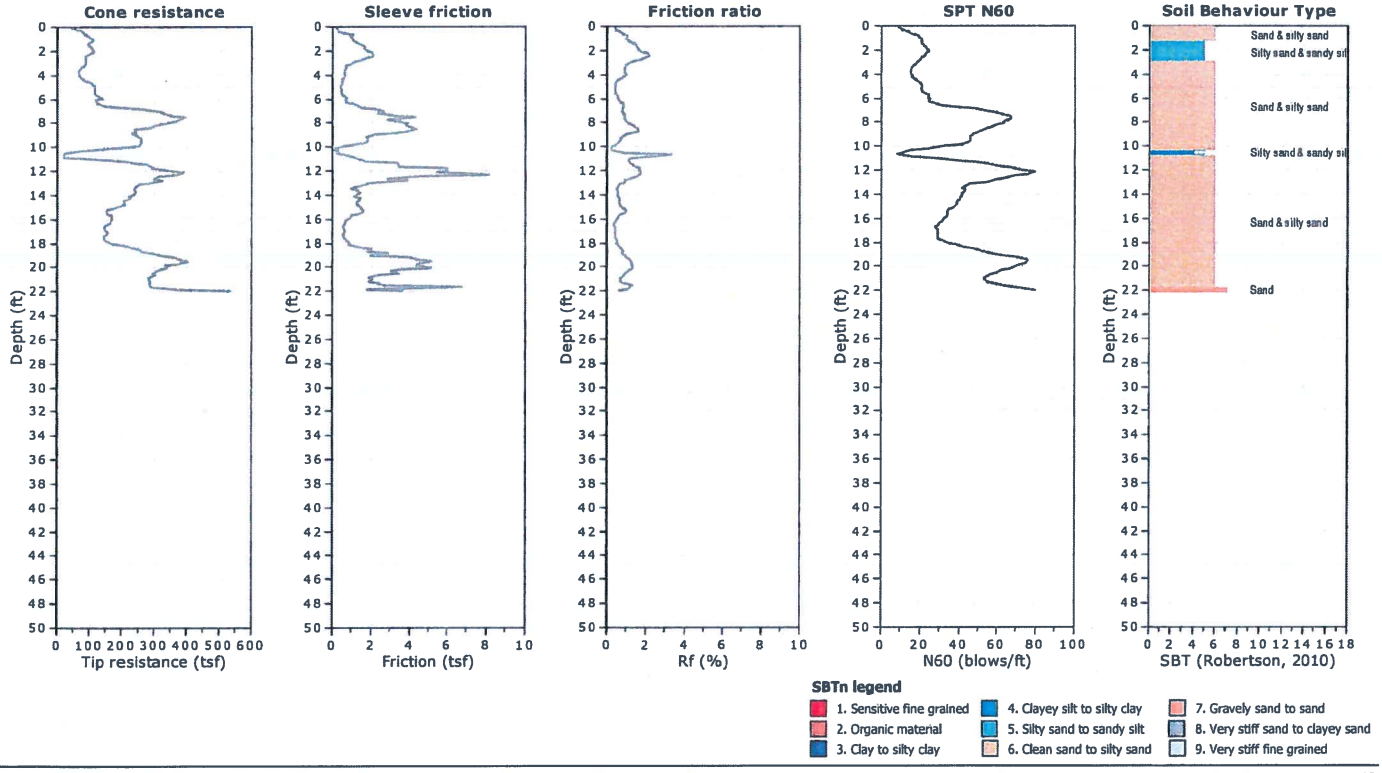
CPT: SCPT-5

CLIENT: PETRA GEOSCIENCES, INC.

Field Rep: ALI

SITE: BOUQUET CANYON - 20605 SUE DRIVE, SANTA CLARITA, CA

Total depth: 21.98 ft, Date: 10/1/2018



GREGG DRILLING, INC.
www.greggdrilling.com

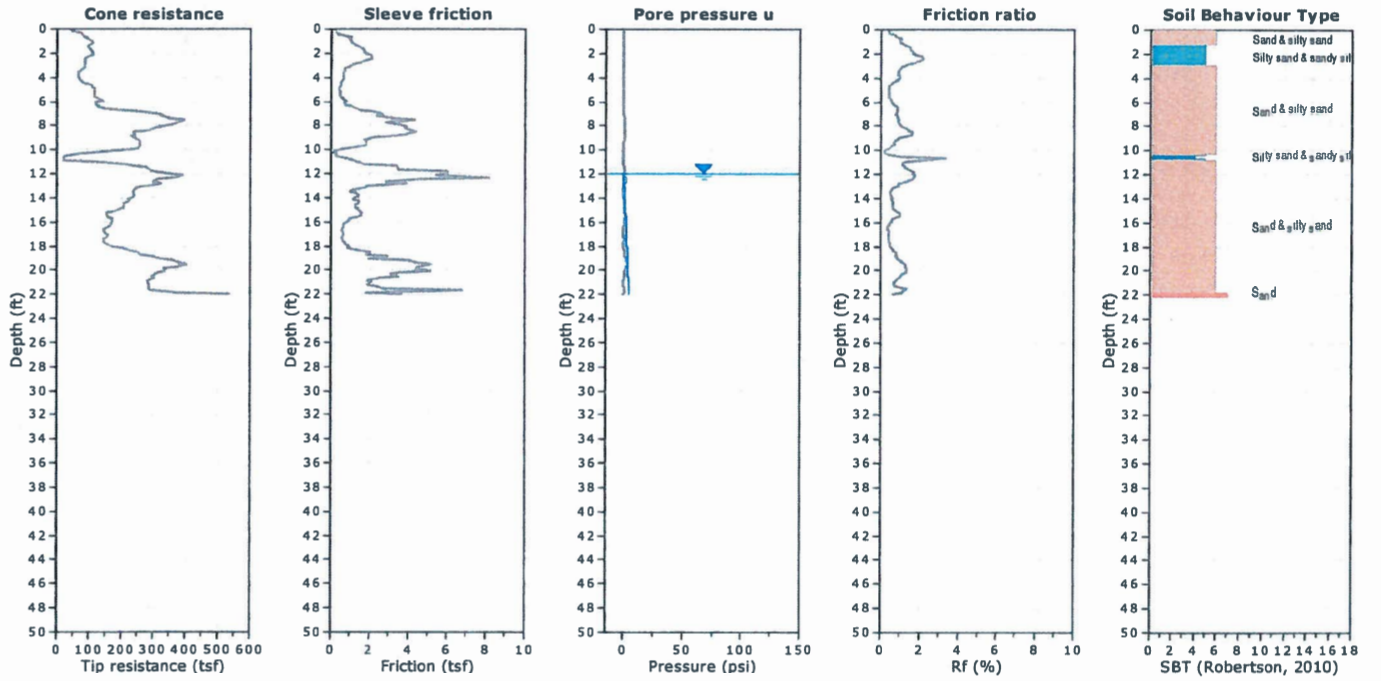
CPT: SCPT-5

CLIENT: PETRA GEOSCIENCES, INC.

SITE: BOUQUET CANYON - 20605 SUE DRIVE, SANTA CLARITA, CA

Field Rep: ALI

Total depth: 21.98 ft, Date: 10/1/2018



WATER TABLE FOR ESTIMATING PURPOSES ONLY

GREGG DRILLING, INC.
www.greggdrilling.com

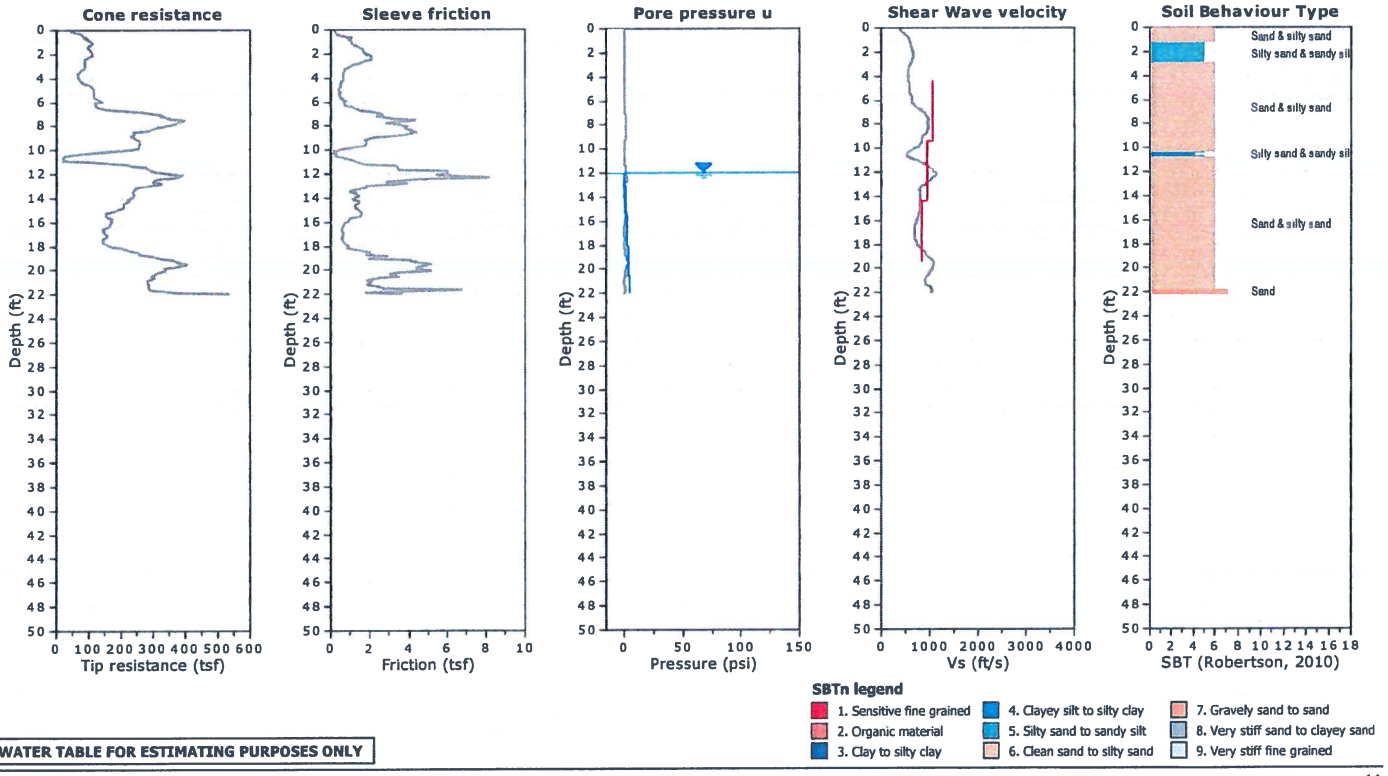
CPT: SCPT-5

CLIENT: PETRA GEOSCIENCES, INC.

SITE: BOUQUET CANYON - 20605 SUE DRIVE, SANTA CLARITA, CA

Field Rep: ALI

Total depth: 21.98 ft, Date: 10/1/2018



WATER TABLE FOR ESTIMATING PURPOSES ONLY

GREGG DRILLING, INC.
www.greggdrilling.com

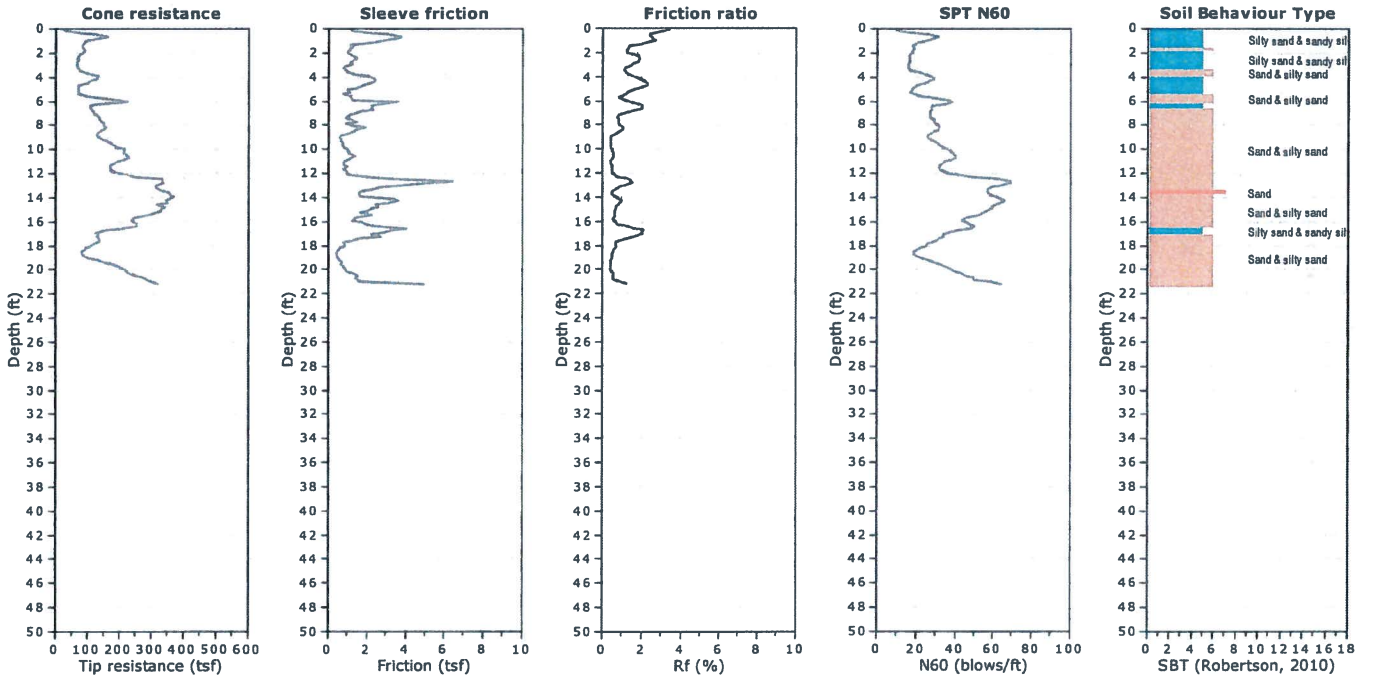
CPT: SCPT-5A

CLIENT: PETRA GEOSCIENCES, INC.

Field Rep: ALI

SITE: BOUQUET CANYON - 20605 SUE DRIVE, SANTA CLARITA, CA

Total depth: 21.16 ft, Date: 10/1/2018



GREGG DRILLING, INC.
www.greggdrilling.com

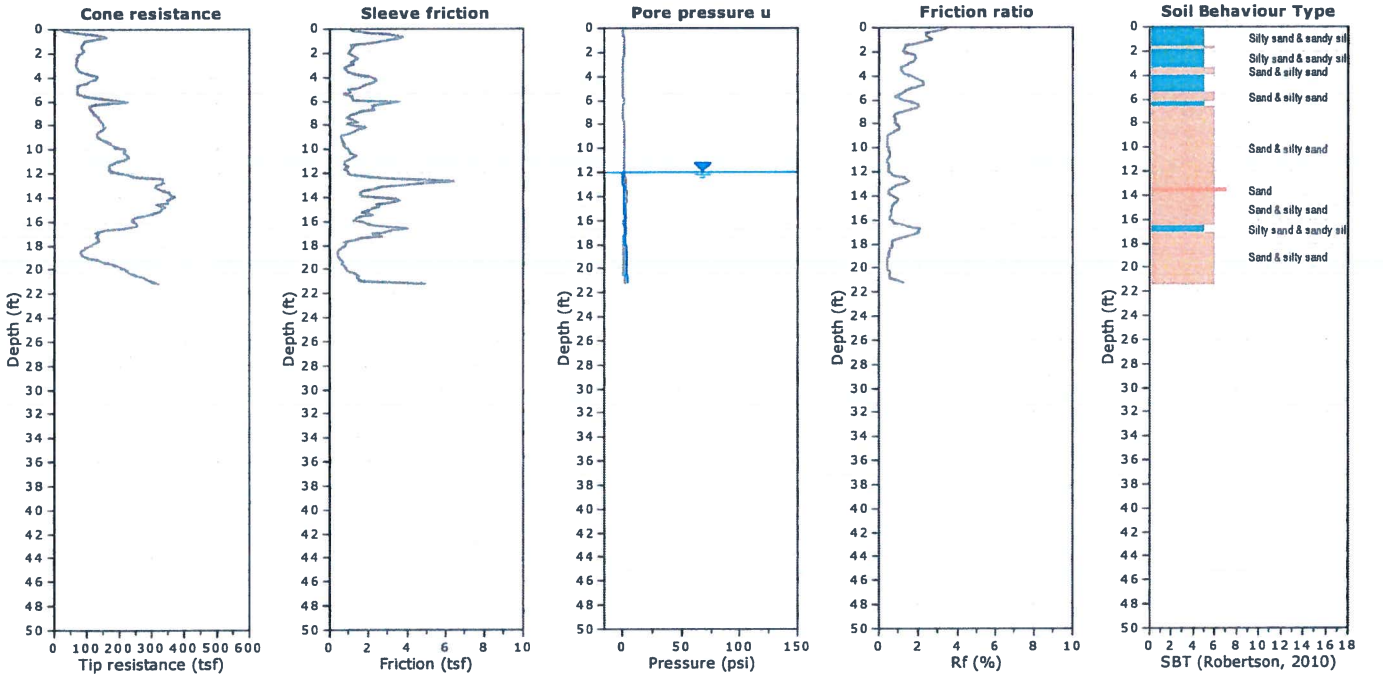
CPT: SCPT-5A

CLIENT: PETRA GEOSCIENCES, INC.

SITE: BOUQUET CANYON - 20605 SUE DRIVE, SANTA CLARITA, CA

Field Rep: ALI

Total depth: 21.16 ft, Date: 10/1/2018



WATER TABLE FOR ESTIMATING PURPOSES ONLY

GREGG DRILLING, INC.
www.greggdrilling.com

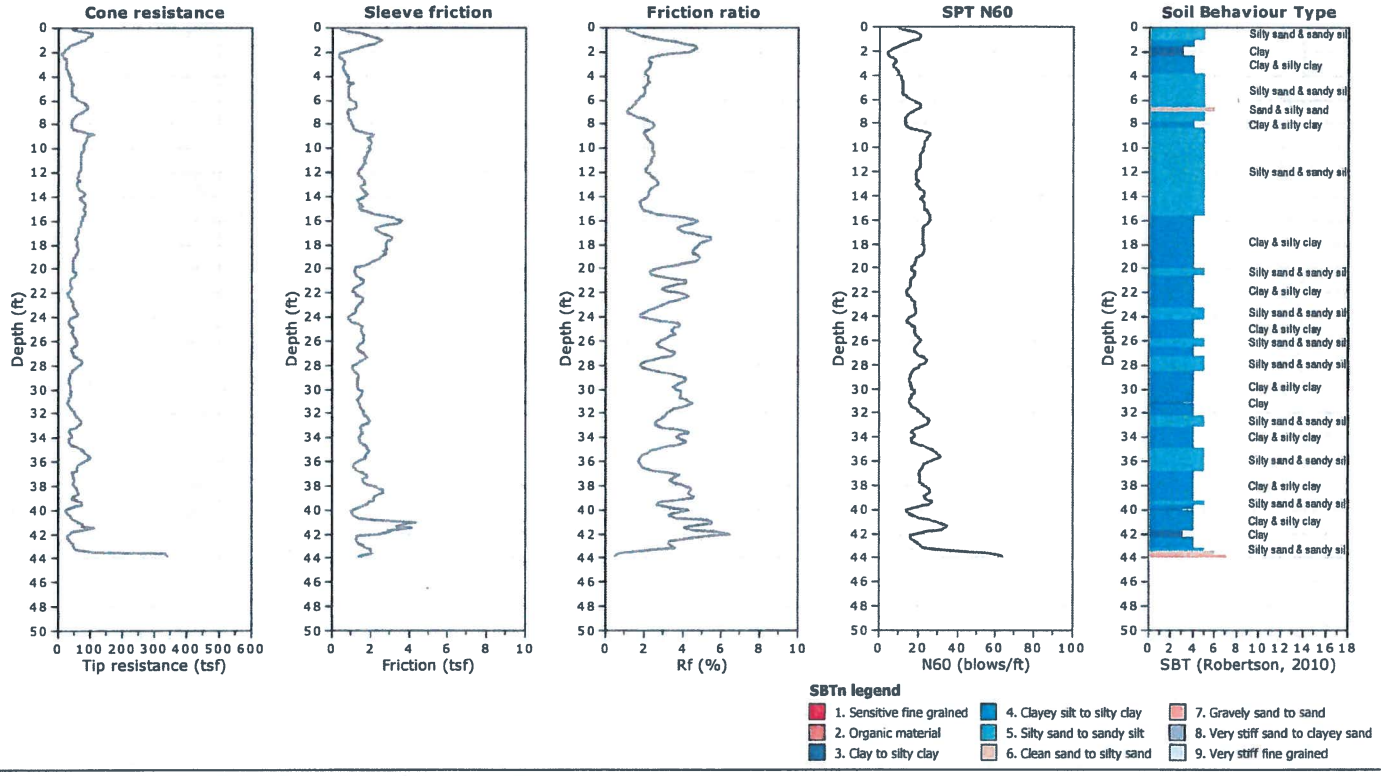
CPT: SCPT-6

CLIENT: PETRA GEOSCIENCES, INC.

Field Rep: ALI

SITE: BOUQUET CANYON - 20605 SUE DRIVE, SANTA CLARITA, CA

Total depth: 43.80 ft, Date: 10/1/2018



GREGG DRILLING, INC.
www.greggdrilling.com

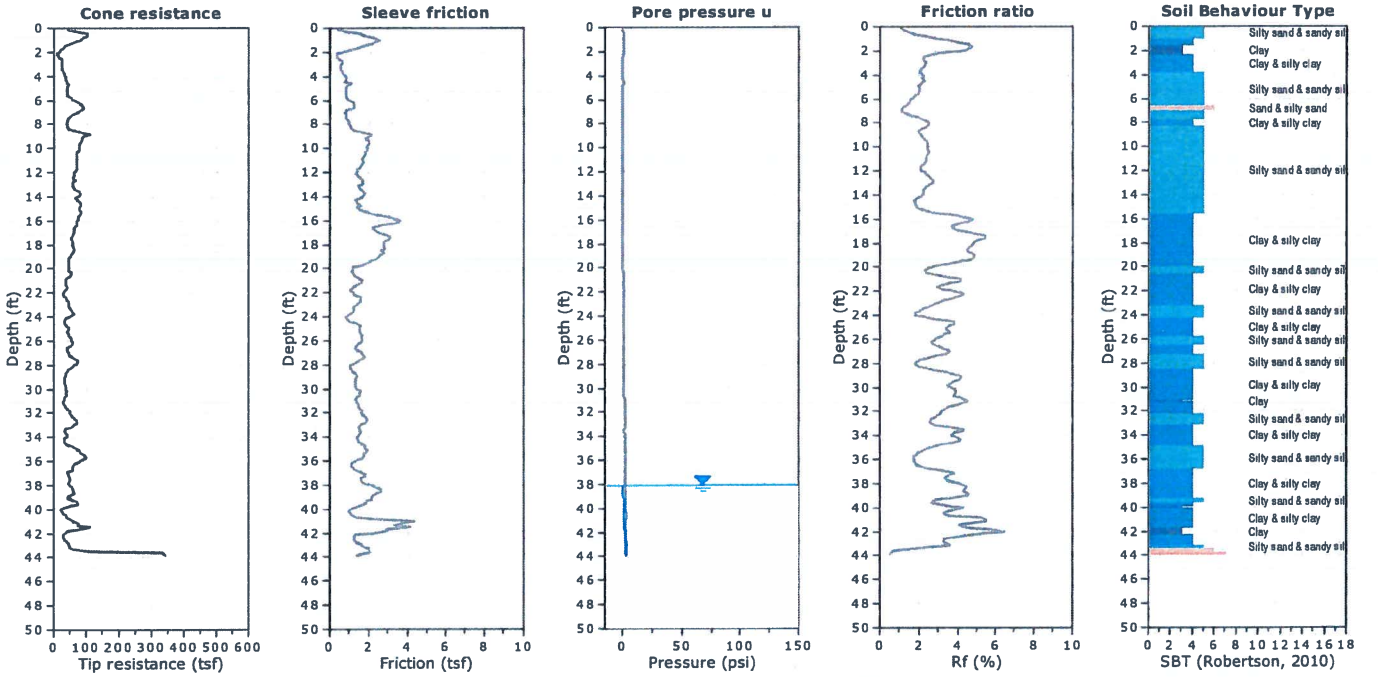
CPT: SCPT-6

CLIENT: PETRA GEOSCIENCES, INC.

SITE: BOUQUET CANYON - 20605 SUE DRIVE, SANTA CLARITA, CA

Field Rep: ALI

Total depth: 43.80 ft, Date: 10/1/2018



SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

WATER TABLE FOR ESTIMATING PURPOSES ONLY

GREGG DRILLING, INC.
www.greggdrilling.com

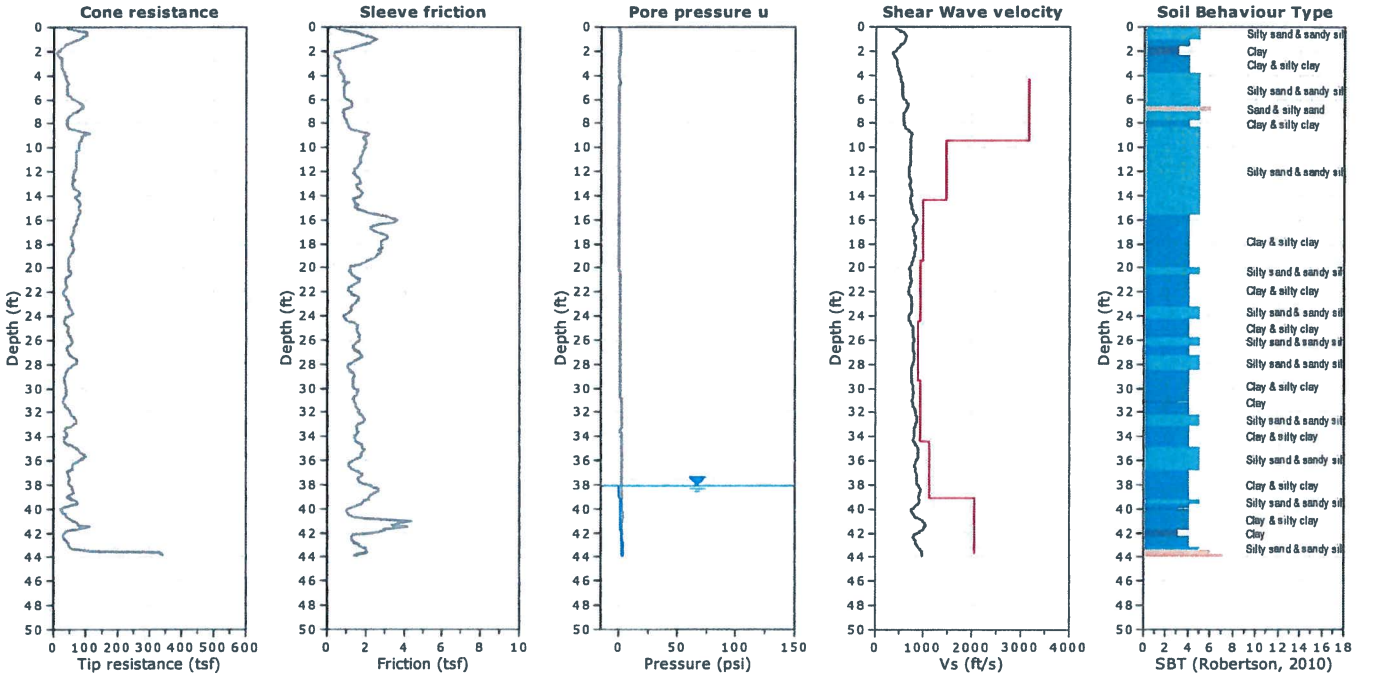
CPT: SCPT-6

CLIENT: PETRA GEOSCIENCES, INC.

Field Rep: ALI

SITE: BOUQUET CANYON - 20605 SUE DRIVE, SANTA CLARITA, CA

Total depth: 43.80 ft, Date: 10/1/2018



WATER TABLE FOR ESTIMATING PURPOSES ONLY

APPENDIX B

LIQUEFACTION ANALYSES

TABLE OF CONTENTS

Petra Geosciences, Inc.
3186 Airway Avenue, Suite K
Costa Mesa, CA 92626
http://www.petra-inc.com/

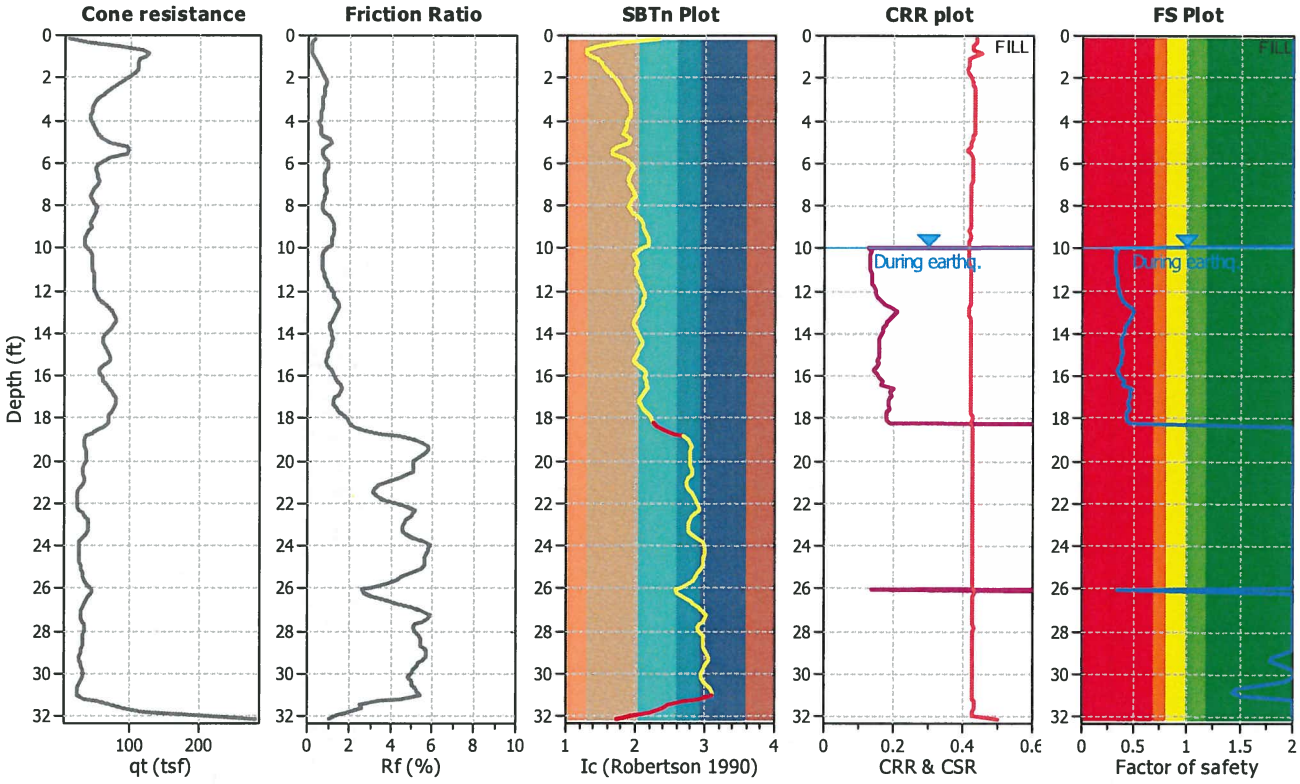
LIQUEFACTION ANALYSIS REPORT

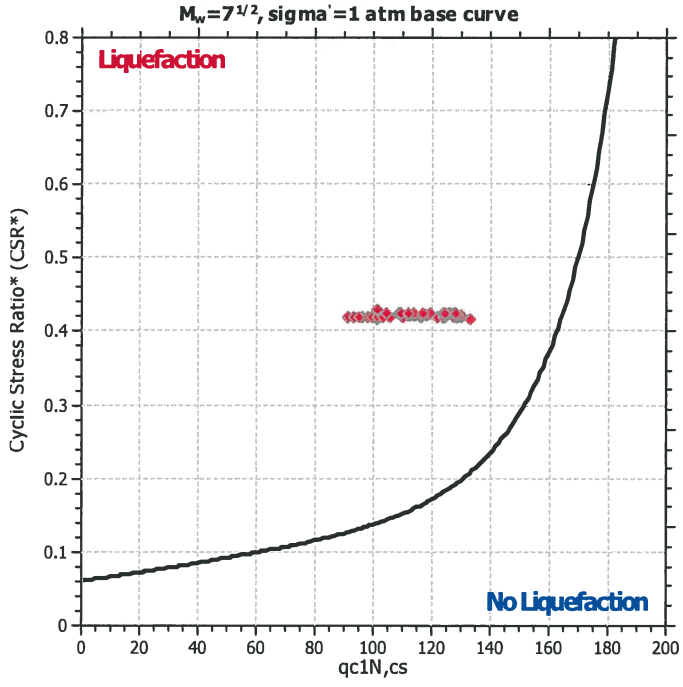
Project title : Bouquet Canyon **Location : Santa Clarita, California**

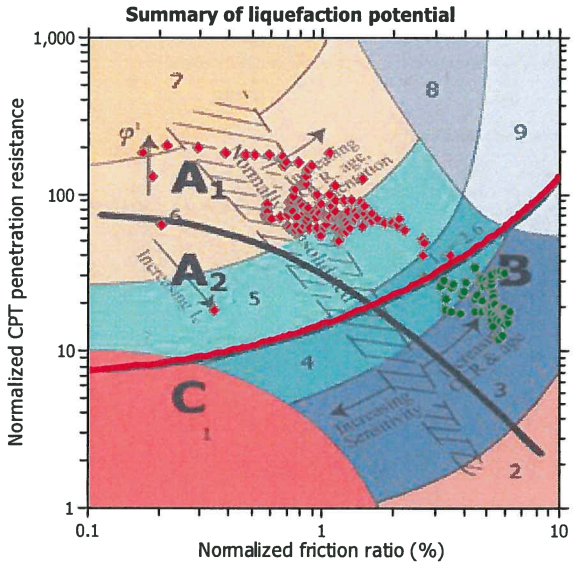
CPT file : CPT-1

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	95.00 ft	Use fill:	Yes	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	53.00 ft	Fill height:	43.00 ft	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	120.00 lb/ft³	Limit depth:	N/A
Earthquake magnitude M_w:	6.85	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.63	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

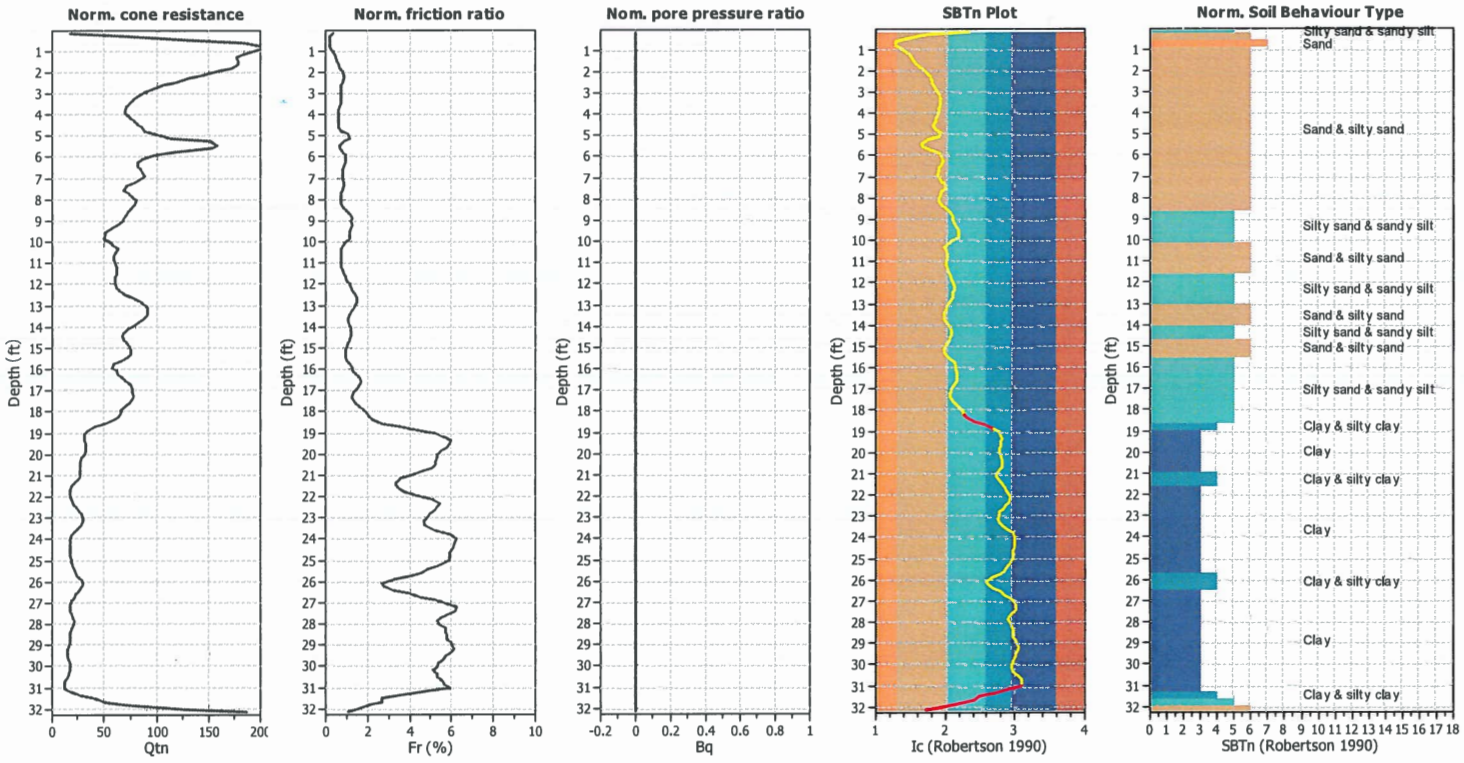






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots (normalized)



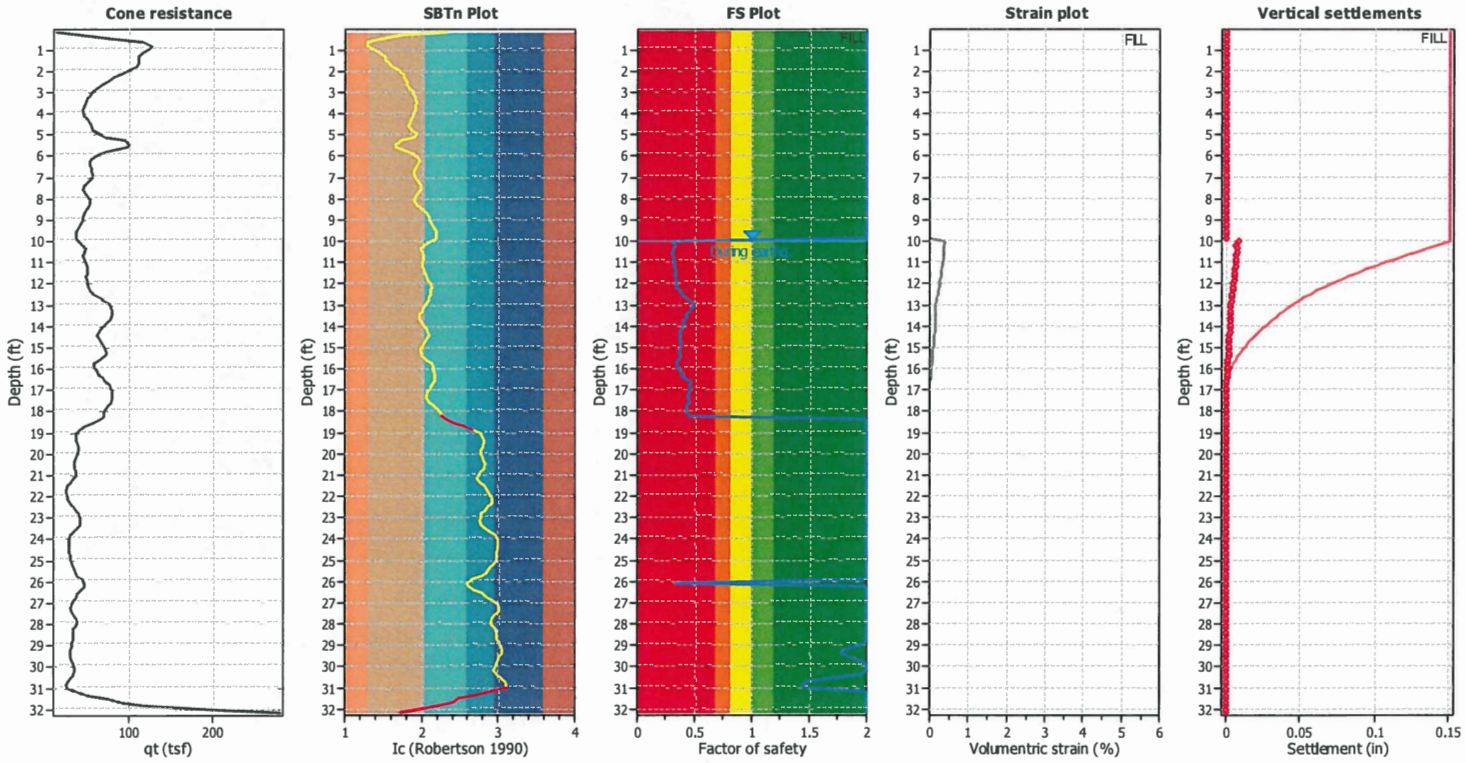
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	53.00 ft	Fill weight:	120.00 lb/ft³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.85	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.63	Use fill:	Yes	Limit depth applied:	No
Depth to water table (insitu):	95.00 ft	Fill height:	43.00 ft	Limit depth:	N/A

SBTn legend

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

Estimation of post-earthquake settlements



Abbreviations

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

Petra Geosciences, Inc.
3186 Airway Avenue, Suite K
Costa Mesa, CA 92626
http://www.petra-inc.com/

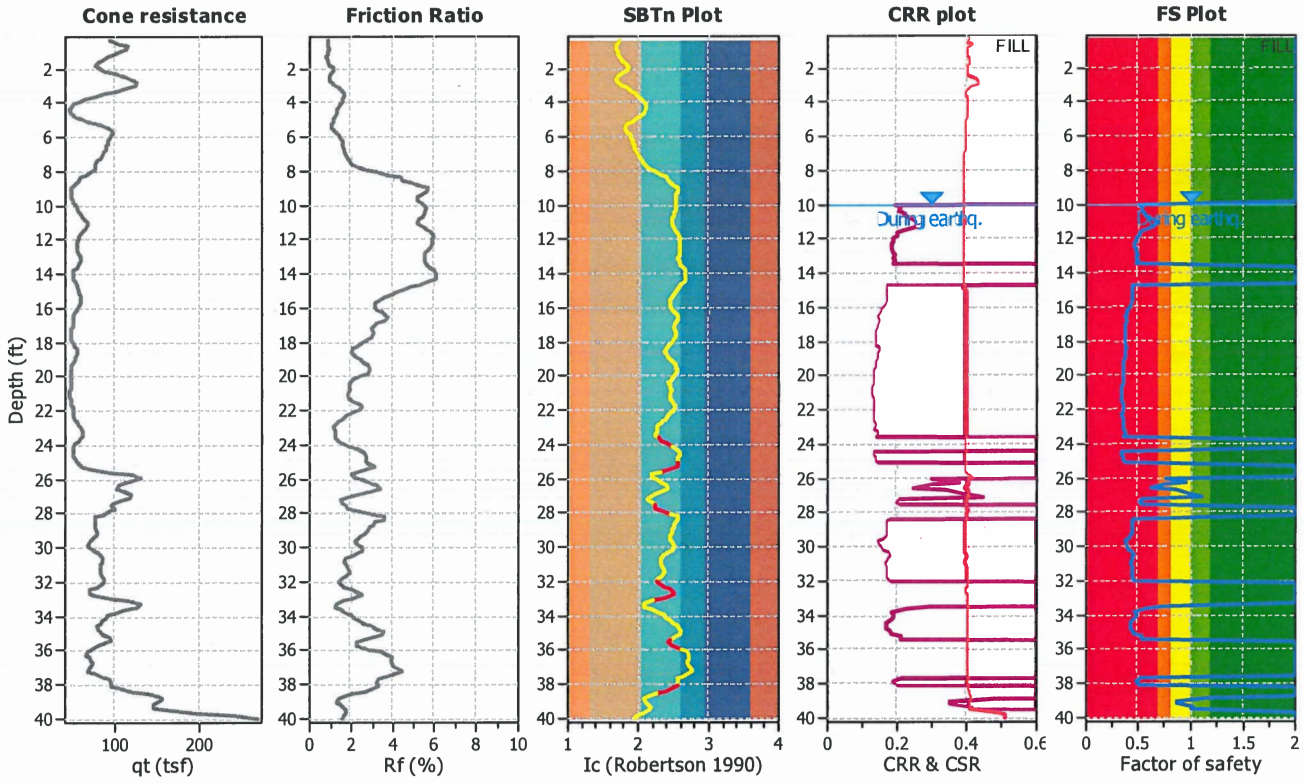
LIQUEFACTION ANALYSIS REPORT

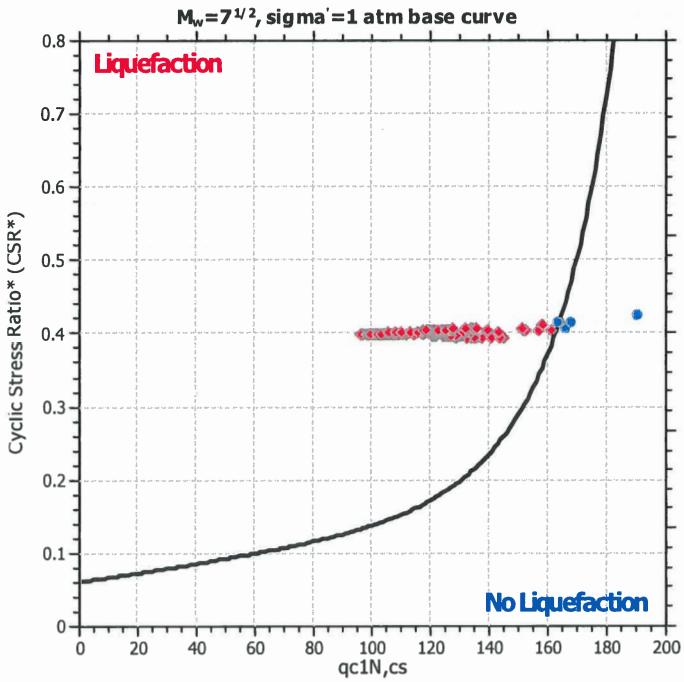
Project title : Bouquet Canyon **Location : Santa Clarita, California**

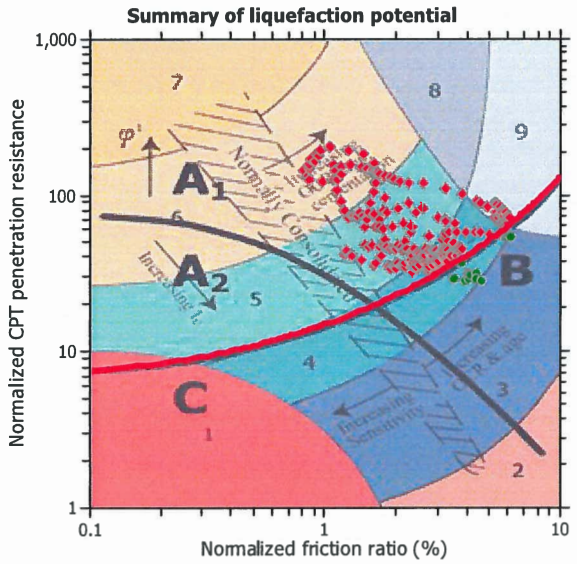
CPT file : CPT-2

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	100.00 ft	Use fill:	Yes	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	64.00 ft	Fill height:	54.00 ft	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	120.00 lb/ft³	Limit depth:	N/A
Earthquake magnitude M_w:	6.85	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.63	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

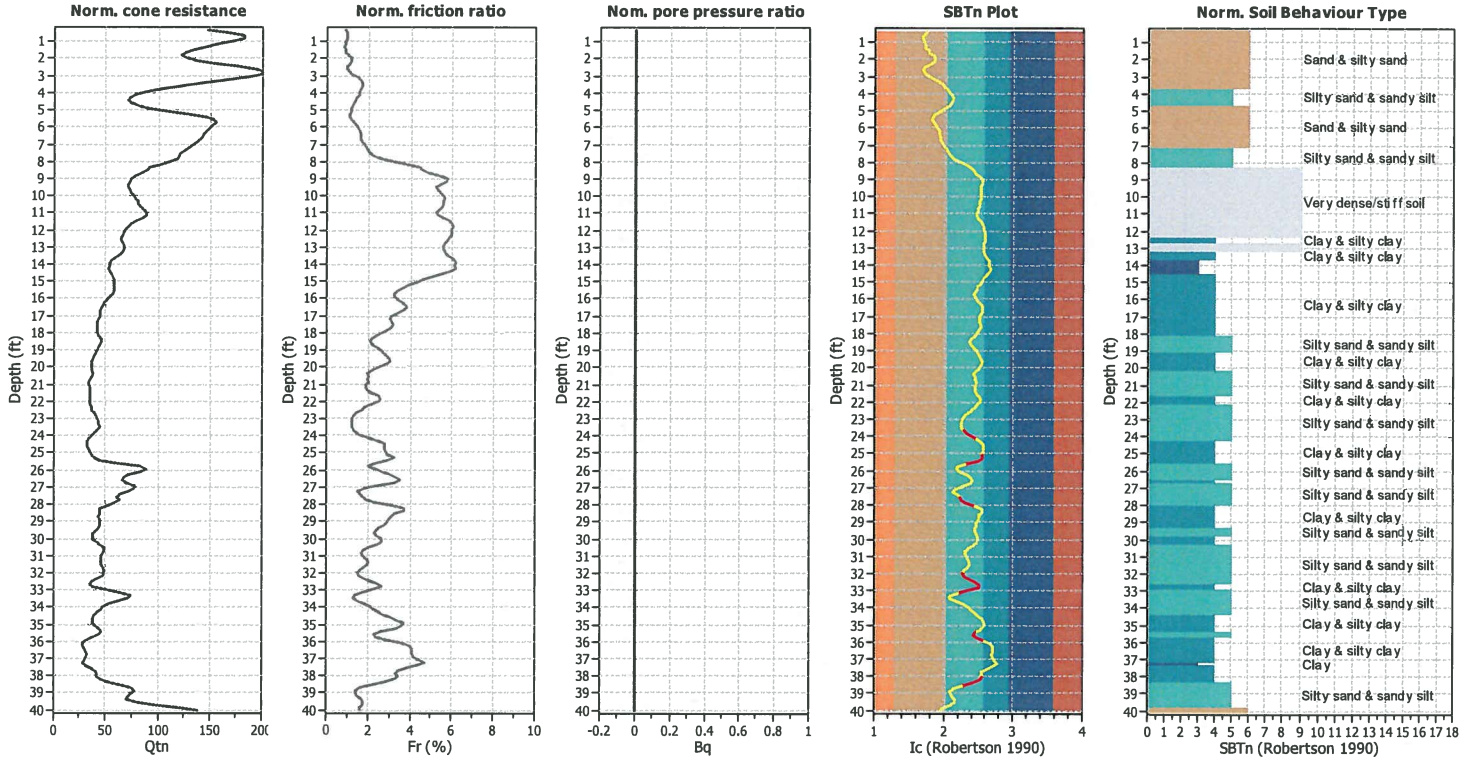






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots (normalized)



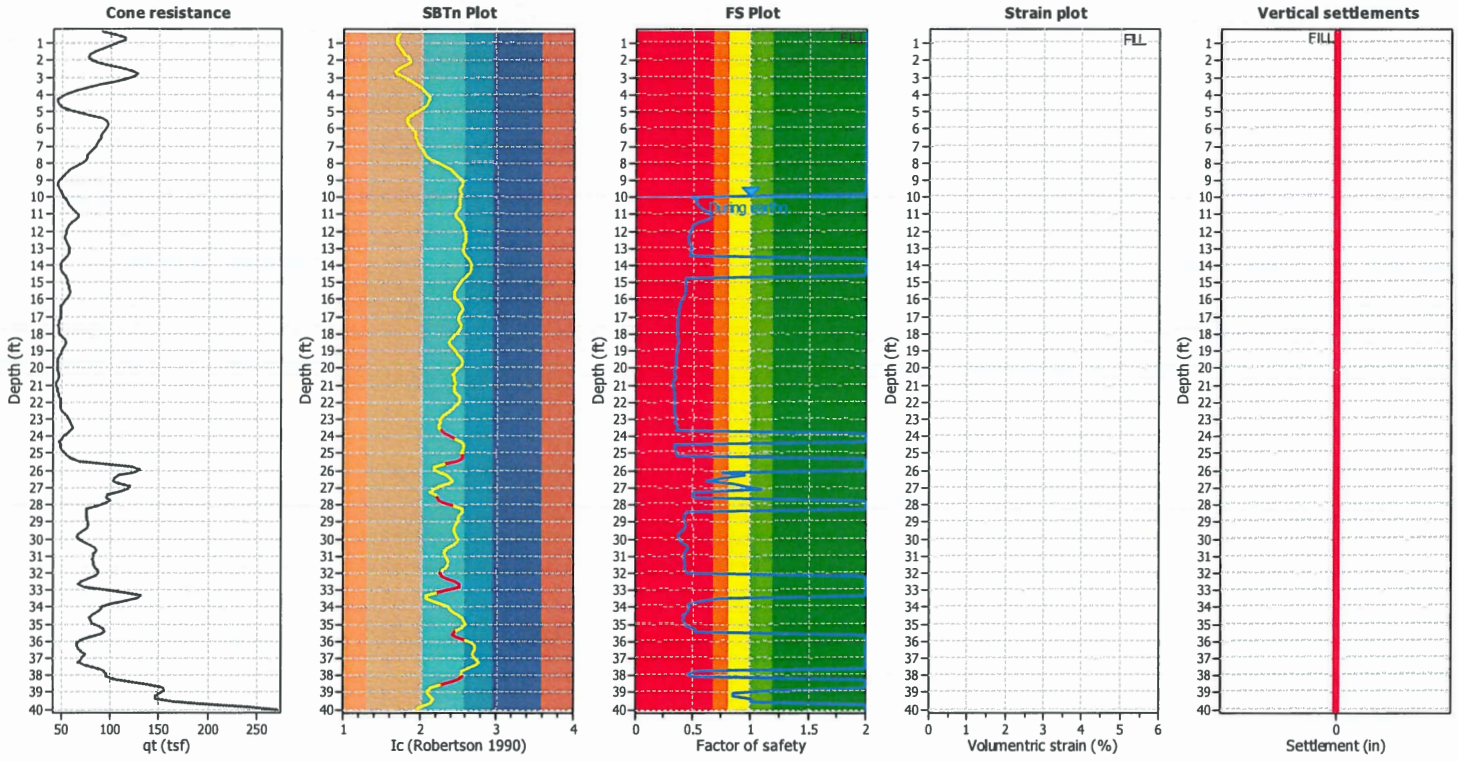
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	64.00 ft	Fill weight:	120.00 lb/ft³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.85	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.63	Use fill:	Yes	Limit depth applied:	No
Depth to water table (insitu):	100.00 ft	Fill height:	54.00 ft	Limit depth:	N/A

SBTn legend

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

Estimation of post-earthquake settlements



Abbreviations

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

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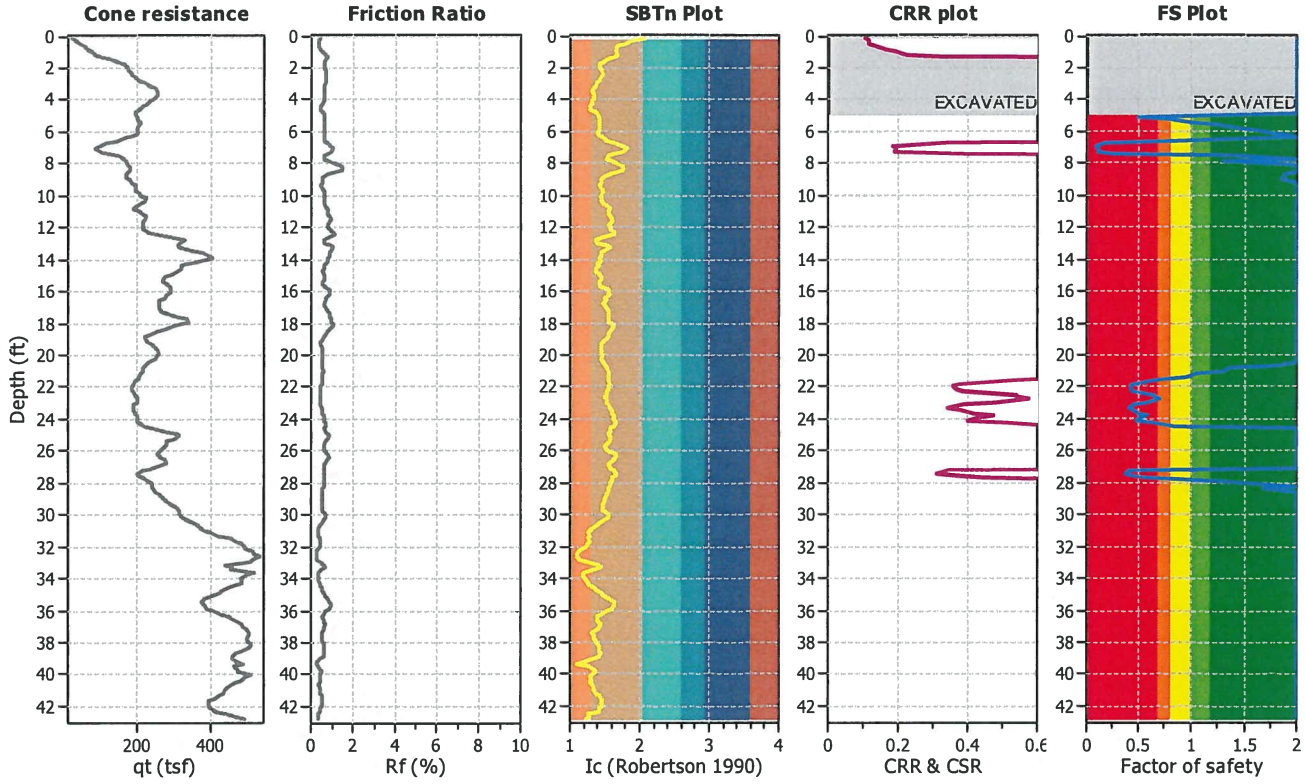
LIQUEFACTION ANALYSIS REPORT

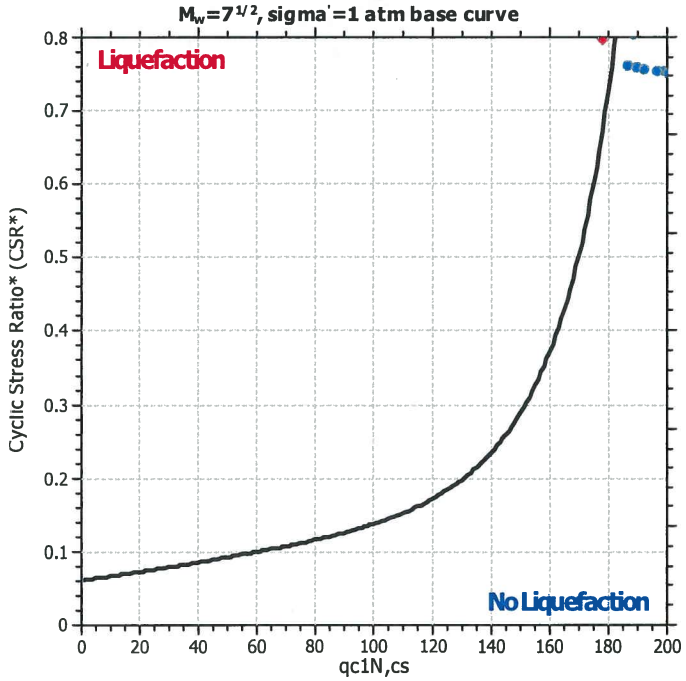
Project title : Bouquet Canyon **Location : Santa Clarita, California**

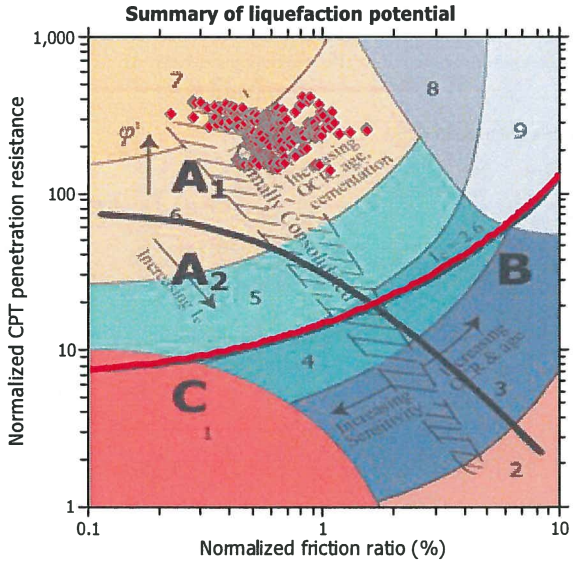
CPT file : CPT-3

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	55.00 ft	Excavation:	Yes	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.00 ft	Excavation depth:	5.00 ft	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Footing load:	0.00 tsf	Limit depth:	N/A
Earthquake magnitude M_w:	6.85	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.63	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

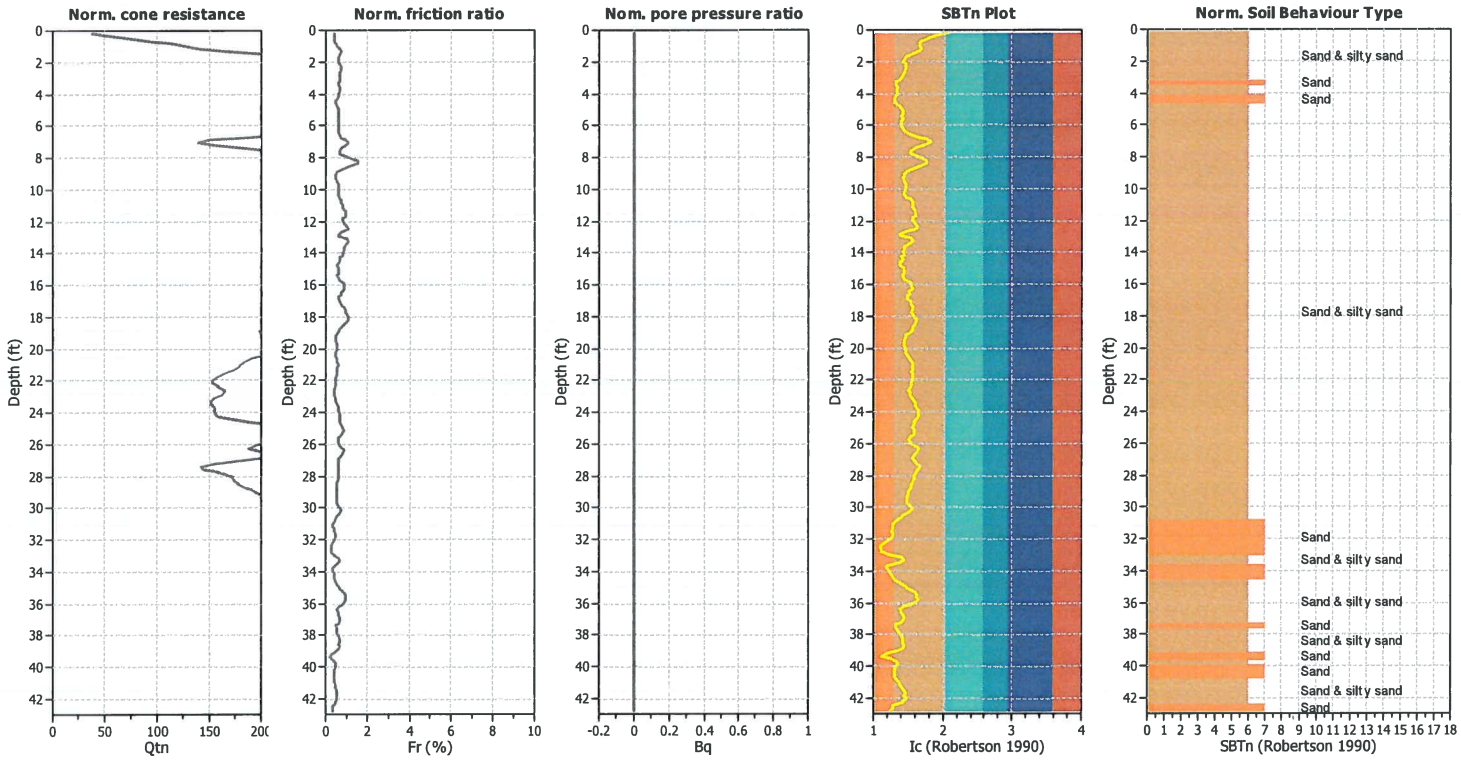






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots (normalized)



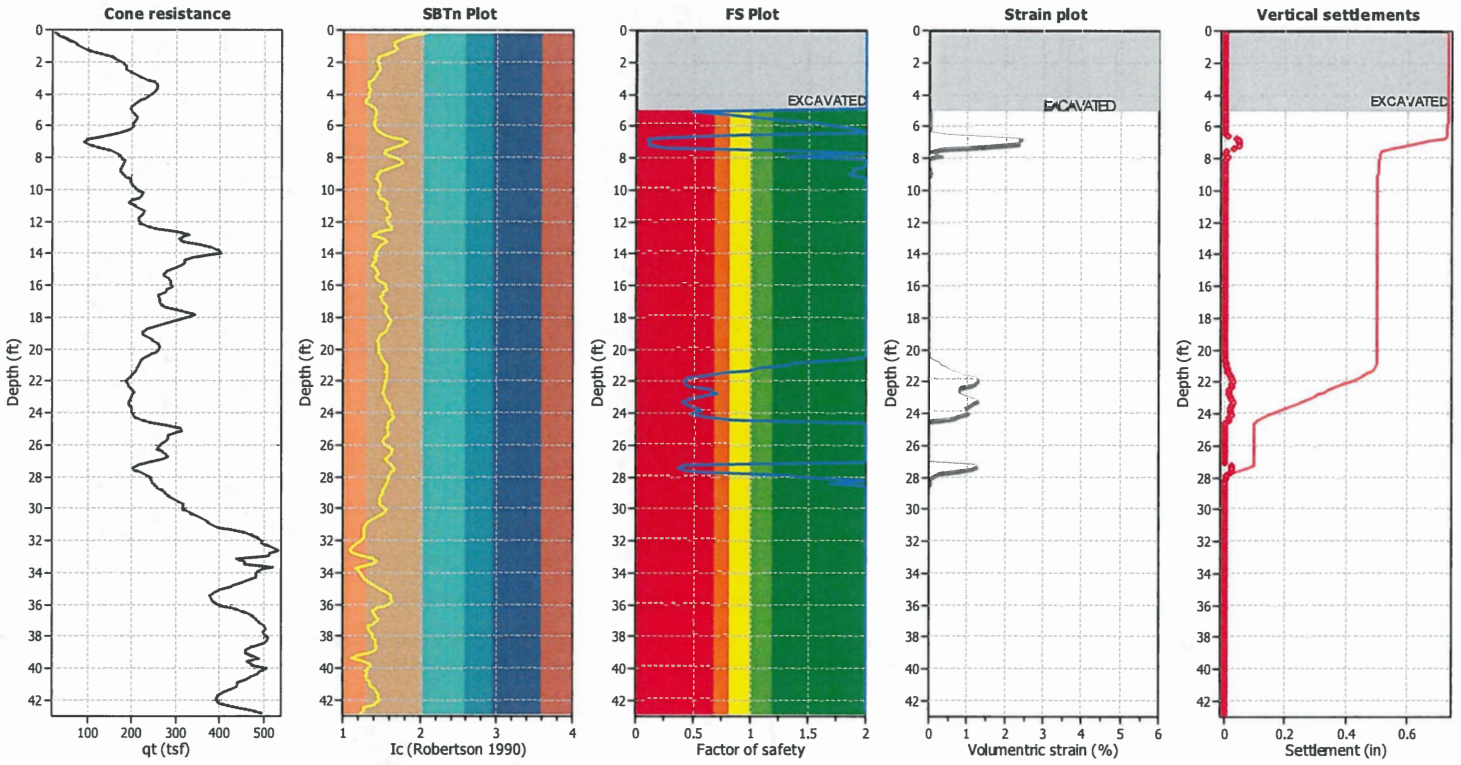
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Footing load:	0.00 tsf
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.85	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.63	Excavation:	Yes	Limit depth applied:	No
Depth to water table (insitu):	55.00 ft	Excavation depth:	5.00 ft	Limit depth:	N/A

SBTn legend

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

Estimation of post-earthquake settlements



Abbreviations

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

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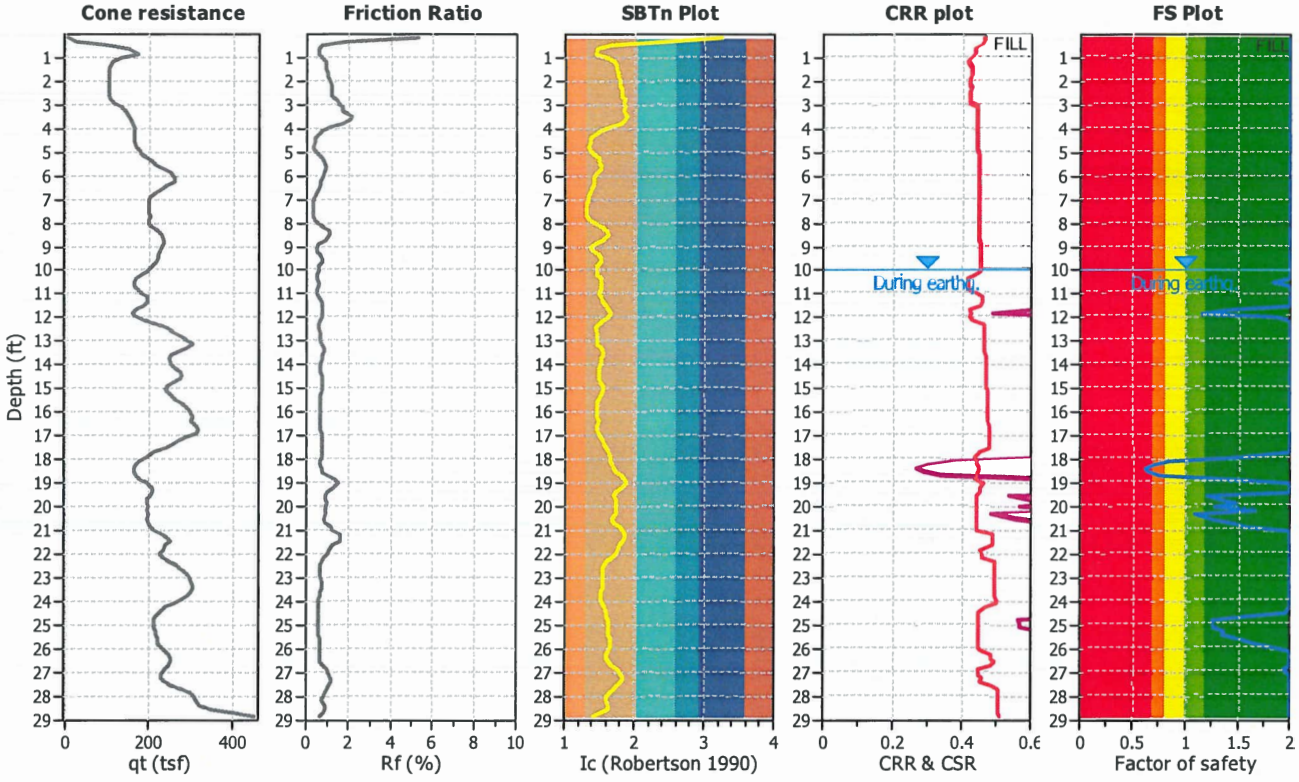
LIQUEFACTION ANALYSIS REPORT

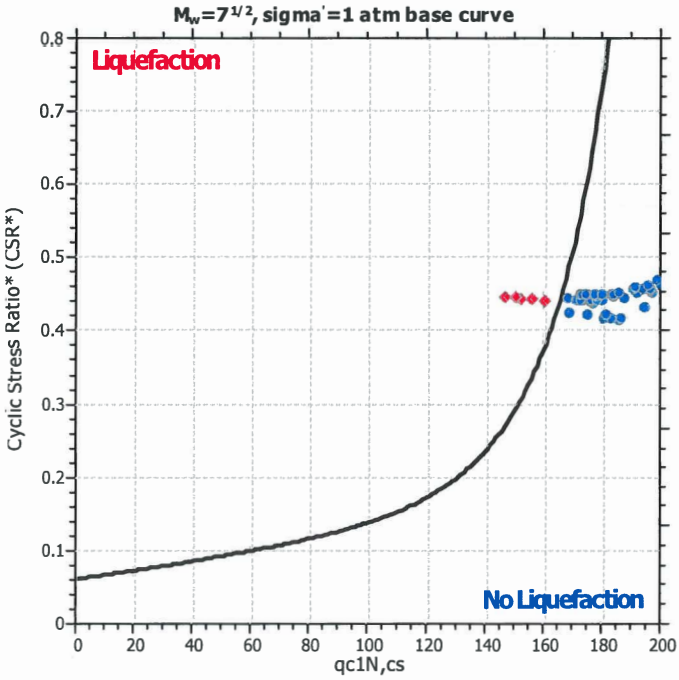
Project title : Bouquet Canyon **Location : Santa Clarita, California**

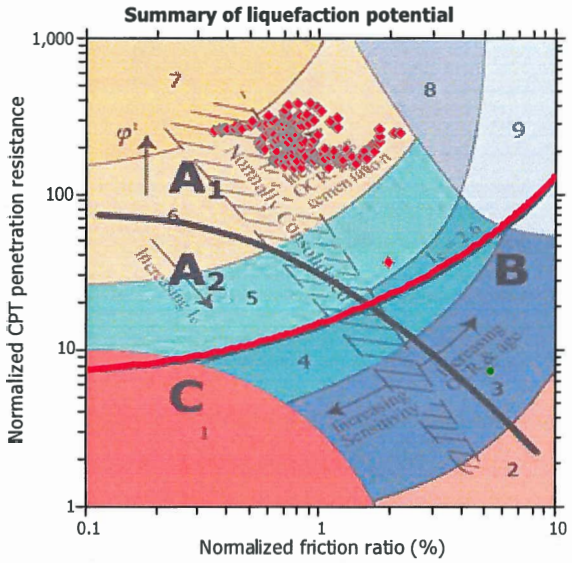
CPT file : CPT-4

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	80.00 ft	Use fill:	Yes	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	43.00 ft	Fill height:	33.00 ft	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	120.00 lb/ft³	Limit depth:	N/A
Earthquake magnitude M_w:	6.85	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.63	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

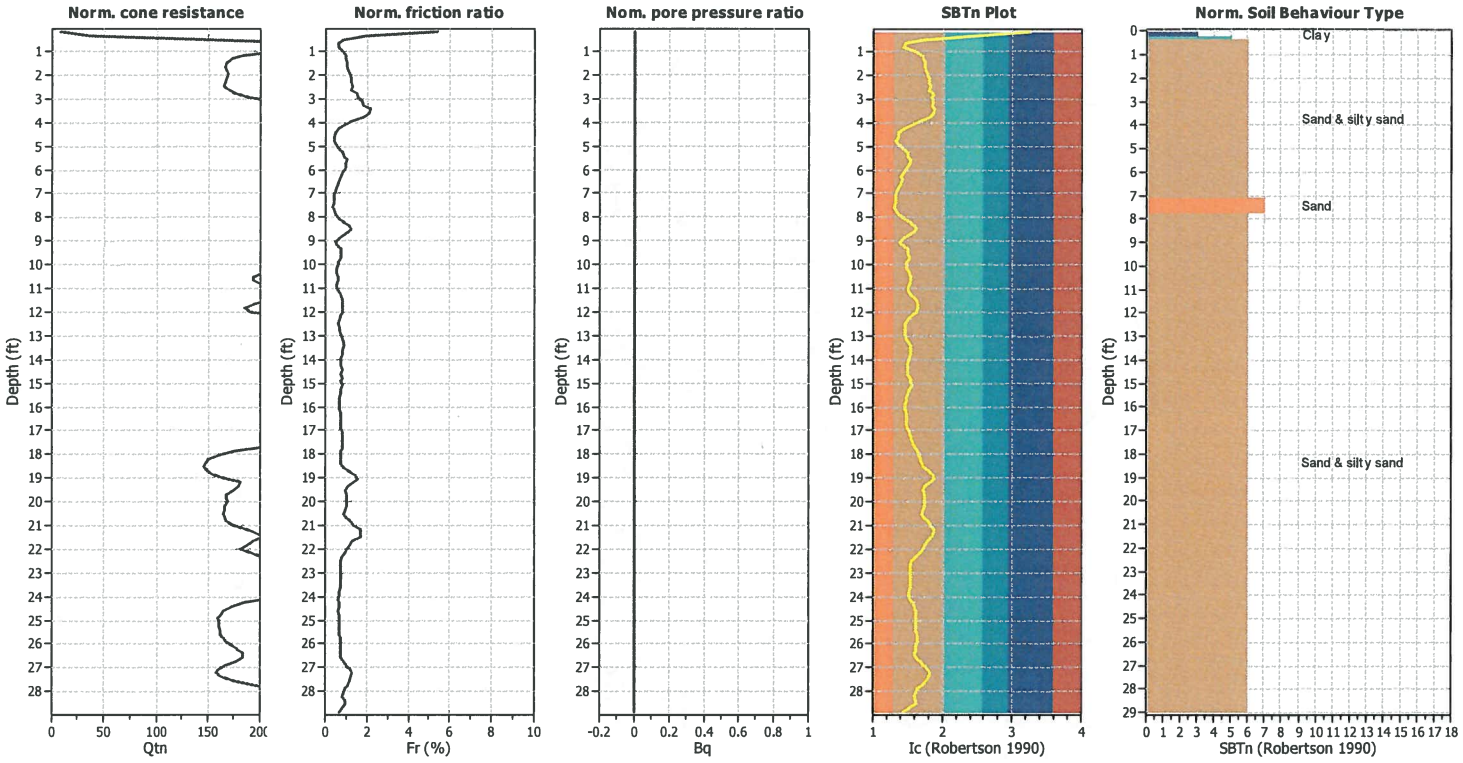






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots (normalized)



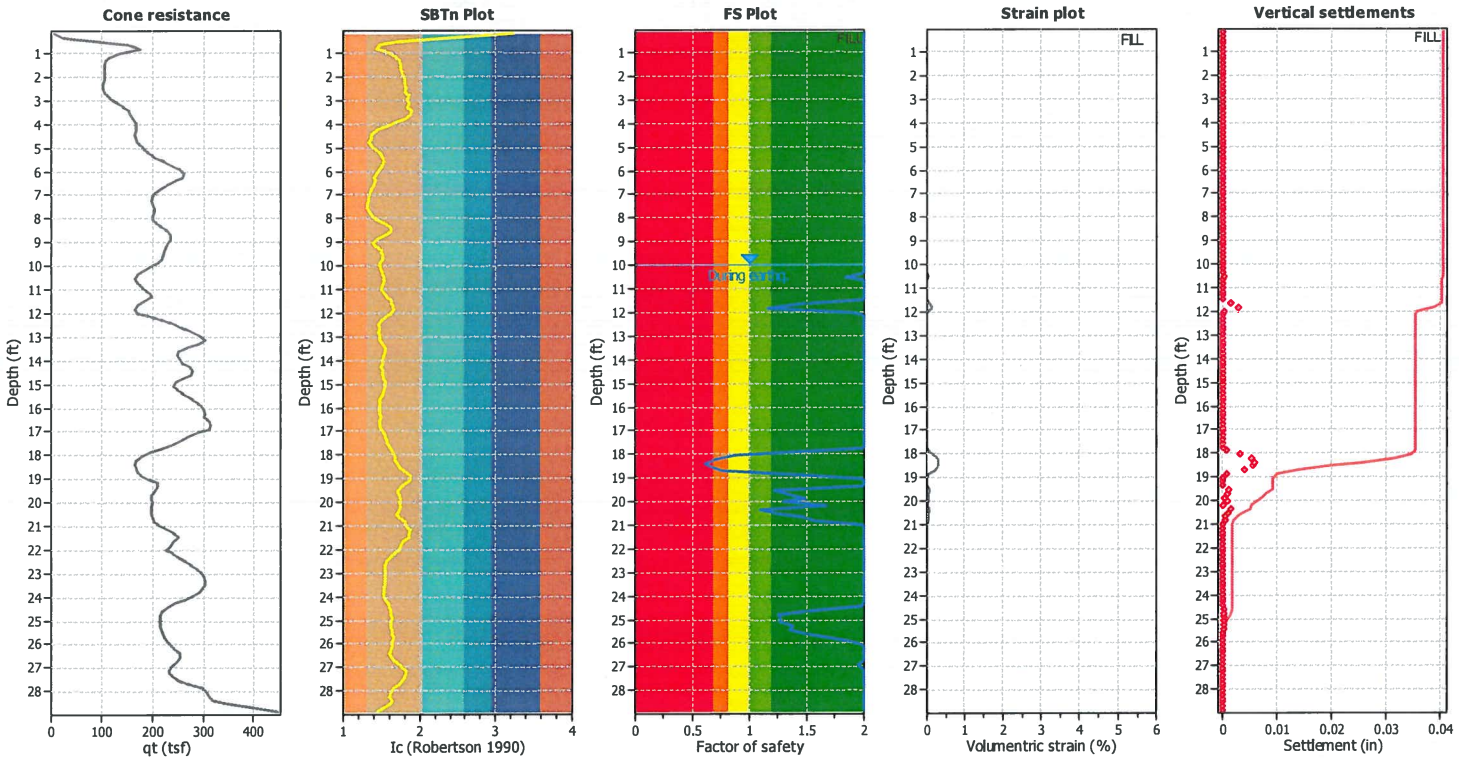
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	43.00 ft	Fill weight:	120.00 lb/ft³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.85	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.63	Use fill:	Yes	Limit depth applied:	No
Depth to water table (insitu):	80.00 ft	Fill height:	33.00 ft	Limit depth:	N/A

SBTn legend

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

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
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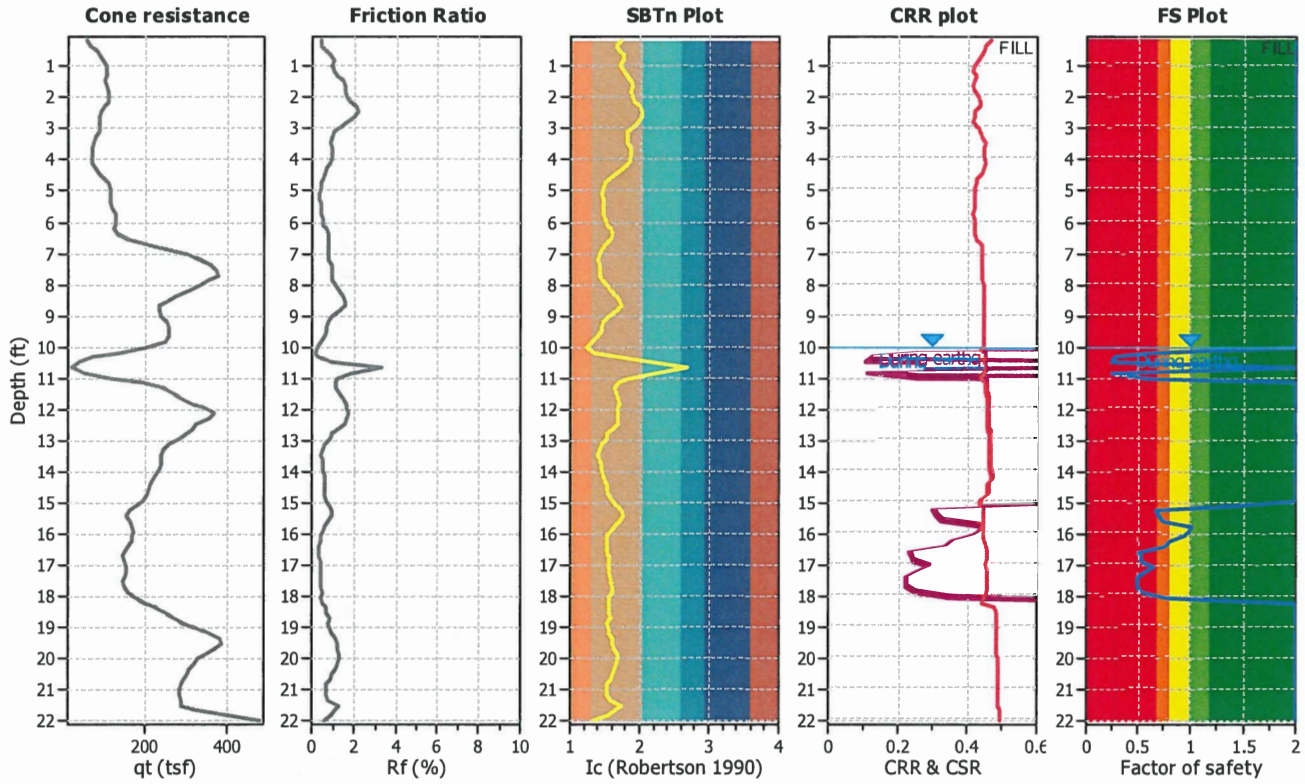
LIQUEFACTION ANALYSIS REPORT

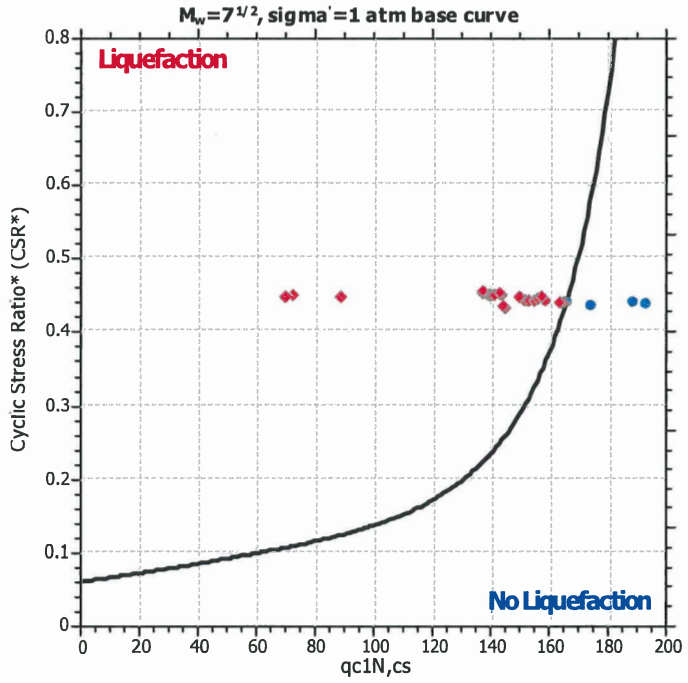
Project title : Bouquet Canyon **Location : Santa Clarita, California**

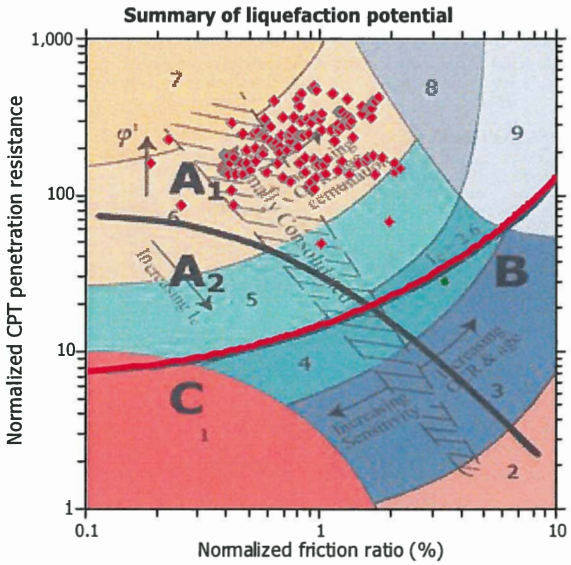
CPT file : CPT-5

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	90.00 ft	Use fill:	Yes	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	40.00 ft	Fill height:	30.00 ft	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	120.00 lb/ft³	Limit depth:	N/A
Earthquake magnitude M_w:	6.85	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.63	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

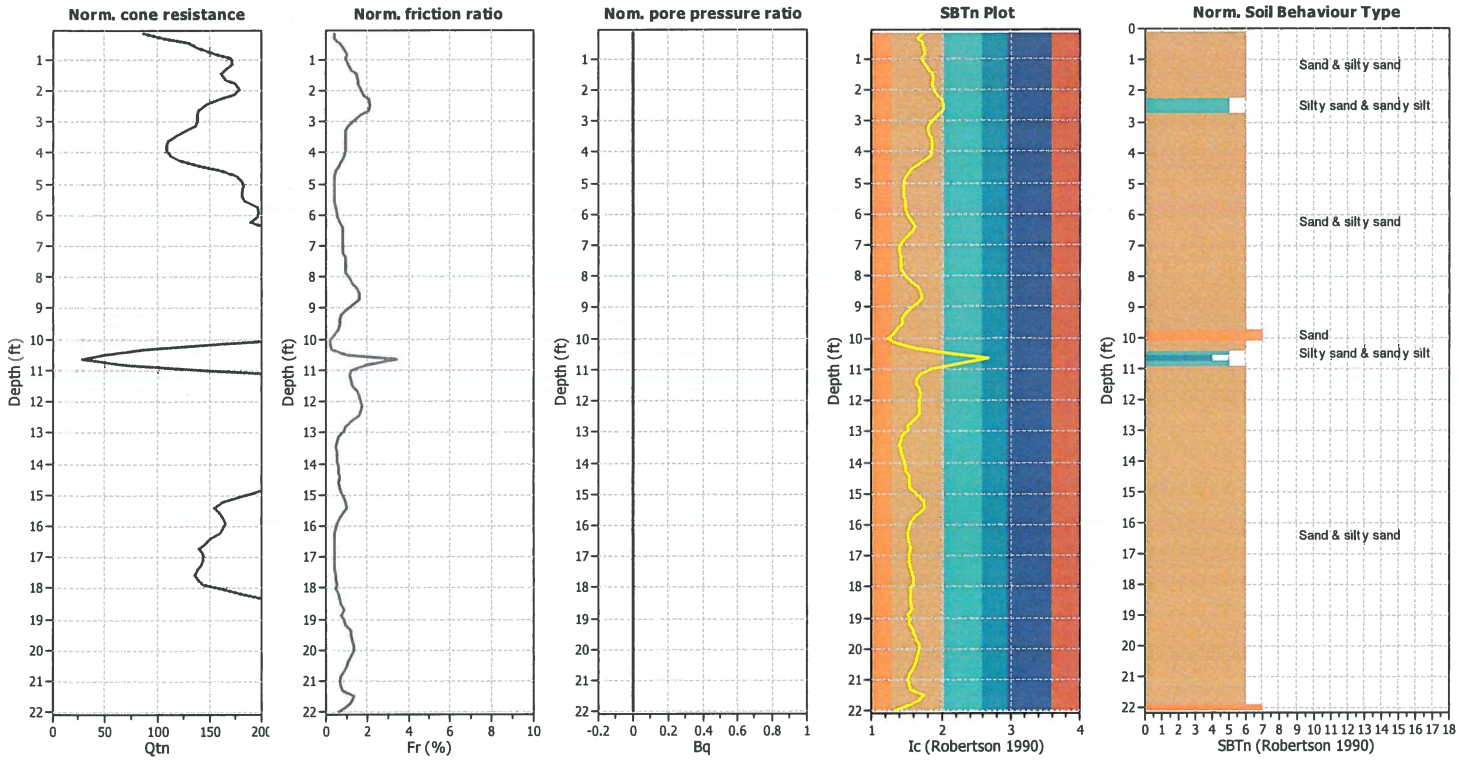






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots (normalized)



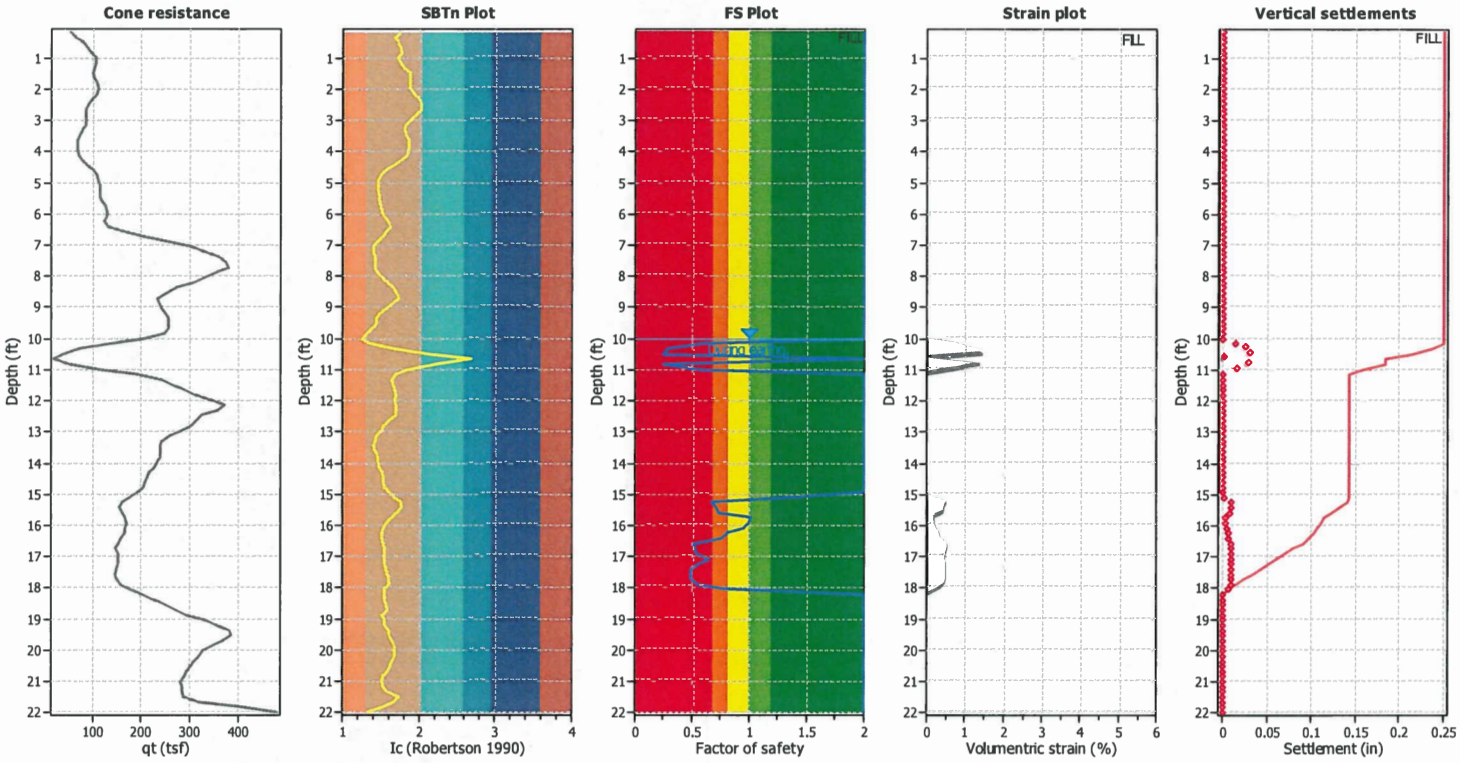
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	40.00 ft	Fill weight:	120.00 lb/ft³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.85	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.63	Use fill:	Yes	Limit depth applied:	No
Depth to water table (insitu):	90.00 ft	Fill height:	30.00 ft	Limit depth:	N/A

SBTn legend

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

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
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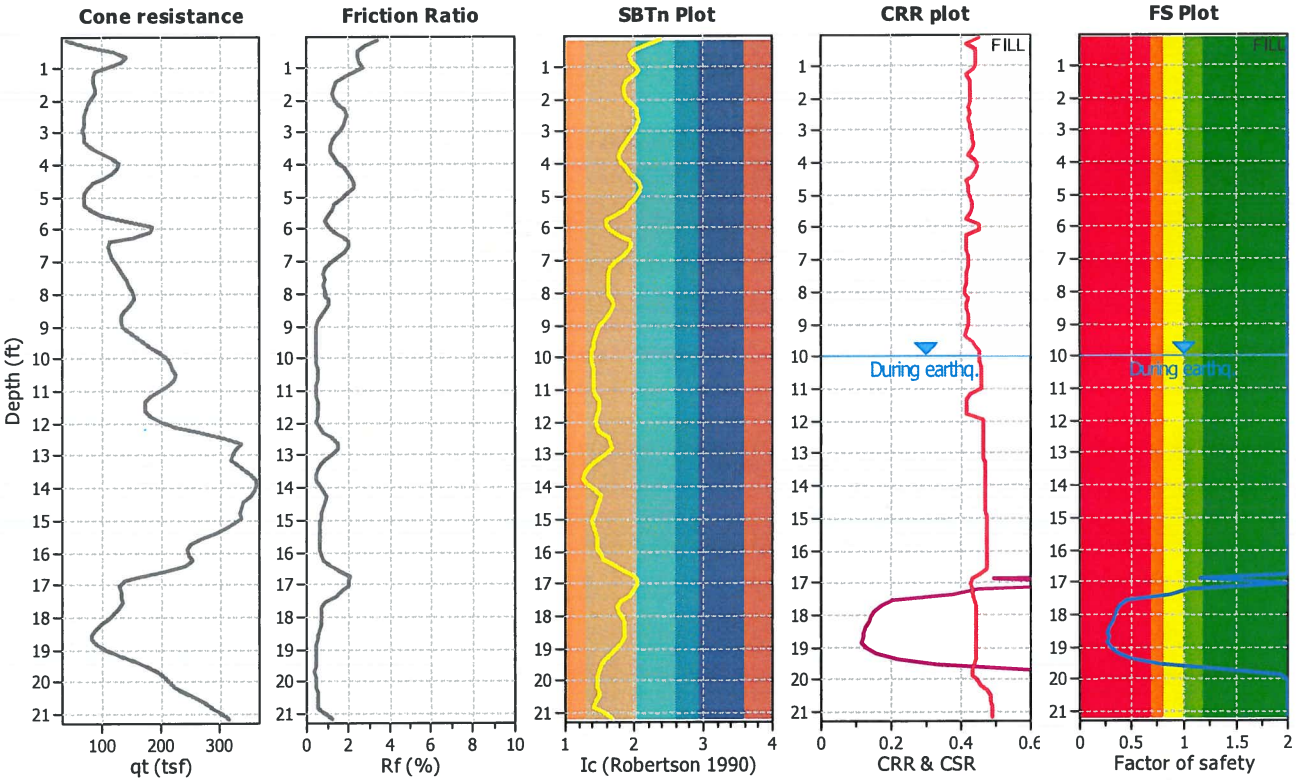
LIQUEFACTION ANALYSIS REPORT

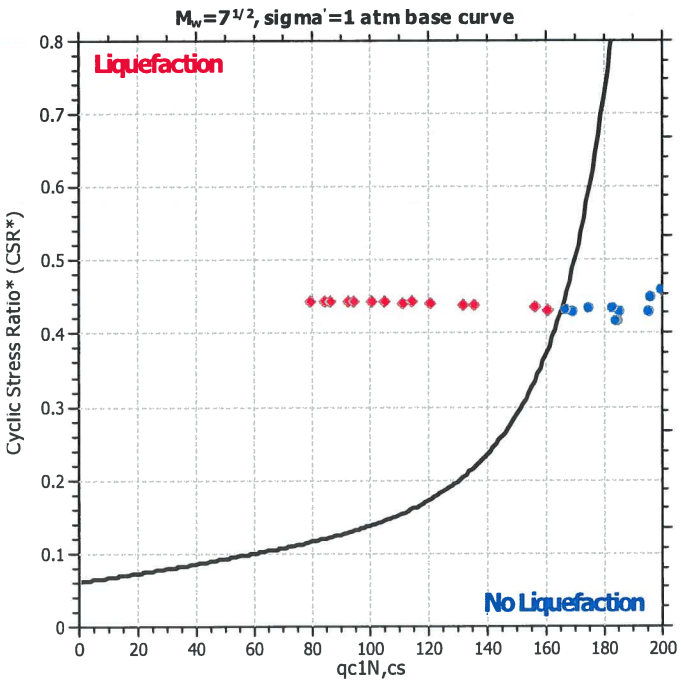
Project title : Bouquet Canyon **Location : Santa Clarita, California**

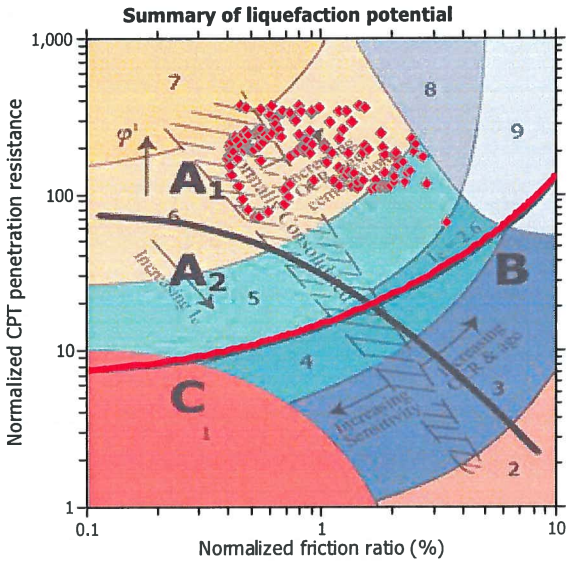
CPT file : CPT-5A

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	90.00 ft	Use fill:	Yes	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	47.00 ft	Fill height:	37.00 ft	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	120.00 lb/ft³	Limit depth:	N/A
Earthquake magnitude M_w:	6.85	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.63	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

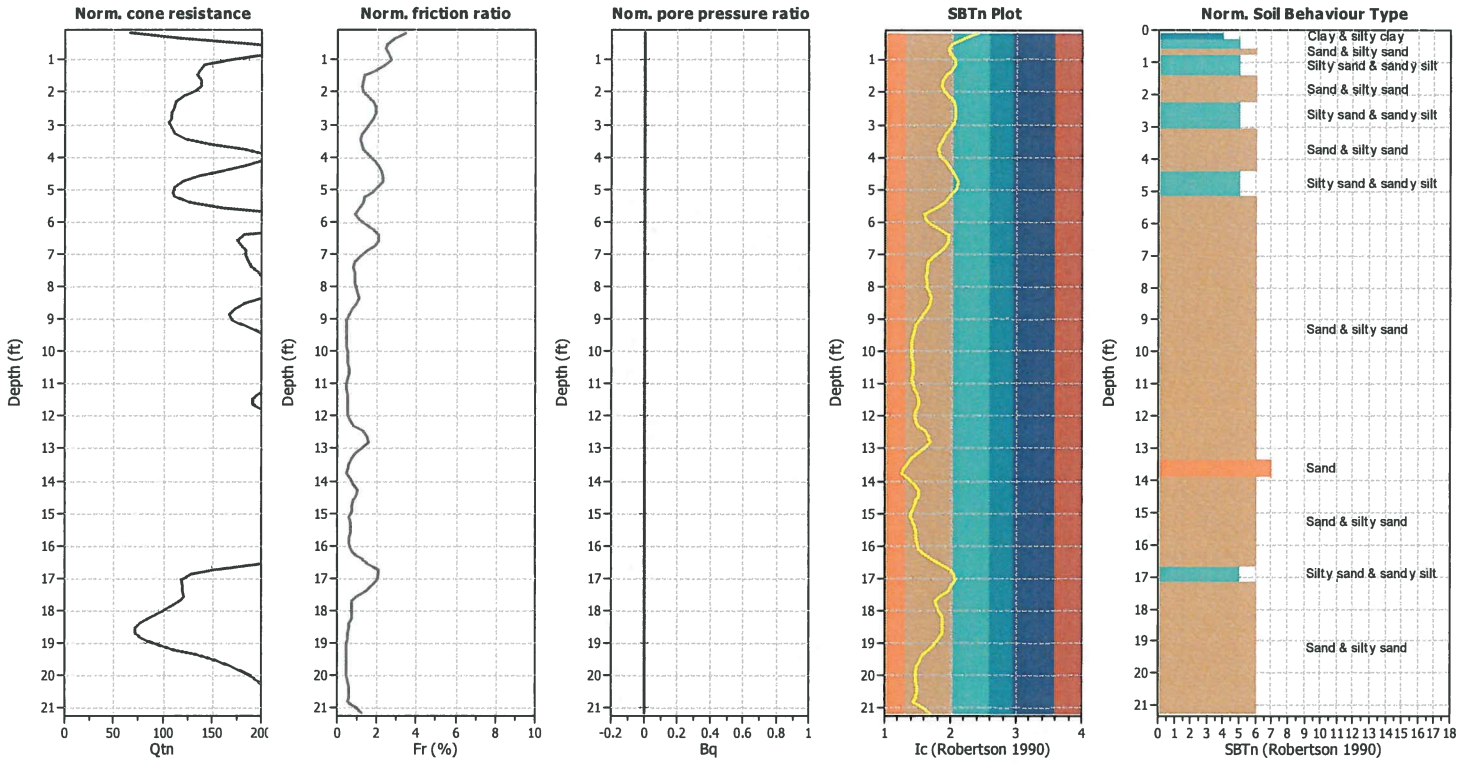






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots (normalized)



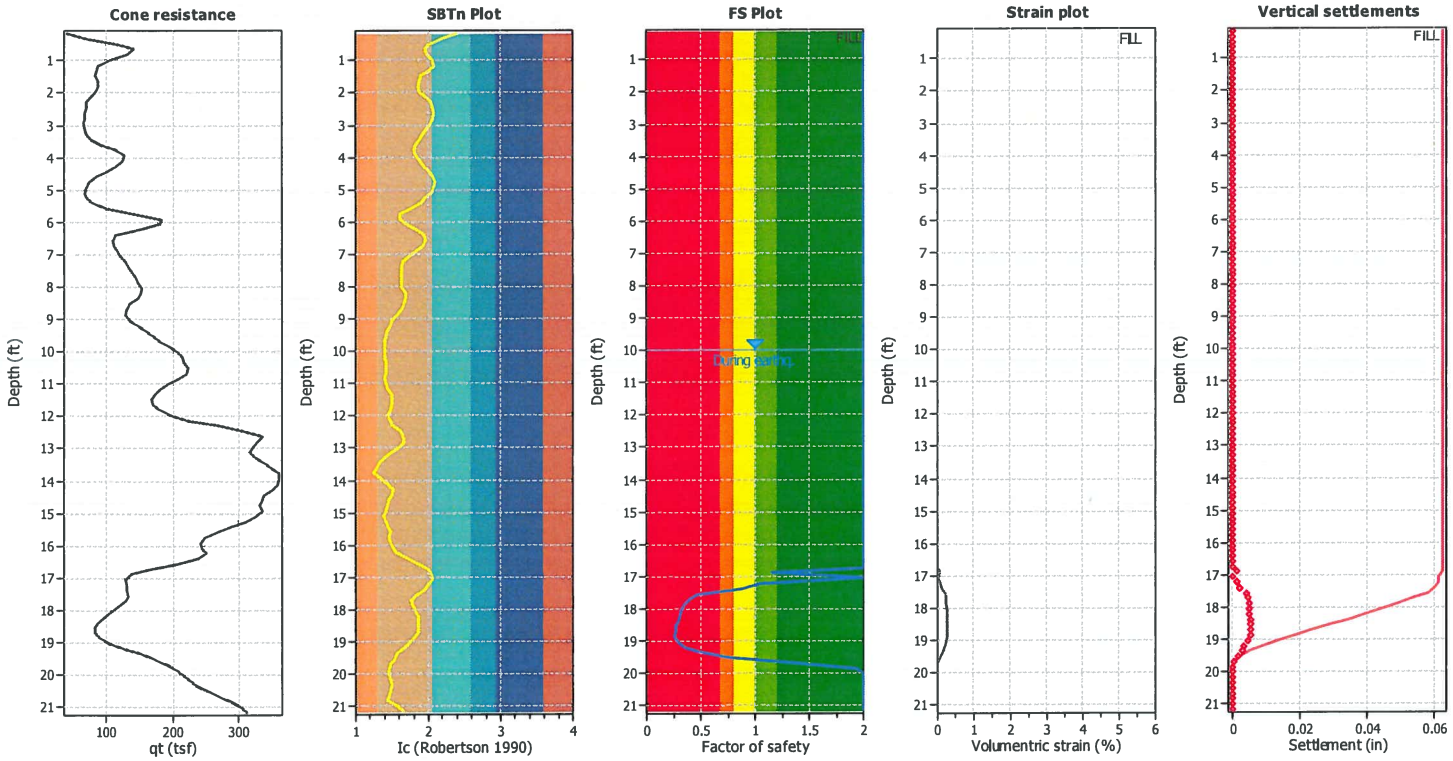
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	47.00 ft	Fill weight:	120.00 lb/ft³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.85	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.63	Use fill:	Yes	Limit depth applied:	No
Depth to water table (insitu):	90.00 ft	Fill height:	37.00 ft	Limit depth:	N/A

SBTn legend

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

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
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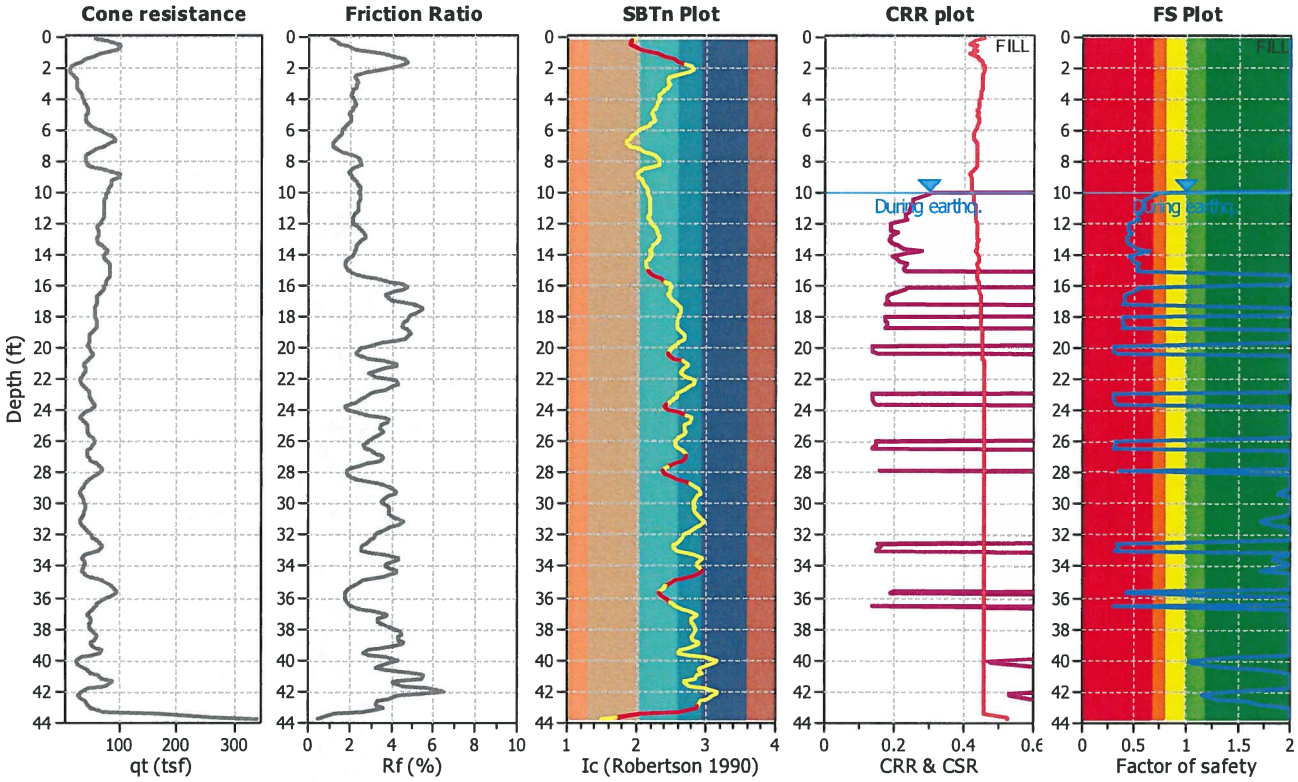
LIQUEFACTION ANALYSIS REPORT

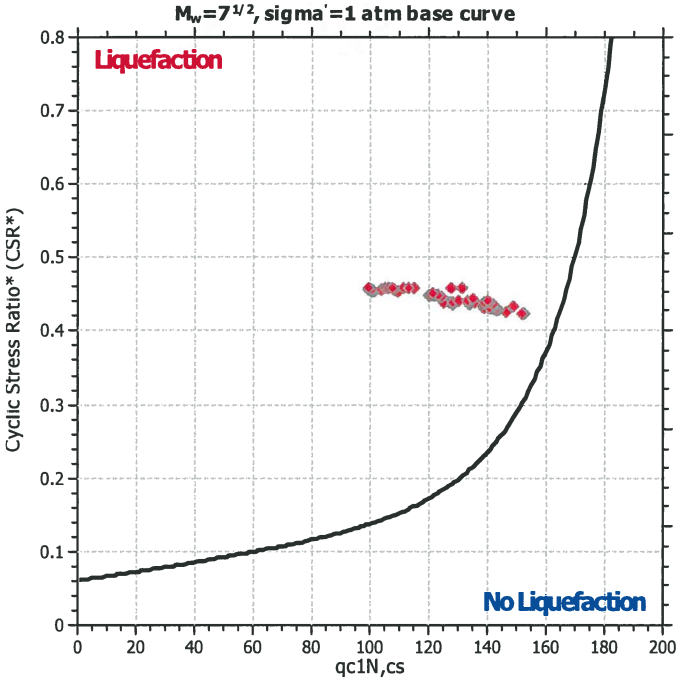
Project title : Bouquet Canyon **Location : Santa Clarita, California**

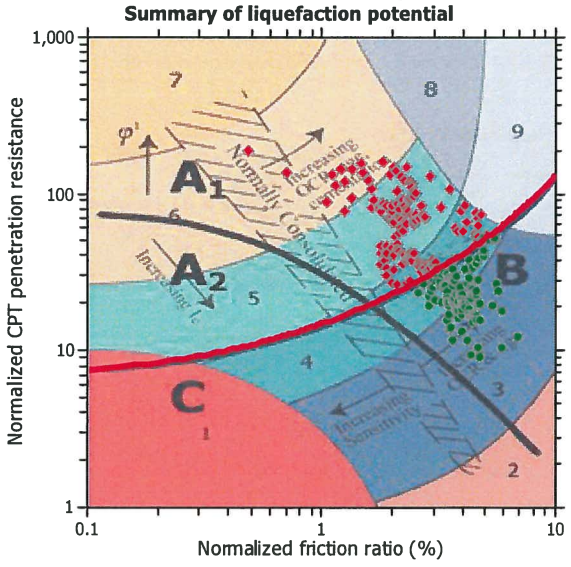
CPT file : CPT-6

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	90.00 ft	Use fill:	Yes	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	44.00 ft	Fill height:	34.00 ft	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	120.00 lb/ft³	Limit depth:	N/A
Earthquake magnitude M_w:	6.85	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.63	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

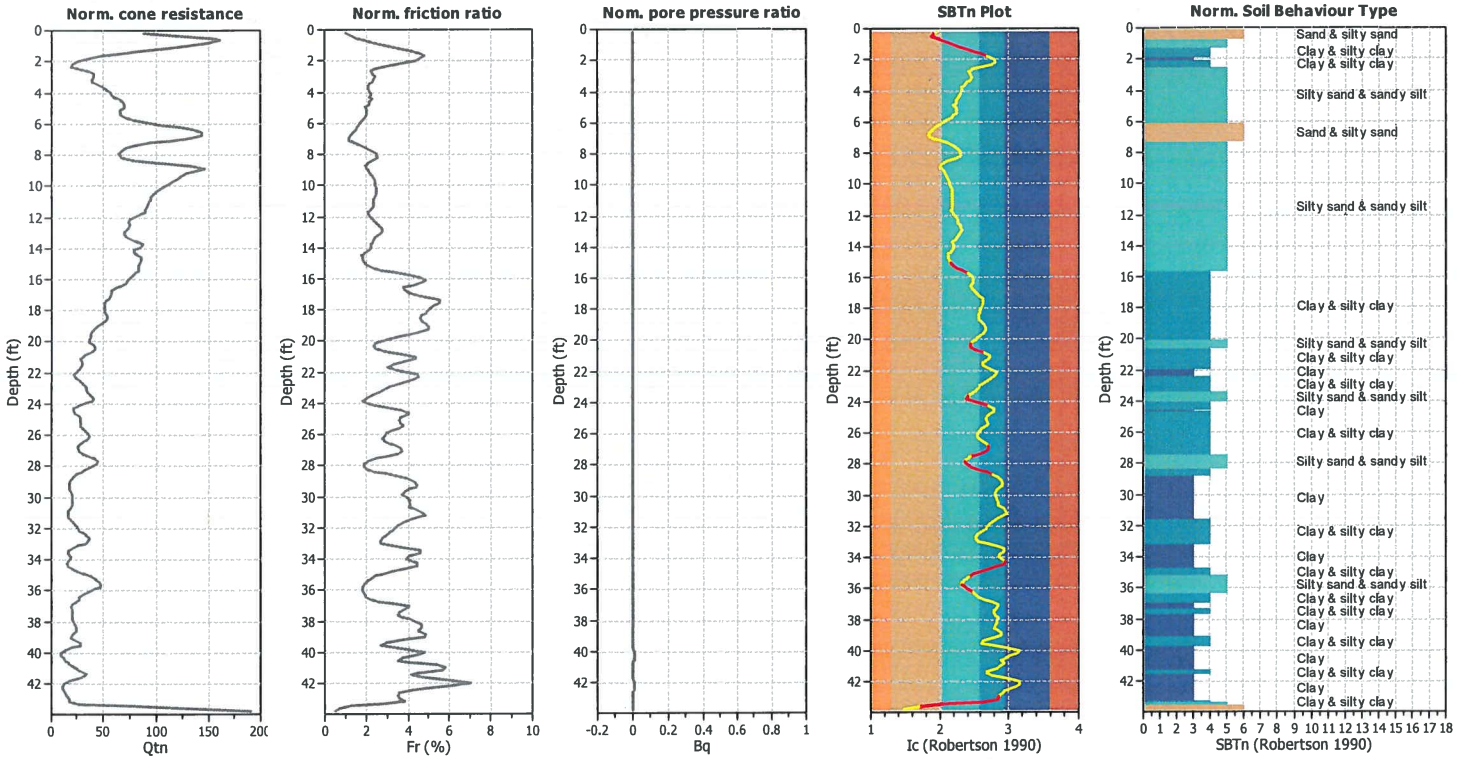






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots (normalized)



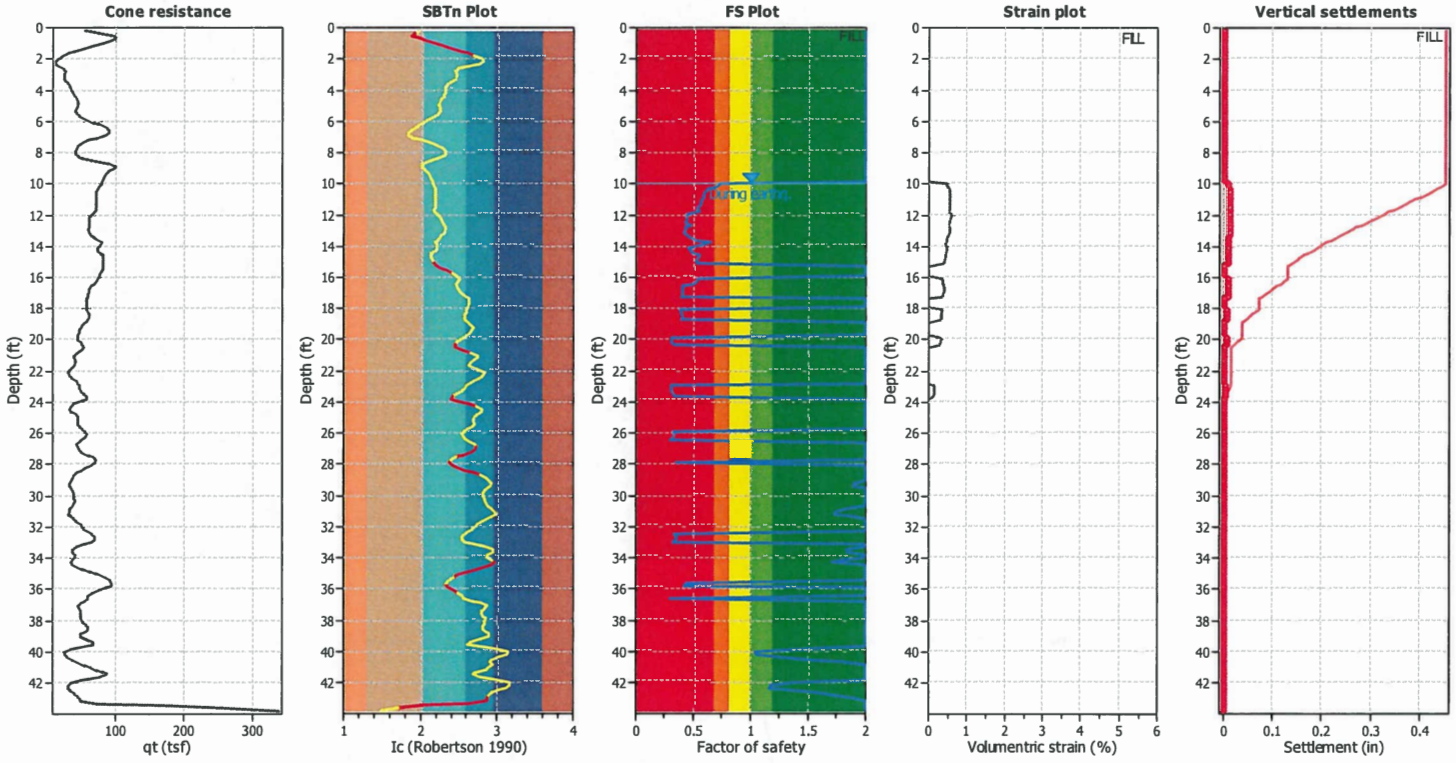
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	44.00 ft	Fill weight:	120.00 lb/ft³		
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes		
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes		
Earthquake magnitude M_w:	6.85	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay		
Peak ground acceleration:	0.63	Use fill:	Yes	Limit depth applied:	No		
Depth to water table (insitu):	90.00 ft	Fill height:	34.00 ft	Limit depth:	N/A		

SBTn legend

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

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_t corrected for pore water effects)
I_c:	Soil Behaviour Type Index
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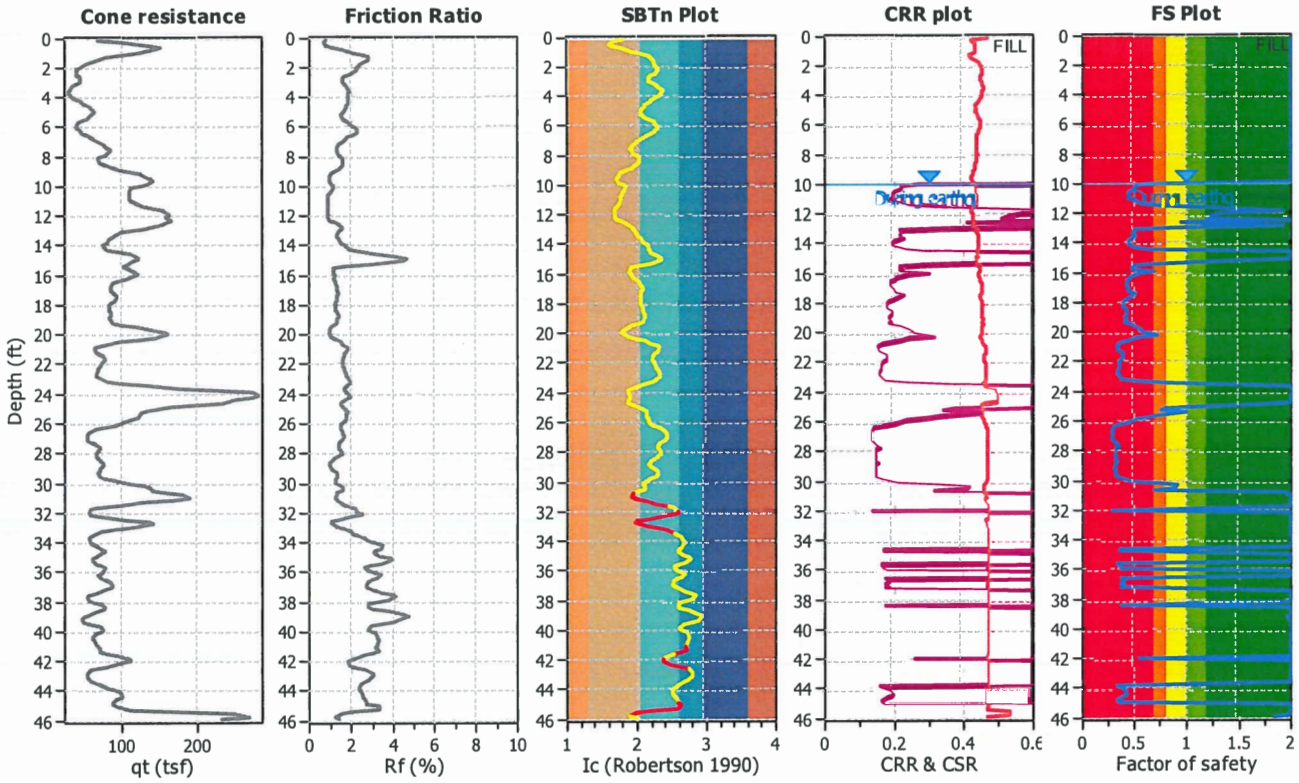
LIQUEFACTION ANALYSIS REPORT

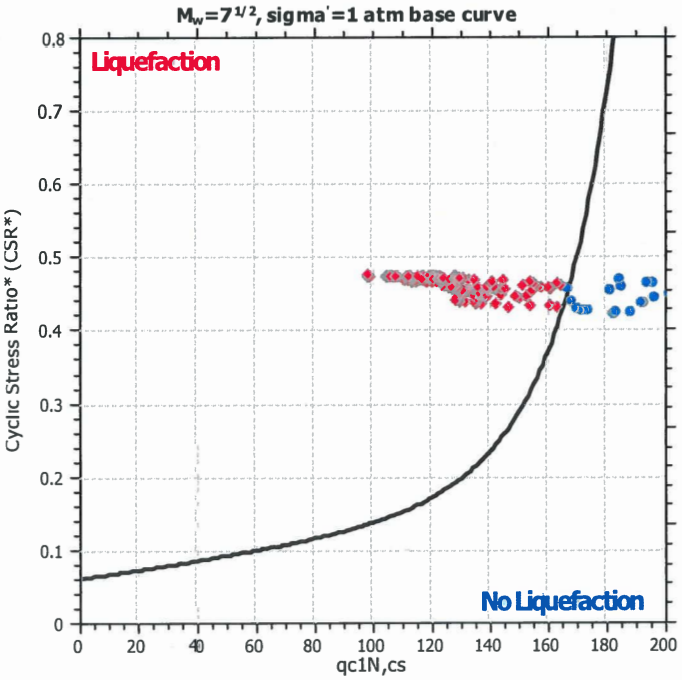
Project title : Bouquet Canyon **Location : Santa Clarita, California**

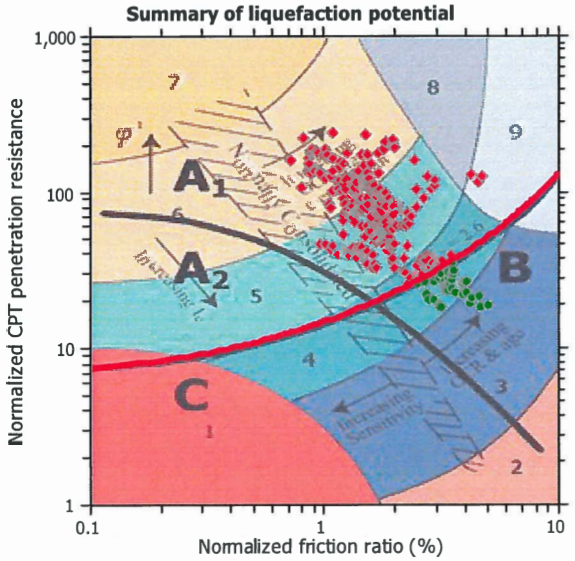
CPT file : CPT-7

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	75.00 ft	Use fill:	Yes	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	40.00 ft	Fill height:	30.00 ft	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	120.00 lb/ft³	Limit depth:	N/A
Earthquake magnitude M_w:	6.85	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.63	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

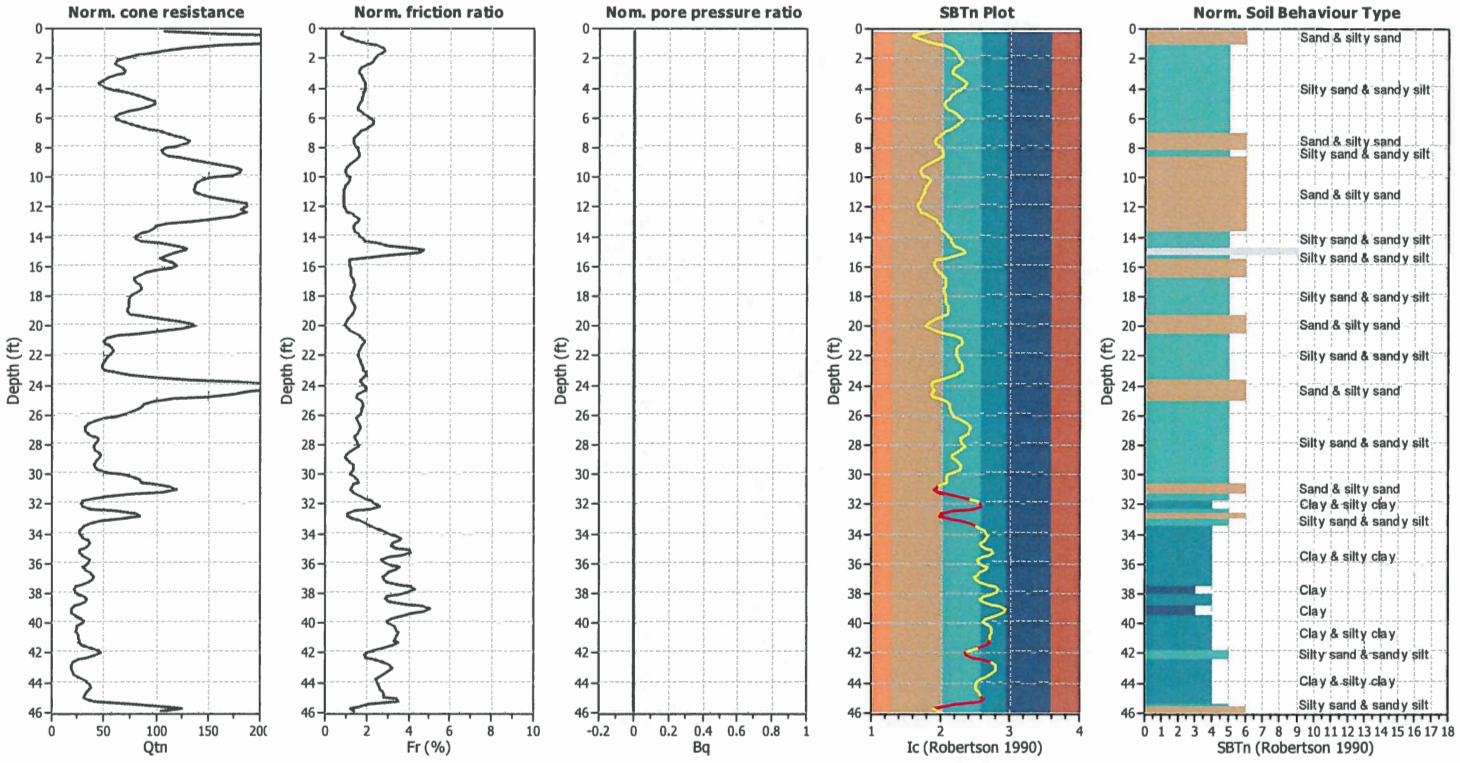






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely ,check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots (normalized)



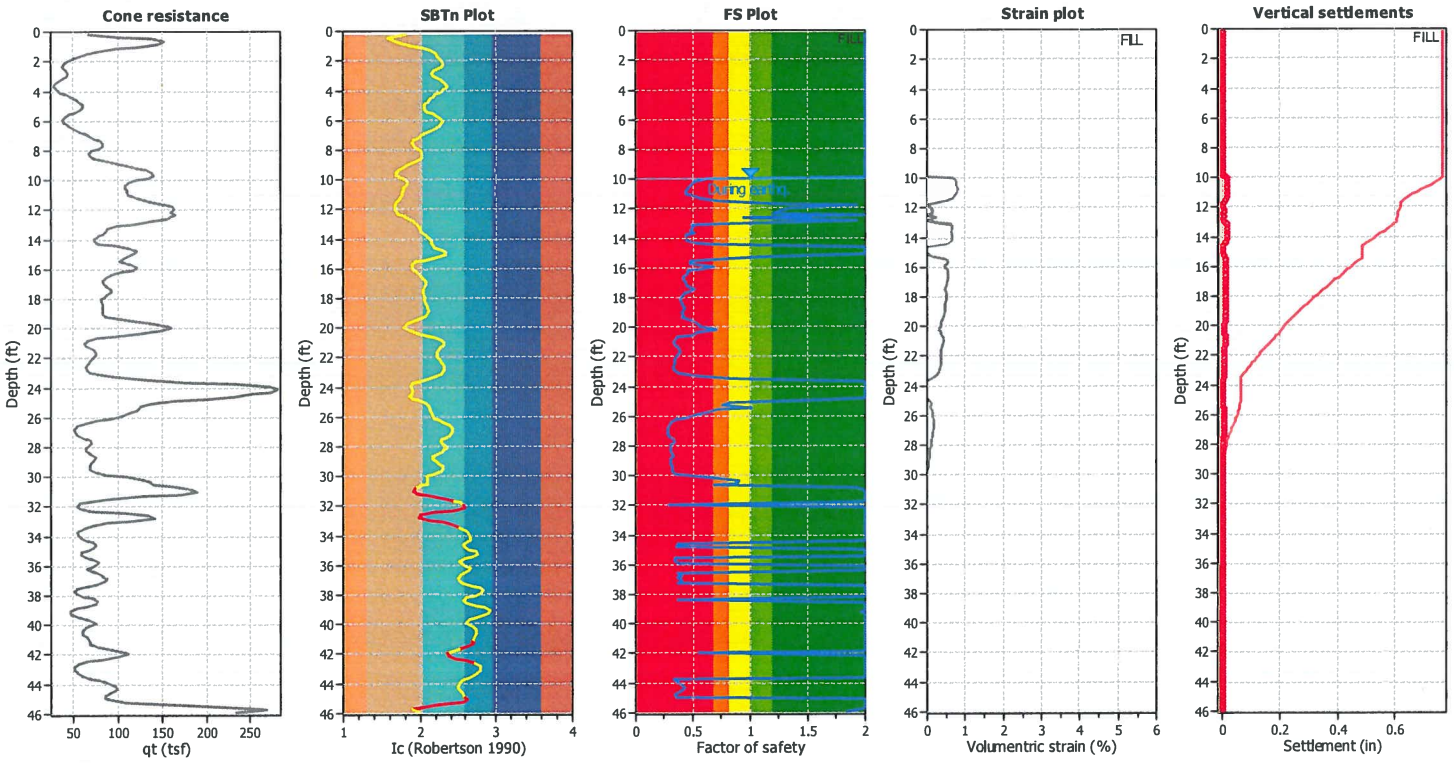
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	40.00 ft	Fill weight:	120.00 lb/ft³		
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes		
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes		
Earthquake magnitude M_w:	6.85	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay		
Peak ground acceleration:	0.63	Use fill:	Yes	Limit depth applied:	No		
Depth to water table (insitu):	75.00 ft	Fill height:	30.00 ft	Limit depth:	N/A		

SBTn legend

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

Estimation of post-earthquake settlements



Abbreviations

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

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http://www.petra-inc.com/

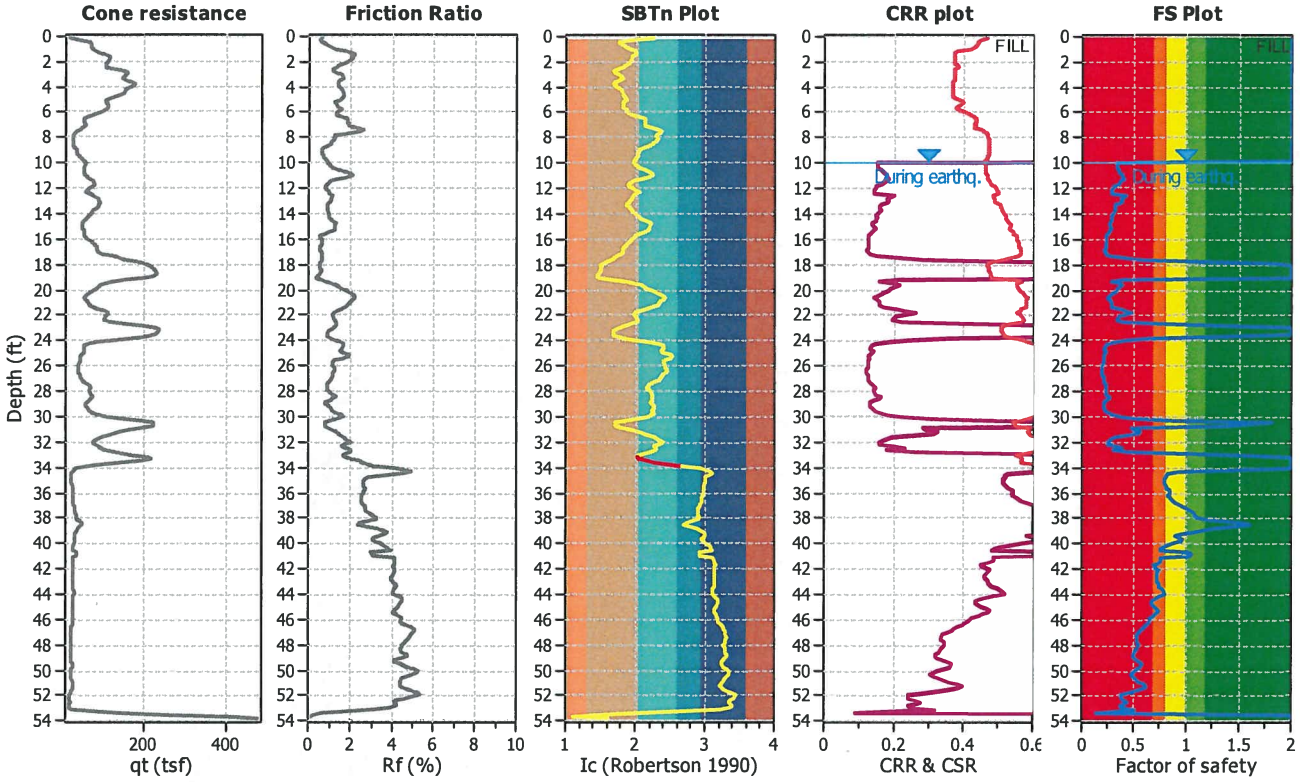
LIQUEFACTION ANALYSIS REPORT

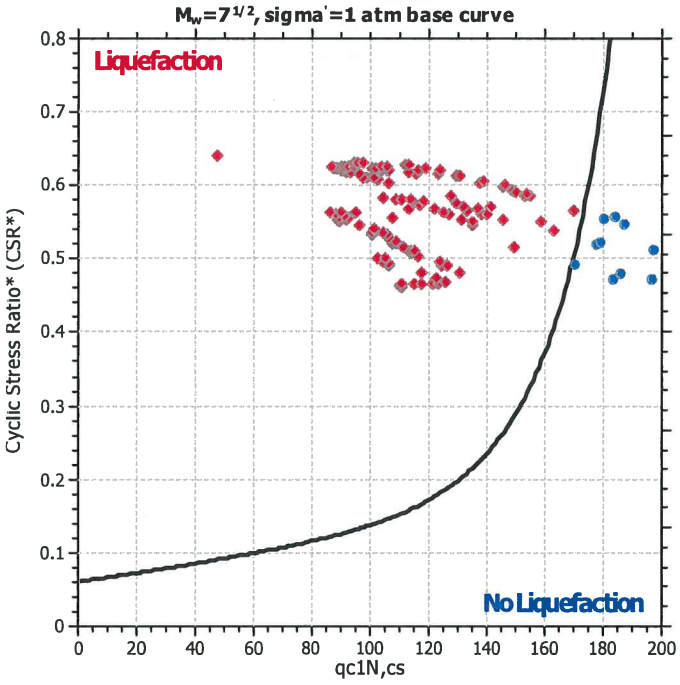
Project title : Bouquet Canyon **Location : Santa Clarita, California**

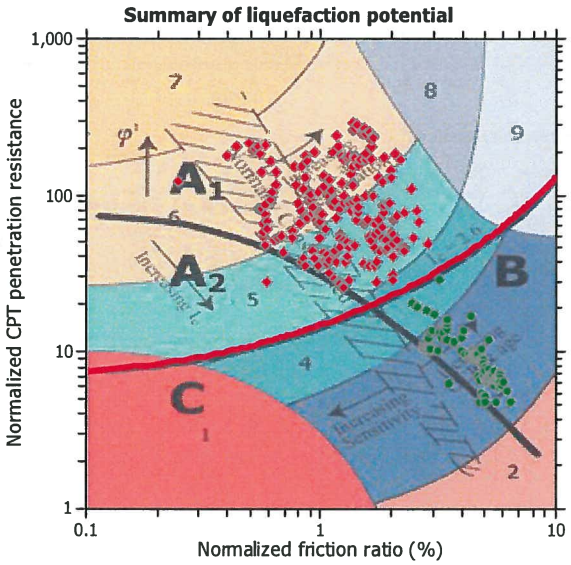
CPT file : CPT-P1

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	60.00 ft	Use fill:	Yes	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	14.00 ft	Fill height:	4.00 ft	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	120.00 lb/ft³	Limit depth:	N/A
Earthquake magnitude M_w:	6.85	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.63	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

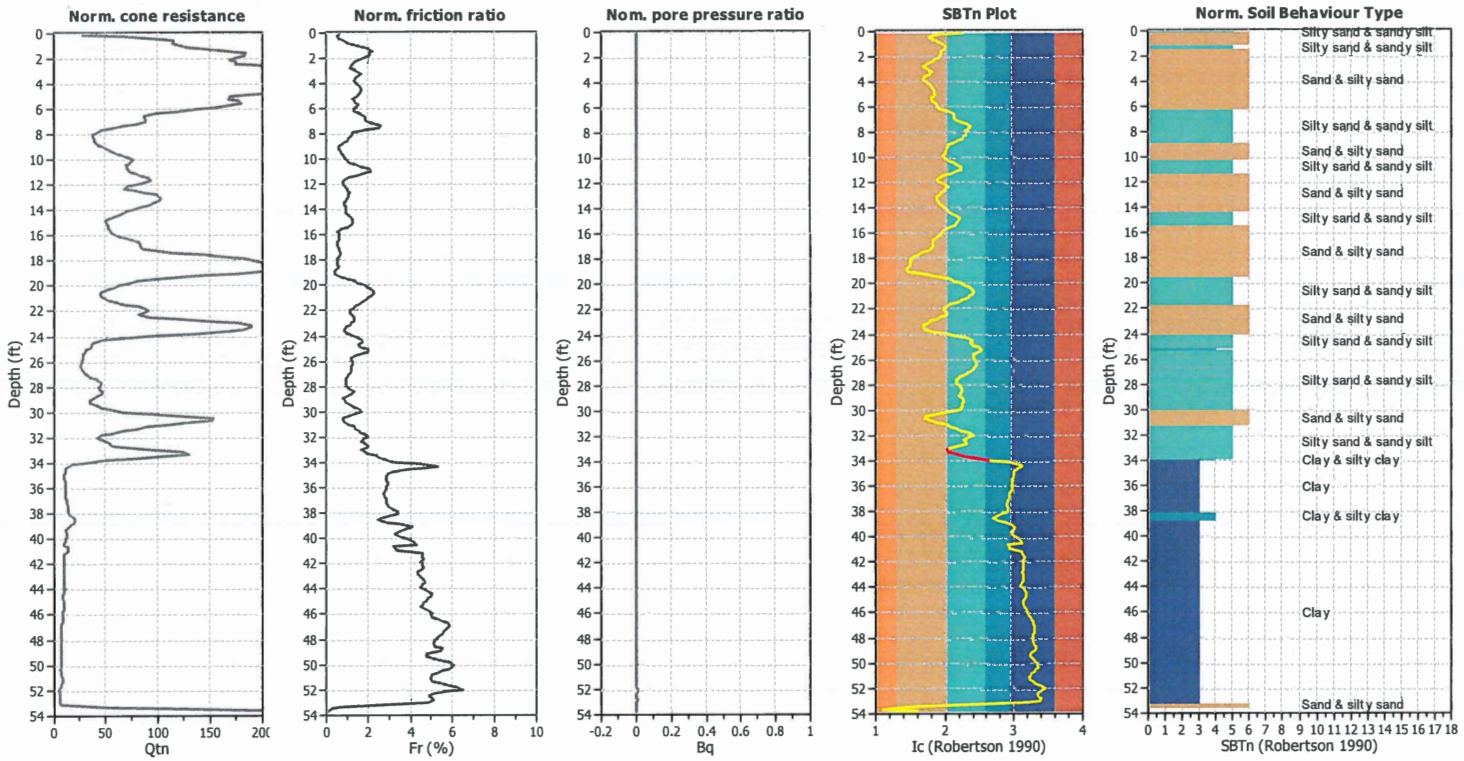






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots (normalized)



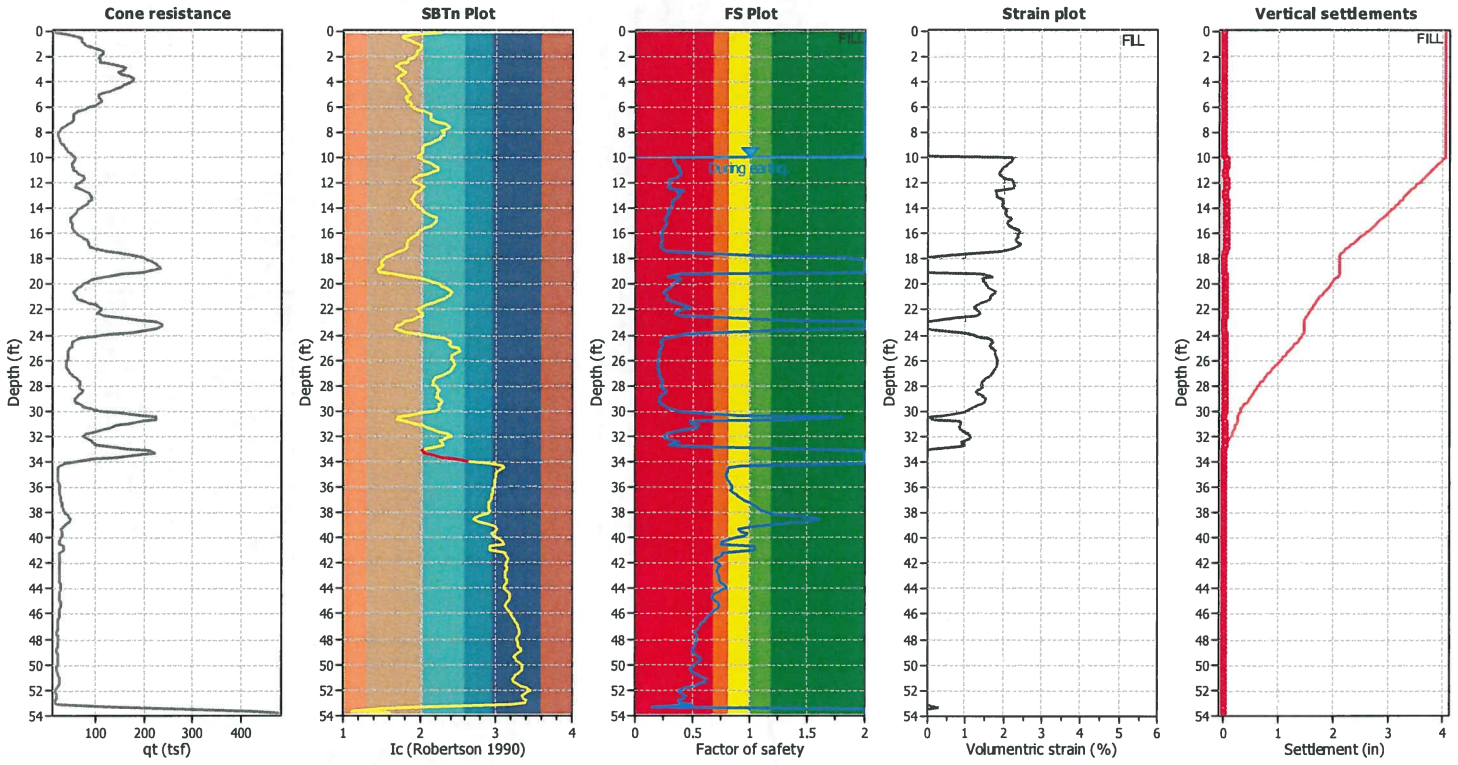
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	14.00 ft	Fill weight:	120.00 lb/ft³		
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes		
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes		
Earthquake magnitude M_w:	6.85	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay		
Peak ground acceleration:	0.63	Use fill:	Yes	Limit depth applied:	No		
Depth to water table (insitu):	60.00 ft	Fill height:	4.00 ft	Limit depth:	N/A		

SBTn legend

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

Estimation of post-earthquake settlements



Abbreviations

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

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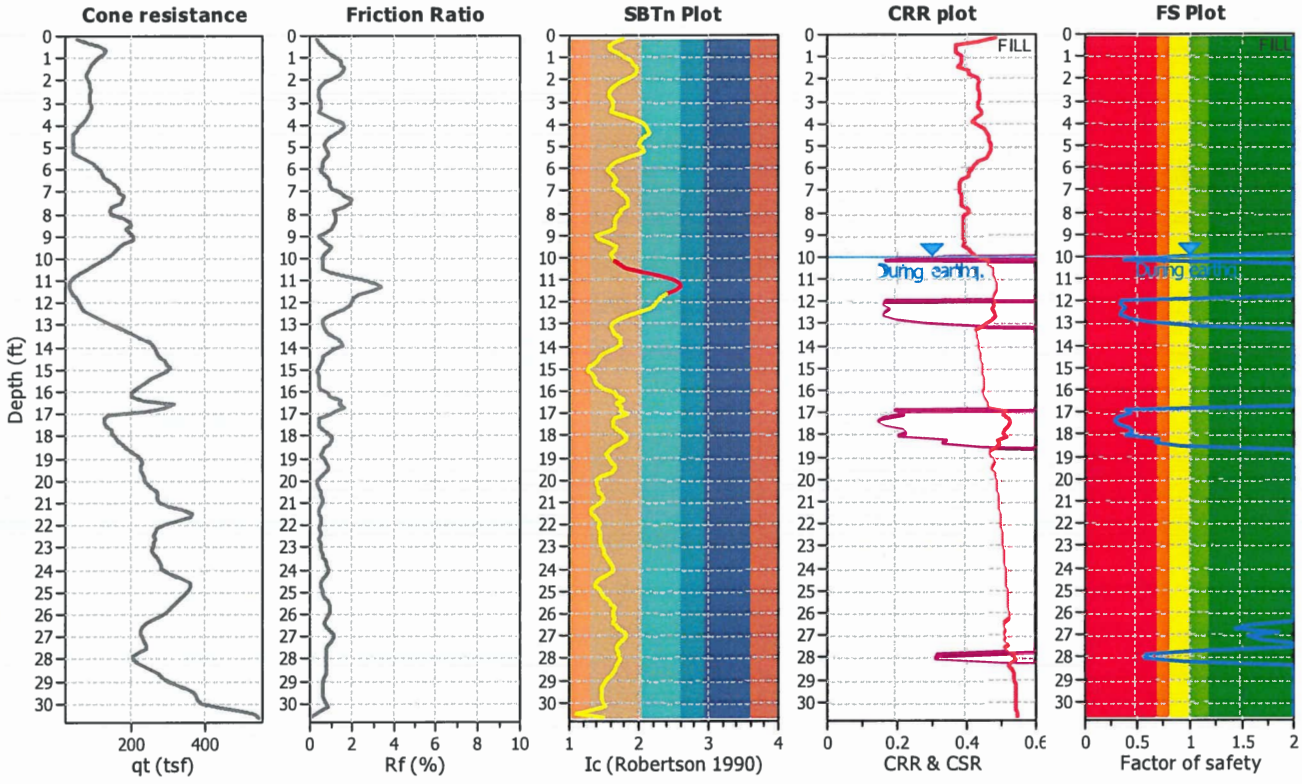
LIQUEFACTION ANALYSIS REPORT

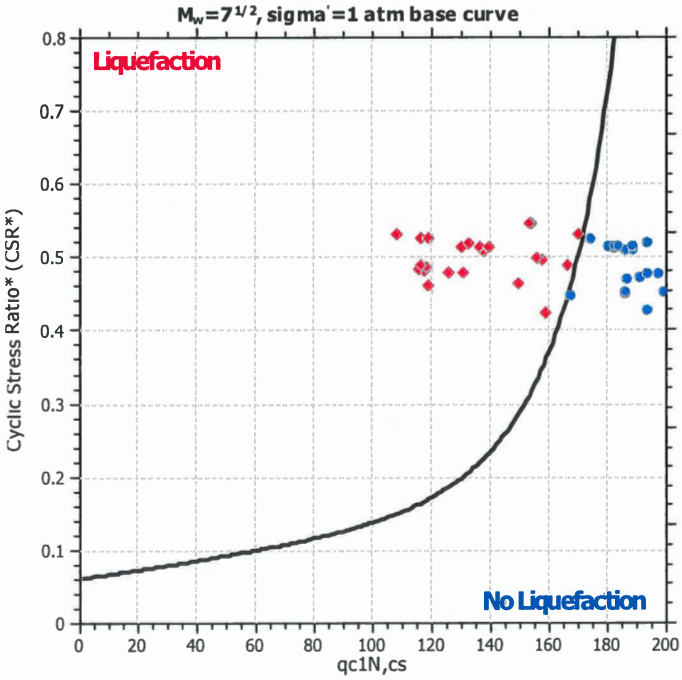
Project title : Bouquet Canyon **Location : Santa Clarita, California**

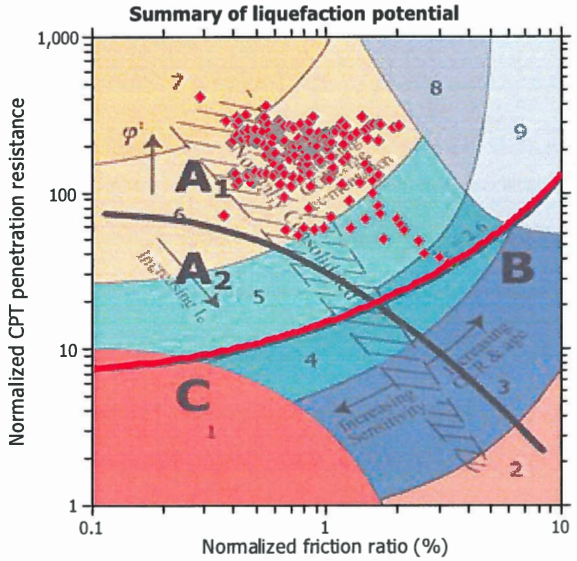
CPT file : CPT-P2

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	60.00 ft	Use fill:	Yes	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	19.00 ft	Fill height:	9.00 ft	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	120.00 lb/ft³	Limit depth:	N/A
Earthquake magnitude M_w:	6.85	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.63	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

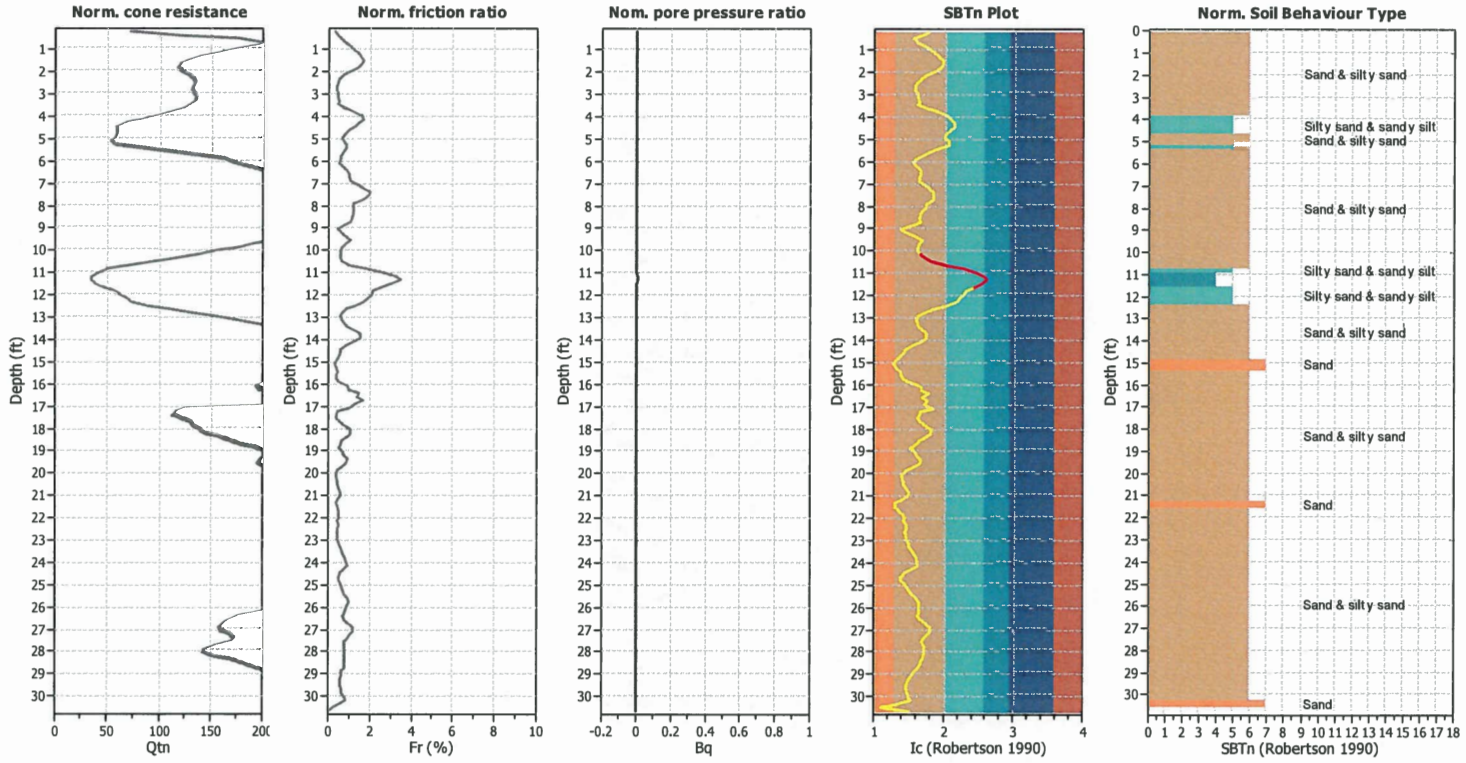






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots (normalized)



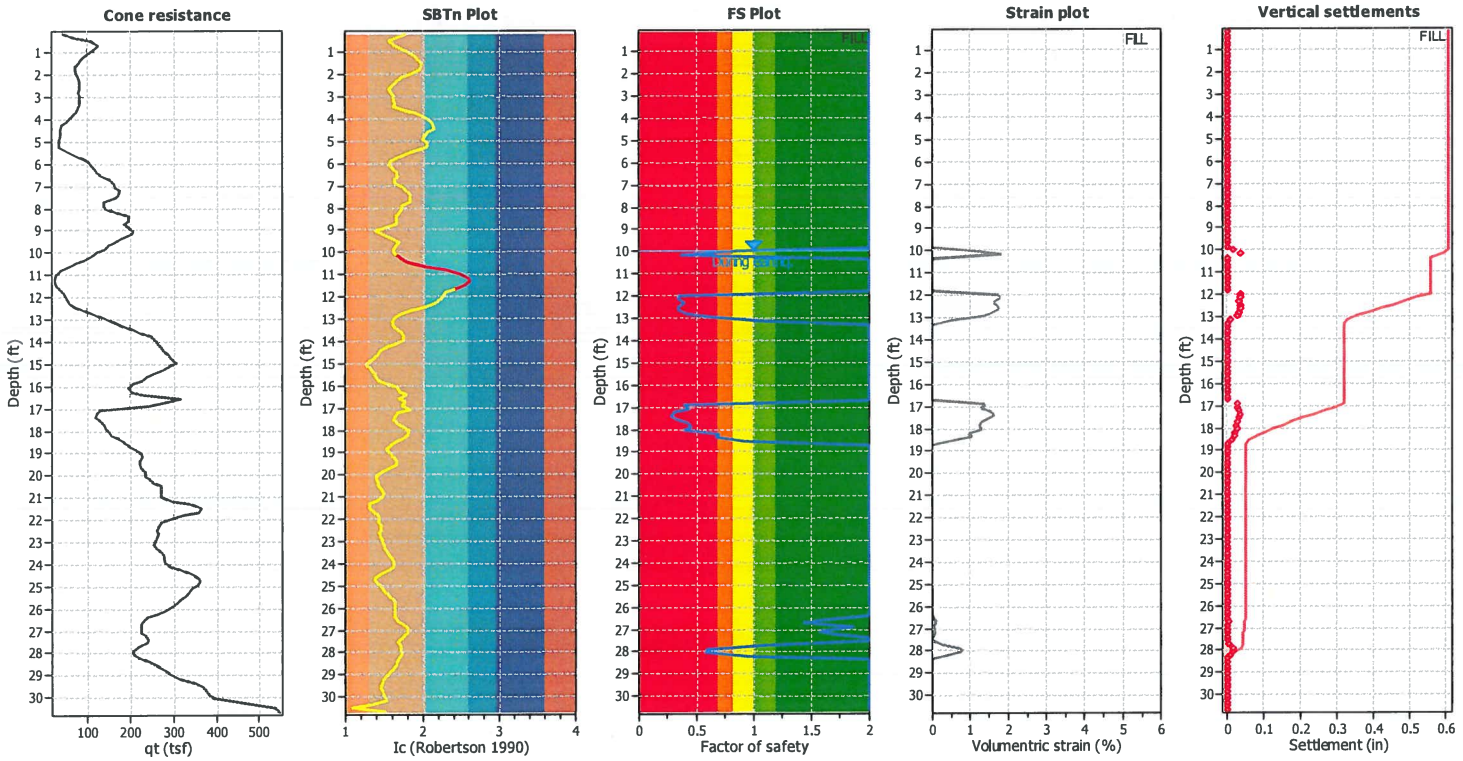
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	19.00 ft	Fill weight:	120.00 lb/ft³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.85	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.63	Use fill:	Yes	Limit depth applied:	No
Depth to water table (insitu):	60.00 ft	Fill height:	9.00 ft	Limit depth:	N/A

SBTn legend

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

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
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Volumentric strain:	Post-liquefaction volumentric strain

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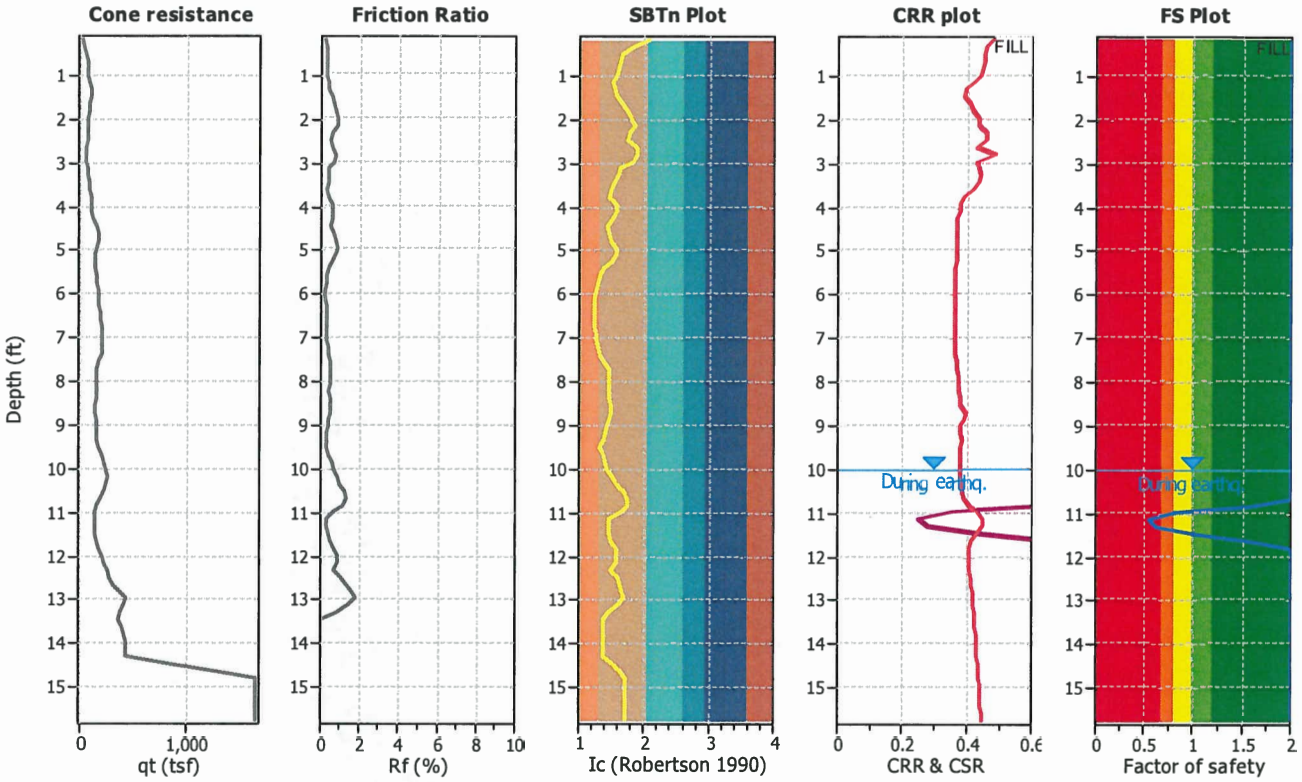
LIQUEFACTION ANALYSIS REPORT

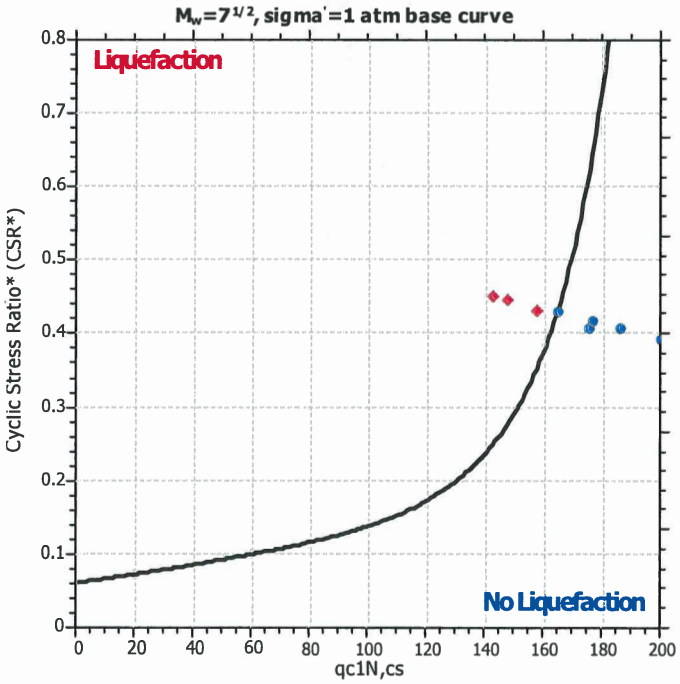
Project title : Bouquet Canyon **Location : Santa Clarita, California**

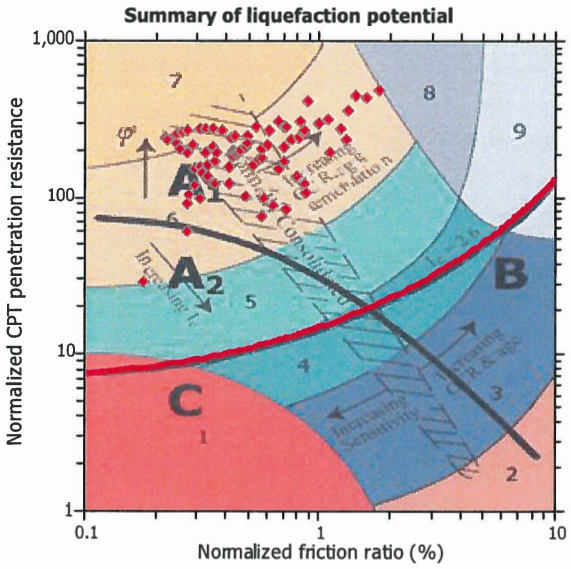
CPT file : CPT-P3

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	58.00 ft	Use fill:	Yes	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	16.00 ft	Fill height:	6.00 ft	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	120.00 lb/ft³	Limit depth:	N/A
Earthquake magnitude M_w:	6.85	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.63	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

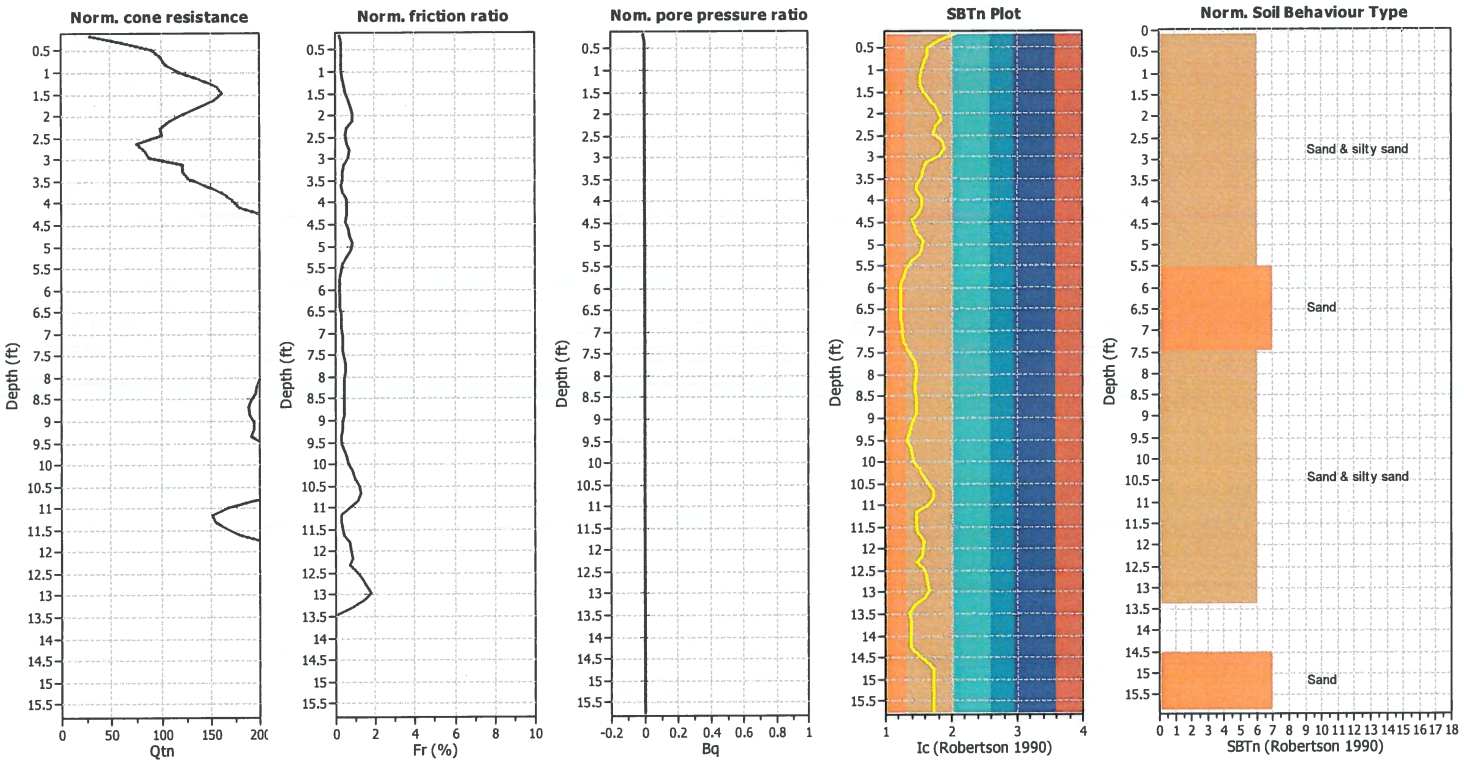






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots (normalized)



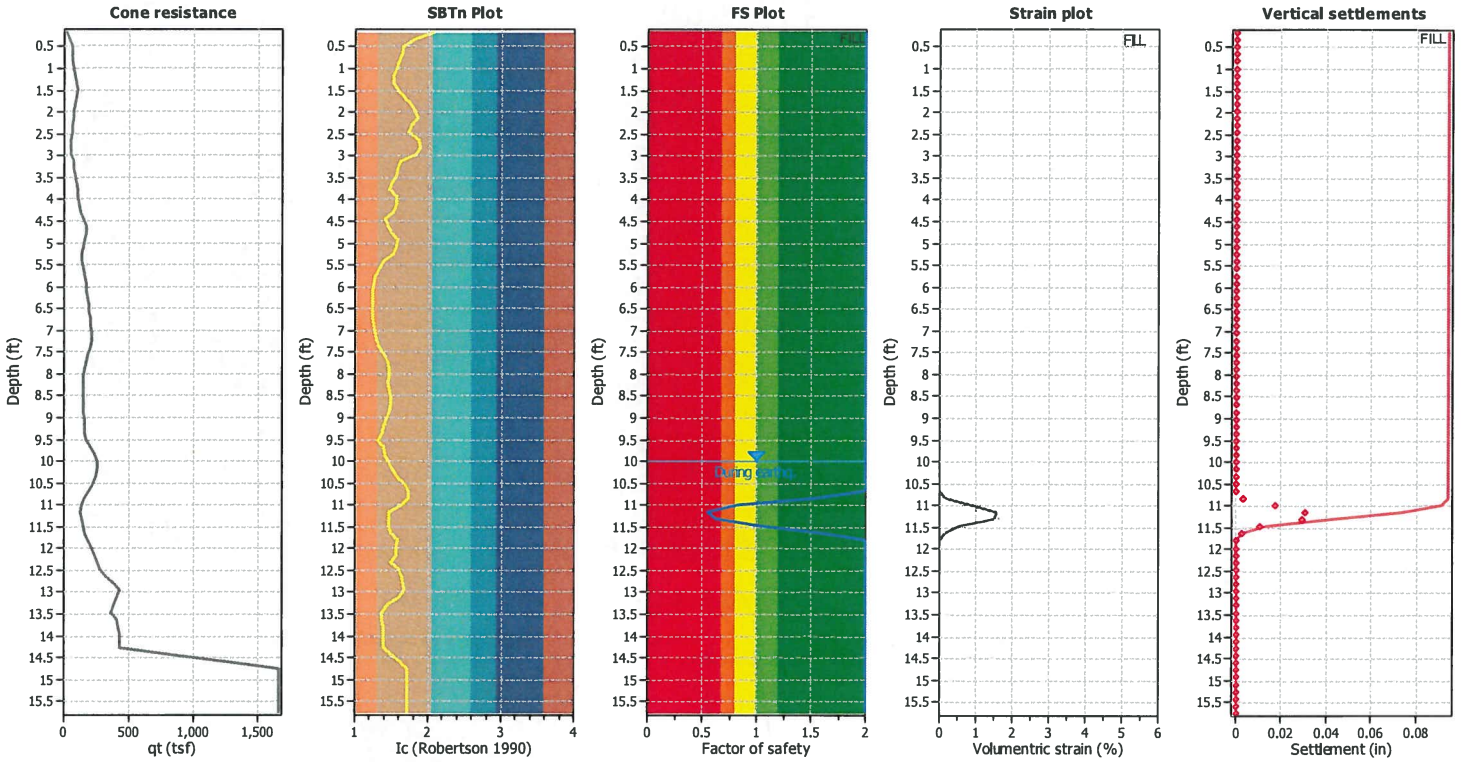
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	16.00 ft	Fill weight:	120.00 lb/ft³		
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes		
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes		
Earthquake magnitude M_w:	6.85	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay		
Peak ground acceleration:	0.63	Use fill:	Yes	Limit depth applied:	No		
Depth to water table (insitu):	58.00 ft	Fill height:	6.00 ft	Limit depth:	N/A		

SBTn legend

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

Estimation of post-earthquake settlements



Abbreviations

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

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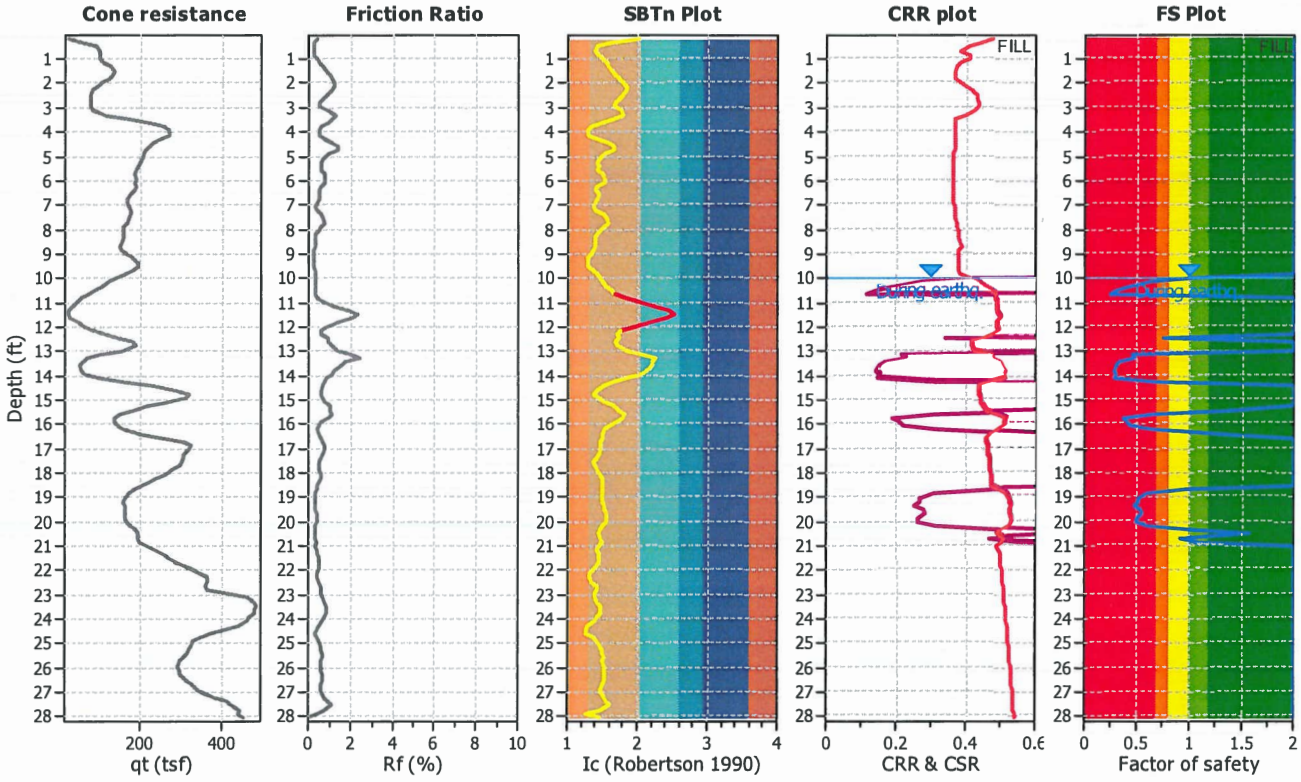
LIQUEFACTION ANALYSIS REPORT

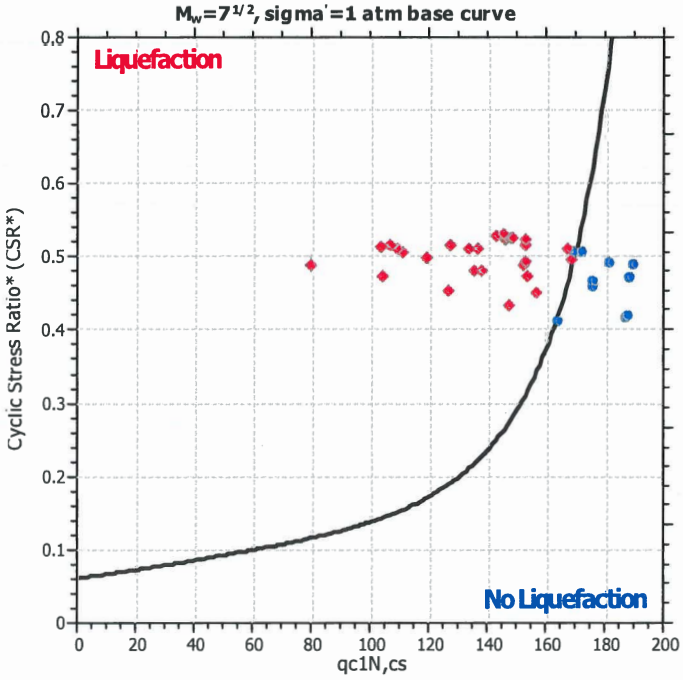
Project title : Bouquet Canyon **Location : Santa Clarita, California**

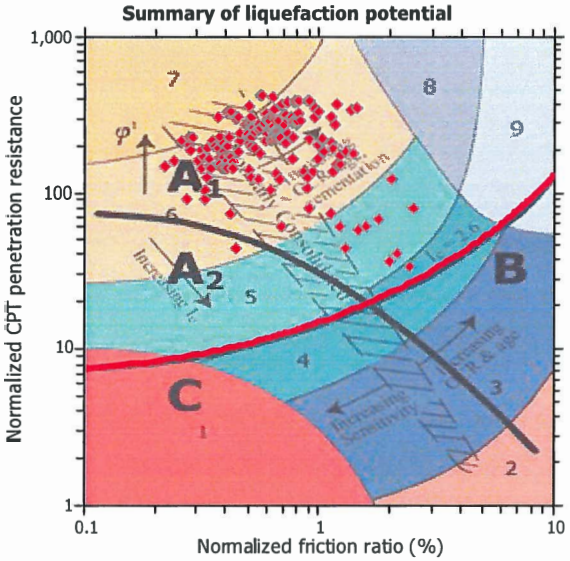
CPT file : CPT-P3B

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	58.00 ft	Use fill:	Yes	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	16.00 ft	Fill height:	6.00 ft	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	120.00 lb/ft³	Limit depth:	N/A
Earthquake magnitude M_w:	6.85	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.63	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

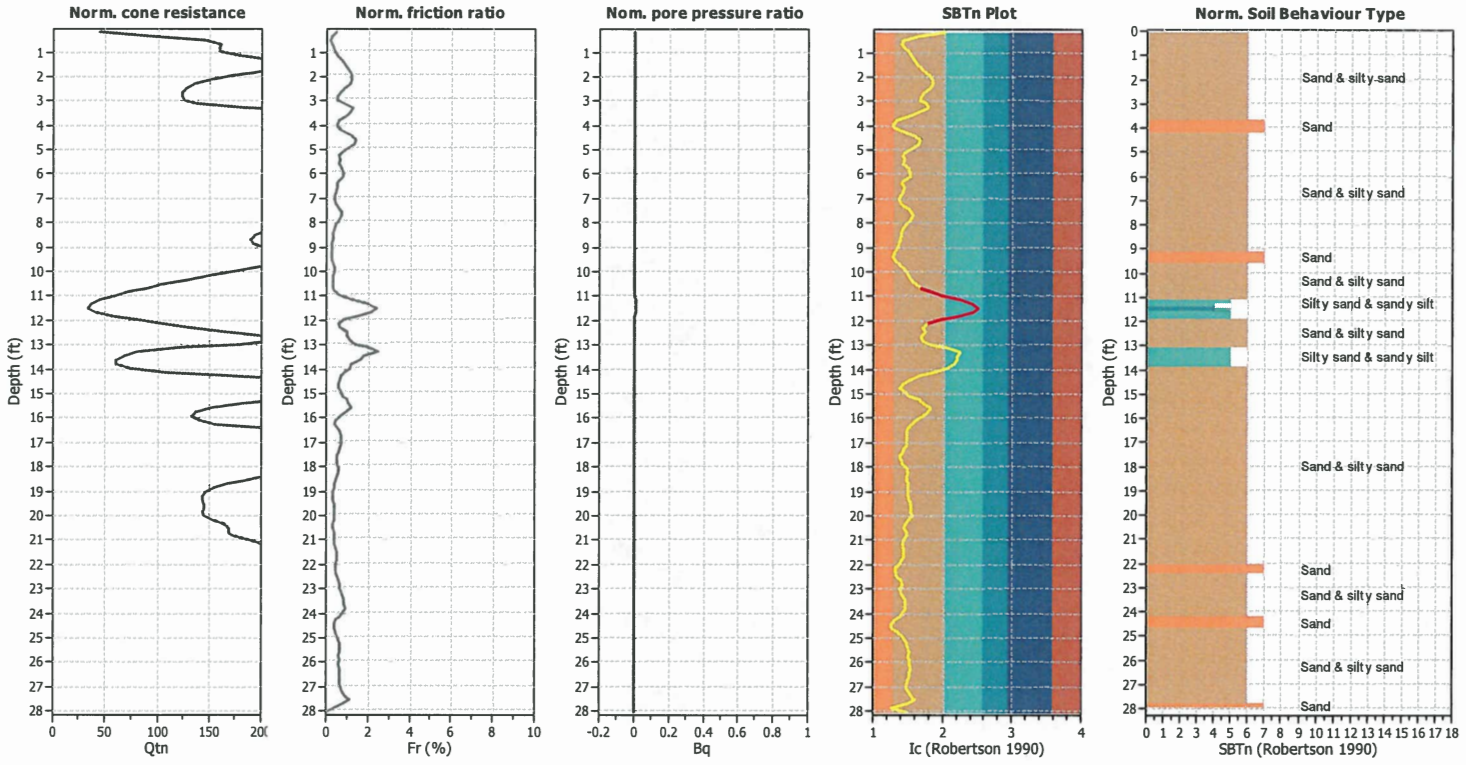






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots (normalized)



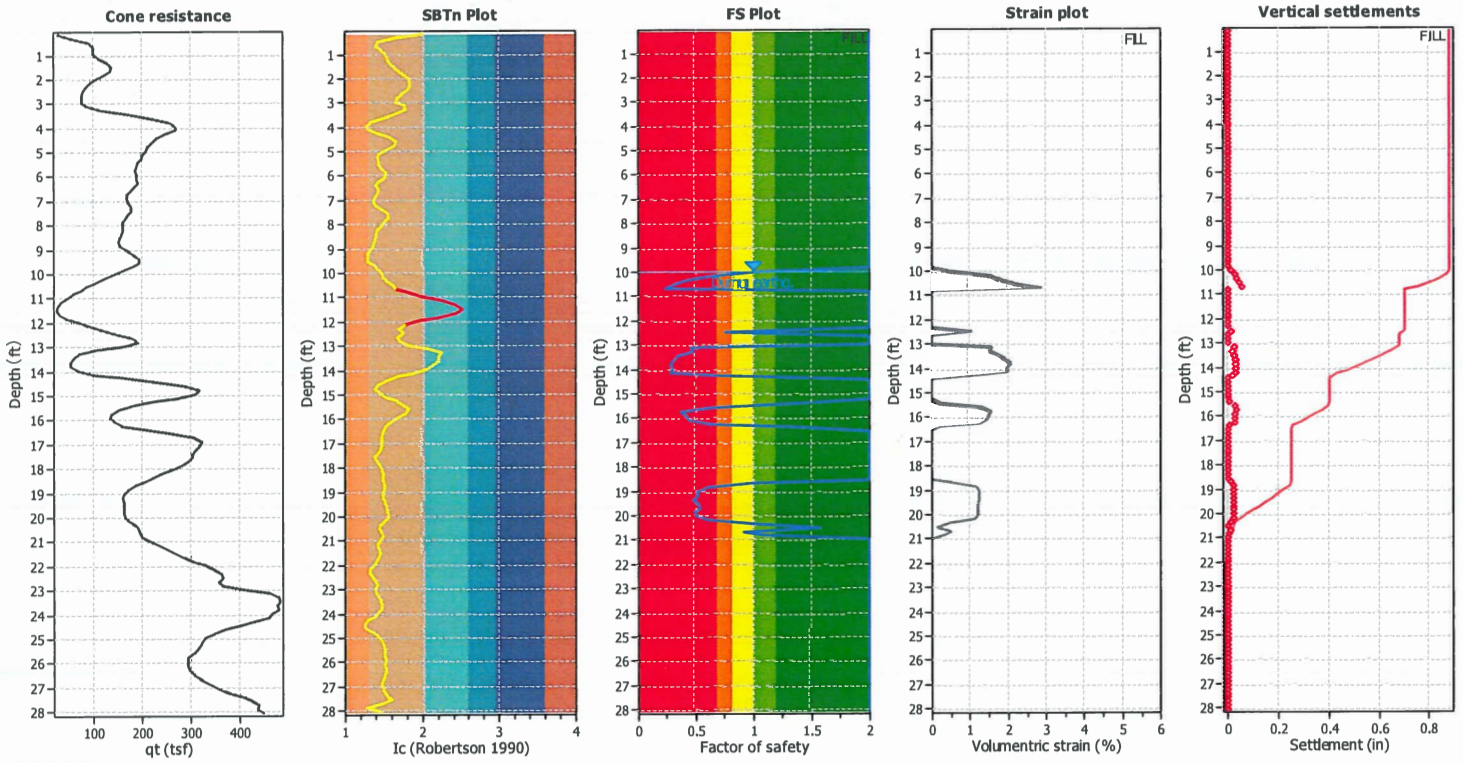
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	16.00 ft	Fill weight:	120.00 lb/ft³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.85	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.63	Use fill:	Yes	Limit depth applied:	No
Depth to water table (insitu):	58.00 ft	Fill height:	6.00 ft	Limit depth:	N/A

SBTn legend

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

Estimation of post-earthquake settlements



Abbreviations

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

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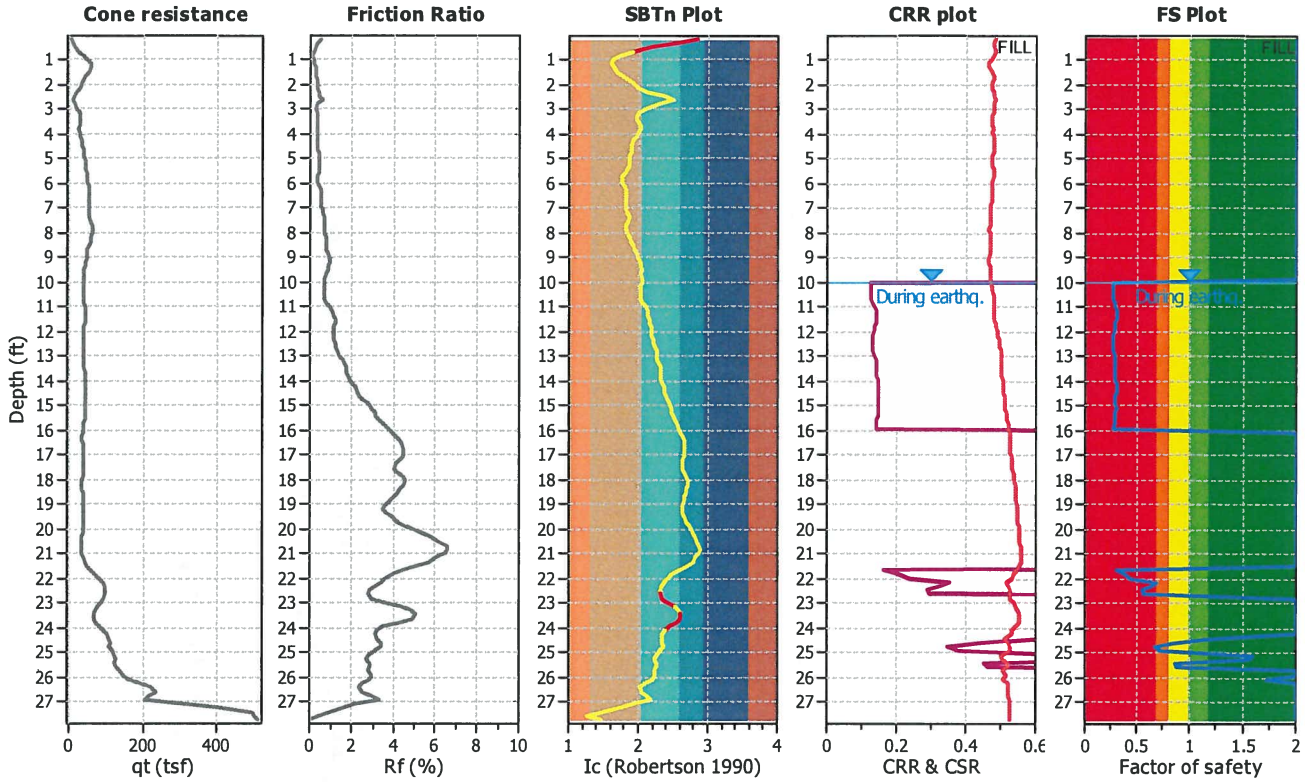
LIQUEFACTION ANALYSIS REPORT

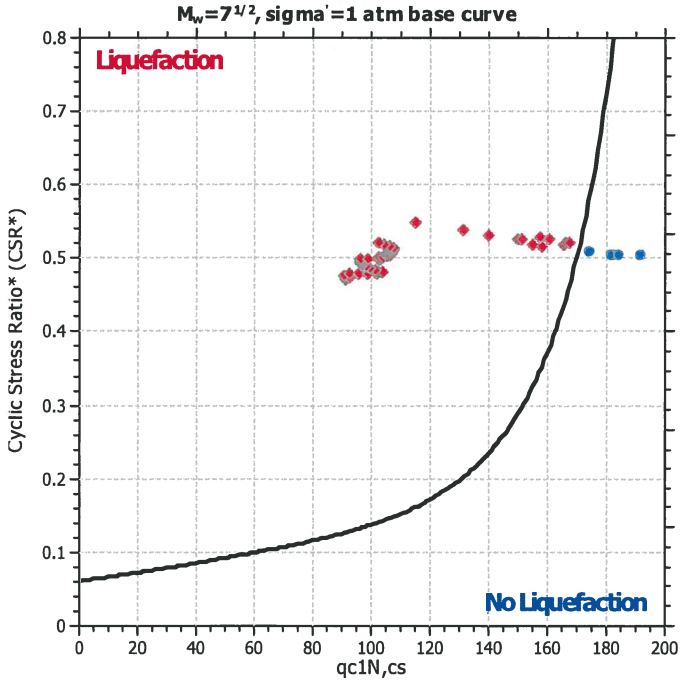
Project title : Bouquet Canyon **Location : Santa Clarita, California**

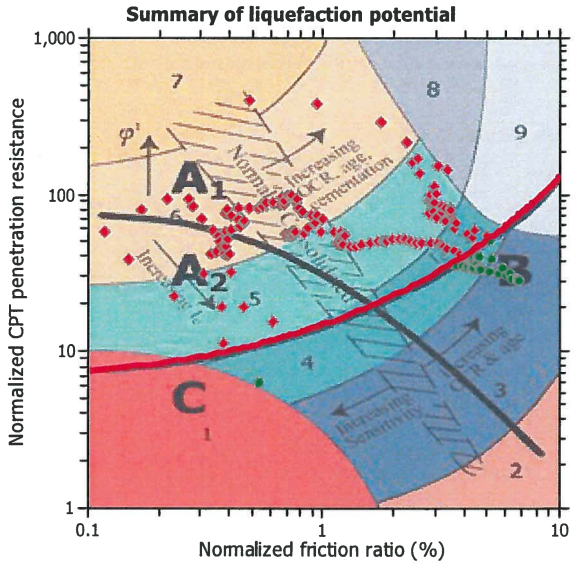
CPT file : CPT-P4

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	50.00 ft	Use fill:	Yes	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	20.00 ft	Fill height:	10.00 ft	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	120.00 lb/ft³	Limit depth:	N/A
Earthquake magnitude M_w:	6.85	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.63	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

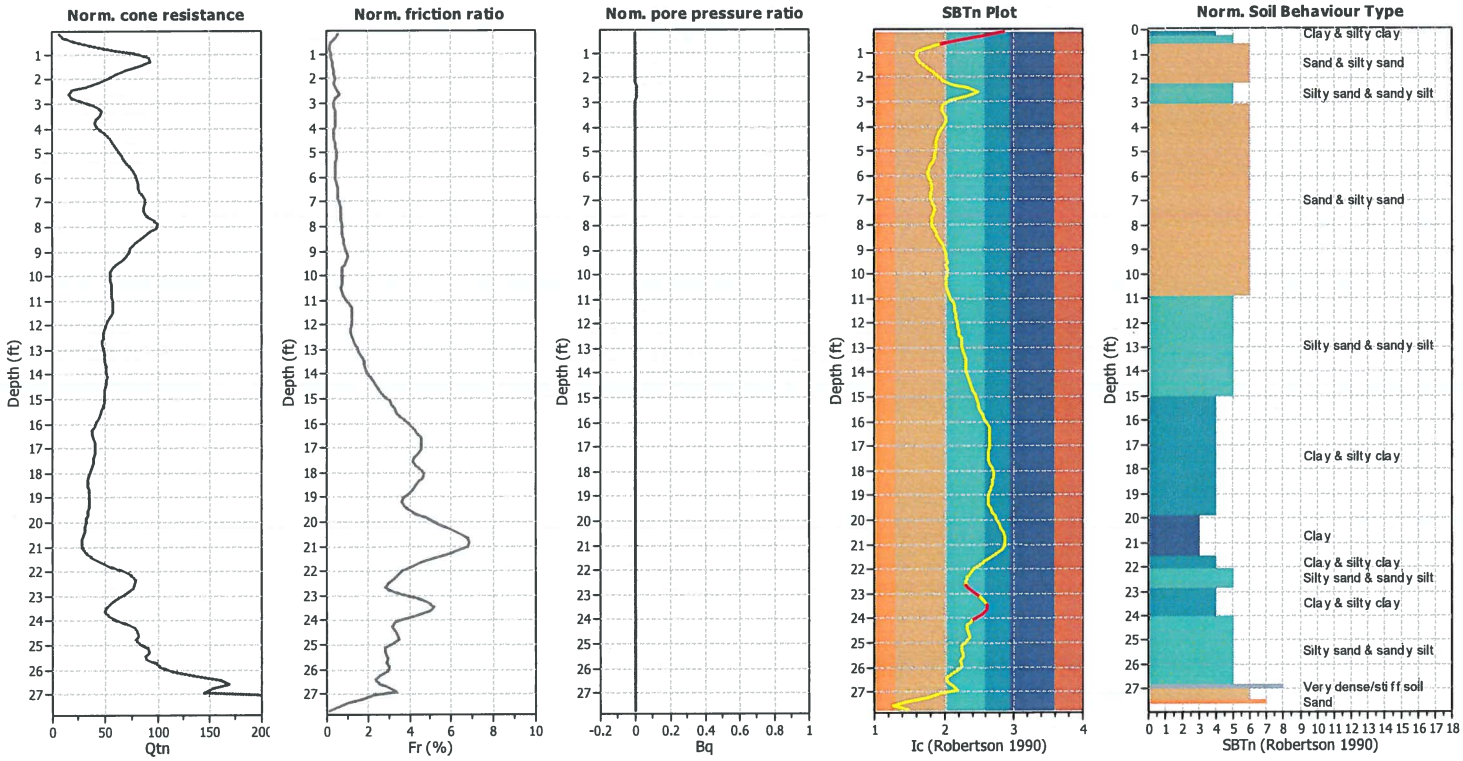






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots (normalized)



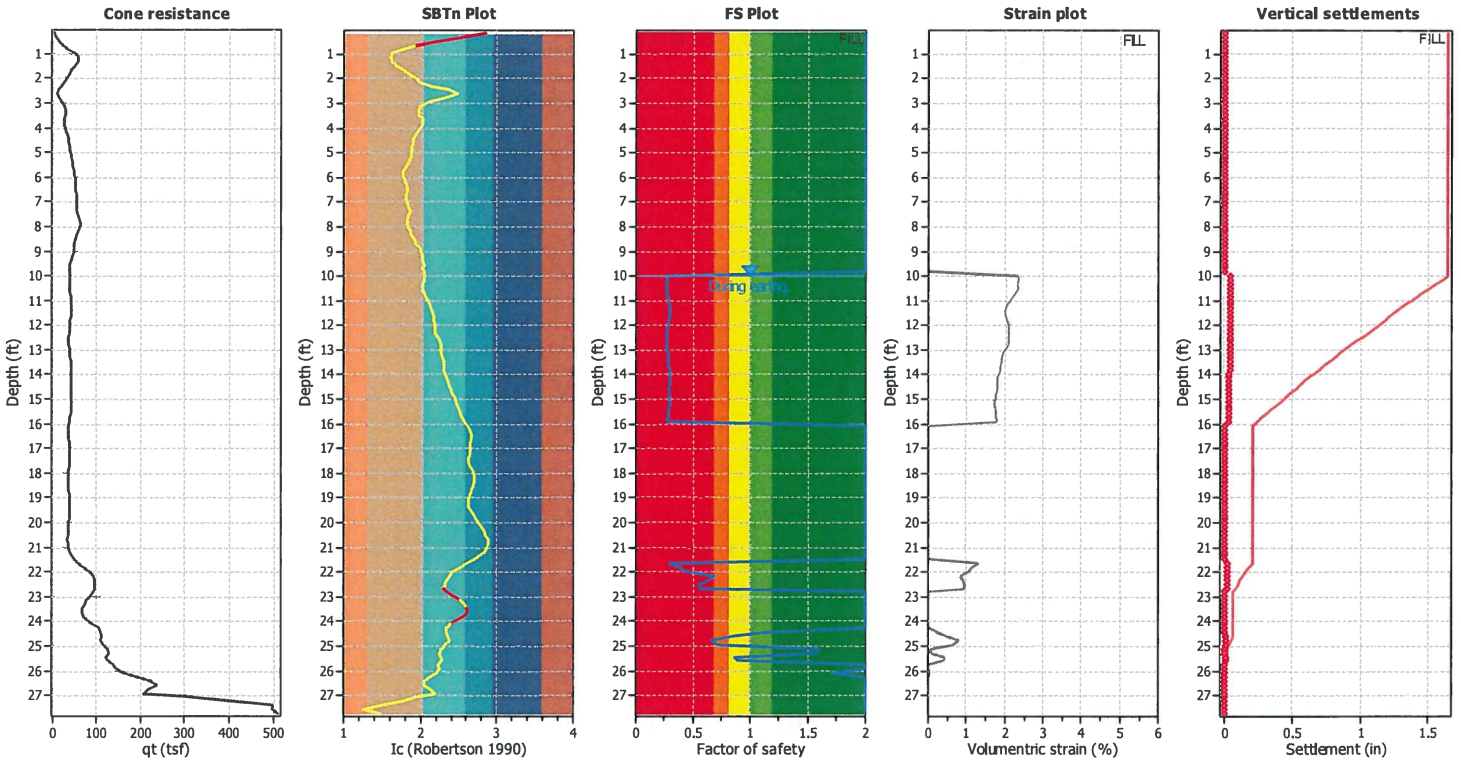
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	20.00 ft	Fill weight:	120.00 lb/ft³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.85	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.63	Use fill:	Yes	Limit depth applied:	No
Depth to water table (insitu):	50.00 ft	Fill height:	10.00 ft	Limit depth:	N/A

SBTn legend

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

Estimation of post-earthquake settlements

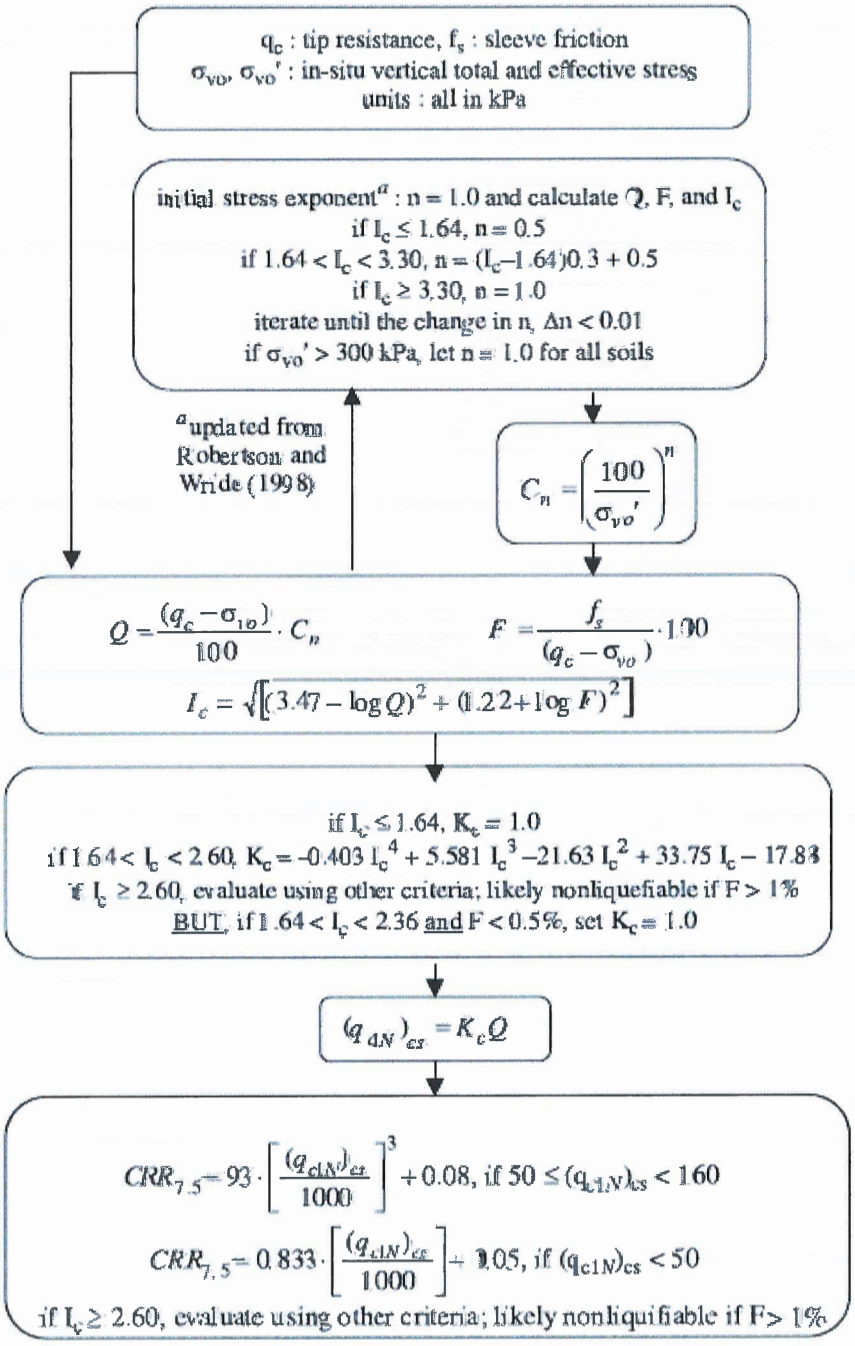


Abbreviations

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

Procedure for the evaluation of soil liquefaction resistance, NCEER (1998)

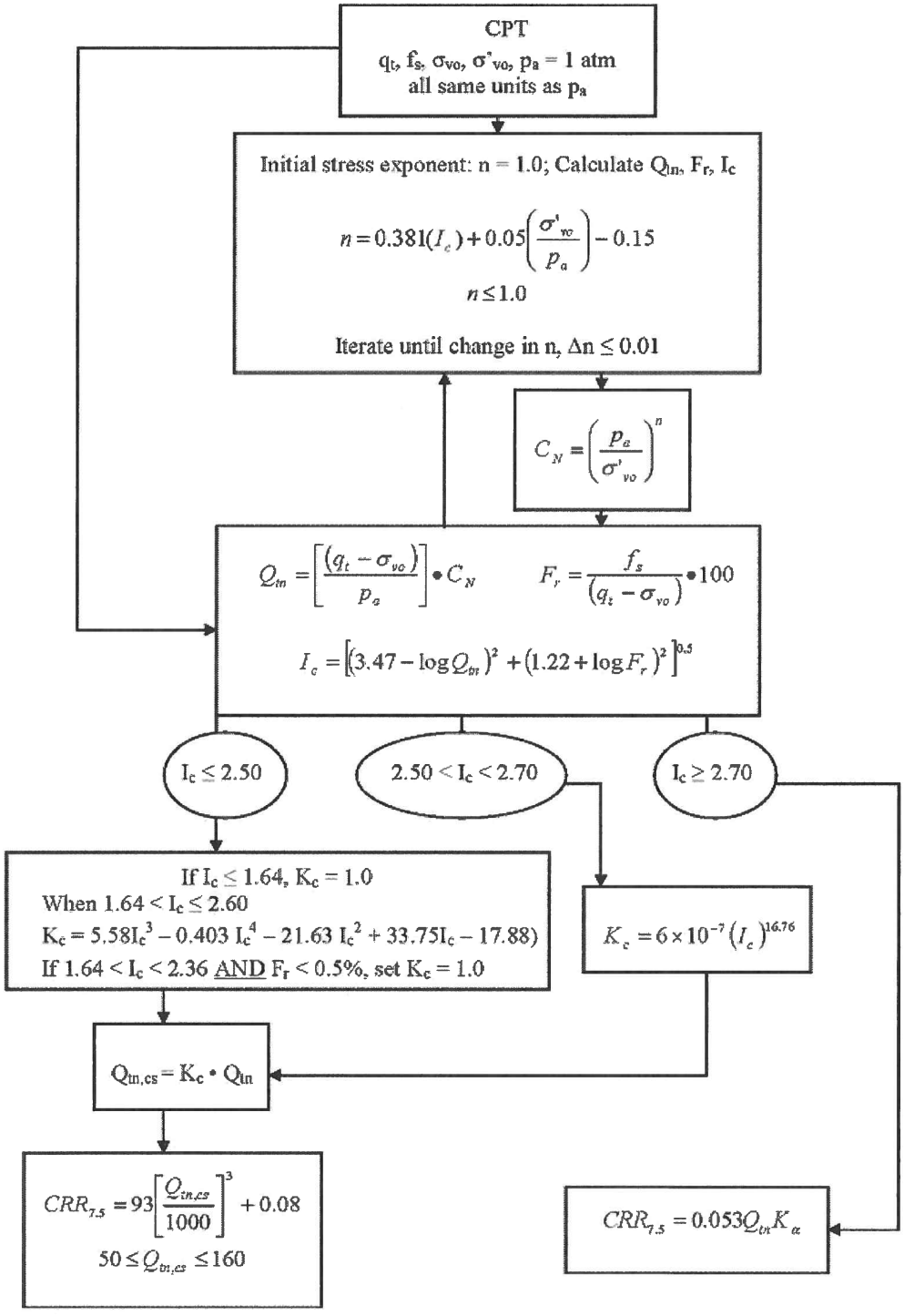
Calculation of soil resistance against liquefaction is performed according to the Robertson & Wride (1998) procedure. The procedure used in the software, slightly differs from the one originally published in NCEER-97-0022 (Proceedings of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils). The revised procedure is presented below in the form of a flowchart[1]:



[1] "Estimating liquefaction-induced ground settlements from CPT for level ground", G. Zhang, P.K. Robertson, and R.W.I. Brachman

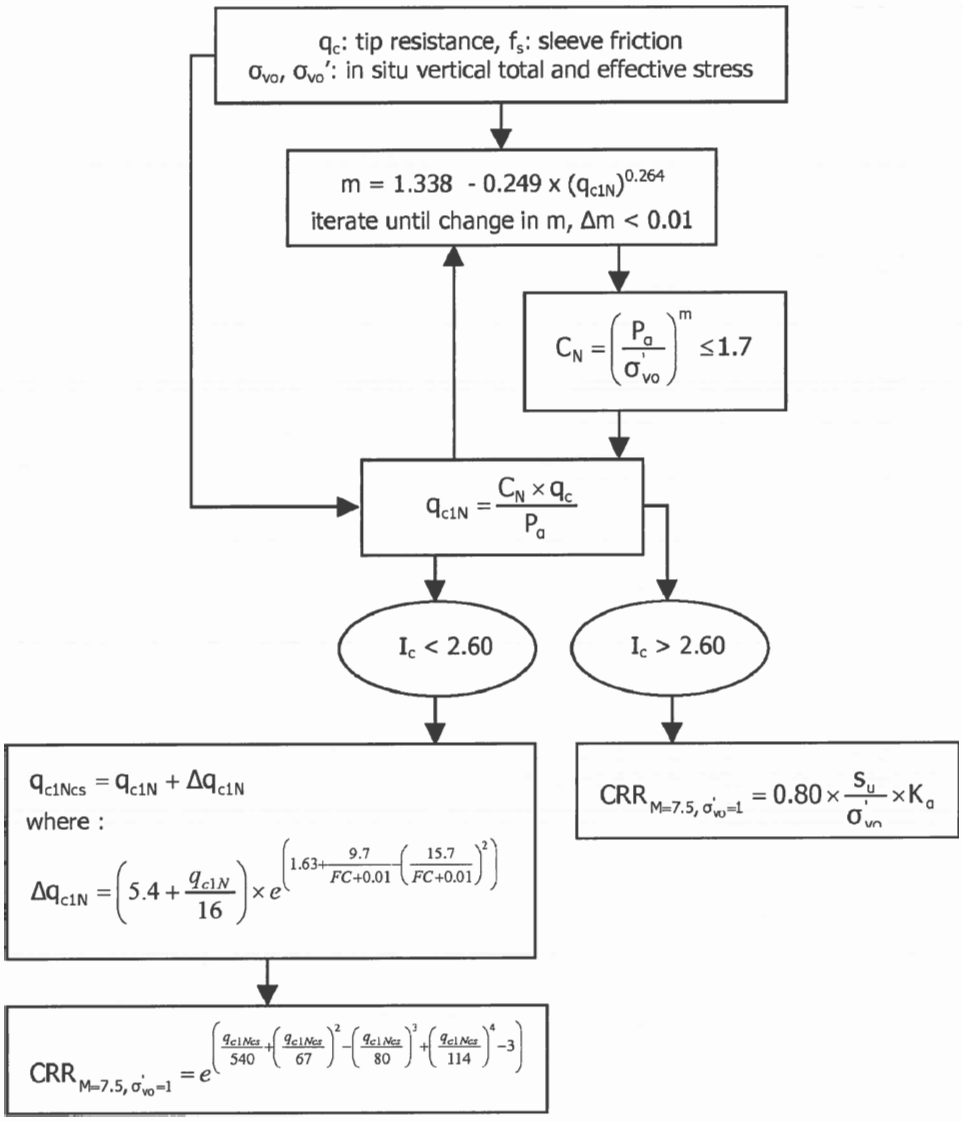
Procedure for the evaluation of soil liquefaction resistance (all soils), Robertson (2010)

Calculation of soil resistance against liquefaction is performed according to the Robertson & Wride (1998) procedure. This procedure used in the software, slightly differs from the one originally published in NCEER-97-0022 (Proceedings of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils). The revised procedure is presented below in the form of a flowchart[1]:

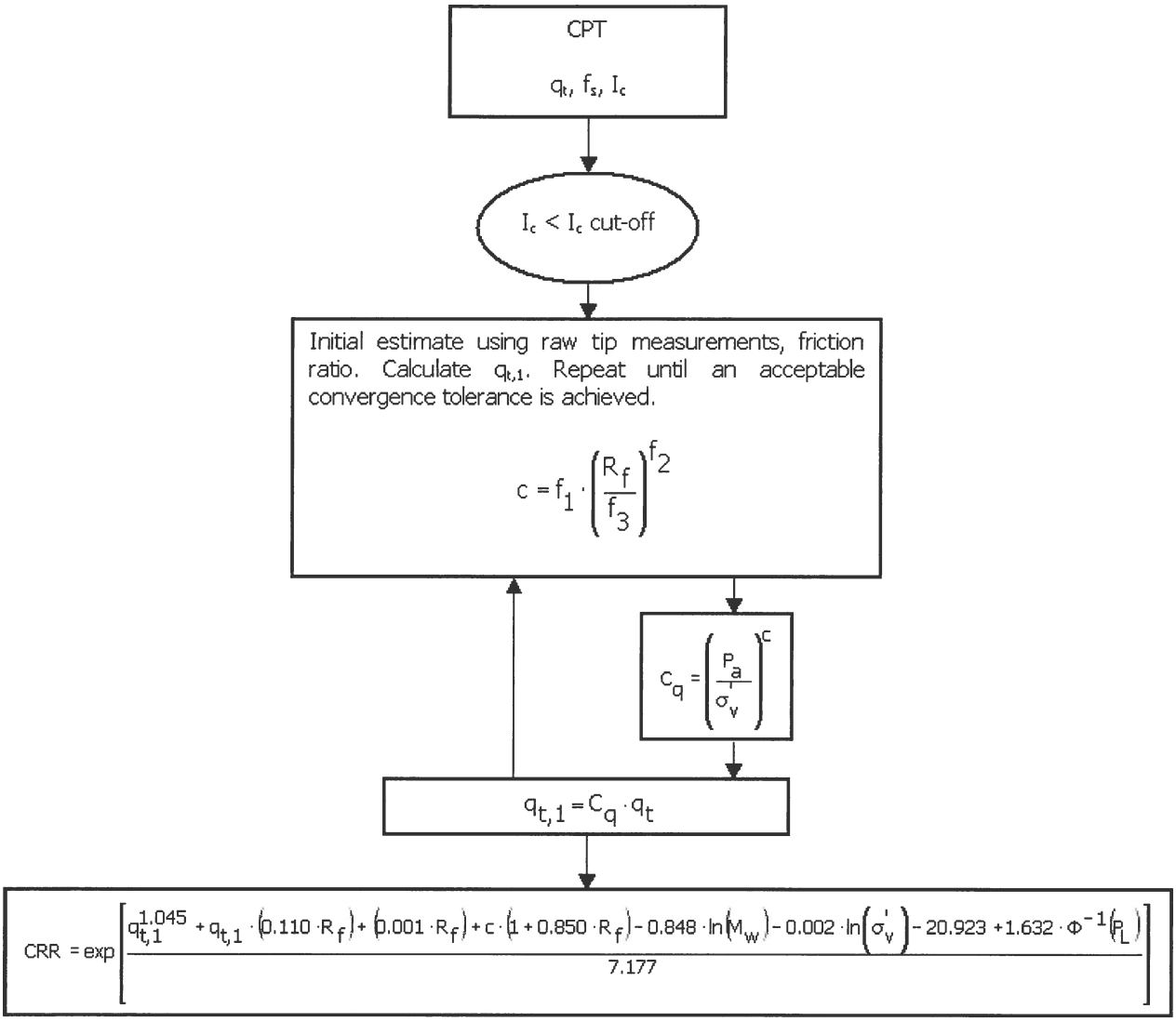


[1] P.K. Robertson, 2009. "Performance based earthquake design using the CPT", Keynote Lecture, International Conference on Performance-based Design in Earthquake Geotechnical Engineering – from case history to practice, IS-Tokyo, June 2009

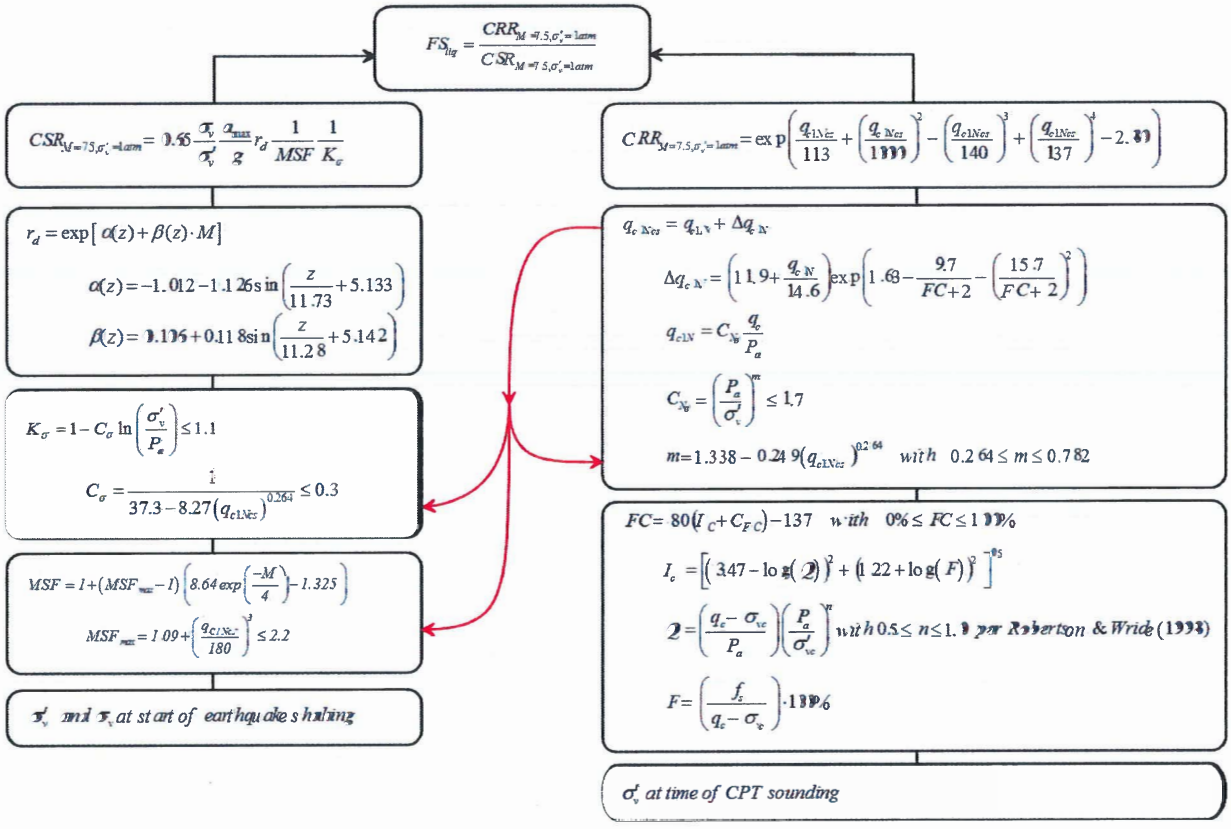
Procedure for the evaluation of soil liquefaction resistance, Idriss & Boulanger (2008)



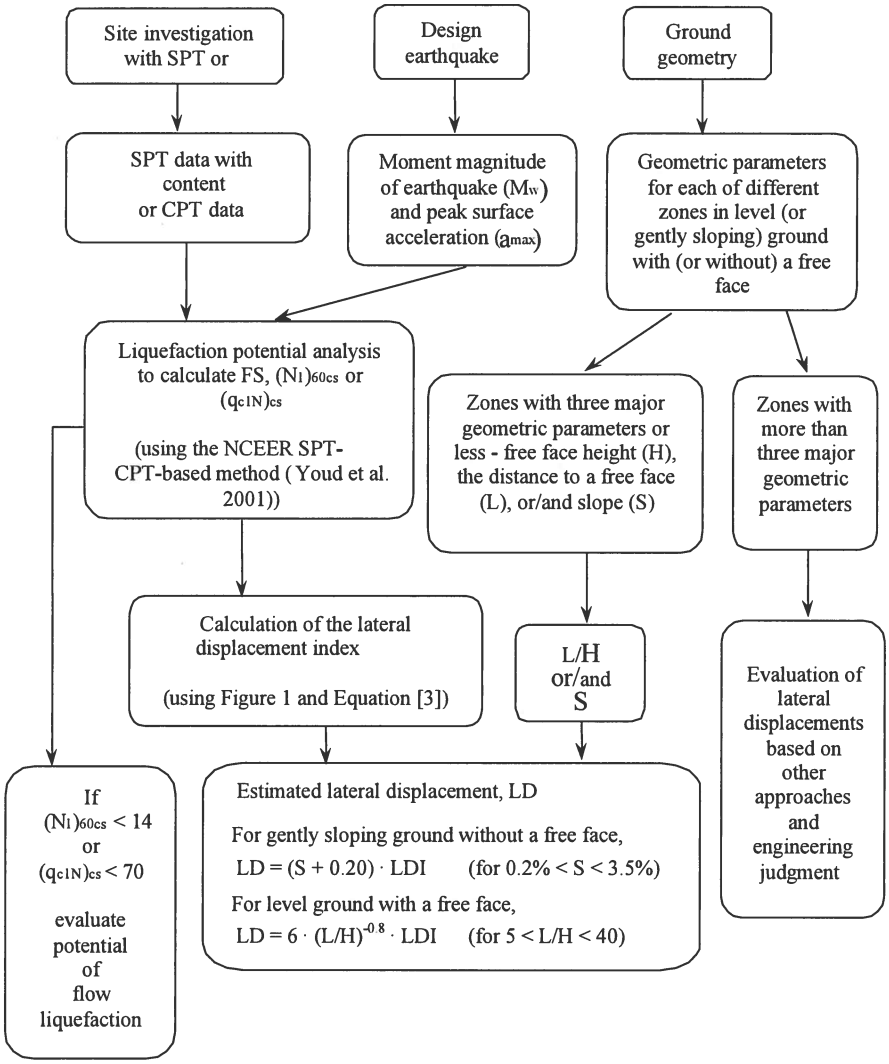
Procedure for the evaluation of soil liquefaction resistance (sandy soils), Moss et al. (2006)



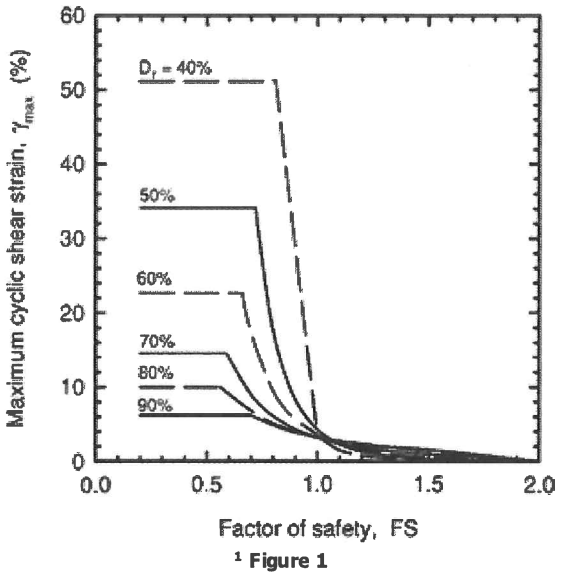
Procedure for the evaluation of soil liquefaction resistance, Boulanger & Idriss(2014)



Procedure for the evaluation of liquefaction-induced lateral spreading displacements



[1] Flow chart illustrating major steps in estimating liquefaction-induced lateral spreading displacements using the proposed approach



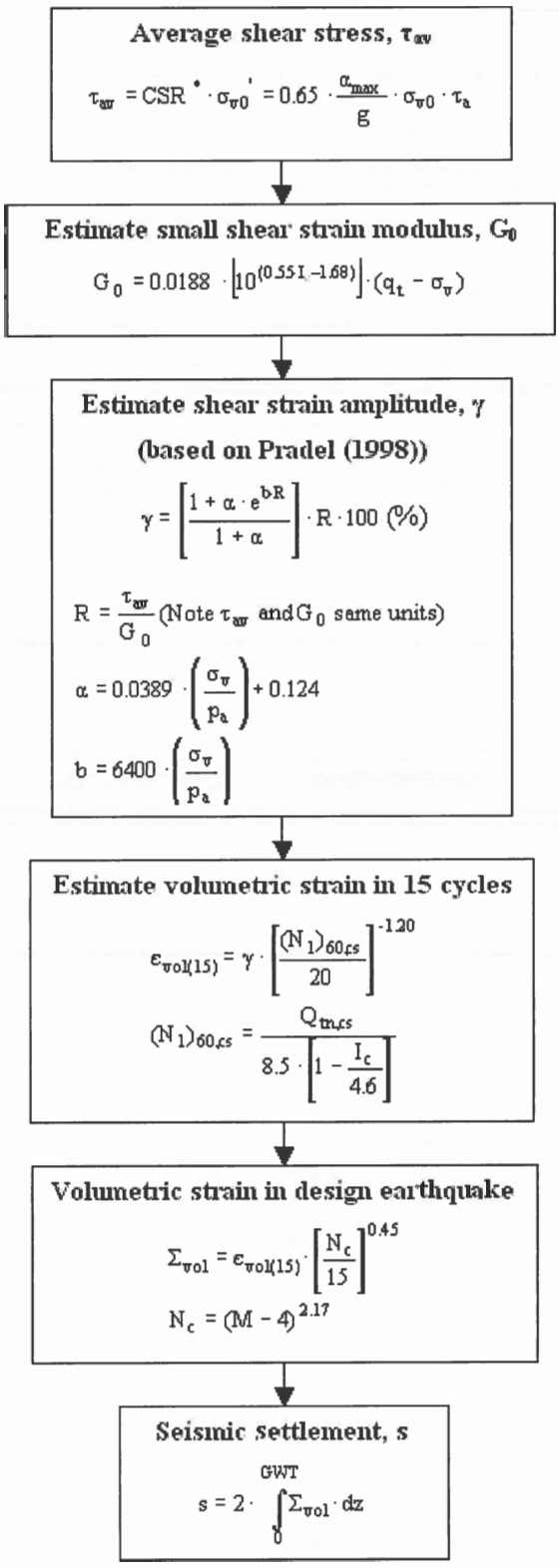
[1] **Figure 1**

$$LDI = \int_0^{z_{max}} \gamma_{max} dz$$

[1] **Equation [3]**

[1] "Estimating liquefaction-induced ground settlements from CPT for level ground", G. Zhang, P.K. Robertson, and R.W.I. Brachman

Procedure for the estimation of seismic induced settlements in dry sands



Robertson, P.K. and Lisheng, S., 2010, "Estimation of seismic compression in dry soils using the CPT" FIFTH INTERNATIONAL CONFERENCE ON RECENT ADVANCES IN GEOTECHNICAL EARTHQUAKE ENGINEERING AND SOIL DYNAMICS, Symposium in honor of professor I. M. Idriss, San Diego, CA

Liquefaction Potential Index (LPI) calculation procedure

Calculation of the Liquefaction Potential Index (LPI) is used to interpret the liquefaction assessment calculations in terms of severity over depth. The calculation procedure is based on the methology developed by Iwasaki (1982) and is adopted by AFPS.

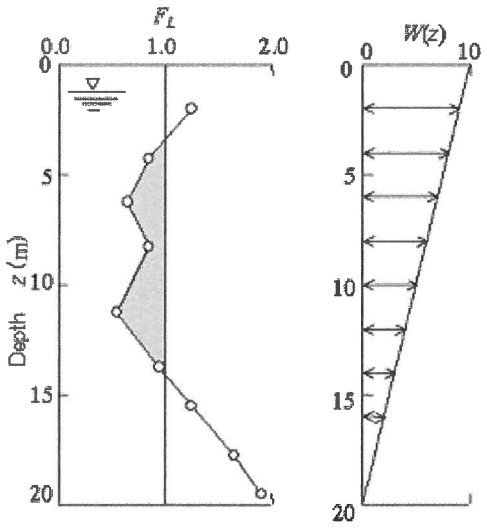
To estimate the severity of liquefaction extent at a given site, LPI is calculated based on the following equation:

$$\mathbf{LPI} = \int_0^{20} (10 - 0{,}5z) \times F_L \times dz$$

where:
F_L = 1 - F.S. when F.S. less than 1
F_L = 0 when F.S. greater than 1
z depth of measurment in meters

Values of LPI range between zero (0) when no test point is characterized as liquefiable and 100 when all points are characterized as susceptible to liquefaction. Iwasaki proposed four (4) discrete categories based on the numeric value of LPI:

- LPI = 0 : Liquefaction risk is very low
- 0 < LPI <= 5 : Liquefaction risk is low
- 5 < LPI <= 15 : Liquefaction risk is high
- LPI > 15 : Liquefaction risk is very high



Graphical presentation of the LPI calculation procedure

Shear-Induced Building Settlement (Ds) calculation procedure

The shear-induced building settlement (Ds) due to liquefaction below the building can be estimated using the relationship developed by Bray and Macedo (2017):

$$Ln(Ds) = c1 + c2 * LBS + 0.58 * Ln\left(Tanh\left(\frac{HL}{6}\right)\right) + 4.59 * Ln(Q) - 0.42 * Ln(Q)^2 - 0.02 * B + 0.84 * Ln(CAVdp) + 0.41 * Ln(Sa1) + \varepsilon$$

where Ds is in the units of mm, c1= -8.35 and c2= 0.072 for LBS ≤ 16, and c1= -7.48 and c2= 0.014 otherwise. Q is the building contact pressure in units of kPa, HL is the cumulative thickness of the liquefiable layers in the units of m, B is the building width in the units of m, CAVdp is a standardized version of the cumulative absolute velocity in the units of g-s, Sa1 is 5%-damped pseudo-acceleration response spectral value at a period of 1 s in the units of g, and ε is a normal random variable with zero mean and 0.50 standard deviation in Ln units. The liquefaction-induced building settlement index (LBS) is:

$$LBS = \sum W * \frac{\varepsilon_{shear}}{z} dz$$

where z (m) is the depth measured from the ground surface > 0, W is a foundation-weighting factor wherein W = 0.0 for z less than Df, which is the embedment depth of the foundation, and W = 1.0 otherwise. The shear strain parameter (ε_shear) is the liquefaction-induced free-field shear strain (in %) estimated using Zhang et al. (2004). It is calculated based on the estimated Dr of the liquefied soil layer and the calculated safety factor against liquefaction triggering (FSL).

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- R. E. S. Moss, R. B. Seed, R. E. Kayen, J. P. Stewart, A. Der Kiureghian, K. O. Cetin, CPT-Based Probabilistic and Deterministic Assessment of In Situ Seismic Soil Liquefaction Potential, Journal of Geotechnical and Geoenvironmental Engineering, Vol. 132, No. 8, August 1, 2006
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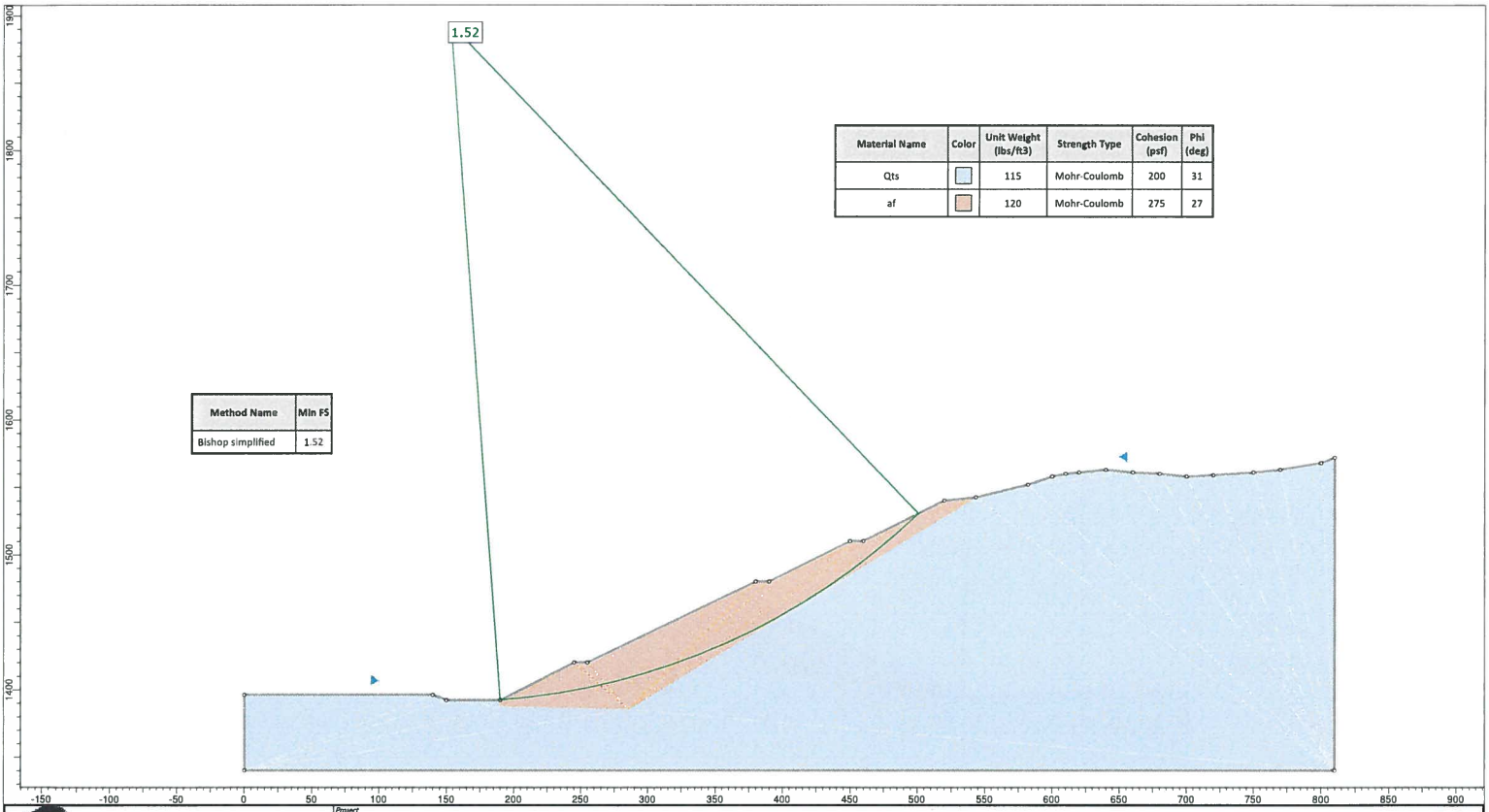
APPENDIX C

SLOPE STABILITY ANALYSES



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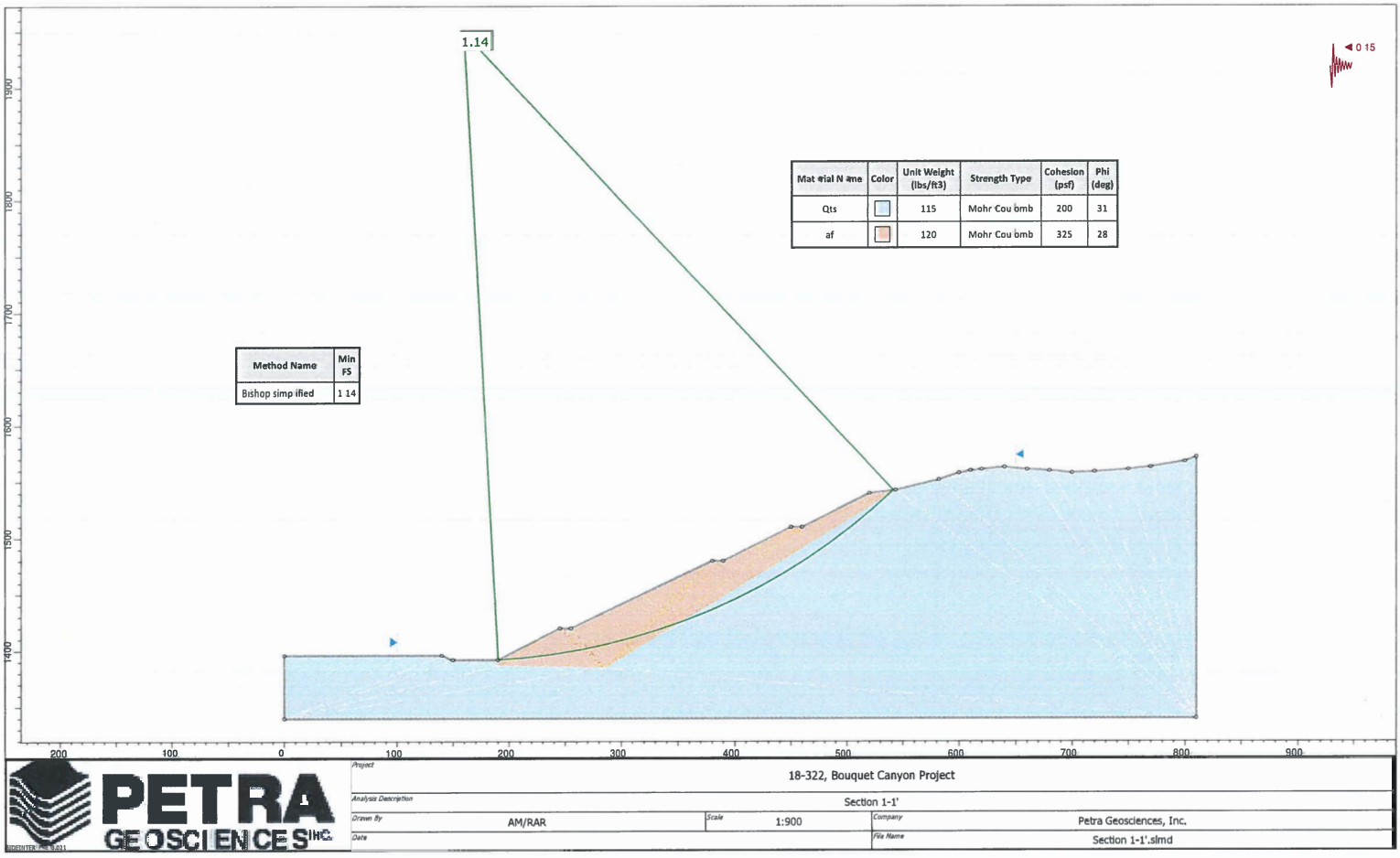

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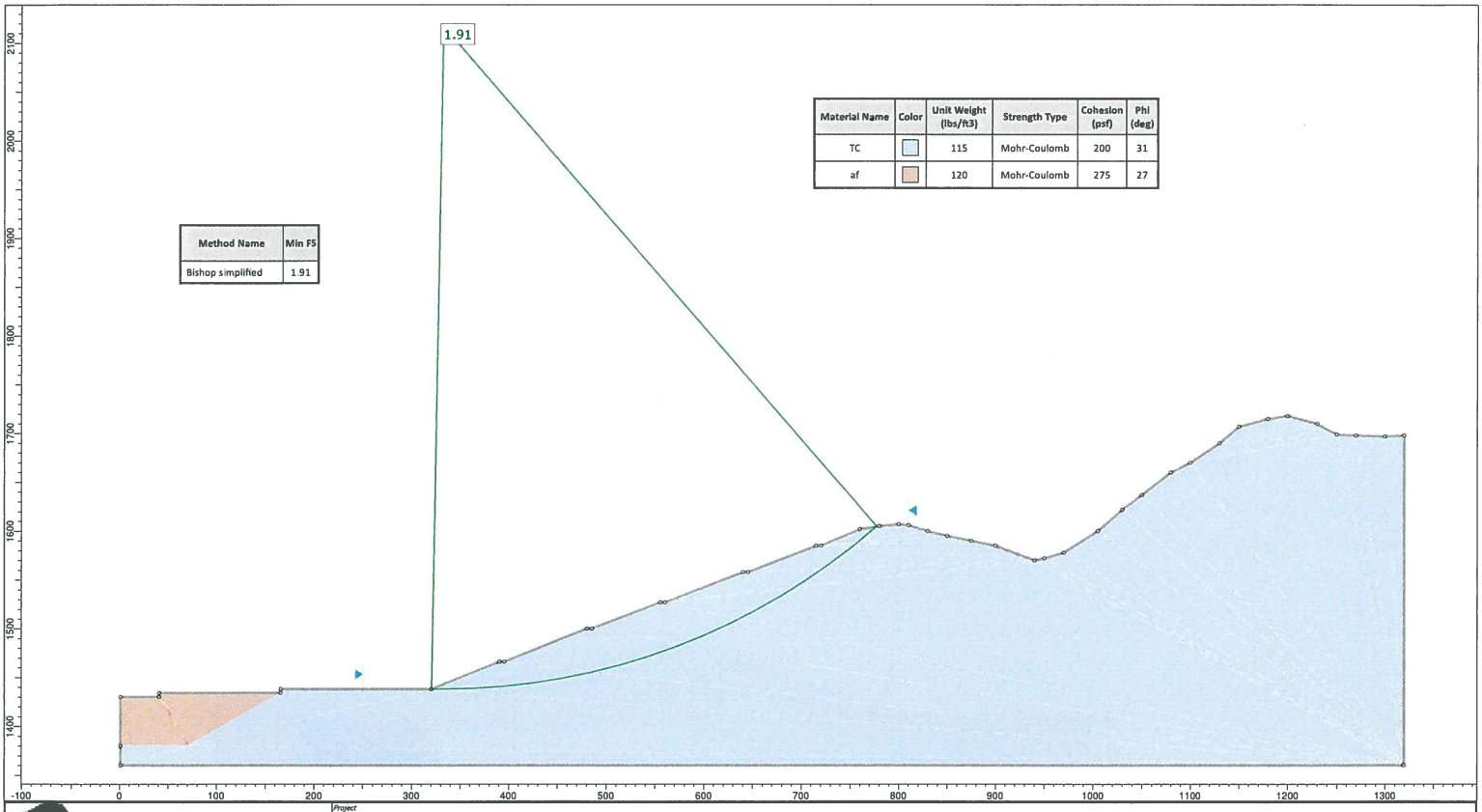

PETRA GEOSCIENCES INC.

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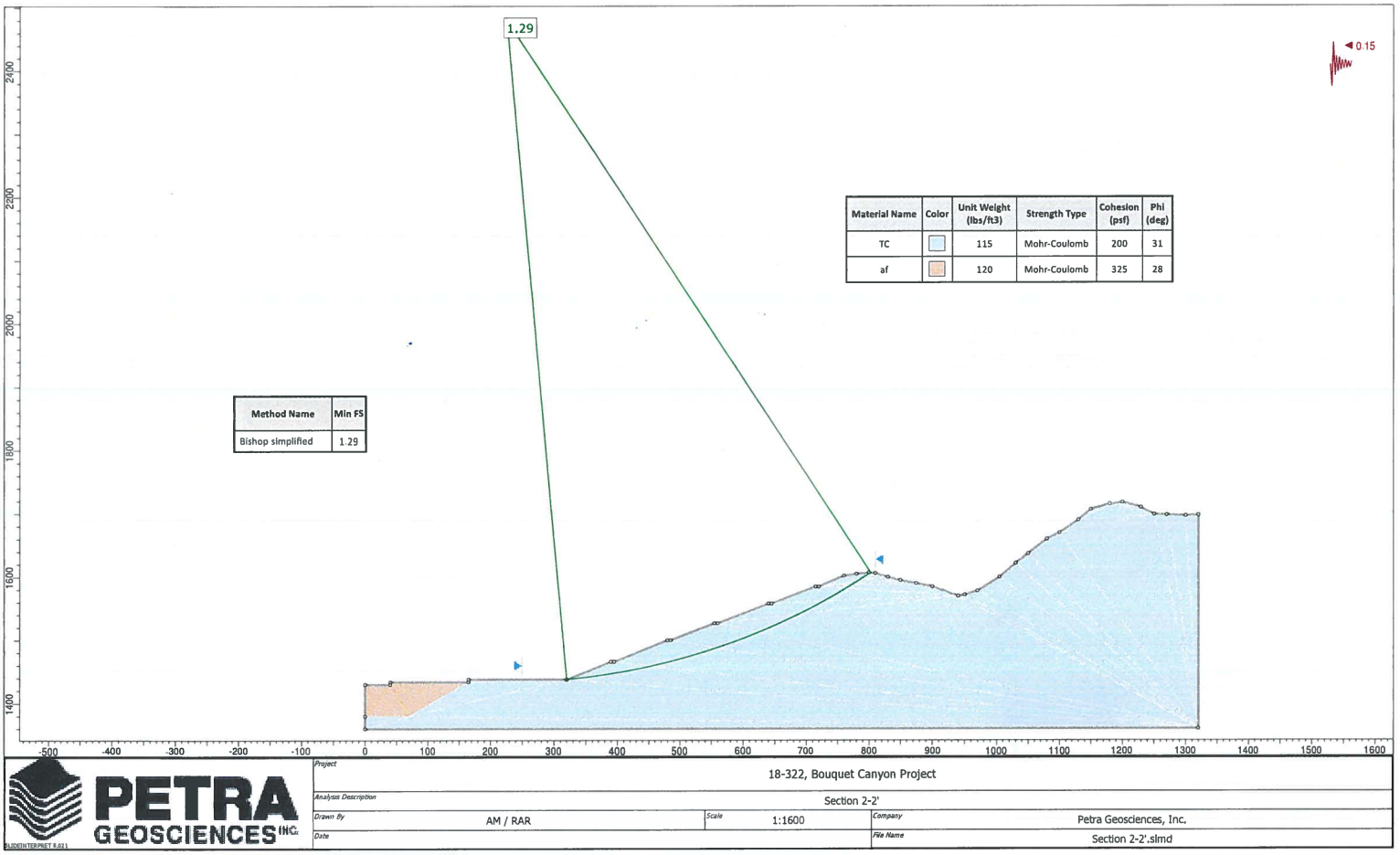

PETRA GEOSCIENCES INC.

SLIDEINTERPRET 8.021

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Appendix E:
Geotechnical Report and Paleontological Resources Record Check

Part 2: Paleontological Resources Records Check

Natural History Museum
of Los Angeles County
900 Exposition Boulevard
Los Angeles, CA 90007

tel 213.763.DINO
www.nhm.org

NATURAL HISTORY MUSEUM
LOS ANGELES COUNTY

Vertebrate Paleontology Section
Telephone: (213) 763-3325

e-mail: smcleod@nhm.org

30 January 2019

Michael Baker International
2729 Prospect Park Drive, Suite 220
Rancho Cordova, CA 95670

Attn: Nichole Jordan Davis, Senior Cultural Resources Manager

re: Vertebrate Paleontology Records Check for paleontological resources for the proposed Bouquet Canyon Road Project, in the City of Santa Clarita, Los Angeles County, project area

Dear Nichole:

I have conducted a thorough search of our paleontology collection records for the locality and specimen data for the proposed Bouquet Canyon Road Project, in the City of Santa Clarita, Los Angeles County, project area as outlined on the portion of the Mint Canyon USGS topographic quadrangle map that you sent to me via e-mail on 16 January 2019. We have no vertebrate fossil localities that lie directly within the proposed project area, but we do have localities nearby from the same sedimentary deposits that occur in the proposed project area.

About the northeastern half of the proposed project area has surficial deposits composed of younger Quaternary Alluvium, derived from the Bouquet Canyon drainage that currently flows through this portion of the proposed project area. These deposits usually do not contain significant vertebrate fossils, at least in the uppermost layers, but they are probably underlain at relatively shallow depth by older sedimentary deposits. In the southwestern portion of the proposed project area there are exposures of the terrestrial Pliocene Saugus Formation. Our closest fossil vertebrate localities in the Saugus Formation are LACM 7988-7989, almost due south of the very western-most portion of the proposed project area north of the Santa Clara River and south of the mouth of Plum Canyon. These localities produced fossil specimens of finch, Fringillidae, deer mouse, *Peromyscus hagermanensis*, wood rat, *Neotoma*, pocket gopher,

Thomomys, pocket mouse, Heteromyidae, and squirrel, Sciuridae. Further to the southwest of the proposed project area, in Saugus near Bouquet Junction, our Saugus Formation localities LACM 6803-6804 produced fossil specimens of horse, *Equus*, and camel, Camelidae.

In the northwestern portion of the proposed project area there are exposures of the marine late Miocene Castaic Formation. North-northwest and due north of the proposed project area, on the first and third ridges east of Haskell Canyon respectively, our Castaic Formation localities LACM 7772-7773 produced fossil specimens of sea turtle, Cheloniidae, carnivore, Carnivora, and baleen whale, Mysticeti. Further to the southeast of the proposed project area, just south of Humphreys, our Castaic Formation locality LACM 7656 produced a rare nearly complete carapace of a fossil leatherback turtle, *Psephophorus*.

Shallow excavations in the uppermost layers younger Quaternary Alluvium as exposed in the northeastern half of the proposed project area are unlikely to uncover significant vertebrate fossils. Deeper excavations there that extend down into older sedimentary deposits, as well as any excavations in the exposures of the Saugus Formation or the Castaic Formation in the southwestern half of proposed project area may well uncover significant fossil vertebrate remains. Any substantial excavations in the proposed project area, therefore should be monitored closely to quickly and professionally recover any fossil remains discovered while not impeding development. Sediment samples should also be collected and processed to determine the small fossil potential in these rock units. Any fossils recovered during mitigation should be deposited in an accredited and permanent scientific institution for the benefit of current and future generations.

This records search covers only the vertebrate paleontology records of the Natural History Museum of Los Angeles County. It is not intended to be a thorough paleontological survey of the proposed project area covering other institutional records, a literature survey, or any potential on-site survey.

Sincerely,

Samuel A. McLeod

Samuel A. McLeod, Ph.D.
Vertebrate Paleontology

enclosure: invoice