Appendix IS-3



Investigation of Potential Faulting

Appendix IS-3.1



Investigation of Potential Faulting:
456 North Rodeo

PD EXHIBIT 11

FEFFER
GEOLOGICAL CONSULTING

December 18, 2018 File No. 2176-85

456 N. Rodeo Drive LLC,
a California limited liability company
19 E. 57th St., New York, NY 10022
Attn: Mr. Franklin Dickinson

SUBJECT: **INVESTIGATION OF POTENTIAL FAULTING**
456 North Rodeo Drive, Beverly Hills, CA 90210

Dear Mr. Dickinson,

We are pleased to submit this report summarizing our fault rupture hazard investigation for 456 N. Rodeo Drive in the City of Beverly Hills, California. This investigation assesses the potential for surface fault rupture and determines if the area of 456 N. Rodeo Drive is suitable for the construction of human-occupied structures. 456 N. Rodeo Drive is currently not mapped as being potentially affected by surface faulting and is approximately 115 feet to the northwest of the currently mapped Santa Monica Fault Zone (SMFZ).

The investigation reviewed pertinent published and unpublished reports, assessed the site geomorphology, and drilled four continuously cored borings and eleven cone penetrometer soundings (CPTs) to determine underlying stratigraphy. The combination of continuous, unbroken late Pleistocene soil horizons and stratigraphy demonstrates the absence of active faulting beneath the site.

We therefore conclude that the project site is not impacted by state-defined active faults. Accordingly, no fault setback distances or "no-build" zones impact or limit future development.

We appreciate this opportunity to be of service. Should you have any questions regarding the information contained in this report, please do not hesitate to contact us.

Sincerely,

FEFFER GEOLOGICAL CONSULTING, INC.



Joshua R. Feffer
Principal Engineering Geologist
C.E.G. 2138

INTRODUCTION AND BACKGROUND

The project site is located on the northeast side of north Rodeo Drive and consists of a commercial lot that is currently occupied by a two-story retail building within a highly developed portion of the City of Beverly Hills, CA (Figure 1). For the purpose of description it is assumed that Rodeo Drive is oriented in a north-south direction. The site is bounded to the north by 468 N. Rodeo Drive, to the east by an alley, and to the west by north Rodeo Drive. Commercial structures and office buildings are located adjacent to the site.

The existing 456 N. Rodeo Drive structure was constructed prior to the establishment of the State-mandated Santa Monica Earthquake Fault Zone (SMFZ). As illustrated on Figure 2 and Figure 8, the subject site is entirely outside of the SMFZ and is located 2 lots and about 115 feet to the northwest from the northernmost edge of the zone (Olson, 2018). To ensure public health and safety, a fault investigation is required by the City of Beverly Hills (2018a). The surface expression of fault-related geomorphic features has been destroyed by urbanization and development within the greater Los Angeles area. Nevertheless, Dolan et al. (2000) identified the fault based on topographic scarps north of Santa Monica Boulevard in the Westwood area (Figure 7). Additional work (Olson, 2015) refined the map representation of the fault scarps, and largely replicates the work by Dolan et al. (2000).

The site is outside of the current Earthquake Zones of Required Investigation (CGS, 2018a). However, it is subject to the Alquist-Priolo Special Studies Zone Act of 1972 (California Public Resources Code, Chapter 7.5, Division 2), and an investigation is required by the City of Beverly Hills (2018a). The AP Special Studies Zone Act specifically defines a fault as active if surface or near surface displacement cannot be demonstrated as inactive within the past 11,700 years (Holocene). This investigation specifically assesses the potential for surface fault rupture at 456 N. Rodeo Drive.

SCOPE OF WORK

Trenching is the preferred method for evaluating the presence or absence of faults because it offers a continuous, direct exposure of the fault zone or near surface stratigraphy. However, in this portion of the SMFZ, trenching is difficult due to existing structures. Therefore, as accepted by the City of Beverly Hills Seismic Guidelines (2018a) this fault study consists of several strategically placed continuously cored borings in combination with cone penetrometer tests excavated to approximately 50 feet deep to address the issue of surface faulting at the site. Borings and cone penetrometer tests taken as part the investigation for 468 N. Rodeo Drive are considered part of this project (Figure 11). The scope of work for this fault investigation consists of the following tasks:

- Review of published and unpublished geotechnical data in the site vicinity;
- Analysis of topographic maps of the site vicinity;
- Obtaining drilling permits and marking of underground utilities;
- Excavating and logging a total of 4 fifty foot borings across the site;
- Pushing a total of 11 CPT soundings across the site;
- Preparation of this report.

FAULT ACTIVITY CRITERIA

In general, fault activity is based on the age of displaced and undisturbed sediment. According to the CGS (2018b), a fault can be either age-undetermined, Holocene-active, or a pre-Holocene fault (see details below). If charcoal or other numerically datable specimens are present, a numeric age can be established. If no datable material exists, then a relative age can be assigned to movement along the fault based on the relative development of buried paleosols (pedogenic profiles; Appendix B).

According to CGS Special Publication 42 (2018b), a fault is defined as the following:

> *"A shear or zone of closely associated shears across which earth materials on one side have been displaced with respect to those on the other side because of tectonic forces. A fault is distinguished from those fractures or shears caused by landsliding or other gravity-driven surficial failures.*
>
> ***age-undetermined fault:*** *A fault whose age of most recent movement is not known or is unconstrained by dating methods or by limitations in stratigraphic resolution.*
>
> ***Holocene-active fault:*** *A fault that has had surface displacement within Holocene time (the last 11,700 years).*
>
> ***pre-Holocene fault:*** *A fault whose recency of past movement is older than 11,700 years, and thus does not meet the criteria of Holocene-active fault as defined in the State Mining and Geology Board regulations (California Code of Regulations, Title 14, Division 2, Section 3601.(a)).*" (CGS, 2018b, p. 1-2)

REGIONAL AND LOCAL GEOLOGY

The site is located in the Los Angeles Basin, a part of the Transverse Ranges Geomorphic province (Figure 3). The Los Angeles Basin lies within a transitional zone between the Transverse Ranges to the north and the Peninsular Ranges (Yerkes et. al., 1965). The basin is bounded on the north by the Santa Monica Mountains, on the east by the Elysian Hills, the west by the Newport-Inglewood Uplift and the south by the La Brea high, an area of shallow bedrock.

The predominate structure in the project area is the east-west trending Malibu Coast-Santa Monica-Raymond-Cucamonga fault system (Crook et al., 1983), which extends for approximately 125 miles to form the southern boundary of the Transverse Ranges. This fault system is also referred to as the Transverse Ranges Southern Boundary fault system (TRSB) by Dolan et al. (2000). This complex system of east-west trending faults accommodates north-south shortening and uplift, and concurrent westward motion of the Western Transverse Ranges. Individual faults within the TRSB fault system exhibit varying degrees of both left-lateral strike-slip and contractional dip-slip faulting and related folding (Hill et al., 1979; Crook et al., 1983; Jones et al., 1990; Dolan et al., 2000). All faults within the system show evidence for Quaternary activity and several, including the Santa Monica and Hollywood faults, have been demonstrated by site-specific paleoseismic studies to be active during the Holocene (Jones et al., 1990; Weaver and Dolan, 2000; Dolan et al., 2000).

From a local perspective, the site is located within the uplifted and dissected Beverly Hills area. Hoots and Kew (1931) and Yerkes and Campbell (2005) mapped Holocene aged alluvium over older

Pleistocene aged alluvial and terrestrial fan deposits (Figure 4) while Dibblee and Ehrenspeck (1991) mapped younger Holocene aged alluvial gravels at the surface overlying older Pleistocene age alluvial fan sediments (Figure 5). More recent mapping (Figure 6) from Campbell (2014) indicates that the sediments exposed in the area consist of primarily lower Holocene to upper Pleistocene age alluvium near the ground surface underlain by upper to lower Pleistocene aged alluvial fan deposits, and interbedded terrestrial fan and shallow marine sediments. None of these regional geologic maps delineate the SMFZ in the vicinity of the project site area.

Santa Monica Fault Zone

The SMFZ portion of the TRSB trends east-west from the Santa Monica coastline on the west to the Hollywood area on the east (see Figure 2). It is an oblique-reverse, left-lateral fault that is thought to be a surface expression of tectonic deformation related to Pliocene-Quaternary structural development of the Santa Monica Mountains. Integration of subsurface oil and gas exploration seismic data and well logs with surficial mapping indicate the mountains are underlain by a large southward-vergent asymmetric anticline formed over a regional north-dipping thrust ramp at a depth of 6 to 9 miles. Geophysical studies conducted at the Veteran's Administration (VA) property in West Los Angeles indicate the SMFZ is a gently dipping thrust fault with secondary near-vertical faults extending from the primary basal fault toward the ground surface (Pratt et al., 1998; Dolan et al., 2000).

The surface expression of the SMFZ is limited to fault-related geomorphic features, many of which have been destroyed by urbanization and development within the greater Los Angeles area (Figure 7). This has resulted in a poor understanding of the lateral extent, location, and rupture history of the SMFZ. Nevertheless, Dolan et al. (2000) identified a probable fault location based on topographic scarps north of Santa Monica Boulevard (Figure 7). The most prominent of these scarps is located at the base of a late to middle Pleistocene fan surface in west Los Angeles that extends from approximately University High School to the Mormon Temple, juxtaposing older surficial deposits and relatively shallow bedrock to the north against younger surficial deposits and a thick expanse of old alluvium to the south. Both trenching studies and seismic reflections profiles reveal that, at the VA property, the SMFZ topographic scarp contains a series of steeply dipping to sub-vertical faults that offset late Quaternary sediments (Crook et al., 1983; Pratt et al., 1998; Dolan et al., 2000; Catchings et al., 2001). Radiometric dating of key stratigraphic horizons at the VA site indicate that five to six surface-rupturing events have occurred between approximately 50,000 and 1,000-3,000 years before present (Dolan et al., 2000).

West of the project site, the SMFZ has typically been mapped just north of and parallel to Santa Monica Boulevard, following a series of scarps at the base of late to middle Pleistocene fan surfaces (Dolan et al., 2000; Bedrossian et al., 2012; Olson, 2015). However, recent subsurface explorations and geophysical studies in Century City (e.g., Parsons, 2011) have inferred the presence of a zone of faulting that extends south of Santa Monica Boulevard as well. Parsons (2011) interpreted these faults as active, however, subsequent studies have refuted this interpretation. Kenney (2012; 2013) reviewed the data by Parsons (2011) and subsequent studies and supplemented them with his own geologic and geomorphic analysis. Kenney (2012) interpreted the data to indicate that the primary basal SMFZ actually projects far to the south of the project site, and that faulting along and south of Santa Monica Boulevard should be attributed to the newly designated "Santa Monica Boulevard Fault Zone" (SMBFZ).

Faults associated with the SMBFZ dip steeply to the north and are thought to exhibit right-lateral displacement (Kenney, 2012), although a definitive sense of slip has not been established (Kenney, 2013). These faults are interpreted to be secondary structures related to the primary basal reverse SMFZ

that is thought to underlie the Century City area at depth (Kenney, 2012; Lettis, 2013). Based on our review of the recent Century City studies (discussed in detail below), the faults subject to this investigation are part of the SMBFZ.

Both Kenney (2012) and Parsons (2011) indicate there is no direct evidence that SMBFZ faults along and south of Santa Monica Boulevard are active. To date, the only evidence of Holocene activity within the SMFZ and SMBFZ is for faults that are coincident with the topographic scarp north of Santa Monica Boulevard (e.g., Dolan et al., 2000; Geocon, 2014). Updated mapping of the SMBFZ (Figure 8) provided by the City of Beverly Hills (2018b), based on mapping by the CGS, locates the fault zone as extending from the beyond the western city boundary trending northeastward and terminating near north Maple Drive and Alden Drive (City of Beverly Hills, 2018b). Furthermore, the SMBFZ postulated by Kenney (2012) or just the SMFZ as it is commonly referred to, is approximately 115 feet south of the subject site (see Figure 2 and Figure 8).

Newport-Inglewood Fault Zone

The Newport-Inglewood fault (NIFZ) zone is mapped across the western portion of the Los Angeles Basin and generally trends north to northwest. The fault zone is topographically expressed onshore by elevated surfaces which extend from the Newport Mesa in the south to the Beverly Hills area in the north (Earth Consultants International, 2018). As currently mapped, the northern portion of the Newport-Inglewood Fault ends near Pico Boulevard south of the Beverly Hills area (see Figure 2 and Figure 8); however, the location of the northern fault strands has been debated widely in the geological literature.

Hollywood Fault Zone

The Hollywood Fault generally trends in an east to west direction and extends from the City of Beverly Hills about 10 miles towards the east. As currently mapped by the CGS (2018a) and adopted by the City of Beverly Hills (2018b) the westernmost edge of the Hollywood Fault Zone is located approximately 1 mile northeast of 456 N. Rodeo Drive and does not impact the site (see Figures 2 and 8).

TOPOGRAPHIC / GEOMORPHIC REVIEW

Existing topography was examined for recognizable scarps or breaks in slope that may suggest the location of faulting through a combined review of previous geomorphic analyses (Earth Consultants International, 2018 and Lettis, 2013 and Dolan et. al., 2000) and historical U.S. Geologic Survey topographic maps (Figures 7 and 9).

Geomorphically, the site is on a degraded Holocene-aged alluvial fan surface that has been incised by north-south to northwest-southeast trending drainages (Figures 4, 5, 6, 7, and 9). Locally, the area gently slopes to the east and southeast which is consistent with natural sedimentary and fluvial processes. To the southwest of the site a prominent southeast-facing escarpment, which has historically been used to locate the Santa Monica fault, is crosscut by multiple northwest trending drainages (e.g., Dolan et al., 2000). This scarp shown in Figure 7 is prominently expressed approximately 3 mi southwest of the site at the Mormon Temple. However, from the Mormon Temple to the site, this scarp becomes less pronounced in the landscape and unrecognizable in the vicinity of the subject site (see Figure 9) where urbanization masks geomorphic features related to faulting.

PREVIOUS INVESTIGATIONS

This firm prepared a Fault Investigation Report for 468 N. Rodeo Drive, located directly north and neighboring to the subject site, dated August 20, 2018 (FGC, 2018a). The subsurface investigation utilized the data from the same continuous borings and CPTs conducted for this report. (see Figures 10 and 11). The investigation concluded that no faults traverse the subject property and that the underlying sediment exhibited multiple continuous stratigraphic horizons across the entire boring and CPT transect. The Fault Investigation report was reviewed by Roy J. Shlemon and Associates and recommended for approval on August 29th, 2018. The City of Beverly Hills issued a formal approval for the referenced site on August 29th, 2018. Data from the approved report for 468 North Rodeo Drive are used to support the findings and conclusion of this report.

The Fault Investigation Report prepared by this firm for 461 N. Beverly Drive is located approximately 20 feet east of 456 N. Rodeo Drive dated September 20, 2018 (FGC, 2018b). The subsurface investigations consisted of a transect of 5 continuously cored borings drilled to a maximum depth of 50 feet below the ground surface (See Figure 11). The investigation was conducted far enough to the southeast to shadow southern portion of the 456 N. Rodeo site and concluded that no faults traverse the subject property and that the underlying sediment across the site exhibits multiple continuous stratigraphic horizons across the entire boring transect. The Fault Investigation report was reviewed by Roy J. Shlemon and Associates and recommended for acceptance on October 2nd, 2018. The City of Beverly Hills issued a formal approval for the referenced site on October 8th, 2018. Data from the approved report for 461 North Beverly Drive are used to support the findings and conclusion of this report.

In 2011, Parsons-Brinkerhoff (Parsons) completed a fault study for the METRO Westside Subway Extension for the purpose of locating potential subway station and tunnel alignments. Based on their interpretation of continuous-core borings, cone penetrometer tests (CPTs), and geophysical surveys, Parsons (2011) depicted two zones of faulting in the area: 1) a zone of northeast-southwest trending faults, generally parallel to and south of Santa Monica Boulevard, which they attributed to the SMFZ and 2) a zone of northwest-southeast trending faults coincident with the West Beverly Hills Lineament (WBHL). These faults were considered active based on geomorphic evidence and interpreted association with known active faults. To the west of the project site, Parsons (2011) interpreted the SMFZ to span a width from the topographic scarp north of Santa Monica Boulevard to approximately 150 feet southeast of the boulevard. Parsons (2011) interpreted additional faults immediately to the southeast of this zone, but they were unable to determine whether these faults were active.

Leighton Consultants Inc. (Leighton, 2012) performed a fault investigation at Beverly Hills High School focused on the WBHL faults interpreted by Parsons (2011). Leighton (2012) advanced borings, CPTs, and excavated trenches along Parsons' (2011) borehole and CPT transects. Based on the observation of unbroken Pleistocene age soils across the grounds of the high school, Leighton concluded that the faults identified by Parsons (2011) were not active. Furthermore, Leighton (2012) provided geologic evidence that the WHBL scarp is an erosional feature, rather than a tectonic feature. The California Geological Survey (CGS) approved the Leighton report and agreed that none of the investigated faults were active (CGS, 2013).

Feffer Geological Consulting and Geocon, (2012) prepared a fault report for the 10000 Santa Monica project located immediately north of the BHHS campus and lies immediately adjacent to the MTA Santa Monica station site and between MTA Transects 2 and 4. The 10000 investigation included a trench

across the entire site that paralleled the Leighton/MTA Transect 4 and the MTA Transect 2. The trench crossed the location of several fault strands proposed by MTA (Parsons, 2011) associated with their WBHL fault zone as well as the new WBHL fault location. No faults, active or otherwise, were found in the 10000 Santa Monica trench to depths of 30+ feet and ages of >300,000 years.

Kenney GeoScience (Kenney, 2012, 2013) performed geomorphic, structural, and stratigraphic analysis using the available subsurface data from the Metro investigation (Parsons, 2011), the Beverly Hills High School fault investigation (Leighton, 2012), and other data generated from recent fault studies in the Beverly Hills/Century City area (e.g., Feffer-Geocon, 2012; Legg, 2012). Based on these data, Kenney (2012) developed a tectonic and geologic history of the area, which included an evaluation of the location and activity of suspected faults. As discussed above, Kenney (2012, 2013) interpreted the faults along Santa Monica Boulevard as secondary upper plate structures, and referred to them as the SMBFZ. This interpretation is based on the observation that the SMBFZ faults are dominantly strike-slip (possibly right-lateral). Although individual faults within the SMBFZ may exhibit normal or reverse apparent displacement, there is little net vertical displacement across the zone (Kenney, 2013). This contrasts with the observations north of Santa Monica Boulevard, where oblique left-lateral reverse motion has produced net north-side-up displacement across the fault (e.g., Dolan et al., 2000; Geocon, 2014).

Kenney (2012) noted that multiple investigations and reevaluations of the faults first interpreted by Parsons (2011) along Santa Monica Boulevard had not produced any evidence of Holocene-age activity for the SMBFZ. In fact, the most recent data indicates that activity along these faults likely ceased approximately 40,000 to 50,000 years ago (Kenney, 2012). However, Kenney (2013) noted that additional study of these faults is needed in order to confidently assess their activity.

Subsequent to Kenney's (2012, 2013) reinterpretation of the SMFZ and the SMBFZ, Geocon West, Inc. (Geocon, 2013) conducted a fault study for Westfield at the Century City mall. This study was specifically designed to identify the evidence for Holocene activity (or lack thereof) along the SMBFZ south of Santa Monica Boulevard. Geocon's (2013) study consisted of one boring transect along Avenue of the Stars, and another boring transect along Century Park West. Geocon (2013) documented a thick section of unfaulted Pleistocene-age alluvium overlying faulted sections of Lakewood Formation sediments. Based on the apparent continuation of the Pleistocene-age geologic units overlying several faults, Geocon (2013) concluded that no active faults were present at the Westfield site, and no restrictions on future development of the Westfield Site are necessary with respect to potential faulting.

The Los Angeles County Metropolitan Transit Authority prepared a report in 2017 for Transect 9 (Figure 8) of Tunnel Reach 5 located approximately 1500 feet to the southwest of the subject site (MTA, 2017). The following is a summary from FER-259 (Olson, 2018):

"In 2017, AMEC Foster Wheeler performed a supplemental fault investigation for the planned LA Metro Westside Purple Line subway extension (Metro, 2017) to assess a strand of the Santa Monica Fault Zone encountered during the preliminary fault investigation report (Parsons Brinckerhoff, 2011), which trended northeasterly towards a section of the proposed subway alignment. To investigate for potential faulting, a series of continuous core borings and CPTs were drilled along Laskey Drive, turning east at Charleville Boulevard, and continuing north along Spaulding Drive (see Figure 14, locality 15). This was referred to as Transect 9, which continues the numbering sequence from Parsons Brinckerhoff (2011). The new subsurface profile was constructed using data collected from twenty new continuous core borings drilled from 110 to 245 feet deep and 34 CPTs advanced to depths ranging from 61 to 117

feet. Based on the subsurface data the consultants identify Holocene and Pleistocene alluvial units overlying bedrock of the Pleistocene Lakewood and San Pedro Formations." (Olson, 2018, p. 31-32)

"From their observations and interpretations of the subsurface data, AMEC Foster Wheeler identified a significant fault zone at depth between their stations 6+50 and 9+00 (Figure 19) consisting of up to three strands, which dip steeply to the north. The faults exhibited greater than 90 feet of apparent down-to-the-north vertical displacement of the contact between the older alluvium and the Lakewood Formation. From the southern end of the cross section, the depth to the Pleistocene bedrock units consistently increases to the north until they are abruptly truncated and no longer encountered north of the inferred fault zone. AMEC states these faults appear to extend up near the present-day ground surface and offset Holocene sediments dated between approximately 9,100 and 16,500 years old based on radiometric dating of charcoal samples. The locations of the fault traces in the near surface sediments is based on identifying the location where laterally persistent laminated fine-grained "sag deposits" to the north are abruptly missing in adjacent down-gradient borings. It is postulated these fine-grained silts and clays were deposited in depressions or impounded drainages formed by topographic scarps created by surface-rupturing events along faults in this zone. Additional faults were also interpreted between borings north and south of this main zone." (Olson, 2018, p. 32)

As illustrated on Figure 8, MTA Transect 9 is located approximately 0.4 miles southwest of 456 N. Rodeo Drive. The interpretation of faulting by MTA (2017) is similar to the previously identified activity of the Santa Monica Fault Zone by MTA, and has been questioned by many consultants. None of the purported active faults conclusively offset Holocene age soil.

Earth Consultants International (ECI), (2018) prepared a Fault Investigation Report for 322 N. Foothill Road in the City of Beverly Hills. The site is located entirely within the AP Fault Hazard zone. To resolve the issue of Holocene time faulting, ECI drilled two continuously cored borings, pushed 6 CPT soundings, and excavated one trench. The consultant estimated the age of subsurface paleosols and observed and documented un-broken pre-Holocene stratigraphy and concluded that the site is not impacted by faulting.

METHODOLOGY

Approach

The subsurface investigation was designed to investigate across the subject site in a northwest-southeast oriented transect within the alley adjacent to the subject site. (see Figure 10). Typically, trenching is the preferred method for evaluating the presence or absence of faults because it offers a continuous, direct exposure of the fault zone or near surface stratigraphy. However, this portion of the SMBFZ is difficult to expose in trenches due to the dense urban cover in the vicinity. Because of existing structures, underground utilities, and the extent of data collected from the neighboring sites (FGC, 2018a 2018b), this fault study consists of a transect of 4 continuously cored borings and 11 CPT soundings. The borings and CPT's are located on a 1 inch = 10 foot scale base map, and the subsurface data are plotted on a 1 inch = 10 foot scale cross section for interpretation (Figures 12 and 13).

Field Exploration

Prior to beginning the subsurface field exploration, work permits were obtained from the City of Beverly Hills. Underground Service Alert (USA) was notified to identify buried utilities in the vicinity of the proposed excavations, and an independent utility locating company was also contracted to verify "no-conflict" areas for the drilling/CPT exploration.

Subsurface exploration of the four continuously cored borings and eleven CPT soundings were completed on July 31, 2018. The borings and CPT's were excavated to a maximum depth of 50 feet beneath the existing ground surface. The boring logs and soil descriptions, and CPT report are included in Appendices A, B, and C and Tables 1 and 2 respectively.

GEOLOGIC MATERIALS

The continuity of soil (pedogenic) horizons and primary stratigraphic contacts provides data to evaluate the presence or absence of faulting. Five conformable stratigraphic units within the alluvium were encountered in each of the 4 borings and 11 CPT's (Appendix B). In general, these units consist of a basal coarse-grained sediments, fining-upward to fine sand and silt and local clays, typically capped by a buried paleosol.

Holocene Alluvial Fan Deposit 1 (Qal1)

The uppermost unit in section A-A' (Figures 12 and 13) is composed of silty sand to silty sand with clay. Gravels are generally fine, sub angular to sub rounded fragments of slate. Hues are in the 7.5YR range (brown). We interpret this unit as a late Holocene age alluvial deposit (sheet flow), and designate it as Qal1. A thin veneer of artificial fill overlies this unit across a majority of the study area. Unit Qal1 includes both a surficial alluvial deposit and a weakly-developed and truncated argillic soil.

Holocene Alluvial Fan Deposit 2 (Qal2)

The lowest Holocene unit in section A-A' (Figures 12 and 13) is composed of sandy clay to clayey sand. Localized gravels at the base of this unit are generally massive and fine to medium grained, sub rounded fragments of slate. Hues are in the 7.5YR range (brown). We interpret this unit as an early Holocene to latest Pleistocene aged alluvial deposit (axial valley deposit), and designate it as Qal2. A thin scour deposit overlies and truncates this unit across a majority of the study area. Qal2 includes alluvial deposits with a thick, diffuse (cumulic), and weakly-developed argillic soil.

Pleistocene Alluvial Fan Deposit 1 (Qoa1)

The uppermost Pleistocene unit in section A-A' (Figures 12 and 13) is composed of gravelly clayey sand to sandy clay. Gravels are generally fine to medium grained, sub angular and highly weathered fragments of slate. Hues are in the 7.5 to 5YR range (brown to reddish brown). We interpret this unit as a late Pleistocene age alluvial fan deposit (debris flow), and designate it as Qoa1. A strong scour deposit overlies this unit across the entire study area. Unit Qoa1 includes alluvial deposits that contain a well-developed and truncated argillic soil. The contact between Qal2 and Qoa1 is found at a depth of approximately 26 feet across the entire study area.

Pleistocene Alluvial Fan Deposit 2 (Qoa2)

Beneath unit Qoa1, we encountered a unit composed of silty sand with gravel to sandy clay. Gravel is interbedded within this unit, and is composed of fine, medium and coarse-grained, rounded slate and sandstone. Hues are in the 7.5YR range (brown) with localized faint mottling with 2.5YR olive to grayish brown. This unit is interpreted as a highly weathered late Pleistocene braided stream channel deposit that contains two highly truncated, thin and moderately well-developed soil remnants and we designate it as unit Qoa2. The contact between Qoa1 and Qoa2 is found at a depth of approximately 34 feet across the entire study area.

Pleistocene Alluvial Fan Deposit 3 (Qoa3)

Beneath unit Qoa2, we encountered a unit composed of sandy clay to silty sand with gravel. Gravel is interbedded within this unit, and is composed of fine and medium-grained, highly weathered and sub rounded to sub angular slate and sandstone. Hues are in the 7.5YR range (brown) with faint localized mottling with 2.5YR olive to grayish brown. This unit is interpreted as a highly weathered late Pleistocene braided stream channel deposit that contains a highly truncated, stacked and well developed soil remnant designated as Qoa3. Unit Qoa3 is the oldest unit encountered during the subsurface exploration. The contact between Qoa2 and Qoa3 is found at a depth of approximately 45 feet across the entire study area.

Soil Development/Soil Profiles

The borings (see Figures 12, 13 and Appendix A) lie across a graded (or stripped) and artificially filled surface that is geomorphically inactive. The soil profile in each boring at depth consists of a truncated sequence of multiple stacked and truncated Alfisol soils (Qoa1, Qoa2, and Qoa3). The entire section in this locality is capped by 6 to 7 feet of artificial fill. Parent materials for these soils consist chiefly of slate-rich debris flow and/ or stream terrace deposits that have most likely emanated from Benedict Canyon. The deepest exposures contain faint mottling and gleying that increases with depth and may faintly overprint or mask some of the original soil properties (mainly soil color). Soil profiles in each boring contains a surface soil and 4 buried soils to depths of approximately 50 feet below the ground surface. This stratigraphic section tracks across the entire area investigated. The individual soil profile members and relative age estimates are briefly described below.

The uppermost or surface soil on site (Qal1) is a highly truncated soil remnant that consists of one weakly developed argillic diagnostic subsurface horizon (Bt – BC). The deposit consists of a crudely stratified fining upwards sequence. This soil member is characterized by a coarse-grained deposit with 7.5YR hues and few thin thick clay films on ped faces and coating gravel and has an estimated relative age of 4 – 8 ka (Appendix B).

The lowest Holocene soil on site (Qal2) is a diffuse and cumulic soil remnant that consists of a thick and weakly developed argillic diagnostic subsurface horizon (2Bt – 2BC – 2C). The deposit consists of a crudely stratified fining upwards sequence. This soil member is characterized by basal gravel and fine-grained deposit with 7.5YR hues and common thin thick clay films on ped faces and coating gravel. Qal2 has an estimated relative age of 12 – 21 ka (Appendix B).

The youngest Pleistocene aged soil on site (Qoa1) is the remnant of a strongly developed Alfisol soil. This is a highly truncated soil that consists of two moderately well-developed argillic diagnostic

subsurface horizons (3Bt1 – 3Bt2 – 3BC). The deposit consists of a fining upwards to massive deposit and most likely represents the distal portion of a debris flow deposit. This soil member is characterized by a gravel-rich and fine-grained deposit with 5 to 7.5YR hues and many thin and common moderately thick clay films on ped faces and coating gravel. This soil member has a relative age estimate of 25 - 51 ka.

The third buried soil member on site (Qoa2) is a truncated and older cumulic soil remnant that consists of a thick and moderately well-developed argillic soil profile (4Btb – 4BC). The deposit consists of a crudely stratified fining upwards sequence. This soil member is characterized by a fine-grained deposit with 7.5YR hues locally mottled with 2.5YR hues, with common thin and few to common moderately thick clay films on ped faces and has an estimated relative age of 33 – 64 ka (Appendix B).

The oldest and lowest buried soil member on site (Qoa3) is a truncated and stacked soil remnant that consists of two moderately well-developed punctuated argillic soil profiles (5Btb – 5BC - 6Bt – 6BC). The deposit consists of two crudely stratified fining upwards sequences. This soil member is characterized by a stratified deposit with 7.5YR hues locally mottled with 2.5YR hues, with few to common thin and few moderately thick clay films. Qoa3 and the entire stratigraphic section under study has an estimated relative age of 46 – 94 ka (Appendix B).

In conclusion, the entire stratigraphic sequence exposed at the project site is estimated to be in excess of 46 ka in age. The project site contains Pleistocene-aged materials at depth. The stratigraphic units encountered provide visually and texturally distinct, mappable contacts that are overlapping across the project site area and across the transect of borings. No features or structural characteristic of faulting, such as shear zones or high angle contacts between units, were observed within the core samples. The contacts between Qoa1 and Qoa2 and between Qoa2 and Qoa3 are observed to undulate and slope gently the south as would be expected by normal sedimentary processes.

EVIDENCE FOR THE ABSENCE OF FAULTING

Several subsurface geologic relationships at 456 N. Rodeo Drive provide direct evidence that preclude Holocene faulting. When these relationships are considered together, there is compelling evidence for the absence of faulting beneath the subject site. The primary lines of evidence that support the interpretation that no faults traverse the site are:

• **Continuous, unfaulted soil horizons and primary stratigraphy across the site.** The exploration conducted on site exhibits multiple continuous stratigraphic horizons across the entire boring and CPT transect. All of the deposits encountered along the transect correlate well across the project site. If faults with a vertical component of slip were active in this area, they would have produced recognizable, vertical separations of these Pleistocene units. Similarly, active strike-slip faulting would have produced an apparent dip-slip component or truncation of units due to the juxtaposition of different Pleistocene strata or pedogenic horizons.

• **No faults were encountered in the subsurface exploration.** No features characteristic of faulting, such as shear zones or high angle contacts between units were observed within the collected continuously cored samples. Though not compelling enough to preclude the presence of faulting, it is consistent with and corroborates other lines of evidence.

• **No irregularities or topographic features indicative of faulting were observed:** Geomorphically, the project site exists on an incised and degraded Holocene-aged alluvial fan deposit. Mapping by Campbell at al., (2014), Yerkes and Campbell (2005), Dibblee and Ehrenspeck (1991) and Hoots and Kew (1931) confirm this and is further supported by the findings of this report. Moreover, the site lies north of the eastward projection of the existing Santa Monica Fault Zone, and no escarpments are apparent on historic topographic maps.

Supporting evidence from neighboring investigations: The data collected and conclusions reached within the approved accompanying reports for 468 N Rodeo Drive and 461 N. Beverly Drive reinforce the conclusions and overall findings of this report (FGC, 2018a, 2018b).

CONCLUSIONS AND RECOMMENDATIONS

The fault investigation for 456 N. Rodeo Drive documents continuous unbroken, pre-Holocene sediments across the entire site. The observed continuous and un-broken stratigraphy implies that no active faults traverse the site. The project site is not exposed to the hazard of surface fault rupture which would impact or limit future development of the site.

While the area explored in our study is not likely subject to surface faulting, a future earthquake on the Santa Monica Boulevard, Santa Monica, Hollywood, or Newport - Inglewood fault zones will likely produce very strong, near-field ground motions at the project site that must be assessed by an appropriate geotechnical evaluation of the site.

LIMITATIONS

The conclusions and recommendations presented herein are the results of an inherently limited scope. Specifically, the scope of services consisted of an assessment of whether or not active faults are present within the area explored at the site. The conclusions and recommendations contained in this report are professional opinions derived in accordance with current standards of professional practice. No warranty is expressed or implied.

This report has been prepared for the exclusive use of 456 N. Rodeo Drive LLC and applies only to potential future development at the site located at 456 N. Rodeo Drive in the City of Beverly Hills, California. In the event that significant changes in the development planning should occur, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed by Feffer Geological, and the conclusions and recommendations of this report are verified in writing.

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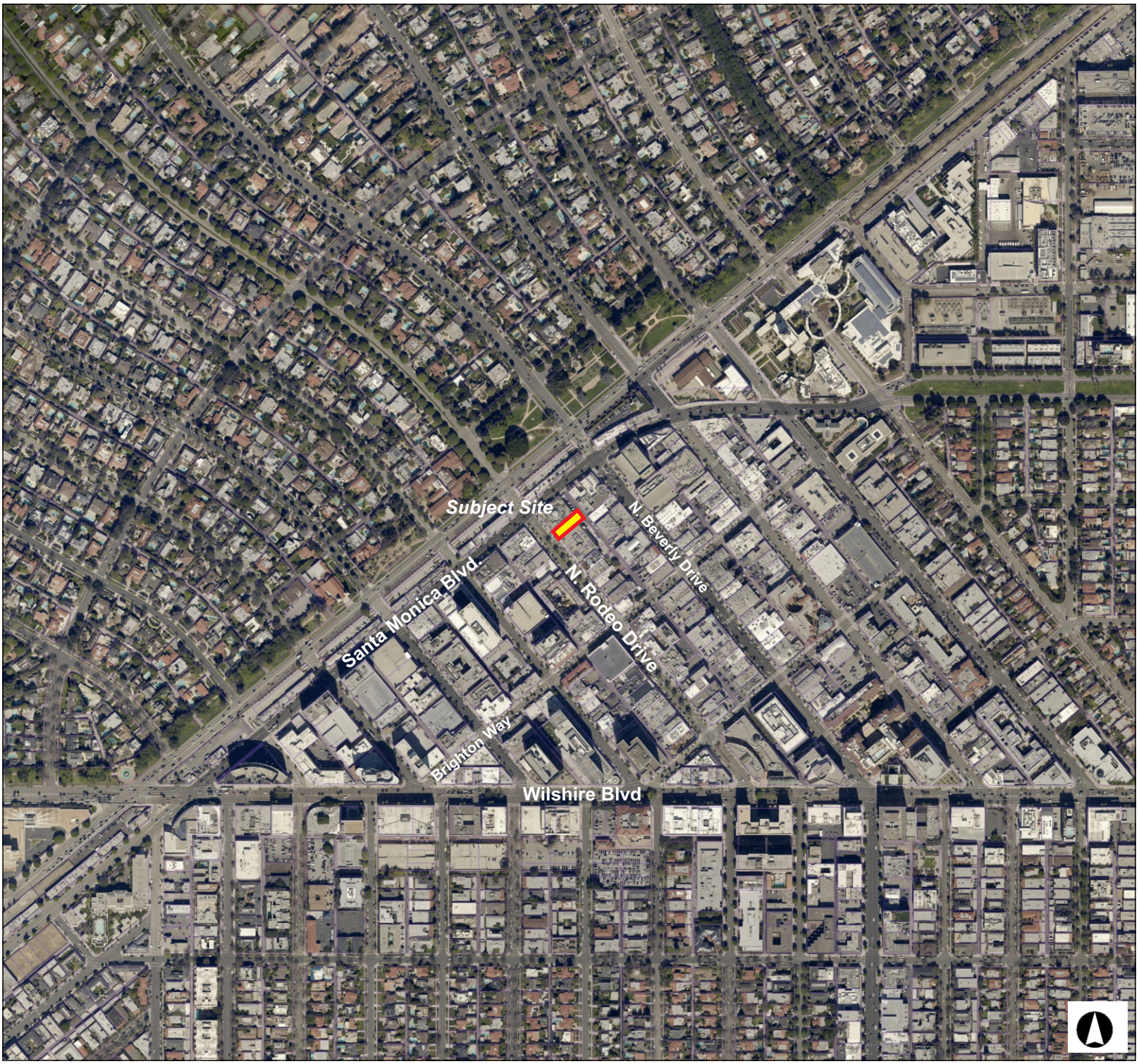
Figures

(Oversized Documents Included: Fig. 2, Fig. 4, Fig. 8, Fig. 10, Fig. 11, Fig. 12, Fig. 13)

&

Tables

456 N. Rodeo Drive



This map is for reference only and should not be used for legal decisions. While the County of Los Angeles makes its best effort to ensure data is accurate, the County makes no representation or warranty of any kind.



FEFFER GEOLOGICAL CONSULTING

Approximate Scale (*Feet*)

1,600 0 800 1,600

Figure 1

Site Location Map

Modified From The LACounty.gov GIS Viewer

Figure 2

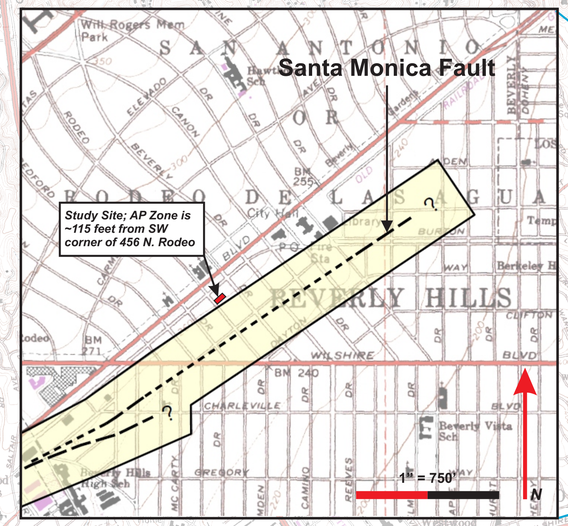
Modified from Plate 3 - FER 259

FAULTS RECOMMENDED FOR ZONING

EXPLANATION

- fault, approximately located
- fault, certain
- fault, concealed
- fault, inferred
- fault, inferred, queried
- Recommended Alquist-Priolo Earthquake Fault Zones
- Existing Alquist-Priolo Earthquake Fault Zones

FEFFER GEOLOGICAL CONSULTING



Hollywood Fault

Hollywood Quadrangle

456 N. Rodeo

Santa Monica Fault

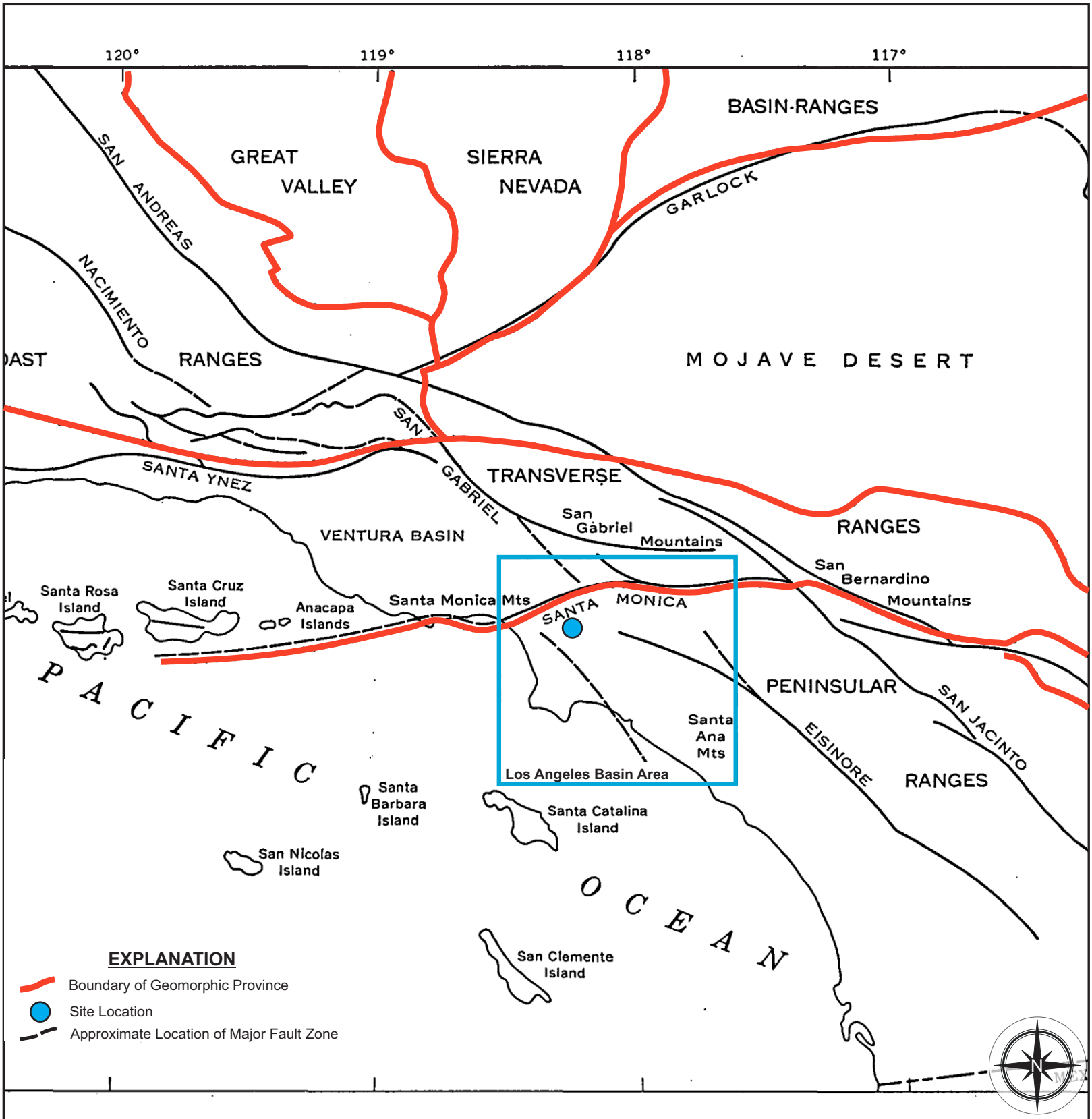
West Pico Fault

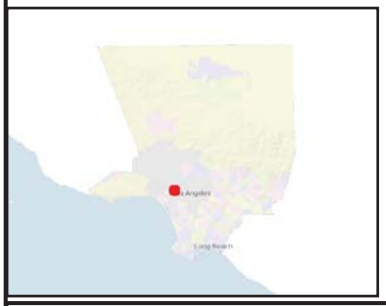
Newport-Inglewood Fault

Topanga Quadrangle

Beverly Hills Quadrangle

0 1,500 3,000 4,500 6,000 Feet





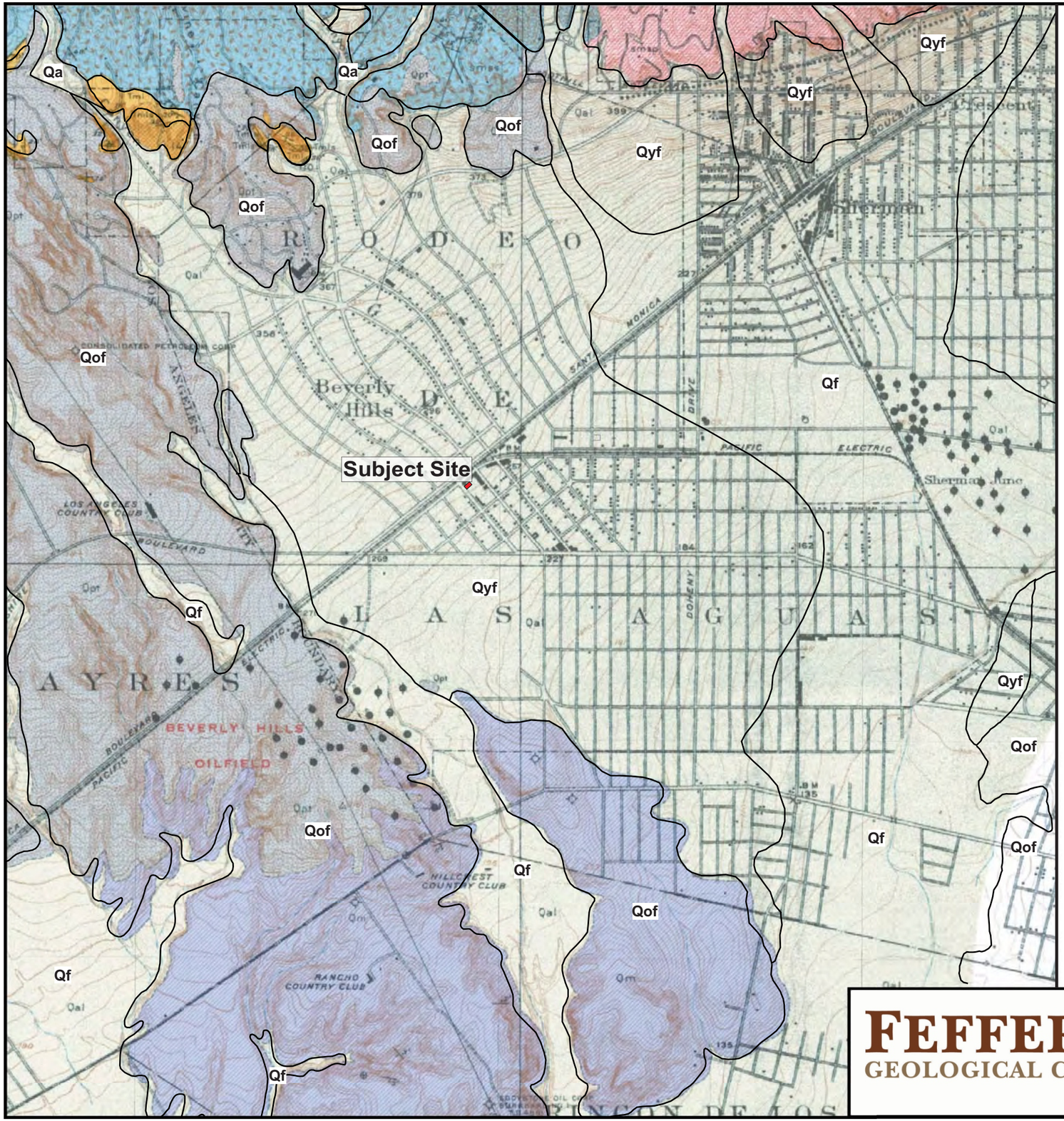
FEFFER GEOLOGICAL CONSULTING

MILES
0 40 80

Figure 3

Regional Geomorphic Province Map

Modified from Yerkes et al., (1965)



EXPLANATION

Geomorphic surfaces which include active channels (Qa), active alluvial fan deposits (Qf), young alluvial fan deposits (Qyf), and old alluvial fan deposits (Qof). (Yerkes and Campbell, 2005)

Sedimentary Deposits

Qal — Alluvium: Coarse unconsolidated deposits in valleys and stream channels (Holocene)

Qpt — Alluvial plain, stream, and marine terrace deposits (Upper Pleistocene)

Sedimentary Rocks

Qm — Marine deposits: Marine sandstone, conglomerate, and clay shale (Upper Pleistocene).

Tml — Modelo Formation: Marine; lower member; consisting of interbedded, hard, platy siliceous shale and softer brown shale (Miocene).

Tmls — Modelo Formation: Marine; lower member; consisting of lenticular beds of coarse grained sandstone (Miocene).

Metamorphic Rocks

smss — Santa Monica Slate: Dark gray to blue-black slate (Triassic).

smsp — Santa Monica Slate: Dark gray mica schist and phyllite cut by white quartz veins (Triassic).

Igneous Rocks

g — Granite and granodorite (Jurrasic).

N

2000 1000 0 2000 4000

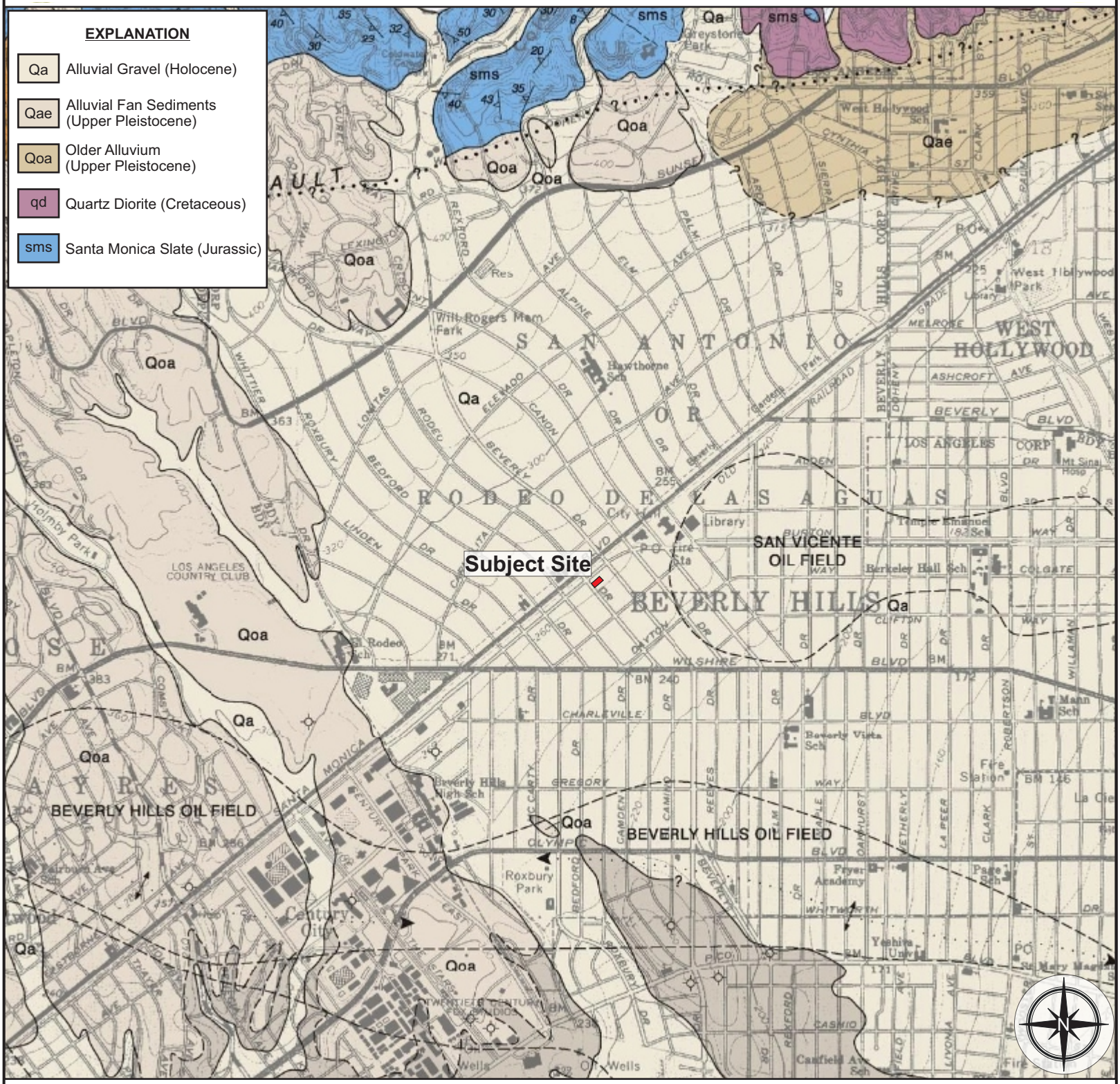
FEET

Modified from Hoots and Kew (1931) and Yerkes and Campbell (2005)
Contour Interval: 25 and 5 feet

FEFFER GEOLOGICAL CONSULTING

Figure 4
Regional Geologic Map

Modified from Earth Consultants International (2018)





FEFFER GEOLOGICAL CONSULTING

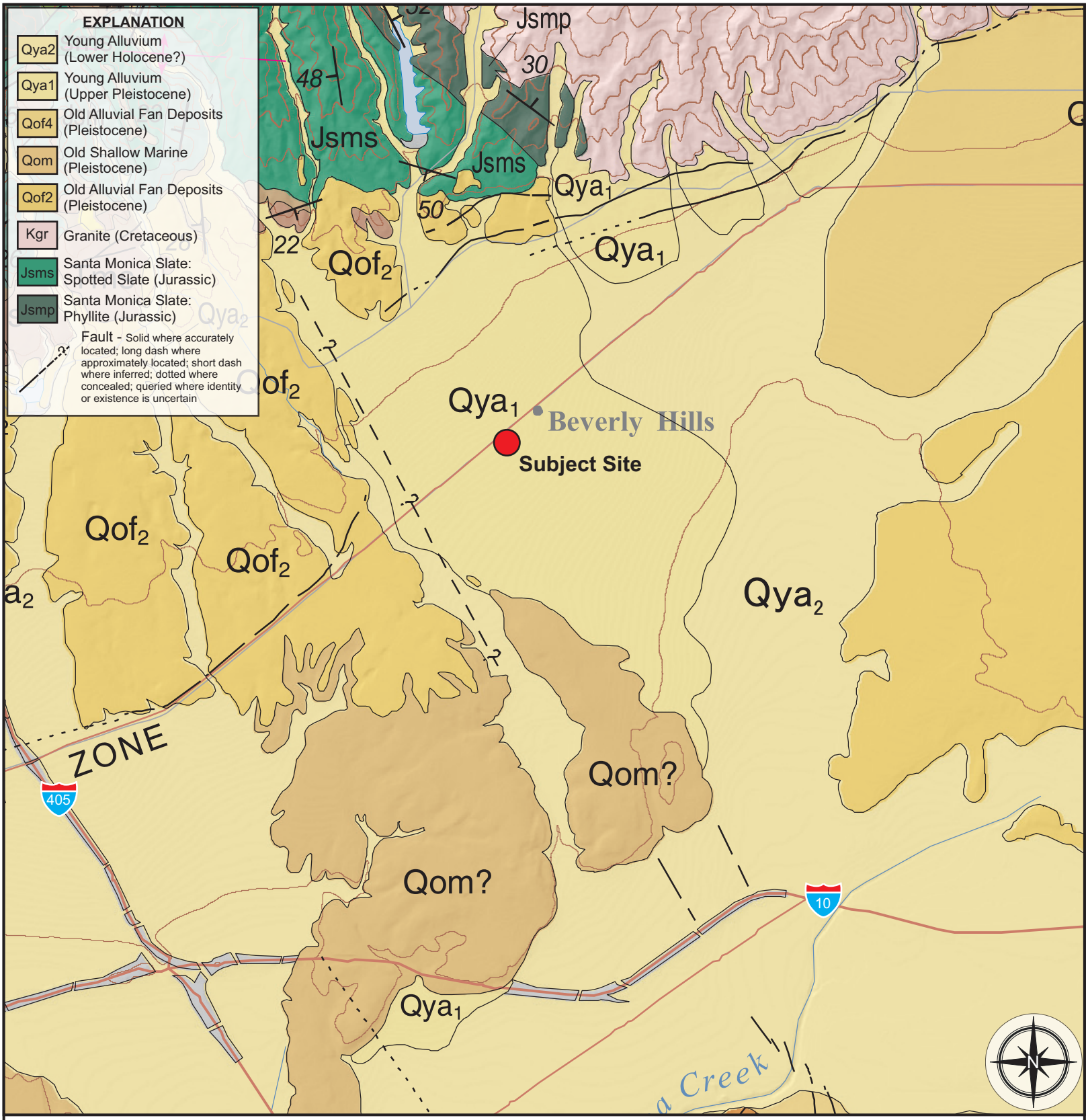
MILES
0 0.5 1

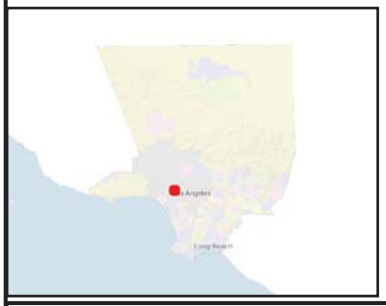
SCALE 1:24000

Figure 5

Regional Geologic Map

Modified from Dibblee & Ehrenspeck (1991)





FEFFER GEOLOGICAL CONSULTING

MILES
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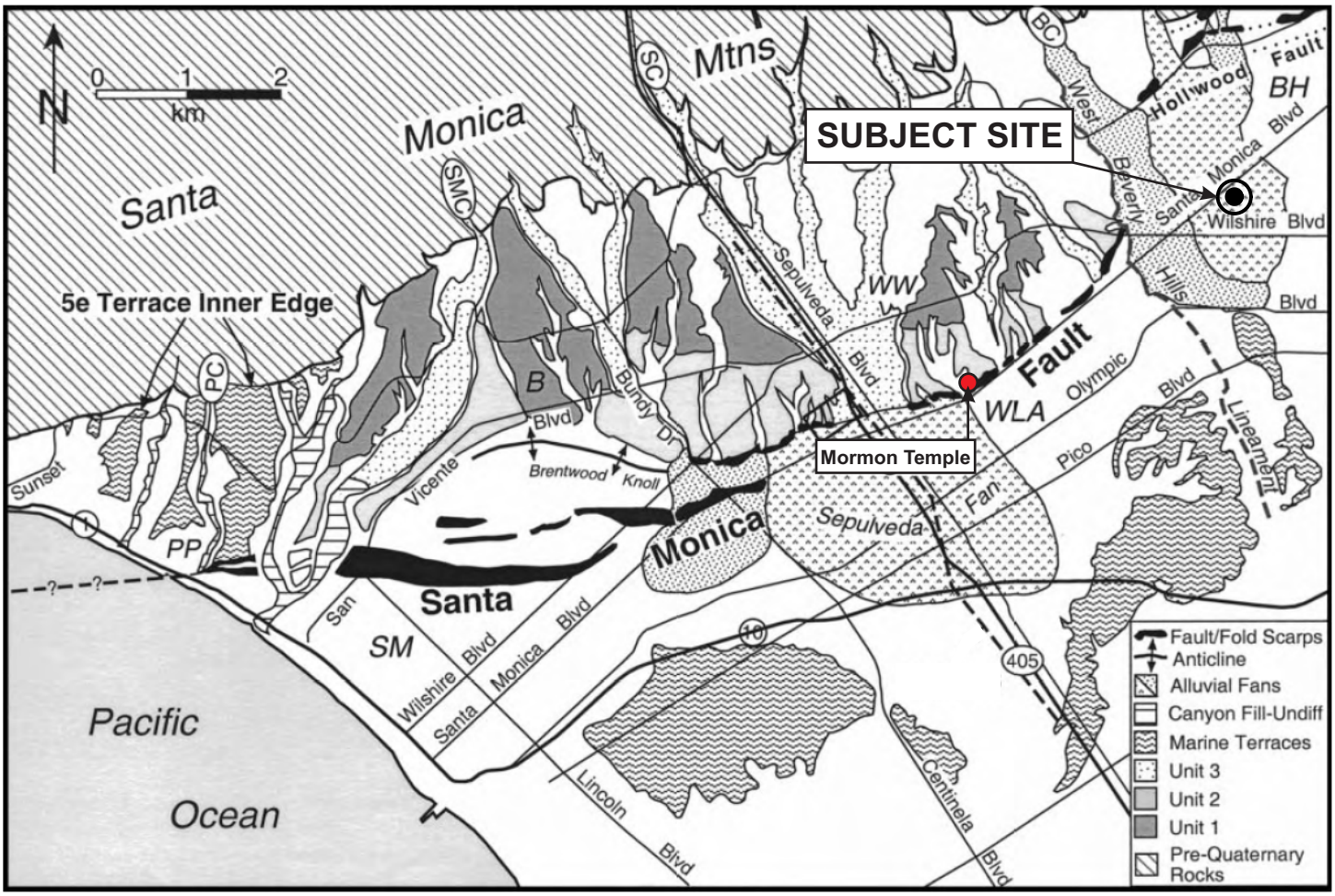
SCALE 1:100,000

Figure 6

Regional Geologic Map

Modified from Campbell et. al., (2014)

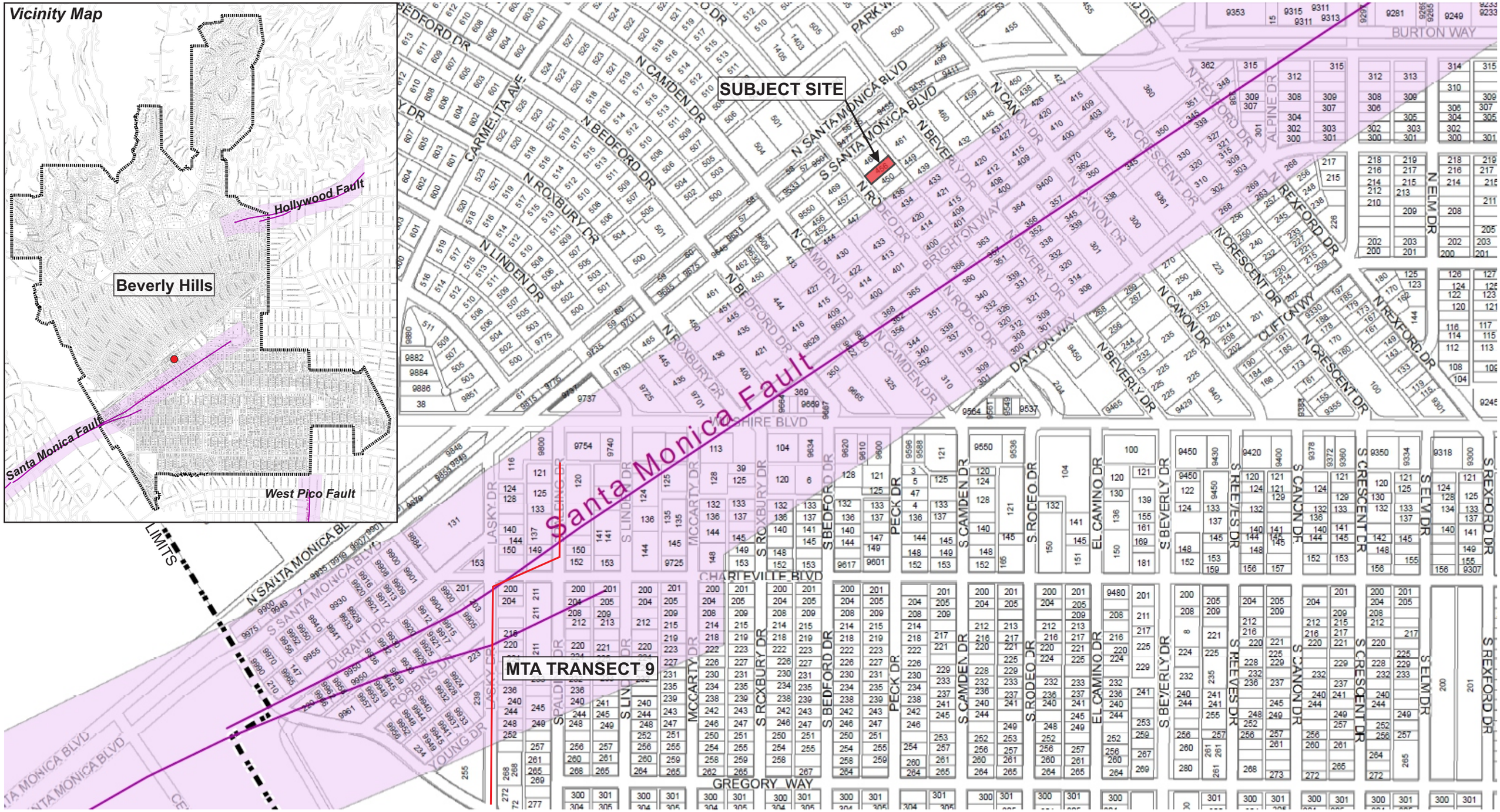


FEFFER GEOLOGICAL CONSULTING

Figure 7

Regional Fault Expression Map

Modified from Dolan et al., (2000)



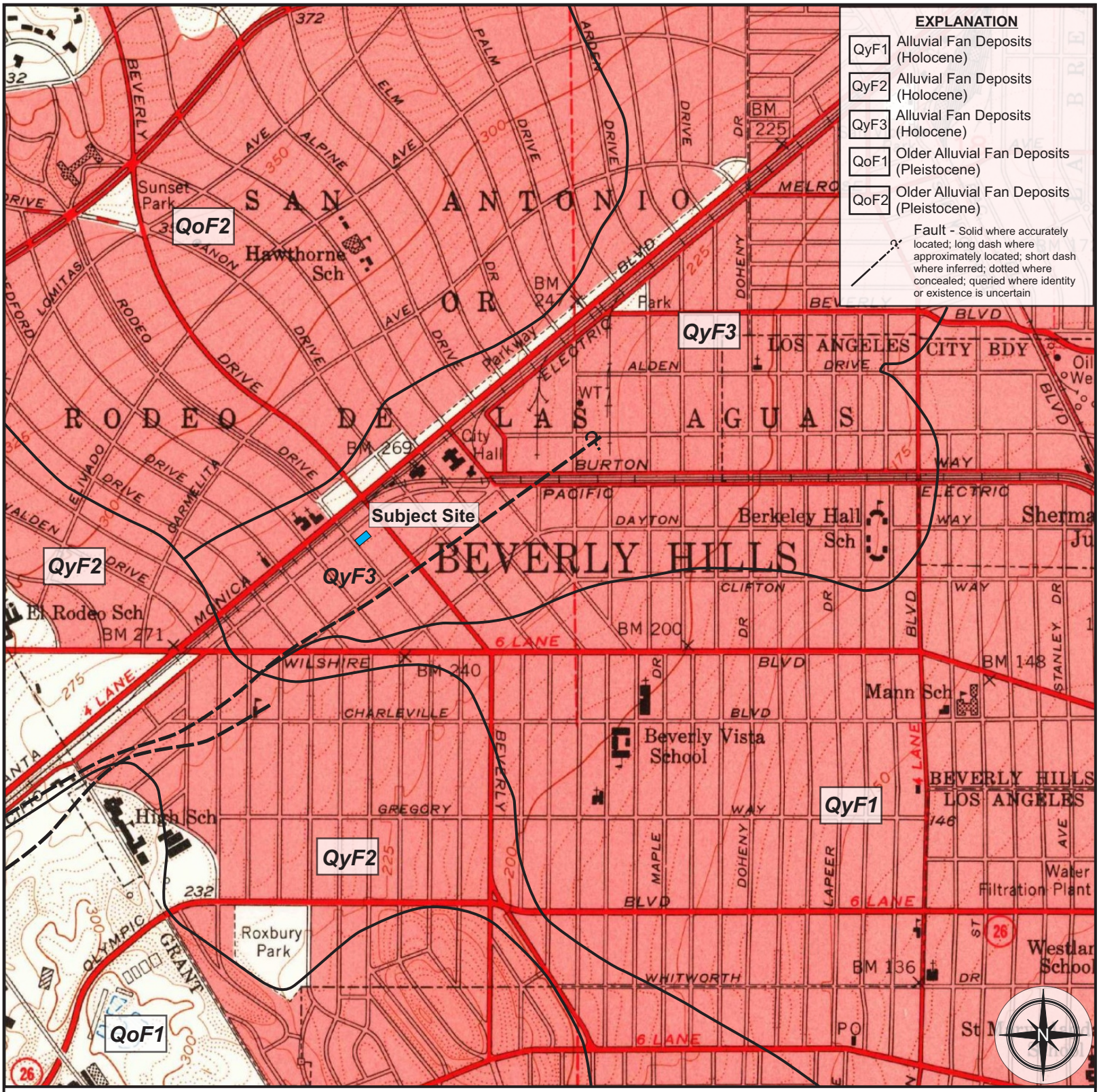
FEFFER
GEOLOGICAL CONSULTING

Figure 8

Beverly Hills Fault Map

Modified from the City of Beverly Hills "Final Earthquake Fault Zone January 2018" (2018)

250 125 0 250 750
FEET





FEFFER GEOLOGICAL CONSULTING

MILES
0 0.5 1

SCALE 1:24000

Figure 9

Site Topographic and Quaternary Geologic Map

Modified from the LACounty.gov GIS Viewer (2018) and USGS (1950)

DATE OF FIELD SURVEY

OCTOBER 11, 2017

TAX PARCEL NO.

4343-016-002

TITLE INFORMATION

THE TITLE INFORMATION SHOWN HEREON IS PER PRELIMINARY REPORT FOR TITLE INSURANCE NO. 09171118-917-JW7-DA6, DATED OCTOBER 6, 2017 AS PREPARED BY COMMONWEALTH LAND TITLE COMPANY, LOS ANGELES, CALIFORNIA [TITLE OFFICER: DOUG ABERNATHY, TELEPHONE: (213) 330-3055] NO RESPONSIBILITY OF CONTENT, COMPLETENESS OR ACCURACY OF SAID REPORT IS ASSUMED BY THIS MAP OR THE SURVEYOR.

RECORD OWNER

KARL B. SCHURZ, TRUSTEE OF THE KARL B. SCHURZ SEPARATE PROPERTY TRUST, UNDER DECLARATION OF TRUST DATED DECEMBER 10, 1986.

LEGAL DESCRIPTION

LOT 3 IN BLOCK 2 OF BEVERLY, IN THE CITY OF BEVERLY HILLS, COUNTY OF LOS ANGELES, STATE OF CALIFORNIA, AS PER MAP RECORDED IN BOOK 11 PAGE 94 OF MAPS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY.

TITLE EXCEPTIONS AND EASEMENTS

A. TAXES.

(NOT A SURVEY MATTER – PERTAIN TO TAXES)

B. THE HEREIN DESCRIBED PROPERTY LIES WITHIN THE BOUNDARIES OF A MELLO-ROOS COMMUNITY FACILITIES DISTRICT (CFD), RECORDED NOVEMBER 6, 2002 AS INSTRUMENT NO. 02-2660064 OFFICIAL RECORDS.

(NOT A SURVEY MATTER – PERTAIN TO TAXES)

C. TAXES.

(NOT A SURVEY MATTER – PERTAIN TO TAXES)

1. WATER RIGHTS, CLAIMS OR TITLE TO WATER, WHETHER OR NOT DISCLOSED BY THE PUBLIC RECORDS.

2. A COMMUNITY OIL AND GAS LEASE FOR THE TERM THEREIN PROVIDED, EXECUTED BY THE PARTIES HEREIN NAMED, AND OTHER PARTIES AS OWNERS OF OTHER LANDS DESCRIBED IN SAID LEASE, WITH CERTAIN COVENANTS, CONDITIONS AND PROVISIONS, TOGETHER WITH EASEMENTS, IF ANY, RECORDED SEPTEMBER 23, 1964 AS INSTRUMENT NO. 3160 OFFICIAL RECORDS. AN AGREEMENT TO AMEND OR MODIFY CERTAIN PROVISIONS OF SAID LEASE, AS SET FORTH IN THE DOCUMENT RECORDED JUNE 1, 1984 AS INSTRUMENT NO. 84-656696, OFFICIAL RECORDS.

(DOCUMENT AFFECTS – NOTHING TO PLOT)

3. A COMMUNITY OIL AND GAS LEASE FOR THE TERM THEREIN PROVIDED, EXECUTED BY THE PARTIES HEREIN NAMED, AND OTHER PARTIES AS OWNERS OF OTHER LANDS DESCRIBED IN SAID LEASE, WITH CERTAIN COVENANTS, CONDITIONS AND PROVISIONS, TOGETHER WITH EASEMENTS, IF ANY, RECORDED APRIL 7, 1998 AS INSTRUMENT NO. 98-563201, OFFICIAL RECORDS.

(DOCUMENT AFFECTS – NOTHING TO PLOT)

4. A DEED OF TRUST TO SECURE AN INDEBTEDNESS, RECORDED OCTOBER 24, 2006 AS INSTRUMENT NO. 06-2358118 OFFICIAL RECORDS.

(DOCUMENT AFFECTS – NOTHING TO PLOT)

5. AN ASSIGNMENT OF ALL THE MONEYS DUE, OR TO BECOME DUE AS RENTAL, AS ADDITIONAL SECURITY FOR THE OBLIGATIONS SECURED BY DEED OF TRUST, RECORDED OCTOBER 24, 2006 AS INSTRUMENT NO. 06-2358118 OFFICIAL RECORDS. ASSIGNED TO SYMETRA LIFE INSURANCE COMPANY, A WASHINGTON CORPORATION, RECORDED OCTOBER 24, 2006 AS INSTRUMENT NO. 06-2358117 OFFICIAL RECORDS

(DOCUMENT AFFECTS – NOTHING TO PLOT)

6. ANY INVALIDITY OR DEFECT IN THE TITLE OF THE VESTEES IN THE EVENT THAT THE TRUST REFERRED TO HEREIN IS INVALID OR FAILS TO GRANT SUFFICIENT POWERS TO THE TRUSTEE(S) OR IN THE EVENT THERE IS A LACK OF COMPLIANCE WITH THE TERMS AND PROVISIONS OF THE TRUST INSTRUMENT.

(NOT A SURVEY MATTER)

7. ANY RIGHTS, INTERESTS, OR CLAIMS WHICH MAY EXIST OR ARISE BY REASON OF THE FOLLOWING MATTERS DISCLOSED BY SURVEY, PROJECT NO.: 17-509DRC, DATED: OCTOBER 13, 2017, LAST REVISED _____, 2017 AND PREPARED BY: DRC ENGINEERING, INC.

8. ANY RIGHTS OF THE PARTIES IN POSSESSION OF A PORTION OF, OR ALL OF, SAID LAND, WHICH RIGHTS ARE NOT DISCLOSED BY THE PUBLIC RECORDS.

9. INTENTIONALLY DELETED.

10. INTENTIONALLY DELETED.

ALTA/NSPS TABLE A ITEM NOTES

ITEM 2 THE SITE ADDRESS OBSERVED WHILE CONDUCTING THE SURVEY IS: 456 NORTH RODEO DRIVE, BEVERLY HILLS, CA 90210

ITEM 3 THE LAND SHOWN ON THIS SURVEY LIES ENTIRELY WITHIN FLOOD ZONE "X" (UNSHADED), BEING DESCRIBED AS "AREAS DETERMINED TO BE OUTSIDE THE 0.2% ANNUAL CHANCE FLOODPLAIN." PER FLOOD INSURANCE RATE MAP (FIRM) – COMMUNITY PANEL NUMBER 06037C1585F, DATED SEPTEMBER 26, 2008

ITEM 4 THE GROSS LAND AREA IS: 7,634 SF / 0.175 ACRES

ITEM 6(a) THE CURRENT ZONING CLASSIFICATION IS "C-3" COMMERCIAL ZONE PER THE PLANNING & ZONING RESOURCE COMPANY ZONING VERIFICATION LETTER DATED OCTOBER 19, 2017.

BUILDING SET-BACK LINES:
FRONT/SIDE/REAR: NOT APPLICABLE / NONE SPECIFIED.

MAXIMUM BUILDING HEIGHT OR STORIES:
45 FEET OR 3 STORIES, WHICHEVER IS LESS.

ITEM 6(b) SEE THE SURVEY PLAT FOR THE LOCATION OF SETBACK LINES.

ITEM 7(a) SEE THE SURVEY PLAT FOR EXTERIOR DIMENSIONS OF ALL BUILDINGS AT GROUND LEVEL.

ITEM 7(b)(1) SEE THE SURVEY PLAT FOR THE SQUARE FOOTAGE OF THE EXTERIOR FOOTPRINT OF ALL BUILDINGS AT GROUND LEVEL.

ITEM 7(c) SEE THE SURVEY PLAT FOR THE MEASURED HEIGHT ABOVE GRADE OF ALL BUILDINGS.

ITEM 8 SEE THE SURVEY PLAT FOR ANY SUBSTANTIAL FEATURES OBSERVED IN THE PROCESS OF CONDUCTING THE SURVEY.

ITEM 9 SEE THE SURVEY PLAT FOR ANY PARKING STRIPING AND TYPE OF PARKING SPACE. THE PARKING COUNT IS AS FOLLOWS:

REGULAR SPACES	8
HANDICAP SPACES	1
TOTAL SPACES	9

ITEM 10(a) (PARTY WALLS) SEE SURVEY FOR PARTY WALLS ON THE SUBJECT PROPERTY.

ITEM 13 SEE THE SURVEY PLAT FOR THE NAMES OF ADJOINING OWNERS.

ITEM 14 SEE THE SURVEY PLAT FOR THE DISTANCE TO THE NEAREST INTERSECTING STREET.

ITEM 16 THERE WAS NO EVIDENCE OF RECENT EARTH MOVING WORK, BUILDING CONSTRUCTION, OR BUILDING ADDITIONS OBSERVED IN THE PROCESS OF CONDUCTING THE FIELDWORK.

ITEM 17 THERE ARE NO PROPOSED CHANGES IN STREET RIGHT OF WAY LINES, OR OBSERVED EVIDENCE OF RECENT STREET OR SIDEWALK CONSTRUCTION OR REPAIRS DURING THE PROCESS OF CONDUCTING THE FIELDWORK.

ITEM 18 THE SURVEYOR DID NOT OBSERVE ANY MARKERS DELINEATING WETLANDS ON SUBJECT PROPERTY.

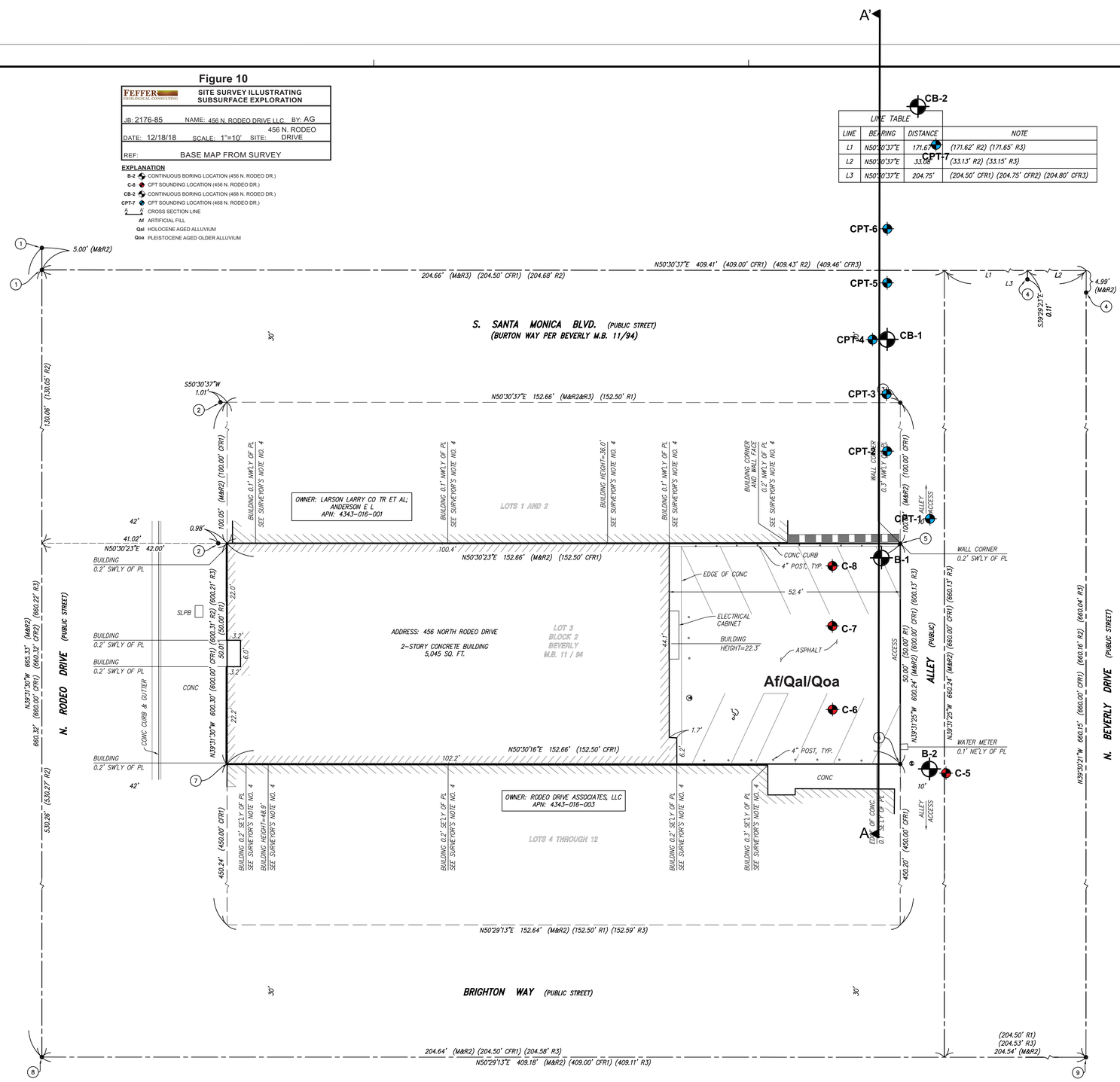
ITEM 19 (IMPROVEMENTS WITHIN OFFSITE EASEMENTS) THE COMMITMENT DID NOT LIST ANY OFFSITE EASEMENTS OR SERVITUDES BENEFITTING THE SURVEYED PROPERTY.

Figure 10

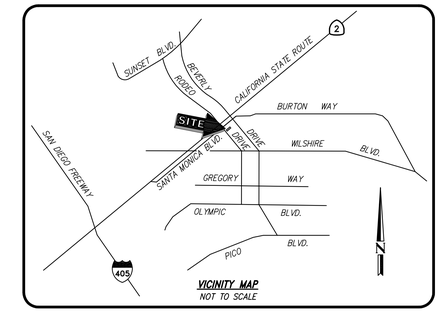
FEFFER GEOLOGICAL CONSULTING	SITE SURVEY ILLUSTRATING SUBSURFACE EXPLORATION
JB: 2176-85	NAME: 456 N. RODEO DRIVE LLC. BY: AG
DATE: 12/18/18	SCALE: 1"=10' SITE: 456 N. RODEO DRIVE
REF:	BASE MAP FROM SURVEY

EXPLANATION

- B-2 CONTINUOUS BORING LOCATION (456 N. RODEO DR.)
- C-8 CPT SOUNDING LOCATION (456 N. RODEO DR.)
- CB-2 CONTINUOUS BORING LOCATION (468 N. RODEO DR.)
- CPT-7 CPT SOUNDING LOCATION (468 N. RODEO DR.)
- A A' CROSS SECTION LINE
- Af ARTIFICIAL FILL
- Qal HOLOCENE AGED ALLUVIUM
- Qoa PLEISTOCENE AGED OLDER ALLUVIUM



LINE TABLE			
LINE	BEARING	DISTANCE	NOTE
L1	N50°30'37"E	171.67'	(171.62' R2) (171.65' R3)
L2	N50°30'37"E	33.09'	(33.13' R2) (33.15' R3)
L3	N50°30'37"E	204.75'	(204.50' CFR1) (204.75' CFR2) (204.80' CFR3)



VICINITY MAP
NOT TO SCALE

BASIS OF BEARINGS

THE BEARINGS SHOWN HEREON ARE BASED ON THE CENTERLINE LINE OF RODEO DRIVE AS SHOWN ON PUBLIC WORK FIELD BOOK 1316, PAGES 1201 AND 1202, BEING NORTH 39°31'30" WEST.

MONUMENT AND ESTABLISHMENT NOTES

- ● INDICATES FOUND MONUMENT AS NOTED BELOW.
- (1) INDICATES FOUND SPIKE AND WASHER, TAG STAMPED "LS 5411" PER (R2).
- (2) INDICATES FOUND LEAD, TACK, AND TAG, STAMPED "LS 6385", 1.00' O/S ON LOT LINE PROD. PER (R2).
- (3) INDICATES FOUND SPIKE AND WASHER TAG, STAMPED "LS 6385" PER (R2).
- (4) INDICATES FOUND SPIKE AND WASHER, TAG STAMPED "LS 5411" PER (R2) AND (R3).
- (5) INDICATES FOUND SPIKE AND WASHER, TAG STAMPED "LS 6385" PER (R2).
- (6) INDICATES FOUND SPIKE AND WASHER ILLEGIBLE, NO REFERENCE. ACCEPTED AS EASTERLY CORNER OF LOT 3, BLOCK 2, M.B. 11/94.
- (7) INDICATES SEARCHED FOUND NOTHING. ESTABLISHED BY PROPORTION PER (R2).
- (8) INDICATES FOUND SPIKE AND WASHER, TAG STAMPED "LS 7230", NO REFERENCE.
- (9) INDICATES FOUND 2" BRASS DISK MONUMENT IN WELL, STAMPED "LS 7230" PER (R2) AND (R3), DOWN 0.70'.

REFERENCES

R1	BEVERLY AS FILED IN BOOK 11, PAGE 94 OF MAPS.
R2	PUBLIC WORK FIELD BOOK 1316, PAGES 1201 AND 1202
R3	PUBLIC WORK FIELD BOOK 1316, PAGES 749 AND 750
(...)	INDICATES RECORD DATA PER R1 UNLESS OTHERWISE NOTED.
M&R	INDICATES MEASURE DATA AND RECORD DATA ARE THE SAME.
CFR	INDICATES "CALCULATED FROM RECORD".

ABBREVIATIONS

CONC	CONCRETE
PL	PROPERTY LINE
SLPB	STREET LIGHT PULL BOX

SYMBOL LEGEND

- ELECTRIC MANHOLE
- SEWER CLEANOUT

LINE LEGEND

- PROPERTY LINE
- CENTER LINE
- BLOCK WALL
- BUILDING LINE

SURVEYORS NOTES

1. THE ACCOMPANYING SURVEY WAS MADE ON THE GROUND AND CORRECTLY SHOWS THE LOCATION OF ALL BUILDINGS, STRUCTURES AND OTHER IMPROVEMENTS SITUATED ON THE ABOVE PREMISES; AND THERE ARE NO VISIBLE ENCROACHMENTS ON THE SUBJECT PROPERTY OR UPON ADJACENT LAND ABUTTING SAID PROPERTY EXCEPT AS SHOWN HEREON.
2. THE PROPERTY DESCRIBED HEREON IS THE SAME AS THE PROPERTY DESCRIBED IN PRELIMINARY REPORT FOR TITLE INSURANCE, ORDER NO. 09171118-917-JW7-DA6 WITH AN EFFECTIVE DATE OF AUGUST 11, 2017 AT 7:30 A.M., PREPARED BY COMMONWEALTH LAND TITLE COMPANY, AND ALL EASEMENTS, COVENANTS AND RESTRICTIONS REFERENCED IN SAID TITLE COMMITMENT OR APPARENT FROM A PHYSICAL INSPECTION OF THE SITE OR OTHERWISE KNOWN HAVE BEEN PLOTTED HEREON OR OTHERWISE NOTED AS TO THEIR EFFECT ON THE SUBJECT PROPERTY.
3. THE SUBJECT PROPERTY HAS DIRECT PHYSICAL ACCESS TO N. RODEO DRIVE AND THE ALLEY AS SHOWN ON BEVERLY AS FILED IN BOOK 11, PAGE 94 OF MAPS.
4. BUILDING ENCROACHES 0.1' INTO THE PROPERTY LOCATED NORTHWESTERLY AND 0.2' TO 0.3' ONTO THE PROPERTY LOCATED SOUTHEASTERLY.

10' 0' 10' 20' 30'
GRAPHIC SCALE: 1"=10'

ALTA/NSPS LAND TITLE SURVEY
456 NORTH RODEO DRIVE
BEVERLY HILLS, CALIFORNIA
TITLE, BOUNDARY, & TOPOGRAPHIC INFORMATION

SURVEYOR'S CERTIFICATE

TO: GARY M. CRAMER, SUCCESSOR TRUSTEE OF THE KARL B. SCHURZ TRUST; SVAP II ACQUISITIONS, LLC, A FLORIDA LIMITED LIABILITY COMPANY; SVAP II RODEO DRIVE, LLC, A DELAWARE LIMITED LIABILITY COMPANY; COMMONWEALTH LAND TITLE COMPANY; CHICAGO TITLE INSURANCE COMPANY; LVMH MOET HENNESSY LOUIS VUITTON, INC.; AND 456 N RODEO DRIVE, LLC

THIS IS TO CERTIFY THAT THIS MAP OR PLAT AND THE SURVEY ON WHICH IT IS BASED WERE MADE IN ACCORDANCE WITH THE 2016 MINIMUM STANDARD DETAIL REQUIREMENTS FOR ALTA/NSPS LAND TITLE SURVEYS, JOINTLY ESTABLISHED AND ADOPTED BY ALTA AND NSPS, AND INCLUDES ITEMS 2, 3, 4, 6(a), 6(b), 7(a), 7(b)(1), 7(c), 8, 9, 10(a), 13, 14, 16, 17, 18, 19, AND 20 OF TABLE "A" THEREOF. THE FIELD WORK WAS COMPLETED ON OCTOBER 11, 2017

PASCAL R. APOTHELOZ, PLS 7734
EMAIL: papotheloz@drc-eng.com

LICENSED LAND SURVEYOR PASCAL R. APOTHELOZ LS 7734 STATE OF CALIFORNIA

DATE: 2/27/2018

NO.:	REVISION:	DATE:
1	REVISED SURVEYOR'S CERTIFICATE PER CLIENT REQUEST.	2/27/2018

ISSUE: FINAL
DATE: 10/24/2017
CHECKED: PRA DRAWN: LNB
DRAWING FILE: 17-509alta101
PROJECT NO.: 17-509
SHEET NUMBER: 1 OF 1 SHEET
SCALE: 1" = 10'

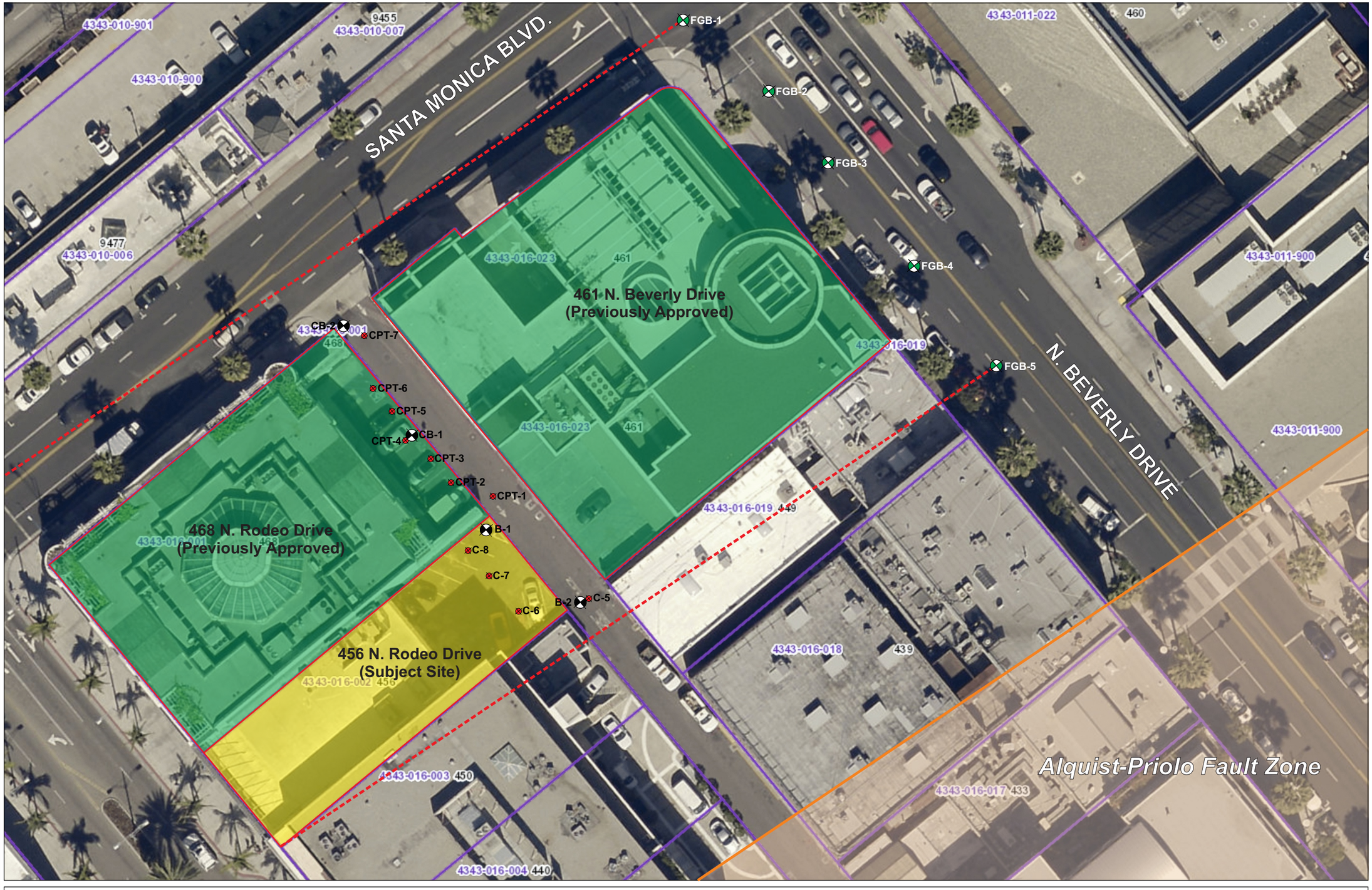
DRC Engineering, Inc.
Civil Engineering/Land Surveying/Land Planning
160 S. Old Springs Road, Ste. 210
Anaheim Hills, California 92808
(714) 685-6860

L:\2017\17-509 Geology Report\Fig1\17-509alta101.dwg, Feb 27, 2018 - 2:38pm

FEFFER
GEOLOGICAL CONSULTING

Figure 11

Map of Previously Approved Fault Investigations in Relation to 456 N. Rodeo Drive





EXPLANATION

CB-2/B2	BORING LOCATIONS FOR 456 & 468 N RODEO
FGB-5	BORING LOCATIONS FOR 461 N BEVERLY
CPT-7/C-8	CPT LOCATIONS FOR 456 & 468 N RODEO
	LATERAL LIMITS OF SUBSURFACE EXPLORATION PARALLEL TO THE STRIKE OF THE SMFZ
	OUTERMOST LIMIT TO OF ALQUIST-PRIOLO FAULT ZONE FOR THE SANTA MONICA FAULT

Modified from LACounty.gov GIS Viewer (2018)

Notes

FEET
100 0 50 100

This map is for reference only and should not be used for legal decisions. While the County of Los Angeles makes its best effort to ensure data is accurate, the County makes no representation or warranty of any kind.

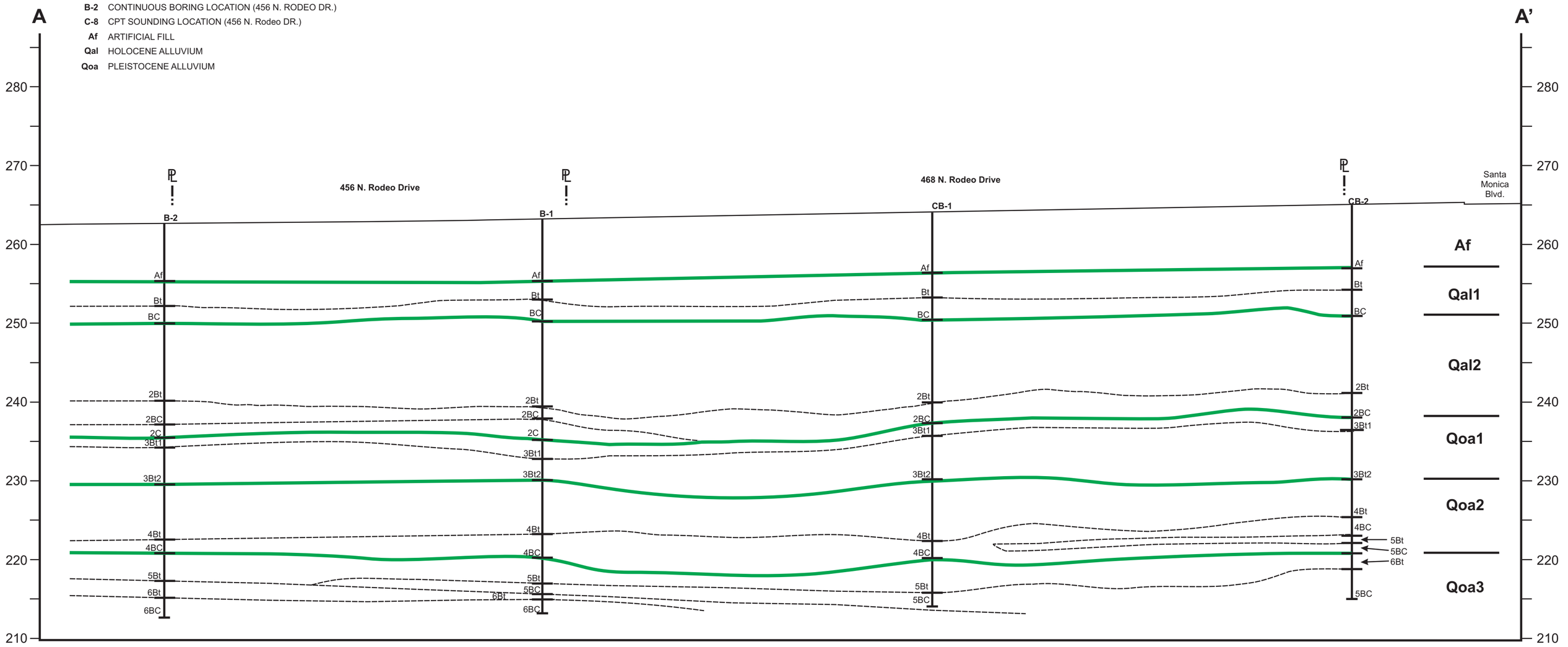
FEFFER GEOLOGICAL CONSULTING	CROSS SECTION A-A’	
JB: 2176-85	NAME: 456 N. RODEO DRIVE LLC.	BY: AG
DATE: 12/18/18	SCALE: 1”=10’	SITE: 456 N. RODEO DRIVE
REF: TOPOGRAPHY FROM LA COUNTY GIS VIEWER		

Figure 12

Boring Depth & Stratigraphic Correlation

EXPLANATION

- **CB-2** CONTINUOUS BORING LOCATION (468 N. RODEO DR.)
- **CPT-7** CPT SOUNDING LOCATION (468 N. Rodeo DR.)
- **B-2** CONTINUOUS BORING LOCATION (456 N. RODEO DR.)
- **C-8** CPT SOUNDING LOCATION (456 N. Rodeo DR.)
- **Af** ARTIFICIAL FILL
- **Qal** HOLOCENE ALLUVIUM
- **Qoa** PLEISTOCENE ALLUVIUM



Graphical Illustration of Lithology

EXPLANATION

- TRUNCATED & BURIED SOIL
- BURIED SOIL

SCOUR DEPOSITS

- BC
- 2BC
- 2C
- 4BC
- 5BC
- 6BC

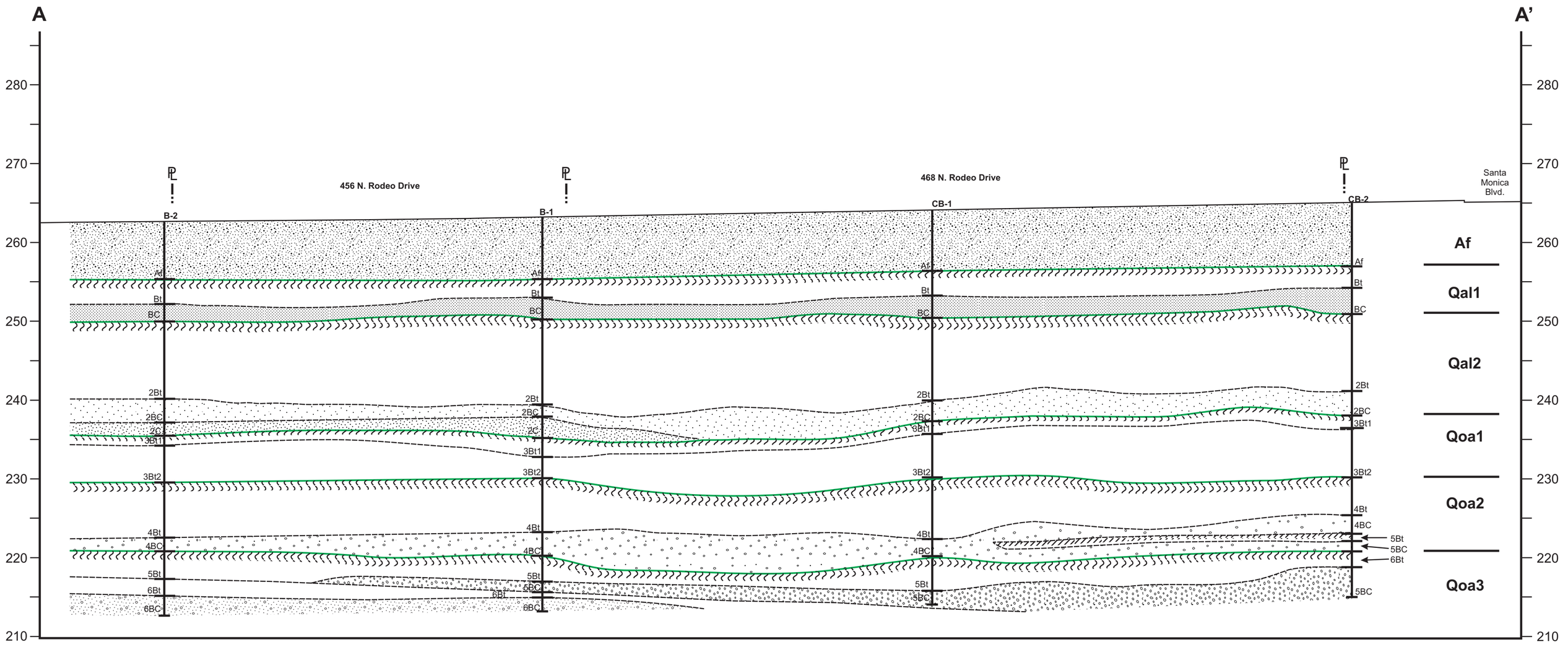
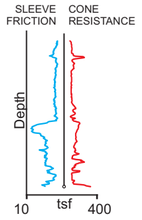


Figure 13

Stratigraphic Correlation of CPTs & Continuous Borings

FEFFER GEOLOGICAL CONSULTING	CROSS SECTION A-A’		
JB: 2176-85	NAME: 456 N. RODEO DRIVE LLC.	BY: AG	
DATE: 12/18/18	SCALE: 1”=10’	SITE: 456 N. RODEO DRIVE	
REF: TOPOGRAPHY FROM LA COUNTY GIS VIEWER			



EXPLANATION

- **CB-2** CONTINUOUS BORING LOCATION (468 N. RODEO DR.)
- **CPT-7** CPT SOUNDING LOCATION (468 N. Rodeo DR.)
- **B-2** CONTINUOUS BORING LOCATION (456 N. RODEO DR.)
- **C-8** CPT SOUNDING LOCATION (456 N. Rodeo DR.)
- **Af** ARTIFICIAL FILL
- **Qal** HOLOCENE ALLUVIUM
- **Qoa** PLEISTOCENE ALLUVIUM

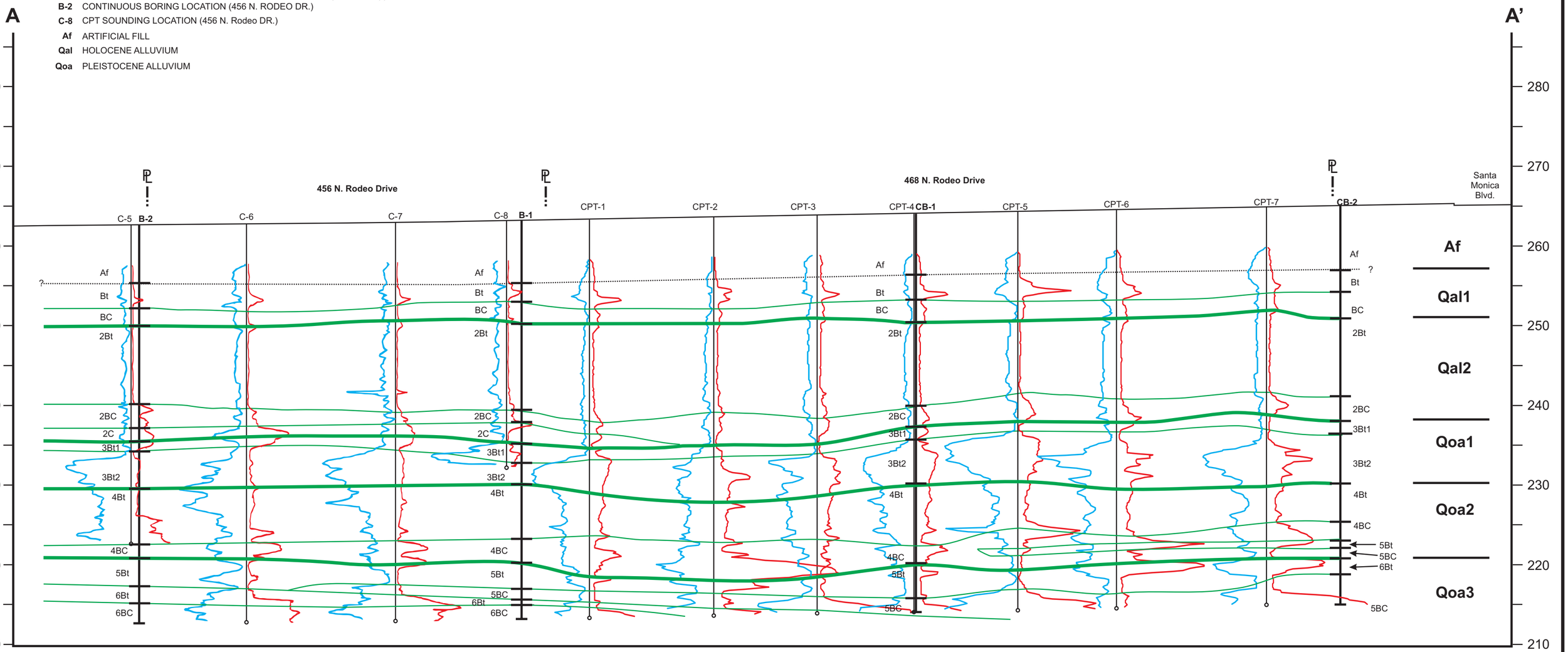


Table 1. Summary of Hollow Stem Auger Borings							
						Groundwater	
Boring No.	Boring Location (See Site Map)	Date Drilled	Total Depth (ft)	Boring G.S. Elevation (ft)	Boring Depth Elevation (ft)	Depth (ft)	Elevation (ft)
CB-1	468 N. Rodeo	7/30/2018	50	264.5	214.5	N.E.	--
CB-2	468 N. Rodeo	7/31/2018	50	265.5	215.5	N.E.	--
B-1	456 N. Rodeo	7/11/2018	50	263.8	213.8	N.E.	--
B-2	456 N. Rodeo	7/11/2018	50	262.5	212.5	N.E.	--

Table 2. Summary of CPT Soundings							
						Groundwater	
CPT No.	Boring Location (See Site Map)	Date	Total Depth (ft)	Boring G.S. Elevation (ft)	Boring Depth Elevation (ft)	Depth (ft)	Elevation (ft)
CPT-1	468 N. Rodeo	7/31/2018	49.87	264	214.13	N.E.	--
CPT-2	468 N. Rodeo	7/30/2018	49.87	264.2	214.33	N.E.	--
CPT-3	468 N. Rodeo	7/31/2018	49.87	264.3	214.43	N.E.	--
CPT-4	468 N. Rodeo	7/31/2018	49.87	264.5	214.63	N.E.	--
CPT-5	468 N. Rodeo	7/31/2018	49.87	264.7	214.83	N.E.	--
CPT-6	468 N. Rodeo	7/31/2018	49.87	265	215.13	N.E.	--
CPT-7	468 N. Rodeo	7/30/2018	49.87	265.4	215.53	N.E.	--
C-5	456 N. Rodeo	7/12/2018	39.77	262.5	222.73	N.E.	--
C-6	456 N. Rodeo	7/11/2018	50.15	263	212.85	N.E.	--
C-7	456 N. Rodeo	7/11/2018	50.07	263.5	213.43	N.E.	--
C-8	456 N. Rodeo	7/12/2018	30.91	263.8	232.89	N.E.	--

APPENDIX 'A'

Boring Logs

LOG OF EXPLORATORY BORING

Job Number: 2176-85
Project: 456 N. Rodeo Drive

Boring No: B-1
Boring Location: See Site Map

Date Performed: 7/11/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
0	1			**0-7.8’:** Fill - Silty sand, scattered concrete and asphalt fragments Hand augered upper 5’ due to utilities	Brown	Medium Dense	Af
5	2	5/5					Af
				Holocene Alluvium (Qal1) **7.8-10’:** Clayey sand, massive, slightly well oxidized, medium to coarse grained, moderately sticky and plastic, poorly sorted sand, common thin and few moderately thick clay films	Brown 7.5 YR 4/3	Hard, friable	Bt
10						Slightly Hard, friable	C
	3	3.7 /5		**10-12.7’:** Silty sand with clay, massive, slightly well oxidized, medium to coarse grained, slightly sticky, moderately plastic, few fine to medium slate gravels, few to common thin clay films	Brown 7.5 YR 5/3	Slightly Hard, friable	BC
				Holocene Alluvium (Qal2) **12.7-23.5’:** Clayey sand, massive, slightly well oxidized, fine to medium grained moderately well sorted sand, moderate to very sticky, very plastic, few localized fine $CaCO_3$ nodules, common thin and very few moderately thick clay films	Brown 7.5 YR 5/4	Hard, firm	2Bt
15	4	5/5					
20							

LOG OF EXPLORATORY BORING

Job Number: 2176-85
Project: 456 N. Rodeo Drive

Boring No: B-1
Boring Location: See Site Map

Date Performed: 7/11/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
20				**12.7-23.5’:** Clayey sand, massive, slightly well oxidized, fine to medium grained moderately well sorted sand, moderate to very sticky, very plastic, few localized fine $CaCO_3$ nodules, common thin and very few moderately thick clay films	Brown 7.5 YR 5/4	Hard, firm	2Bt
	5	4/5					
				23.5-25’: Silty sand with clay, massive, slightly well oxidized, coarse grained poorly sorted sand, common clay stains, slightly sticky, non-plastic	Brown 7.5 YR 5/4	Slightly Hard, friable	2BC
25				**25-27.7’:** Silty sand, massive, coarse grained poorly sorted sand, non-sticky, non-plastic	Brown 7.5 YR 5/3	Soft, friable	2C
	6	3.5 /5		**Pleistocene Older Alluvium (Qoa1)**			
				27.7 -30’: Clayey sand, massive, moderately well oxidized, slight organics, medium grained, moderately well sorted sand, common thin clay films, very sticky, very plastic	Reddish Brown 5 YR 4/3	Very Hard, firm	$3Bt_1$
30				**30-32.8’:** Sandy clay with gravel, massive, moderately well oxidized, coarse grained, poorly sorted sand, with common fine to medium highly weathered gravels, many thin and common moderately thick clay films	Reddish Brown 5 YR 4/4	Very Hard, friable	$3Bt_2$
	7	5/5		**Pleistocene Older Alluvium (Qoa2)**			
				32.8-39.5’: Clayey silt with sand - silty clay, moist, moderately oxidized, becoming fine to medium grained silty sand with clay, containing few scattered medium gravels	Strong Brown 7.5 YR 5/6	Very Hard, firm	4Bt
35							
	8	5/5					
40				**39.5-42.9’:** Becomes medium to coarse sand with scattered gravels, slightly moist	Brown 7.5 YR 5/4	Soft, friable	4BC

LOG OF EXPLORATORY BORING

Job Number: 2176-85
Project: 456 N. Rodeo Drive

Boring No: B-1
Boring Location: See Site Map

Date Performed: 7/11/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
40				**39.5-42.9’:** Becomes medium to coarse sand with scattered gravels, slightly moist	Brown 7.5 YR 5/4	Soft, friable	4BC
	9	3.3 /5		**42.9-46’:** Clayey sand, massive, moderately oxidized, fine to medium grained moderately well sorted sand, very sticky, very plastic, many thin and common moderately thick clay films	Brown 7.5 YR 4/4	Very hard, friable	5Bt
45				**46-47.2’:** Silty sand with gravel, massive, slightly well oxidized, slightly sticky, non-plastic, coarse grained poorly sorted sand common to many fine to medium, highly weathered slate gravel	Brown 7.5 YR 4/3	Slightly hard, friable	5BC
	10	4/5		**Pleistocene Older Alluvium (Qoa3)** **47.2-48’:** Silty sand with clay, massive, moderately well oxidized, highly truncated, medium to coarse grained poorly sorted sand, with few fine to medium gravels, few to common thin and few moderately thick clay films	Strong Brown 7.5 YR 4/6	Very hard, firm	6Bt
				48’: Silty sand with gravel, slightly oxidized, massive, coarse grained, with many fine to medium subangular and highly weathered gravel, non-sticky, non-plastic	Brown 7.5 YR 5/3	Hard, friable	6BC
50				End at 50, Fill to 7.8’, No Water, No Caving			
55							
60							

LOG OF EXPLORATORY BORING

Job Number: 2176-85
Project: 456 N. Rodeo Drive

Boring No: B-2
Boring Location: See Site Map

Date Performed: 7/11/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
0	1			**0-7.2’:** Fill - Silty sand, scattered concrete and asphalt fragments Hand augered upper 5’ due to utilities	Brown	Medium Dense	Af
5	2	5/5					Af
				Holocene Alluvium (Qal1) **7.2-10.2’:** Silty sand with clay, massive, slight organics, moderately sticky, very plastic, medium to coarse grained poorly sorted sand, common thin and few moderately thick clay films	Brown 7.5 YR 4/4	Hard, firm	Bt
10						Slightly Hard, friable	C
	3	3.9 /5		**10.2-12.5’:** Silty sand with clay, massive, medium to coarse grained poorly sorted sand, slightly well oxidized, few fine gravels, few thin clay films, slightly sticky, slightly plastic	Brown 7.5 YR 5/4	Slightly Hard, friable	BC
				Holocene Alluvium (Qal2) **12.5-22.2’:** Clayey sand, massive, medium grained moderately well sorted sand, very sticky, very plastic, slightly well oxidized	Brown 7.5 YR 4/3-4	Hard, firm	2Bt
15	4	5/5					
20							

Feffer Geological Consulting

Figure

LOG OF EXPLORATORY BORING

Job Number: 2176-85
Project: 456 N. Rodeo Drive

Boring No: B-2
Boring Location: See Site Map

Date Performed: 7/11/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
20				**12.5-22.2’:** Clayey sand, massive, medium grained moderately well sorted sand, very sticky, very plastic, slightly well oxidized	Brown 7.5 YR 4/3-4	Hard, firm	2Bt
	5	4.5 /5		**22.2-25’:** Silty sand with clay, massive, moderately well oxidized slightly sticky, slightly plastic, coarse grained poorly sorted sand, few fine to medium slate gravels, common thin clay films	Brown 7.5 YR 4/3	Slightly Hard, friable	2BC
25				**25-26.7’:** Silty sand with gravel, massive, slightly well oxidized, coarse grained poorly sorted sand with common fine to medium gravel, non-sticky, non-plastic	Brown 7.5 YR 5/3	Soft, very friable	2C
	6	2.9 /5		**Pleistocene Older Alluvium (Qoa1)** **26.7-28’:** Clayey sand, massive, moderately oxidized, slight organics, medium grained, common thin and few moderately thick clay films	Reddish Brown 5 YR 4/3	Very Hard, firm	$3Bt_1$
				28-33’: Clayey sand with gravel, massive, moderately oxidized, coarse grained poorly sorted sand, common to many fine to medium slate rich gravels, moderately sticky, moderately plastic	Reddish Brown 5 YR 4/4	Very Hard, friable	$3Bt_2$
30	7	5/5		**Pleistocene Older Alluvium (Qoa2)** **33-39.7’:** Sandy clay, massive, faintly mottled, moderately well oxidized, fine to medium grained, moderately well sorted sand	Strong Brown 7.5 YR 4/4	Very Hard, firm	4Bt
35	8	5/5					
40				See Next Page	Brown 7.5 YR 5/4	Slightly Hard, friable	4BC

LOG OF EXPLORATORY BORING

Job Number: 2176-85
Project: 456 N. Rodeo Drive

Boring No: B-2
Boring Location: See Site Map

Date Performed: 7/11/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
40				**39.7-41.5’:** Silty sand with gravel, crudely stratified, coarse grained poorly sorted sand with common to many fine to medium gravels, non to slightly sticky, non-plastic, few clay stains on gravel	Brown 7.5 YR 5/4	Slightly Hard, friable	4BC
	9	3.4 /5		**41.5-45’:** Clayey sand, massive, moderately well oxidized, fine grained well sorted sand, moderately sticky, very plastic, common thin and few moderately thick clay films	Strong Brown 7.5 YR 4/6	Very hard, friable	5Bt
45				**Pleistocene Older Alluvium (Qoa3)** **45-47.5’:** Sandy clay, massive, moderately well oxidized, slight organics, medium to coarse grained poorly sorted sand with few fine to medium gravels, common thin clay films and common moderately thick clay films	Reddish Brown 5 YR 4/4	Very hard, firm	6Bt
	10	3.6 /5		**47.5’:** Silty sand with gravel, crudely stratified, coarse grained poorly sorted sand, slightly well oxidized, common to many fine to medium gravel, sub angular and highly weathered	Brown 7.5 YR 5/4	Hard, friable	5BC
50				End at 50, Fill to 7.2’, No Water, No Caving			
55							
60							

Feffer Geological Consulting

Figure

LOG OF EXPLORATORY BORING

Job Number: 2188-85
Project: 468 N. Rodeo Drive

Boring No: CB-1
Boring Location: See Site Map

Date Performed: 7/30/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
0	1			**0-7.5’:** Fill - Silty sand, scattered concrete and asphalt fragments Hand augered upper 7’ due to utilities	Brown	Medium Dense	Af
5	2	3/3		**Holocene Alluvium (Qal1)** **7.5-10.5’:** Clayey sand, massive, moderate to very sticky, very plastic, medium to coarse grained, poorly sorted, common thin and fine moderately thick clay films with basal scour, of sand with silt	Brown 7.5 YR 4/3	Hard, friable	Af Bt
10						Slightly Hard, friable	C
	3	3.6 /5		**10.5-13.3’:** Silty sand with clay, slightly sticky, moderately plastic, medium to coarse grained, poorly sorted sand, slightly to well oxidized, few common thin clay films	Brown 7.5 YR 5/4	Slightly Hard, friable	BC
15	4	5/5		**Holocene Alluvium (Qal2)** **13.3’:** Sandy clay, clayey sand, very sticky, very plastic, medium to coarse grained, poorly sorted sand, common $CaCO_3$ veinlets, many thin and few moderately thick clay films	Brown 7.5 YR 5/4	Hard, firm	2Bt
20							

Feffer Geological Consulting

Figure

LOG OF EXPLORATORY BORING

Job Number: 2188-85
Project: 468 N. Rodeo Drive

Boring No: CB-1
Boring Location: See Site Map

Date Performed: 7/30/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
20	5	4.3 /5		**13.3-24’:** Sandy clay, clayey sand, very sticky, very plastic, medium to coarse grained, poorly sorted sand, common $CaCO_3$ veinlets, many thin and few moderately thick clay films	Brown 7.5 YR 5/4	Hard to firm	2Bt
25				**24-26.5’:** Silty sand with clay and gravel, massive to crudely stratified, slightly to moderately sticky, slightly plastic, coarse grained, poorly sorted sand, common fine to medium gravel, few to common thin clay films,	Brown 7.5 YR 5/3	Soft, very friable	2BC
	6	4/5		**Pleistocene Older Alluvium (Qoa1)** **26.5-28’:** Clayey sand, massive, moderately well oxidized, med. - coarse grained sand, very sticky, very plastic, slight organics, common thin and few moderately thick clay films	Reddish Brown 5 YR 4/3	Firm to Very Hard	$3Bt_1$
30				**28-33.5’:** Clayey sand with gravel, massive, moderately well oxidized, coarse grained, poorly sorted sand with common to many thin and common moderately thick clay films	Reddish Brown 5 YR 4/4	Very Hard, friable	$3Bt_2$
	7	5/5		**Pleistocene Older Alluvium (Qoa2)** **33.5-42.5’:** Sandy clay, massive, faintly mottled, very sticky and very plastic, moderately well oxidized, medium grained, moderately well sorted sand	Brown 7.5 YR 5/4	Very Hard, firm	4Bt
35	8	5/5					
40							

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Figure

LOG OF EXPLORATORY BORING

Job Number: 2188-85
Project: 468 N. Rodeo Drive

Boring No: CB-1
Boring Location: See Site Map

Date Performed: 7/30/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
40				**33.5-42.5’:** Sandy clay, massive, faintly mottled, very sticky and very plastic, moderately well oxidized, medium grained, moderately well sorted sand	Brown 7.5 YR 5/4	Very Hard, firm	4Bt
	9	4.2 /5		**42.5-43.7’:** Silty sand with clay, massive, moderately well oxidized, coarse grained poorly sorted sand with common thin clay films, few fine to medium sub rounded slate gravels, slightly sticky, non to slightly plastic	Brown 7.5 YR 5/4	Slightly hard, friable	4BC
				Pleistocene Older Alluvium (Qoa3)	Strong Brown 7.5 YR 5/6	Very hard, firm	5Bt
45				**43.7-48.2’:** Sandy clay, massive, moderately well oxidized, fine grained well sorted sand, plugged with clay, many thin common moderately thick clay films, very sticky, very plastic			
	10	4.6 /5		**48.2’:** Silty sand with gravel, crudely stratified, slightly well oxidized, coarse grained poorly sorted sand, non to slightly sticky, non plastic, with common fine to medium slate gravels	Brown 7.5 YR 5/4	Soft, very friable	5BC
50				End at 50, Fill to 7.5’, No Water, No Caving			
55							
60							

LOG OF EXPLORATORY BORING

Job Number: 2188-85
Project: 468 N. Rodeo Drive

Boring No: CB-2
Boring Location: See Site Map

Date Performed: 7/31/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
0	1			**0-7.3’:** Fill - Silty sand, scattered concrete and asphalt fragments Hand augered upper 7’ due to utilities	Brown	Medium Dense	Af
5	2	2.8 /3		**Holocene Alluvium (Qal1)** **7.3-10.3’:** Silty sand with clay, massive, slightly to moderately sticky, slightly plastic, medium grained moderately well-sorted sand, slightly well oxidized, common fine clay films (7.5 YR 4/4), basal scour at top of run 2.	Brown 7.5 YR 4/3	Slightly Hard, friable	Af Bt C
10	3	4.9 /5		**10.3- 13.1’:** Silty sand, massive, slightly sticky, moderately to slightly plastic, medium grained moderately well-sorted sand, moderately well oxidized, few fine clay films (7.5 YR 4/4), sand scour deposit	Brown 7.5 YR 5/4	Slightly Hard, friable	BC
15	4	4.9 /5		**Holocene Alluvium (Qal2)** **13.5-23.2’:** Clayey sand grades to sandy clay with depth, massive, very sticky, very plastic, fine grained well-sorted sand, slightly well oxidized, plugged with clay	Brown 7.5 YR 4/2	Hard, firm	2Bt
20							

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Figure

LOG OF EXPLORATORY BORING

Job Number: 2188-85
Project: 468 N. Rodeo Drive

Boring No: CB-2
Boring Location: See Site Map

Date Performed: 7/31/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
20				**13.5-23.2’:** Clayey sand grades to sandy clay with depth, massive, very sticky, very plastic, fine grained well-sorted sand, slightly well oxidized, plugged with clay	Brown 7.5 YR 4/2	Hard to firm	2Bt
	5	3.6 /5					
				23.2-26.8’: Silty sand, massive, crudely stratified, slightly sticky, non-plastic, coarse grained with common fine and medium gravels	Brown 7.5 YR 5/4	Slightly hard, very friable	2BC
25							
				Pleistocene Older Alluvium (Qoa1)			
	6	2.7 /5		**26.8-28.2’:** Sandy clay with silt, massive, fine grained, very sticky, very plastic, slight organics	Reddish Brown 5 YR 4/3	Firm to Very Hard	$3Bt_1$
				28.2-33’: Clayey sand with gravel, massive, very sticky, very plastic	Reddish Brown 5 YR 4/4	Very Hard, friable	$3Bt_2$
30							
	7	4.3 /5		**33-35’:** Coarse grained to poorly sorted sand, scattered gravel, fine grained sand, plugged with clay			
35				**Pleistocene Older Alluvium (Qoa2)**			
	8	5/5		**34.8-39.4’:** Sandy clay, massive, very hard, very sticky, very plastic, fine grained well-sorted sand, moderately well oxidized, plugged with clay	Brown 7.5 YR 5/4	Very Hard, firm	4Bt
40				**39.4-41.8’: See next page**	Brown 7.5 YR 4/3	Hard, friable	4BC

LOG OF EXPLORATORY BORING

Job Number: 2188-85
Project: 468 N. Rodeo Drive

Boring No: CB-2
Boring Location: See Site Map

Date Performed: 7/31/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
40				**39.4-41.8’:** Silty sand with clay and gravel, stratified, slightly sticky, non to slightly plastic, coarse grained, poorly sorted sand, slightly well oxidized, common clay films	Brown 7.5 YR 4/3	Hard, friable	4BC
	9	4.2 /5		**41.8-42.8’:** Clayey sand, massive, moderately well oxidized, fine grained well-sorted sand, moderately sticky, moderately plastic, few moderately thick clay films	Brown 7.5 YR 5/4	Very Hard, friable	5Bt
				42.8-45’: Silty sand with gravel, massive, slightly well oxidized, coarse grained, poorly sorted sand, with common fine and medium gravel, slightly sticky, non plastic, common clay stains	Brown 7.5 YR 5/3	Slightly Hard, very friable	5BC
45				**Pleistocene Older Alluvium (Qoa3)** **45-46’:** Sandy clay, massive, very hard, moderately well oxidized, fine grained, very sticky, very plastic, plugged with clay	Brown 7.5 YR 5/4	Very Hard, firm	6Bt
	10	4.1 /5		**46-50’:** Silty sand with gravel, crudely stratified, slightly sticky, slightly plastic, slightly well oxidized, coarse grained with common fine and medium gravel	Brown 7.5 YR 5/3	Slightly Hard, very friable	6BC
50				End at 50, Fill to 7.3’, No Water, No Caving			
55							
60							

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Figure

APPENDIX ‘B’

Soil Stratigraphy & Soil Age Estimates

Soil Stratigraphy Study And Relative Age Estimates For A Fault Rupture Hazard Investigation At 456 North Rodeo Drive, Beverly Hills, CA

Prepared by:

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Submitted to:

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1990 South Bundy Drive, 4th Floor
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August 20, 2018

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Feffer Geological Consulting, Inc.
1990 South Bundy Drive, 4th Floor
Los Angeles, CA 91025

August 20, 2018

Subject: Soil Stratigraphy Study And Relative Age Estimates For A Fault Rupture Hazard Investigation At 456 North Rodeo Drive, Beverly Hills, CA.

Dear Mr. Feffer:

I am pleased to present to you this soil stratigraphic study and relative-age determinations to be used with your fault rupture hazard assessment of the proposed development located at 456 North Rodeo Drive in the City of Beverly Hills, California.

Feffer Geological retained John Helms CEG to describe and assist in correlations of the soil stratigraphy from continuously cored borehole samples and to assign relative age dates for the deposits identified across the site. The continuously cored bore hole samples were obtained from a single transect of borings, transect A. One borehole (CB-1) was completely described from transect A, and three additional boreholes (CB-2, B-1, and B-2) from transect A have been reviewed and summarized. The detailed soil descriptions are used to calculate various soil development indices (or SDIs). The SDI values were then compared to the SDI values from similar described soils with known ages to estimate age ranges for the soils understudy.

The attached report classifies the described soil profiles, identifies stratigraphic relationships, defines soil chronosequences, and estimates the relative ages for the two soil profiles described in detail. Calculated SDI's show strong correlations to the SDI values of other published, described, and dated soil profiles with similar parent materials.

Age estimates range from 46 to 94 ka for the stratigraphic section studied along transect A in boring CB-1. There are several distinctive buried soil units that can be correlated across the entire length of Transect A. One distinctive buried soil (buried soil 2, Qoa1) which can be correlated across the entire length of Transect A, is a truncated and well oxidized argillic soil profile that ranges in relative age from 25 – 51 ka. Please see Table 6 in the attached report for a summary listing of all of the determined relative ages at the study site.

Thank you for this opportunity to be of service. Should you have any questions or require additional information, please do not hesitate to contact me.

Sincerely,

REGISTERED GEOLOGIST
JOHN G. HELMS
No. 2272
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

John Helms, CEG 2272

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SOIL STRATIGRAPHY STUDY AND RELATIVE AGE ESTIMATES FOR A FAULT RUPTURE HAZARD STUDY FOR A PROPOSED DEVELOPMENT AT 456 NORTH RODEO DRIVE, BEVERLY HILLS, CALIFORNIA.

INTRODUCTION

Due to a repeating sequence of stratigraphy across the entire transect of borings, one soil profile has been studied for geomorphic characteristics and relative degrees of weathering to estimate deposit relative-age. Boring CB-1 was selected for this process due to it's position being located on the subject property as well as being located near the center of the transect of borings. The relative age estimate is based on index value comparisons with other published and dated soil profile descriptions. The comparative soils are from areas with a similar climate and similar parent material to this study area. The estimated relative ages in this report will be used by Feffer Geological, Inc. to assess the recency and recurrence of faulting across the study area. Alluvial units are assessed chronostratigraphically across four borehole locations from a single transect of borings and CPT's that shadow the area proposed for development. In this study, the soil stratigraphy is defined with soil field description data, and no laboratory data. This study identifies the soil stratigraphy across the area under study and estimates the relative age of one soil profile. Continuously cored and sampled borehole CB-1 has been described in detail, and three additional continuously cored and sampled boreholes (CB-2, B-1, and B-2) has been summarized or briefly described along Transect A. Transect A is located along a graded and stripped alluvial surface.

For the Quaternary geologist, a soil can be defined as a natural body that consists of horizons of organic and/or mineral constituents which differ from its parent material in some way (Birkland, 1984). A chronosequence is a group of soils for which all soil forming factors (such as topography, parent material, vegetation, and climate) except time is relatively equal (Jenny, 1941). Past geologic studies in the coastal region of southern California provide age constraints for several deposits and geomorphic surfaces ranging in age from middle Pleistocene to recent (McFadden, 1982; Rockwell, 1988; and WLA, 1998). Often it has proven difficult to date older deposits due to changes in past climatic regimes. Studies on the impacts of glacial to interglacial climatic changes on soil development in specific regions (McFadden, 1982; Birkland, 1984; McFadden, 1988) indicate that soil development has occurred throughout the Quaternary.

This study is concerned with a section of alluvium derived from the southern range front of the Santa Monica Mountains, which is within the Transverse Ranges Geomorphic Province. A series of stacked and truncated argillic soil subsurface horizons within all of the stratigraphic sections studied indicates that the alluvial stratigraphic section across the entire study area correlates well and is significantly old. Age estimates range from 46 to 94 ka for the stratigraphic section studied near the center portion of transect A in boring CB-1.

Soil relative age estimates have broad ranges, dependent upon the pool of comparative data used. Most of the buried soils across the study area fall into the Alfisol soil order (Soil Conservation Service, 1999). The soil profile that is described in detail is from boring CB-1 in Transect A and summary descriptions were generated for borings CB-2, B-1, and B-2 from Transect A. Boring locations are shown on the geologic map that is provided with the main fault rupture hazard report.

MATERIALS AND METHODS

Continuous core samples collected from boring CB-1 by Feffer Geological, Inc. were described in detail as part of this study. The soils were described using guidelines set by the Soil Survey Staff (1991 and 1999). Specific soil properties such as soil structure and soil horizon boundaries could not be accurately described from the core sample exposures. These soil qualifiers have not been described and do not factor into the estimated soil relative age comparisons.

Soil profile field description values quantify soil properties that are used to develop a soil development index (SDI) value as outlined by Harden (1982). Points are assigned to descriptive data for each of several observed soil properties, such as dry color, moist color, texture, dry and wet consistence, and clay film content, for each soil horizon in a soil profile relative to the soil horizon's thickness, and normalized to a common depth. The maturity of a soil profile is gauged through data collected from active wash deposits (or raw alluvium).

Table 1.1 lists the detailed soil description for the studied boring in longhand format. Table 1.2 lists the soil description using soil conservation service notation and shows the SDI calculations. Table 1.2 shows the calculated SDI values, the soil profile description, and the normalization values for raw alluvium. SDI values are calculated by assigning point values to each described soil properties. The points are summed for each soil horizon and divided by the total number of descriptive properties used. This equals the mean horizon index value (HI). HI values are multiplied by the corresponding soil horizon thickness. The SDI value equals the sum of the thickness normalized horizon indices. The maximum horizon index (MHI) is the value of the horizon with the largest summed descriptive value. MHI is independent of horizon thickness, and is usually the diagnostic subsurface soil horizon for most soil profiles. Tables 1.2 lists all of the determined HI, SDI, and MHI values for the soil profile under study.

SDI and MHI values have shown significant correlations to soil age in many past studies (Harden, 1982; Rockwell *et al.*, 1983; Reheis *et al*., 1989; Rockwell *et al.*, 1994). The soils described in this study are compared to soils described and dated by McFadden (1982 and 1988) in San Bernardino County near Mission Creek, by Rockwell (1983) in the Ventura River basin, and by William Lettis and Associates, Inc. (1998) in West Hollywood. SDI values have all calibrated to a common depth of 7 feet.

The changes in the subsurface pedogenic properties of the Alfisols soil order allows for relative age determinations by emphasizing specific soil properties (such as color and clay film content) that are most diagnostic. Soil properties that express themselves well through time are most often used in the assessment of soil relative ages through a specific soil property index such as the color or clay film index. The color index (Rockwell *et al.,* 1985, 1988) is used to quantify observed colors (in Munsell notation) of each profile in order to compare relative degrees of reddening. The color index is simply the summation of an entire profile's horizon index values for dry colors. The clay film index (Rockwell *et al.,* 1985, 1988) is used to quantify field descriptions of this soil property in order to compare relative profile maturity. The clay film index is simply the summation of an entire soil profile's horizon index values for clay films. MHI is a comparison of a soil pedons master (or diagnostic) subsurface

horizon (typically an argillic or cambic horizon). Independent of horizon thickness, the MHI directly compares the properties of the soil profiles strongest soil horizon.

SOIL RELATIVE AGE METHODS

Soil relative ages are calculated and compared independently for each soil profile described. The soil profile described for this study is located across several buried alluvial surfaces that differ in relative age, facies of deposition, and degrees of preservation. A series of stacked, buried, and truncated hard, clayey soils with illuvial clays characterize a majority of the soil profiles described on this project site.

The soil profile described in detail has a surface age that is implied by estimating the time of inception for the exposed surficial soil. The soil profile described in detail for this study also contains a series of stacked and / or buried soil profiles. In this case, deposit age assessments are obtained by identifying and isolating the different parent materials (or deposits). Then comparing a set of abridged calculated indices to an additional suite of similar soils that have been radiometrically dated yields the equivalent to a buried surface age estimate. Such burial relationships are common along the southern Santa Monica Mountains range front; especially where soils that have developed into alluvial fan deposits which commonly bury or locally truncate older soils that have developed previously in older alluvial deposits. A cumulic soil profile estimated age can assess landform age, and has potential to assess rates of erosion, rates of landform evolution, and rates of tectonic activity across the study area.

The described soil profiles have an SDI value, which is used to estimate the soil relative age. Cumuli relative age estimates for a stacked or buried soil profiles are specifically referred to as “deposit ages”. The relative age estimate for the surface profile or modern soil is referred to as the “surface age”. All of the relative age estimates given are considered minimum ages given that an unknown amount of erosion has occurred after the formation of and before the burial of each truncated surface and buried soil studied.

SOIL SUMMARY DESCRIPTIONS

Soil summary descriptions were generated for borings CB-2, B-1, and B-2 in this study. The summary descriptions record diagnostic pedogenic features for each soil horizon identified. This was done in order to assist with establishing stratigraphic correlations across the site. Relative age estimates were not generated for any of the listed soil summary descriptions. The soil summary descriptions are listed in Tables 2.1, 2.2, and 2.3.

DISCUSSION AND RESULTS

This section contains a brief write up for the continuously cored boring described in detail with designated tables for the soil profile. The attached Table 1.1 presents the soil profile description in longhand format. Table 1.2 presents the results of the calculated SDI values. Table 3 is a summary of the soil relative age estimates for the soil profile under study. Table 4 is a compilation of the comparative data in a format that compares to the data generated for this study. Table 5 is a soil abbreviation key to be used in conjunction with the SDI calculation sheets. Table 6 lists the relative ages for each designated stratigraphic unit that is shown on the geologic cross section in the fault rupture hazard report.

Soil descriptions, SDI calculations, and relative age determinations follow for the soil profile studied.

TRANSECT A BORINGS

One soil profile was described in detail out of core samples from Transect A in boring CB-1. Age estimates range from 46 to 94 ka for the alluvial section studied in boring CB-1 of transect A.

Boring CB-1

The core samples from Transect A, Boring CB-1 were reviewed at the project site on 8/7/2018 and on 8/8/2018. This boring is located near the center of Transect A, and this alluvial section is characterized by a sequence of truncated argillic soils interbedded with massive and crudely stratified scour deposits. See Table 1.1 for a complete soil description of the continuously sampled boring, Table 1.2 for the SDI index value calculations and relative age estimates, and Feffer Geological Inc.'s cross section and geologic map for both the borehole and transect location.

The surface soil (Qal1) in boring CB-1 consists of a weakly-developed Alfisol that is characterized by a severely truncated and organic rich argillic horizon and has an estimated relative age of 4 – 8 ka. The uppermost buried soil (Buried Soil 1 / Qal2) that can be correlated across the entire length of Transect A is a truncated, thick, and diffuse weakly to moderately well-developed Alfisol soil with an estimated relative age value of 12 – 21 ka. The second buried soil in this alluvial sequence is the top of the Pleistocene in this stratigraphic section. This marker bed (Qoa1) can be correlated across the entire area investigated and is a truncated and moderately well-developed Alfisol soil that has an estimated relative age value of 25 – 51 ka. The third buried soil (Buried Soil 3 / Qoa2) also can be correlated across the entire length of Transect A is a truncated, thin and weakly to moderately well-developed Alfisol soil with an estimated relative age value of 33 – 64 ka. The forth buried soil (Qoa3) in Transect A, and the entire stratigraphic section studied has an estimated age that ranges from 46 – 94 ka. This lowest buried soil in this alluvial sequence can be correlated across the entire area investigated and is a truncated and moderately well-developed Alfisol soil.

Differences in the number of soils, depths of burial and unit thicknesses due to differential erosion / truncation laterally along Transect A may cause minor variances in relative age estimates between the individual borings. In order to control for this additional soil summary descriptions were generated across this transect which assesses the same buried surfaces at differing depths of burial and in differing states of preservation.

BORING SUMMARY DESCRIPTIONS

Soil summary descriptions generated for borings CB-1, B-1 , and B-2 are listed in Tables 2.1, 2.2, and 2.3. Relative age estimates were not generated for the soil summary descriptions. The summary descriptions were generated to assist with establishing stratigraphic correlations across the site. The observations for the soil summary descriptions along Transect A were made on 8/8/2018. All of the borings along Transect A appear to contain a thin veneer of artificial fill that is in contact with a sequence of Holocene- and Pleistocene-aged truncated argillic soils and nested sour deposits. Several of the Pleistocene-aged

truncated and /stacked buried soils are maker units which can be correlated across the area investigated.

CONCLUSIONS

A majority of the soils observed across the study area are Alfisols that have developed in alluvial environments. All of the soil profiles across Transect A consist of a series of stacked, truncated, and buried argillic soil horizons. The truncated and buried soils with argillic sub surface soil horizons are weakly and moderately well developed. The Alfisol soils typically have 7.5YR to 5YR color hues with a modest amounts of secondary (pedogenic) clay in a series of argillic (Bt) diagnostic subsurface horizons.

The surface soil profile across the area investigated is laterally continuous across transect A. Lateral variability in observed in the buried soils across the site is due to localized erosion, scouring, infilling, and stacking of these materials in an alluvial environment. In this sedimentological environment surfaces that have been stable long enough to form a robust soil, can suddenly be buried by a new deposit, or scoured out (truncated) and possibly in-filled with younger material. The amount of erosion that has occurred with each truncated soil under study is unknown. Thus the relative age estimates given in this study are minimum ages.

These soil relative age determinations are consistent with the general geologic and pedogenic observations of soils in southern California. Strongly developed, well horizonated, thick, and oxidized Alfisols can be as much as 200 ka in age. Erosion tends to act as a rejuvenating aspect in soil development, by decreasing the strength of the soil development properties and the consequent age estimates are younger. In that past magnitudes and rates of erosion are difficult to assess, the soil relative age estimates are utilized as minimum ages.

The soils observed along Transect A are Holocene and Pleistocene in age. The buried and stacked soils display soil horizons that have weak to moderately strong argillic horizon development. Age estimates range from 46 to 94 ka for the entire alluvial stratigraphic section studied along transect A. The second buried soil (buried soil 2) (Qoa1) that can be correlated across the entire area investigated is a truncated and moderately well-developed argillic soil profile that ranges in relative age from 25 – 51 ka along the length of Transect A. The lowermost buried soil (buried soil 4) (Qoa4) that can be correlated across the entire area investigated is a truncated, stacked, and moderately well-developed argillic soil profile that ranges in relative age from 46 – 94 ka along the length of Transect A.

LIMITATIONS

The conclusions and recommendations presented herein are the results of an inherently limited scope. Specifically, the scope of services consisted of an assessment of relative age from core samples and did not participate in any drilling activities at the site. The conclusions and recommendations contained in this report are professional opinions derived in accordance with current standards of professional practice. No warranty is expressed or implied.

This report has been prepared for the exclusive use of Feffer Geological, Inc. and applies only to the Fault Rupture Hazard Study located at 456 North Rodeo Drive. In the event that significant changes in the interpretations of this study are made, the conclusions and

recommendations contained in this report shall not be considered valid unless the changes are reviewed by John Helms, CEG, and the conclusions and recommendations of this report are verified in writing.

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Table 1.1

456 N. Rodeo Drive

Table 1.1 Soil Description - Transect A; Boring CB 1

Depth (Ft)	Horizon	Transect A; CB-1 Description
0 - 7.5	NR	No Recovery
7.5 - 10.2	Bt	Brown (7.5YR 4/3d, 7.5YR 3/2m), sandy clay loam, slight-organics, slightly well oxidized, hard, friable, moderately to very sticky, very plastic, medium- to coarse-grained poorly sorted sand with few fine sub rounded gravel, few fine and medium pores, clay films few thin on ped faces, clear lower boundary to;
10.5 -13.3	BC	Brown (7.5YR 5/4 d, 7.5YR 4/3 m), loam, slightly hard, friable, slightly well oxidized, slightly sticky, moderately plastic, medium- to coarse-grained poorly sorted sand with few fine sub rounded gravel, clear lower boundary to;
13.3 - 24.0	2Btb	Brown (7.4YR 4/3d, 7.5YR 3/2m), sandy clay loam, slightly oxidized, hard, firm, very sticky, very plastic, medium- to coarse-grained poorly sorted sand with few fine sub rounded gravel, few fine and medium pores, clay films few to common thin on ped faces, calcium carbonate stage 1-, few to common veinlets and slightly disseminated in soil matrix, gradational lower boundary to;
24.0 - 26.5	2BCb	Brown (7.5YR 5/3d, 7.5YR 4/2m), loam, slightly well oxidized, soft to slightly hard, friable, slightly to moderately sticky, slightly plastic, coarse-grained poorly sorted sand with common to many fine, medium, and large sub rounded gravel, common clay stains on gravel, abrupt lower boundary to;
26.5 - 28.0	3Btb1	Reddish brown (5YR 4/3d, 5YR 3/2m), clay loam, well oxidized, slight organics, very hard, firm, very sticky, very plastic, fine- to medium-grained moderately well sorted sand, clay films common thin and few moderately thick on ped faces, gradational lower boundary to;
28.0 - 33.5	3Btb2	Reddish brown (5YR 4/4d, 5YR 3/3m), clay loam to clay, well oxidized, very hard, firm, very sticky, very plastic, medium- to coarse-grained poorly sorted sand with few medium and large high weathered sub angular gravel, clay films common to many thin and few to common moderately thick on ped faces and coating clasts, gradational lower boundary to;
33.5 - 42.5	4Btb	Brown (7.5YR 4/4d, 7.5YR 3/3m), sandy clay loam, faintly mottled, moderately well oxidized, very hard, firm, very sticky, very plastic, medium-grained moderately well sorted sand, clay films few to common thin on ped faces, calcium carbonate stage 1, common veinlets and fine nodules and slightly well disseminated in soil matrix, gradational lower boundary to;
42.5 - 43.7	4BCb	Brown (7.5YR 5/4d, 7.5YR 4/3m), loam, moderately well oxidized, slightly hard, friable, slightly sticky, non- to slightly plastic, coarse-grained poorly sorted sand with common to many fine and medium, sub rounded slate rich gravel, few clay stains on gravel, abrupt lower boundary to;
43.7 - 48.2	5Btb	Strong brown (7.5YR 5/6d, 7.5YR 4/4m), clay, moderately well oxidized, very hard, firm, very sticky, very plastic, fine-grained well sorted sand, clay films common to many thin and common moderately thick on ped faces, gradational lower boundary to;
48.2 - 50.0+	5BCb	Brown (7.5YR 5/4d, 7.5YR 4/3m), loam, stratified, slightly well oxidized, soft to slightly hard, very friable, non- to slightly sticky, non-plastic, coarse-grained poorly sorted sand with common fine and medium sub rounded slate rich gravel, common clay stains coating clasts, undetermined lower boundary.

Table 1.2

Soil Development Index Calculation Sheet
456 N. Rodeo Drive Transect A; Boring CB 1

Unit	Thickness	Color				Texture		Consistence				Clay Films		Horizon	Mean Hor.
	(Feet)	Dry		Moist				Dry		Wet				Values	Values
Raw Alluvium	*3*	*2.5Y 7/3*	*X/10*	*10YR 6/2*	*X/10*	*s*	*X/6*	*lo*	*X/5*	*so, po*	*X/6*	*0*	*X/15*		
Transect A; Boring 1															
Bt	2.7	7.5YR 4/3	0.2	7.5YR 3/2	0.1	scl	0.67	h	0.60	s-vs, vp	0.92	1npf	0.2	0.45	1.21
BC	2.8	7.5YR 5/4	0.3	7.5YR 4/3	0.2	l	0.5	sh	0.40	ss, p	0.50			0.32	0.89
2Btb	10.7	7.5YR 4/3	0.2	7.5YR 3/2	0.1	scl	0.67	h	0.60	vs, vp	1.00	1-2npf	0.23	0.47	5.00
2BCb	2.5	7.5YR 5/3	0.2	7.5YR 4/2	0.1	l	0.5	so - sh	0.35	ss-s, ps	0.42	2vncl	0.2	0.29	0.74
3Btb1	1.5	5YR 4/3	0.3	5YR 3/2	0.2	cl	0.67	vh	0.80	vs, vp	1.00	2npf, 1mkpf	0.4	0.56	0.84
3Btb2	5.5	5YR 4/4	0.4	5YR 3/3	0.3	cl - c	0.92	vh	0.80	vs, vp	1.00	2-3npf, 1-2mkpf	0.45	0.65	3.55
4Btb	9	7.5YR 4/4	0.3	7.5YR 3/3	0.2	scl	0.67	vh	0.80	vs, vp	1.00	1-2npf	0.23	0.53	4.80
4BCb	1.2	7.5YR 5/4	0.3	7.5YR 4/3	0.2	l	0.5	sh	0.40	ss, po-ps	0.25	1vncl	0.17	0.30	0.36
5Btb	4.5	7.5YR 5/6	0.5	7.5YR 4/4	0.3	c	1	vh	0.80	vs, vp	1.00	2-3npf, 2mkpf	0.43	0.67	3.03
5BCb	1.8	7.5YR 5/4	0.3	7.5YR 4/3	0.2	l	0.5	sh	0.40	so-ss, po	0.08	2vnpf	0.23	0.29	0.51

INDEX VALUES AND DETERMINED AGES (ka)

Soil Member	MHI	Mean Soil Index	SDI @ 7 feet	Color Index	Clay Film Index	Soil Age Estimate ka	Section Age Estimate ka	Stratigraphic Unit
Surface Soil	**0.45**	**2.10**	**2.67**	**0.80**	**0.20**	**4 - 8**	**4 - 8**	**Qal1**
Buried Soil 1	**0.47**	**5.74**	**3.04**	**0.60**	**0.43**	**8 - 13**	**12 - 21**	**Qal2**
Buried Soil 2	**0.65**	**4.39**	**4.39**	**1.20**	**0.85**	**13 - 30**	**25 - 51**	**Qoa1**
Buried Soil 3	**0.53**	**5.16**	**3.54**	**1.00**	**0.40**	**8 - 13**	**33 - 64**	**Qoa2**
Buried Soil 4	**0.67**	**3.54**	**3.93**	**1.30**	**0.66**	**13 - 30**	**46 - 94**	**Qoa3**

Table 2.1 - Soil Summary Sheet
456 N. Rodeo Drive Transect A - Boring CB 2

Depth (Ft)	Horizon	Summary Description of Transect A; Boring CB 2
0 - 7.3	NR & Af	No Recovery and Artificial Fill
7.3 - 10.3	Bt	truncated weakly developed argillic with slight organics, slightly hard, medium-grained, few thin clay films
10.3 - 13.1	BC	transitional horizon, massive, medium-grained, sandy basal scour deposit
13.1 - 23.2	2Btb	truncated weak to moderate argillic, fine-grained, few to common thin clay films
23.2 - 26.8	2BCb	transitional horizon, massive, coarse-grained with gravel, basal scour deposit
26.8 - 28.2	3Btb1	truncated, moderately strong argillic, well oxidized, slight organics, medium-grained, common thin and few moderately thick clay films
28.2 - 34.8	3Btb2	strongly developed sub surface argillic horizon, well oxidized, very hard, medium to coarse-grained, common to many thin and common moderately thick clay films
34.8 - 39.4	4Btb	truncated weak to moderate argillic, fine-grained, few to common thin clay films
39.4 - 41.8	4BCb	transitional horizon, massive, coarse-grained with gravel, basal scour deposit
41.8 - 42.8	5Btb	truncated weak to moderate argillic, fine-grained, few to common thin clay films
42.8 - 45.0	5BCb	transitional horizon, massive, coarse-grained with gravel, basal scour deposit
45.0 - 46.0	6Btb	truncated, moderately strong argillic, well oxidized, fine-grained, many thin and common to many moderately thick clay films
46.0 - 50.0+	6BCb	transitional horizon, crudely stratified, coarse-grained with gravel, basal scour deposit

Table 2.2 - Soil Summary Sheet
456 N. Rodeo Drive Transect A - Boring B - 1

Depth (Ft)	Horizon	Summary Description of Transect A; Boring 1
0 - 7.8	NR & Af	No Recovery and Artificial Fill
7.8 - 10.0	Bt	truncated weakly developed argillic with slight organics, slightly hard, medium-grained, few thin clay films
10.0 - 12.7	BC	transitional horizon, massive, medium-grained, sandy basal scour deposit
12.7 - 23.5	2Btb	truncated weak to moderate argillic, fine-grained, few to common thin clay films
23.5 - 25.0	2BCb	transitional horizon, massive, coarse-grained with gravel,
25.0 - 27.7	2Cb	parent material, basal scour deposit
27.7 - 30.0	3Btb1	truncated, moderately strong argillic, well oxidized, slight organics, medium-grained, common thin and few moderately thick clay films
30.0 - 32.8	3Btb2	strongly developed sub surface argillic horizon, well oxidized, very hard, medium to coarse-grained, common to many thin and common moderately thick clay films
32.8 - 39.5	4Btb	truncated weak to moderate argillic, fine-grained, few to common thin clay films
39.5 - 42.9	4BCb	transitional horizon, massive, coarse-grained with gravel, basal scour deposit
42.9 - 46.0	5Btb	truncated weak to moderate argillic, fine-grained, few to common thin clay films
46.0 - 47.2	5BCb	transitional horizon, massive, coarse-grained with gravel, basal scour deposit
47.2 - 48.0	6Btb	truncated, moderately strong argillic, well oxidized, fine-grained, many thin and common to many moderately thick clay films
48.0 - 50.0+	6BCb	transitional horizon, crudely stratified, coarse-grained with gravel, basal scour deposit

Table 2.3 - Soil Summary Sheet
456 N. Rodeo Drive Transect A - Boring B - 2

Depth (Ft)	Horizon	Summary Description of Transect A; Boring B - 2
0 - 7.2	NR & Af	No Recovery and Artificial Fill
7.2 - 10.2	Bt	truncated weakly developed argillic with slight organics, slightly hard, medium-grained, few thin clay films
10.2 - 12.5	BC	transitional horizon, massive, medium-grained, sandy basal scour deposit
12.5 - 22.2	2Btb	truncated weak to moderate argillic, fine-grained, few to common thin clay films
22.2 - 25.0	2BCb	transitional horizon, massive, coarse-grained with gravel,
25.0 - 26.7	2Cb	parent material, basal scour deposit
26.7 - 28.0	3Btb1	truncated, moderately strong argillic, well oxidized, slight organics, medium-grained, common thin and few moderately thick clay films
28.0 - 33.0	3Btb2	strongly developed sub surface argillic horizon, well oxidized, very hard, medium to coarse-grained, common to many thin and common moderately thick clay films
33.0 - 39.7	4Btb	truncated weak to moderate argillic, fine-grained, few to common thin clay films
39.7 - 41.5	4BCb	transitional horizon, massive, coarse-grained with gravel, basal scour deposit
41,5 - 45.0	5Btb	truncated weak to moderate argillic, fine-grained, few to common thin clay films
45.0 - 47.5	6Btb	truncated, moderately strong argillic, well oxidized, fine-grained, many thin and common to many moderately thick clay films
47.5 - 50.0+	6BCb	transitional horizon, crudely stratified, coarse-grained with gravel, basal scour deposit

Table 3. Soil Surface Relative-Age Estimates
456 N. Rodeo Drive - Summary Age Table

Profile Number	Soil Member	Stratigraphic Unit	MHI Value	SDI Value	Clay Film	Relative Age (ka)
Transect A Boring CB-1	Surface Soil	Qal1	0.45	2.67	0.20	4 - 8
	Buried Soil 1	Qal2	0.47	3.04	0.43	12 - 21
	Buried Soil 2	Qoa1	0.65	4.39	0.85	25 - 51
	Buried Soil 3	Qoa2	0.53	3.54	0.40	33 - 64
	Buried Soil 4	Qoa3	0.67	3.93	0.66	46 - 94

Table 4. Comparison Soil Data Indices Value Summary

(McFadden) Mission Creek Soils	SDI At 7'	MHI	Reddening Index	Clay Film Index
S7 0-1000 yrbp	0.59	0.12	0	0
S5 4-13 ka	1.02	0.3	0.1	0
S4 13-70 ka	3.14	0.37	3.94	7.37
S2 70-250 ka	5.61	0.61	4.80	6.24
S2 250-700 ka	2.57	0.39	6.20	10.31

(Rockwell) Ventura River Basin Soils	SDI At 7'	MHI	Reddening Index	Clay Film Index
Qt3 4 - 8 ka	1.7	0.17	0.5	0
Qt4 10 -15 ka	2.7	0.43	2	4
Qt5a 15 – 20 ka	2.8	0.37	3.5	4.2
Qt5b 30 ka	3.2	0.46	5	7

(WLA) West Hollywood Buried Soils	SDI At 7'	MHI	Reddening Index	Clay Film Index
Qol1 100 ka	2.1	0.42	1.05	1.99
Qol2 100-300 ka	7.3	0.8	8.2	13.2

TABLE 5. Soil Field Description Abbreviation Key

Texture		Structure		Consistence						Clay Films		Calcium Carbonate	
				Dry		Moist		Wet				(Pedogenic CaCO3)	
S	- sand	m	- massive	l	- loose	vfr	-very friable	so	non stickey	v1	veryfew	sl dis	slightly dissemenated
LS	- loamy sand	sg	- single grained	so	-soft	fr	-friable	ss	slightly stickey	1	few	I	slight coatings common on clast bottoms
SL	- sandy loam	**OR**		sh	-slightly hard	fi	-firm	s	moderately siteckey	2	common	II	moderately thick coatings on clast bottoms; few medium common fine nooduses
L	- loam	1	- weak	h	-hard	vfi	-very firm	vs	very stickey	3	continuous	III	thick coatings common on clast bottoms, common medium nodules, common fine pendants, many fine nodules
CL	- clay loam	2	- moderate	vh	-very hard			**AND**		**AND**		VI	many thick coatings on clasts bottoms common coarse pendants few clasts completely enveloped
SCL	- sandy clay loam	3	- strong	eh	-extremely hard			po	non plastci	vn	stains	V	many thick coatings on clasts bottoms, many coarse pendants common clasts completely enveloped- petrocalcic
C	- clay	**AND**						ps	slightly plastic	n	thin	V+	many thick coatings on clasts bottoms, many coarse pendants many clasts completely enveloped, completely disseminated in matrix - petrocalcic
Si	- silt	vf	- very fine					p	moderately plastic	mk	moderately thick		
SiL	- silt loam	f	- fine					vp	very plastic	k	thick		
SiCL	- silt clay loam	m	- medium							**AND**			
SiC	- silty clay	c	- coarse							cl	coating clasts		
		vc	- very coarse							pf	ped faces		
		AND								br	brodgeing sand grains		
		gr	- granular							po	lining pores		
		pl	- platty										
		pr	-prismatic										
		abk	-angular blockey										
		sbk	- sub angular blockey										

Table 6. Geological Cross Section Unit Age

Cross Sec. Unit	Description	Age (ka)
Qal1	Truncated surficial weakly developed thin Alfisol soil	4 - 8
Qal2	Truncated thick diffuse moderately well to weakly developed Alfisol soil (Buried Soil 1)	12 - 21
Qoa1	Truncated thick moderately well developed Alfisol soil (Buried Soil 2)	25 - 51
Qoa2	Truncated thin weakly to moderately well developed Alfisol soil (Buried soil 3)	33 - 64
Qoa3	Truncated moderately well developed Alfisol soil (Buried soil 4)	46 - 94

APPENDIX 'C'

CPT Reporting

8/3/18

Feffer Geological Consulting
Attn: Alexander Greene

Subject: CPT Site Investigation
468 Rodeo Drive
Beverly Hills, California
GREGG Project Number: 180590SH

Dear Mr. Greene:

The following report presents the results of GREGG Drilling & Testing's Cone Penetration Test investigation for the above referenced site. The following testing services were performed:

1	Cone Penetration Tests	(CPTU)	☒
2	Pore Pressure Dissipation Tests	(PPD)	☐
3	Seismic Cone Penetration Tests	(SCPTU)	☐
4	UVOST Laser Induced Fluorescence	(UVOST)	☐
5	Groundwater Sampling	(GWS)	☐
6	Soil Sampling	(SS)	☐
7	Vapor Sampling	(VS)	☐
8	Pressuremeter Testing	(PMT)	☐
9	Vane Shear Testing	(VST)	☐
10	Dilatometer Testing	(DMT)	☐

A list of reference papers providing additional background on the specific tests conducted is provided in the bibliography following the text of the report. If you would like a copy of any of these publications or should you have any questions or comments regarding the contents of this report, please do not hesitate to contact our office at (562) 427-6899.

Sincerely,
GREGG Drilling & Testing, Inc.



Frank Stolfi
HRSC Division Manager, Gregg Drilling & Testing, Inc.

Cone Penetration Test Sounding Summary

-Table 1-

CPT Sounding Identification	Date	Termination Depth (feet)	Depth of Groundwater Samples (feet)	Depth of Soil Samples (feet)	Depth of Pore Pressure Dissipation Tests (feet)
CPT-1	7/31/2018	49.87	-	-	-
CPT-2	7/30/2018	49.87	-	-	-
CPT-3	7/31/2018	49.87	-	-	-
CPT-4	7/31/2018	49.87	-	-	-
CPT-5	7/31/2018	49.87	-	-	-
CPT-6	7/31/2018	49.87	-	-	-
CPT-7	7/30/2018	49.87	-	-	-

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Copies of ASTM Standards are available through www.astm.org

Cone Penetration Testing Procedure (CPT)

Gregg Drilling carries out all Cone Penetration Tests (CPT) using an integrated electronic cone system, *Figure CPT*.

The cone takes measurements of tip resistance (q_c), sleeve resistance (f_s), and penetration pore water pressure (u_2). Measurements are taken at either 2.5 or 5 cm intervals during penetration to provide a nearly continuous profile. CPT data reduction and basic interpretation is performed in real time facilitating on-site decision making. The above mentioned parameters are stored electronically for further analysis and reference. All CPT soundings are performed in accordance with revised ASTM standards (D 5778-12).

The 5mm thick porous plastic filter element is located directly behind the cone tip in the u_2 location. A new saturated filter element is used on each sounding to measure both penetration pore pressures as well as measurements during a dissipation test (*PPDT*). Prior to each test, the filter element is fully saturated with oil under vacuum pressure to improve accuracy.

When the sounding is completed, the test hole is backfilled according to client specifications. If grouting is used, the procedure generally consists of pushing a hollow tremie pipe with a "knock out" plug to the termination depth of the CPT hole. Grout is then pumped under pressure as the tremie pipe is pulled from the hole. Disruption or further contamination to the site is therefore minimized.

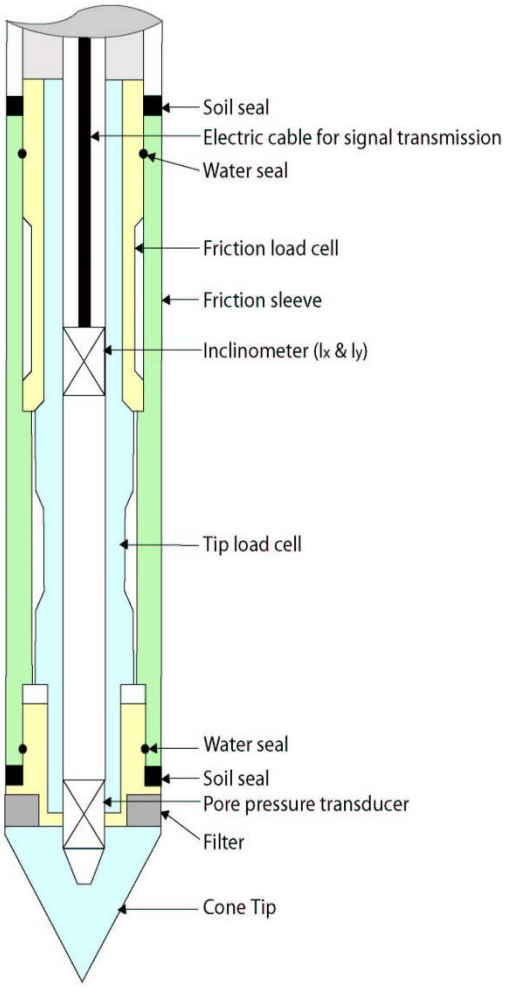


Figure CPT

Gregg 15cm^2 Standard Cone Specifications

Dimensions	
Cone base area	15 cm^2
Sleeve surface area	225 cm^2
Cone net area ratio	0.80
Specifications	
Cone load cell	
Full scale range	180 kN (20 tons)
Overload capacity	150%
Full scale tip stress	120 MPa (1,200 tsf)
Repeatability	120 kPa (1.2 tsf)
Sleeve load cell	
Full scale range	31 kN (3.5 tons)
Overload capacity	150%
Full scale sleeve stress	1,400 kPa (15 tsf)
Repeatability	1.4 kPa (0.015 tsf)
Pore pressure transducer	
Full scale range	7,000 kPa (1,000 psi)
Overload capacity	150%
Repeatability	7 kPa (1 psi)

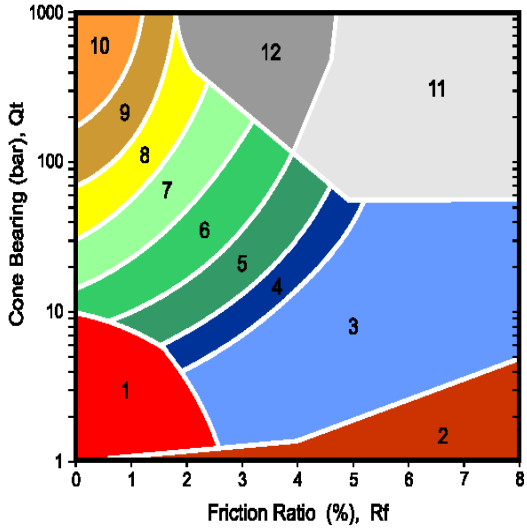
Note: The repeatability during field use will depend somewhat on ground conditions, abrasion, maintenance and zero load stability.

Cone Penetration Test Data & Interpretation

The Cone Penetration Test (CPT) data collected are presented in graphical and electronic form in the report. The plots include interpreted Soil Behavior Type (SBT) based on the charts described by Robertson (1990). Typical plots display SBT based on the non-normalized charts of Robertson et al (1986). For CPT soundings deeper than 30m, we recommend the use of the normalized charts of Robertson (1990) which can be displayed as SBTn, upon request. The report also includes spreadsheet output of computer calculations of basic interpretation in terms of SBT and SBTn and various geotechnical parameters using current published correlations based on the comprehensive review by Lunne, Robertson and Powell (1997), as well as recent updates by Professor Robertson (Guide to Cone Penetration Testing, 2015). The interpretations are presented only as a guide for geotechnical use and should be carefully reviewed. Gregg Drilling & Testing Inc. does not warranty the correctness or the applicability of any of the geotechnical parameters interpreted by the software and does not assume any liability for use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used in the software. Some interpretation methods require input of the groundwater level to calculate vertical effective stress. An estimate of the in-situ groundwater level has been made based on field observations and/or CPT results, but should be verified by the user.

A summary of locations and depths is available in Table 1. Note that all penetration depths referenced in the data are with respect to the existing ground surface.

Note that it is not always possible to clearly identify a soil type based solely on q_t, f_s, and u_2. In these situations, experience, judgment, and an assessment of the pore pressure dissipation data should be used to infer the correct soil behavior type.



ZONE		SBT
1		Sensitive, fine grained
2		Organic materials
3		Clay
4		Silty clay to clay
5		Clayey silt to silty clay
6		Sandy silt to clayey silt
7		Silty sand to sandy silt
8		Sand to silty sand
9		Sand
10		Gravely sand to sand
11		Very stiff fine grained*
12		Sand to clayey sand*

*over consolidated or cemented

Figure SBT (After Robertson et al., 1986) – Note: Colors may vary slightly compared to plots

Cone Penetration Test (CPT) Interpretation

Gregg uses a proprietary CPT interpretation and plotting software. The software takes the CPT data and performs basic interpretation in terms of soil behavior type (SBT) and various geotechnical parameters using current published empirical correlations based on the comprehensive review by Lunne, Robertson and Powell (1997). The interpretation is presented in tabular format using MS Excel. The interpretations are presented only as a guide for geotechnical use and should be carefully reviewed. Gregg does not warranty the correctness or the applicability of any of the geotechnical parameters interpreted by the software and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used in the software.

The following provides a summary of the methods used for the interpretation. Many of the empirical correlations to estimate geotechnical parameters have constants that have a range of values depending on soil type, geologic origin and other factors. The software uses 'default' values that have been selected to provide, in general, conservatively low estimates of the various geotechnical parameters.

Input:

1 Units for display (Imperial or metric) (atm. pressure, p_a = 0.96 tsf or 0.1 MPa)
2 Depth interval to average results (ft or m). Data are collected at either 0.02 or 0.05m and can be averaged every 1, 3 or 5 intervals.
3 Elevation of ground surface (ft or m)
4 Depth to water table, z_w (ft or m) – input required
5 Net area ratio for cone, a (default to 0.80)
6 Relative Density constant, C_{Dr} (default to 350)
7 Young's modulus number for sands, α (default to 5)
8 Small strain shear modulus number
  a. for sands, S_G (default to 180 for SBT_n 5, 6, 7)
  b. for clays, C_G (default to 50 for SBT_n 1, 2, 3 & 4)
9 Undrained shear strength cone factor for clays, N_{kt} (default to 15)
10 Over Consolidation ratio number, k_{ocr} (default to 0.3)
11 Unit weight of water, (default to γ_w = 62.4 lb/ft^3 or 9.81 kN/m^3)

Column

1 Depth, z, (m) – CPT data is collected in meters
2 Depth (ft)
3 Cone resistance, q_c (tsf or MPa)
4 Sleeve resistance, f_s (tsf or MPa)
5 Penetration pore pressure, u (psi or MPa), measured behind the cone (i.e. u_2)
6 Other – any additional data
7 Total cone resistance, q_t (tsf or MPa) $q_t = q_c + u\,(1-a)$

8	Friction Ratio, R_f (%)	$R_f = (f_s/q_t) \times 100\%$
9	Soil Behavior Type (non-normalized), SBT	see note
10	Unit weight, γ (pcf or kN/m^3)	based on SBT, see note
11	Total overburden stress, σ_v (tsf)	$\sigma_{vo} = \sigma\, z$
12	In-situ pore pressure, u_o (tsf)	$u_o = \gamma_w (z - z_w)$
13	Effective overburden stress, σ'_{vo} (tsf)	$\sigma'_{vo} = \sigma_{vo} - u_o$
14	Normalized cone resistance, Q_{t1}	$Q_{t1} = (q_t - \sigma_{vo}) / \sigma'_{vo}$
15	Normalized friction ratio, F_r (%)	$F_r = f_s / (q_t - \sigma_{vo}) \times 100\%$
16	Normalized Pore Pressure ratio, B_q	$B_q = u - u_o / (q_t - \sigma_{vo})$
17	Soil Behavior Type (normalized), SBT_n	see note
18	SBT_n Index, I_c	see note
19	Normalized Cone resistance, Q_{tn} (n varies with I_c)	see note
20	Estimated permeability, k_{SBT} (cm/sec or ft/sec)	see note
21	Equivalent SPT N_{60}, blows/ft	see note
22	Equivalent SPT $(N_1)_{60}$ blows/ft	see note
23	Estimated Relative Density, D_r, (%)	see note
24	Estimated Friction Angle, ϕ', (degrees)	see note
25	Estimated Young's modulus, E_s (tsf)	see note
26	Estimated small strain Shear modulus, Go (tsf)	see note
27	Estimated Undrained shear strength, s_u (tsf)	see note
28	Estimated Undrained strength ratio	s_u/σ_v'
29	Estimated Over Consolidation ratio, OCR	see note

Notes:

1 Soil Behavior Type (non-normalized), SBT (Lunne et al., 1997 and table below)

2 Unit weight, γ either constant at 119 pcf or based on Non-normalized SBT (Lunne et al., 1997 and table below)

3 Soil Behavior Type (Normalized), SBT_n Lunne et al. (1997)

4 SBT_n Index, I_c $I_c = ((3.47 - \log Q_{t1})^2 + (\log F_r + 1.22)^2)^{0.5}$

5 Normalized Cone resistance, Q_{tn} (n varies with Ic)

$Q_{tn} = ((q_t - \sigma_{vo})/pa)\ (pa/(\sigma'_{vo})^n$ and recalculate I_c, then iterate:

When $I_c < 1.64$, n = 0.5 (clean sand)
When $I_c > 3.30$, n = 1.0 (clays)
When $1.64 < I_c < 3.30$, $n = (I_c - 1.64)0.3 + 0.5$
Iterate until the change in n, $\Delta n < 0.01$

6 Estimated permeability, k_{SBT} based on Normalized SBT_n (Lunne et al., 1997 and table below)

7 Equivalent SPT N_{60}, blows/ft Lunne et al. (1997)

$$\frac{(q_t/p_a)}{N_{60}} = 8.5\left(1 - \frac{I_c}{4.6}\right)$$

8 Equivalent SPT $(N_1)_{60}$ blows/ft $(N_1)_{60} = N_{60}\, C_N$,
where $C_N = (pa/\sigma'_{vo})^{0.5}$

9 Relative Density, D_r, (%) $D_r^2 = Q_{tn} / C_{Dr}$
Only SBT_n 5, 6, 7 & 8 *Show 'N/A' in zones 1, 2, 3, 4 & 9*

10 Friction Angle, ϕ', (degrees) $\tan\phi' = \frac{1}{2.68}\left[\log\left(\frac{q_c}{\sigma'_{vo}}\right) + 0.29\right]$
Only SBT_n 5, 6, 7 & 8 *Show'N/A' in zones 1, 2, 3, 4 & 9*

11 Young's modulus, E_s $E_s = \alpha\, q_t$
Only SBT_n 5, 6, 7 & 8 *Show 'N/A' in zones 1, 2, 3, 4 & 9*

12 Small strain shear modulus, Go

a. $G_o = S_G\,(q_t\ \sigma'_{vo}\ pa)^{1/3}$ *For SBT_n 5, 6, 7*

b. $G_o = C_G\, q_t$ *For SBT_n 1, 2, 3& 4*

Show 'N/A' in zones 8 & 9

13 Undrained shear strength, s_u $s_u = (q_t - \sigma_{vo}) / N_{kt}$
Only SBT_n 1, 2, 3, 4 & 9 *Show 'N/A' in zones 5, 6, 7 & 8*

14 Over Consolidation ratio, OCR $OCR = k_{ocr}\, Q_{t1}$
Only SBT_n 1, 2, 3, 4 & 9 *Show 'N/A' in zones 5, 6, 7 & 8*

The following updated and simplified SBT descriptions have been used in the software:

SBT Zones		**SBT_n Zones**	
1	sensitive fine grained	1	sensitive fine grained
2	organic soil	2	organic soil
3	clay	3	clay
4	clay & silty clay	4	clay & silty clay
5	clay & silty clay		
6	sandy silt & clayey silt		

7	silty sand & sandy silt	5	silty sand & sandy silt
8	sand & silty sand	6	sand & silty sand
9	sand		
10	sand	7	sand
11	very dense/stiff soil*	8	very dense/stiff soil*
12	very dense/stiff soil*	9	very dense/stiff soil*

*heavily overconsolidated and/or cemented

Track when soils fall with zones of same description and print that description (i.e. if soils fall only within SBT zones 4 & 5, print 'clays & silty clays')

Estimated Permeability (see Lunne et al., 1997)

SBT_n	Permeability (ft/sec)	(m/sec)
1	$3x\ 10^{-8}$	$1x\ 10^{-8}$
2	$3x\ 10^{-7}$	$1x\ 10^{-7}$
3	$1x\ 10^{-9}$	$3x\ 10^{-10}$
4	$3x\ 10^{-8}$	$1x\ 10^{-8}$
5	$3x\ 10^{-6}$	$1x\ 10^{-6}$
6	$3x\ 10^{-4}$	$1x\ 10^{-4}$
7	$3x\ 10^{-2}$	$1x\ 10^{-2}$
8	$3x\ 10^{-6}$	$1x\ 10^{-6}$
9	$1x\ 10^{-8}$	$3x\ 10^{-9}$

Estimated Unit Weight (see Lunne et al., 1997)

SBT	Approximate Unit Weight (lb/ft^3)	(kN/m^3)
1	111.4	17.5
2	79.6	12.5
3	111.4	17.5
4	114.6	18.0
5	114.6	18.0
6	114.6	18.0
7	117.8	18.5
8	120.9	19.0
9	124.1	19.5
10	127.3	20.0
11	130.5	20.5
12	120.9	19.0

Pore Pressure Dissipation Tests (PPDT)

Pore Pressure Dissipation Tests (PPDT's) conducted at various intervals can be used to measure equilibrium water pressure (at the time of the CPT). If conditions are hydrostatic, the equilibrium water pressure can be used to determine the approximate depth of the ground water table. A PPDT is conducted when penetration is halted at specific intervals determined by the field representative. The variation of the penetration pore pressure (*u)* with time is measured behind the tip of the cone and recorded.

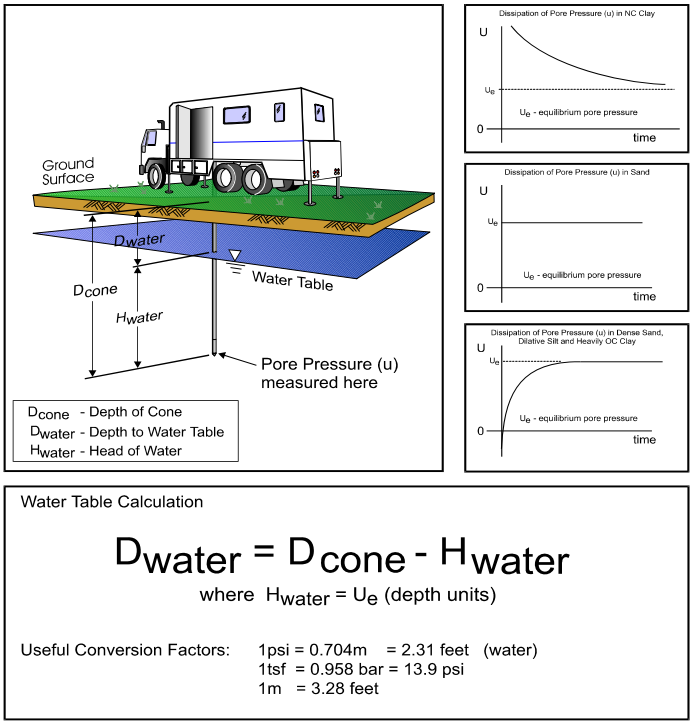
Pore pressure dissipation data can be interpreted to provide estimates of:

- Equilibrium piezometric pressure
- Phreatic Surface
- In situ horizontal coefficient of consolidation (c_h)
- In situ horizontal coefficient of permeability (k_h)

In order to correctly interpret the equilibrium piezometric pressure and/or the phreatic surface, the pore pressure must be monitored until it reaches equilibrium, *Figure PPDT*. This time is commonly referred to as t_{100}, the point at which 100% of the excess pore pressure has dissipated.

A complete reference on pore pressure dissipation tests is presented by Robertson et al. 1992 and Lunne et al. 1997.

A summary of the pore pressure dissipation tests are summarized in Table 1.



Water Table Calculation

$$D_{water} = D_{cone} - H_{water}$$

where $H_{water} = U_e$ (depth units)

Useful Conversion Factors: 1psi = 0.704m = 2.31 feet (water)
1tsf = 0.958 bar = 13.9 psi
1m = 3.28 feet

Figure PPDT

Seismic Cone Penetration Testing (SCPT)

Seismic Cone Penetration Testing (SCPT) can be conducted at various intervals during the Cone Penetration Test. Shear wave velocity (Vs) can then be calculated over a specified interval with depth. A small interval for seismic testing, such as 1-1.5m (3-5ft) allows for a detailed look at the shear wave profile with depth. Conversely, a larger interval such as 3-6m (10-20ft) allows for a more average shear wave velocity to be calculated. Gregg's cones have a horizontally active geophone located 0.2m (0.66ft) behind the tip.

To conduct the seismic shear wave test, the penetration of the cone is stopped and the rods are decoupled from the rig. An automatic hammer is triggered to send a shear wave into the soil. The distance from the source to the cone is calculated knowing the total depth of the cone and the horizontal offset distance between the source and the cone. To calculate an interval velocity, a minimum of two tests must be performed at two different depths. The arrival times between the two wave traces are compared to obtain the difference in time (Δt). The difference in depth is calculated (Δd) and velocity can be determined using the simple equation: $v = \Delta d/\Delta t$

Multiple wave traces can be recorded at the same depth to improve quality of the data.

A complete reference on seismic cone penetration tests is presented by Robertson et al. 1986 and Lunne et al. 1997.

A summary the shear wave velocities, arrival times and wave traces are provided with the report.

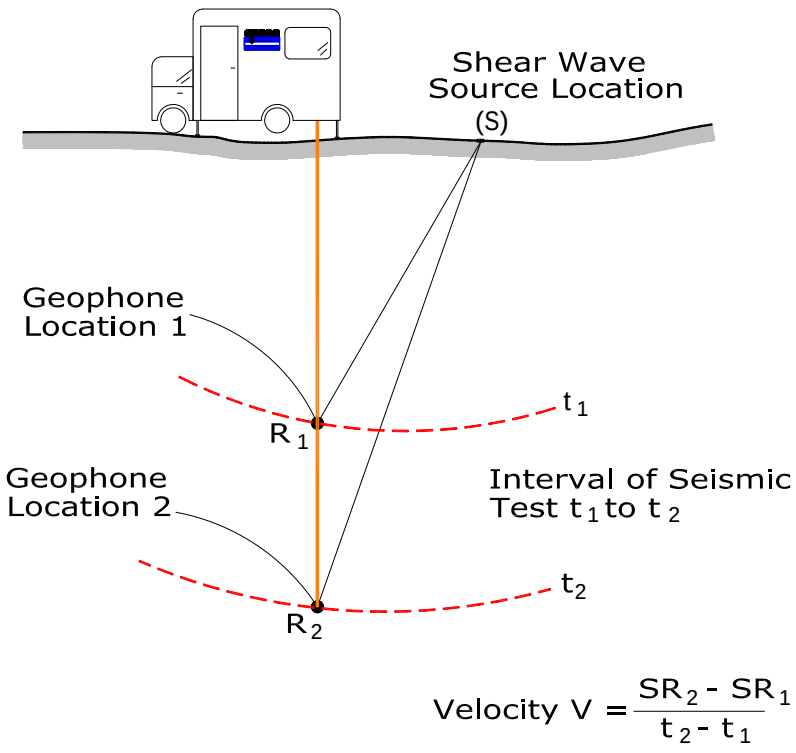


Figure SCPT

Groundwater Sampling

Gregg Drilling & Testing, Inc. conducts groundwater sampling using a sampler as shown in *Figure GWS*. The groundwater sampler has a retrievable stainless steel or disposable PVC screen with steel drop off tip. This allows for samples to be taken at multiple depth intervals within the same sounding location. In areas of slower water recharge, provisions may be made to set temporary PVC well screens during sampling to allow the pushing equipment to advance to the next sample location while the groundwater is allowed to infiltrate.

The groundwater sampler operates by advancing 44.5mm (1¾ inch) hollow push rods with the filter tip in a closed configuration to the base of the desired sampling interval. Once at the desired sample depth, the push rods are retracted; exposing the encased filter screen and allowing groundwater to infiltrate hydrostatically from the formation into the inlet screen. A small diameter bailer (approximately ½ or ¾ inch) is lowered through the push rods into the screen section for sample collection. The number of downhole trips with the bailer and time necessary to complete the sample collection at each depth interval is a function of sampling protocols, volume requirements, and the yield characteristics and storage capacity of the formation. Upon completion of sample collection, the push rods and sampler, with the exception of the PVC screen and steel drop off tip are retrieved to the ground surface, decontaminated and prepared for the next sampling event.

For a detailed reference on direct push groundwater sampling, refer to Zemo et. al., 1992.

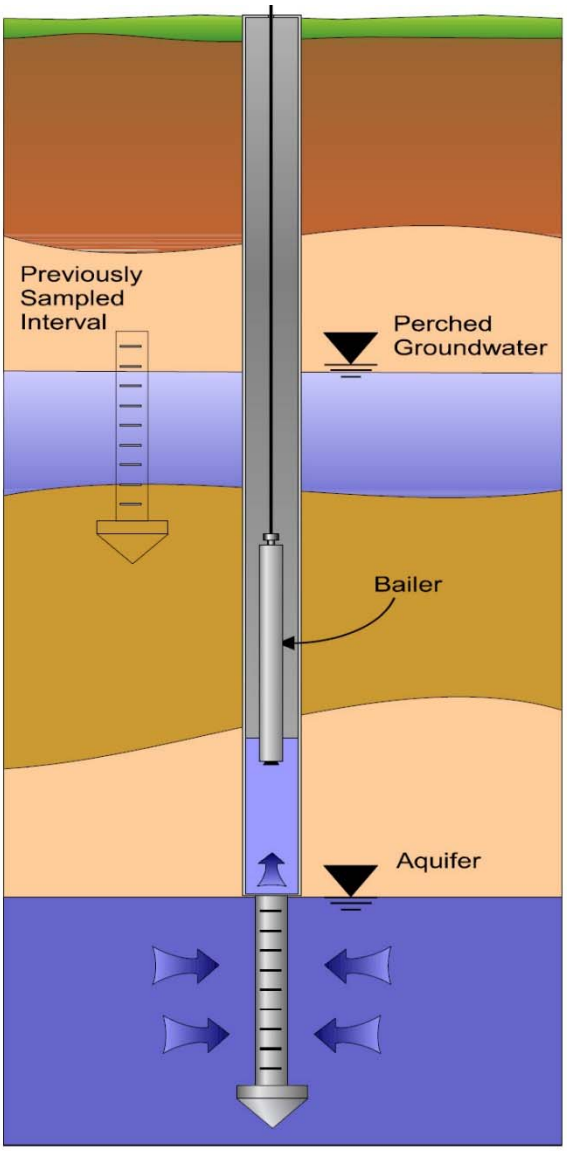


Figure GWS

Soil Sampling

Gregg Drilling & Testing, Inc. uses a piston-type push-in sampler to obtain small soil samples without generating any soil cuttings, *Figure SS*. Two different types of samplers (12 and 18 inch) are used depending on the soil type and density. The soil sampler is initially pushed in a "closed" position to the desired sampling interval using the CPT pushing equipment. Keeping the sampler closed minimizes the potential of cross contamination. The inner tip of the sampler is then retracted leaving a hollow soil sampler with inner 1¼" diameter sample tubes. The hollow sampler is then pushed in a locked "open" position to collect a soil sample. The filled sampler and push rods are then retrieved to the ground surface. Because the soil enters the sampler at a constant rate, the opportunity for 100% recovery is increased. For environmental analysis, the soil sample tube ends are sealed with Teflon and plastic caps. Often, a longer "split tube" can be used for geotechnical sampling.

For a detailed reference on direct push soil sampling, refer to Robertson et al, 1998.

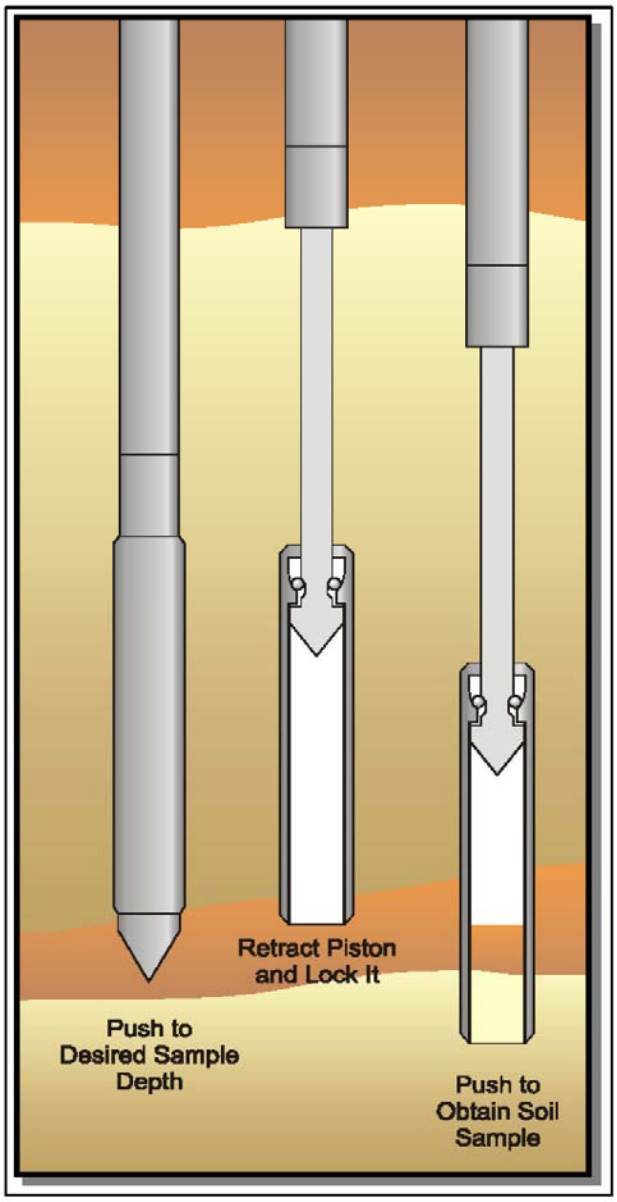


Figure SS

GREGG DRILLING, INC.
www.greggdrilling.com

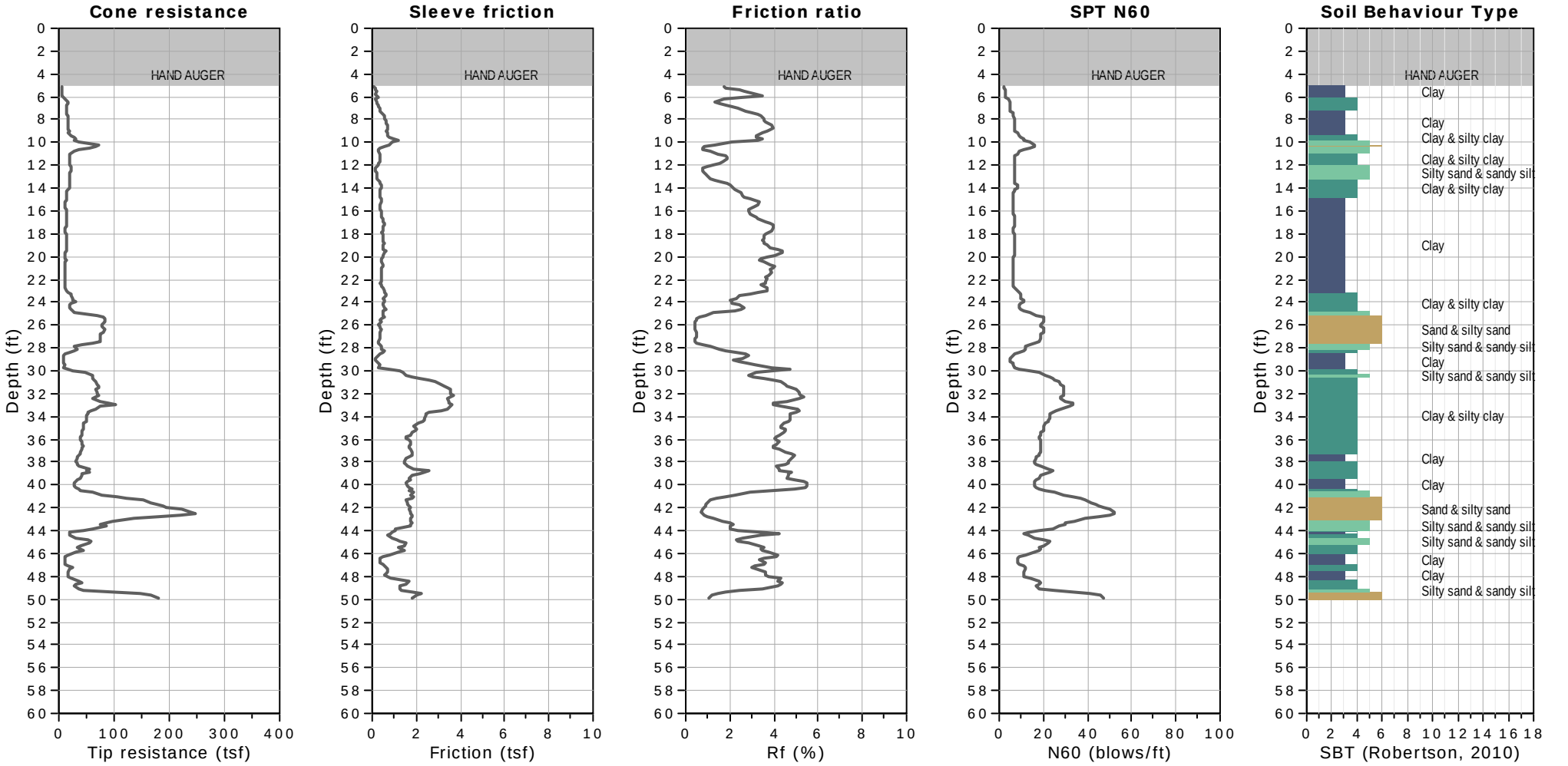
CPT: CPT-1

CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/31/2018

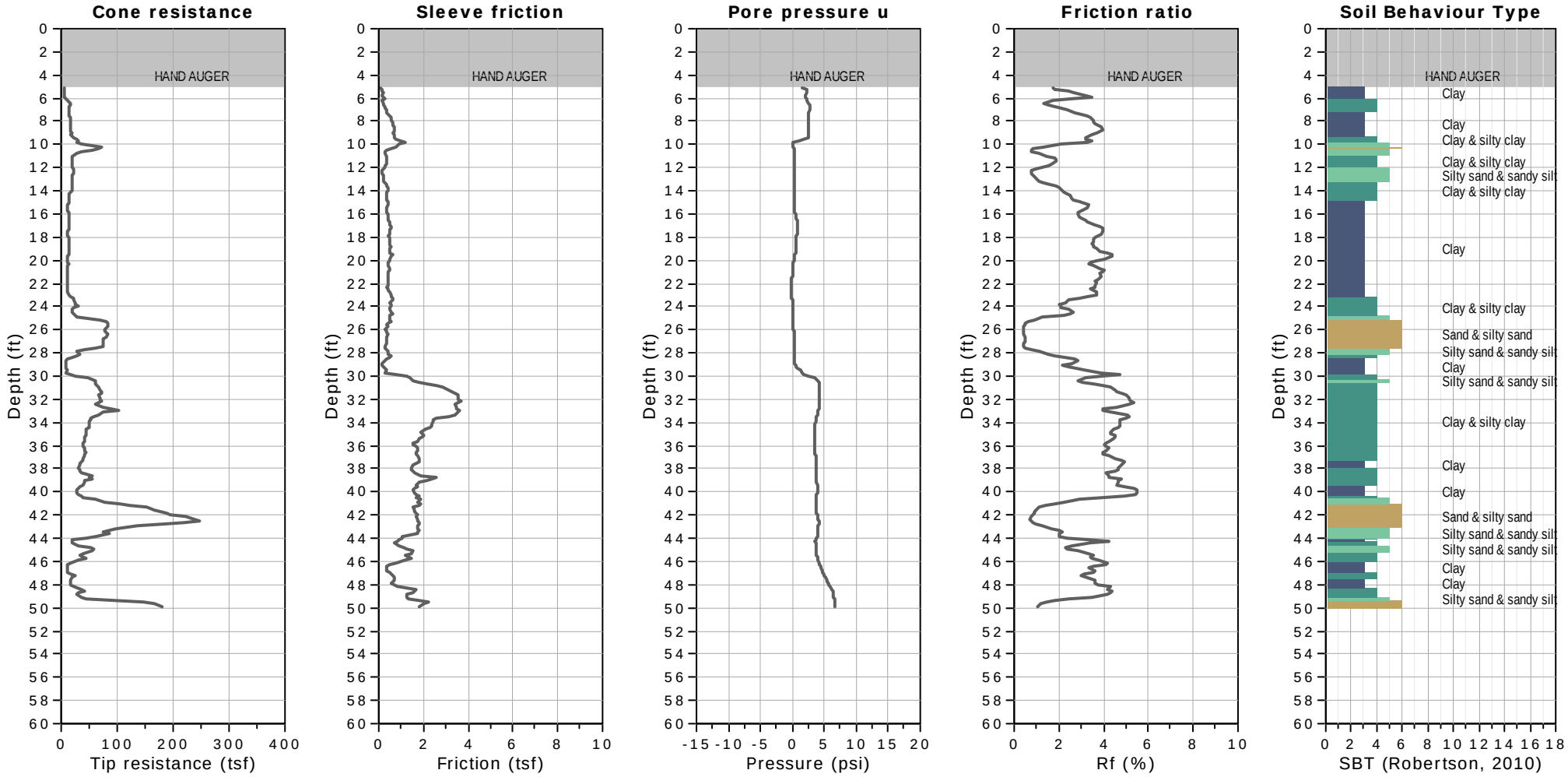


CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/31/2018



WATER TABLE FOR ESTIMATING PURPOSES ONLY

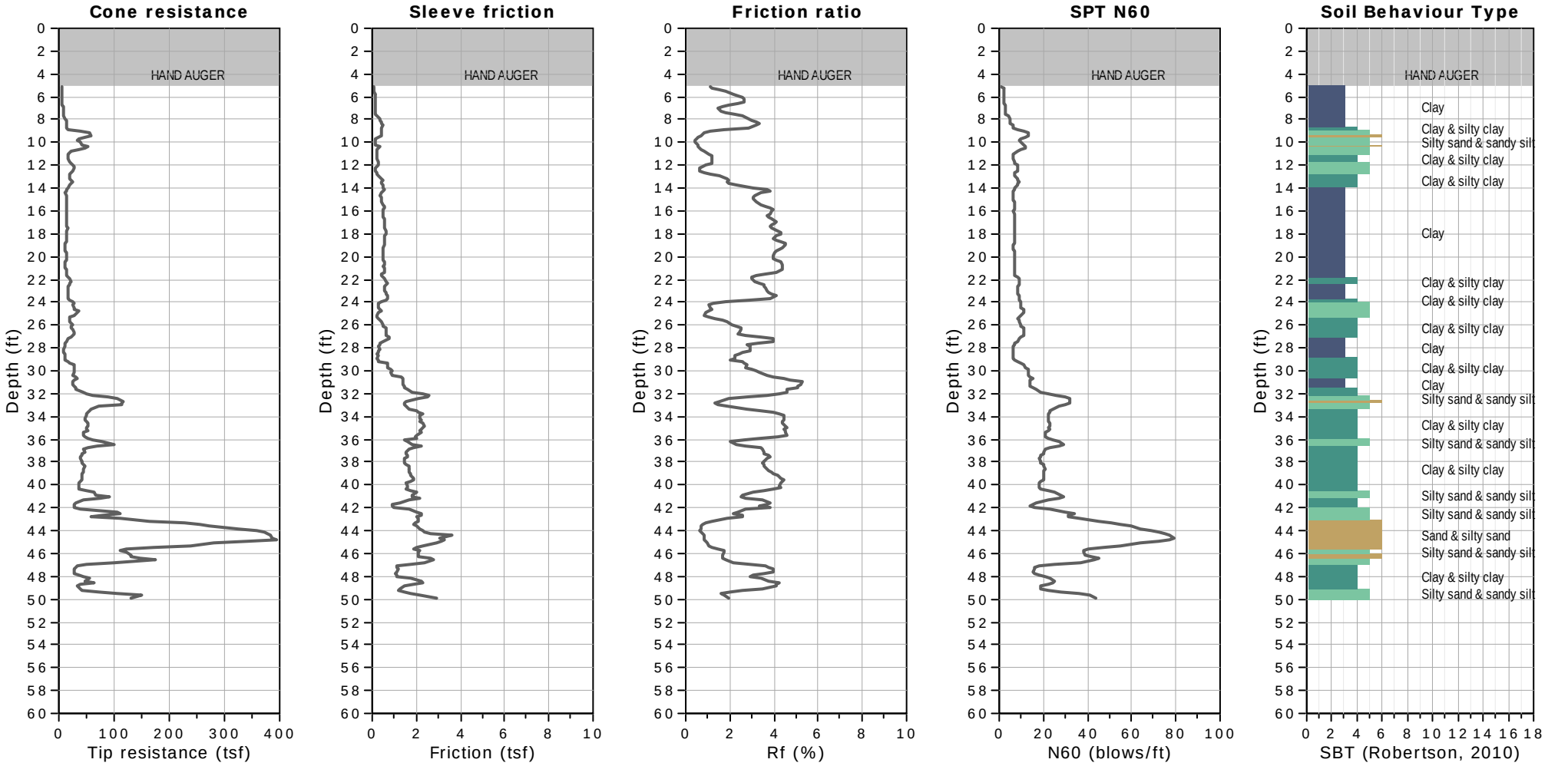
CPT: CPT-2

CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/30/2018

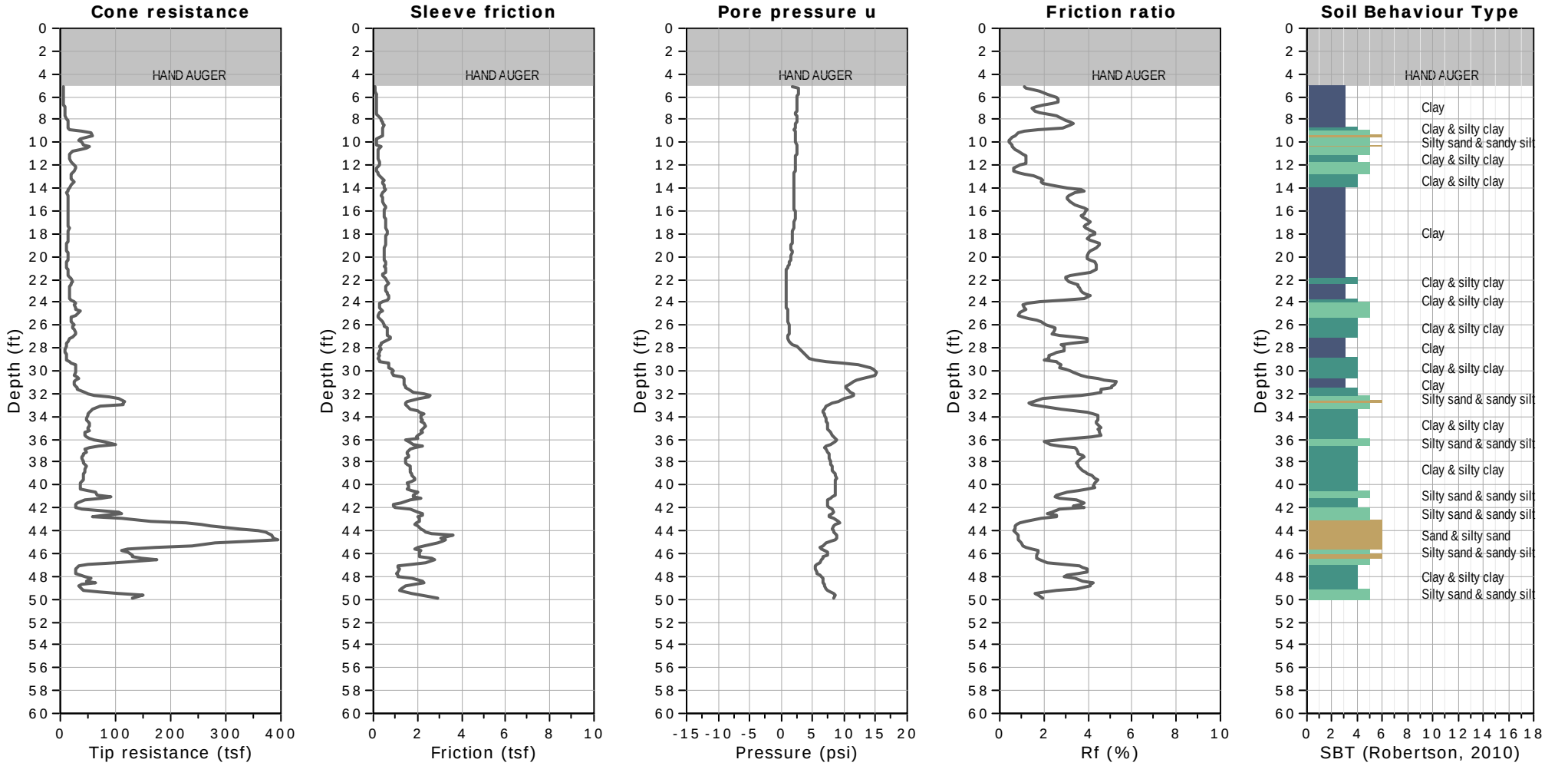


CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/30/2018



WATER TABLE FOR ESTIMATING PURPOSES ONLY

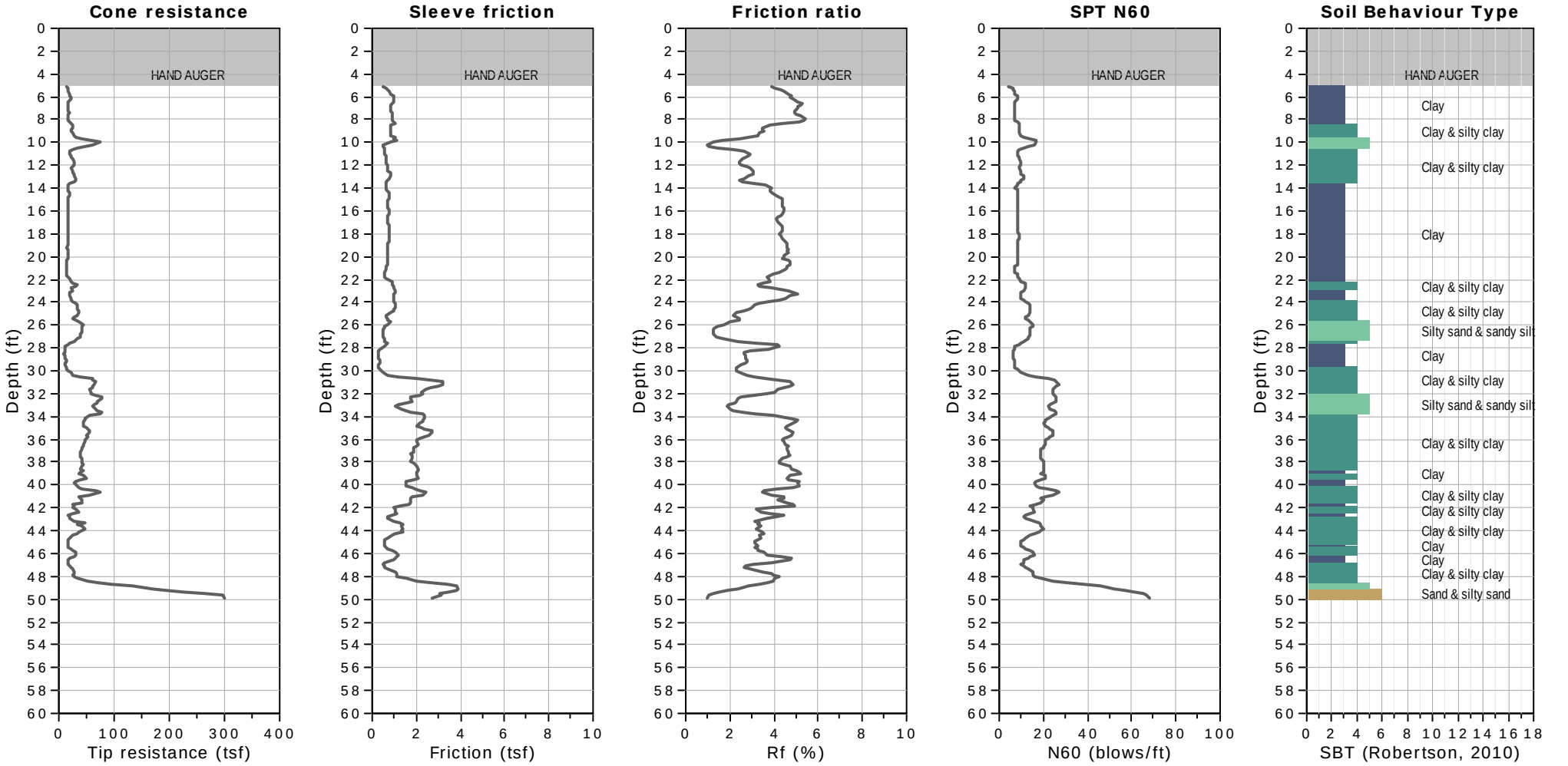
CPT: CPT-3

CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/31/2018

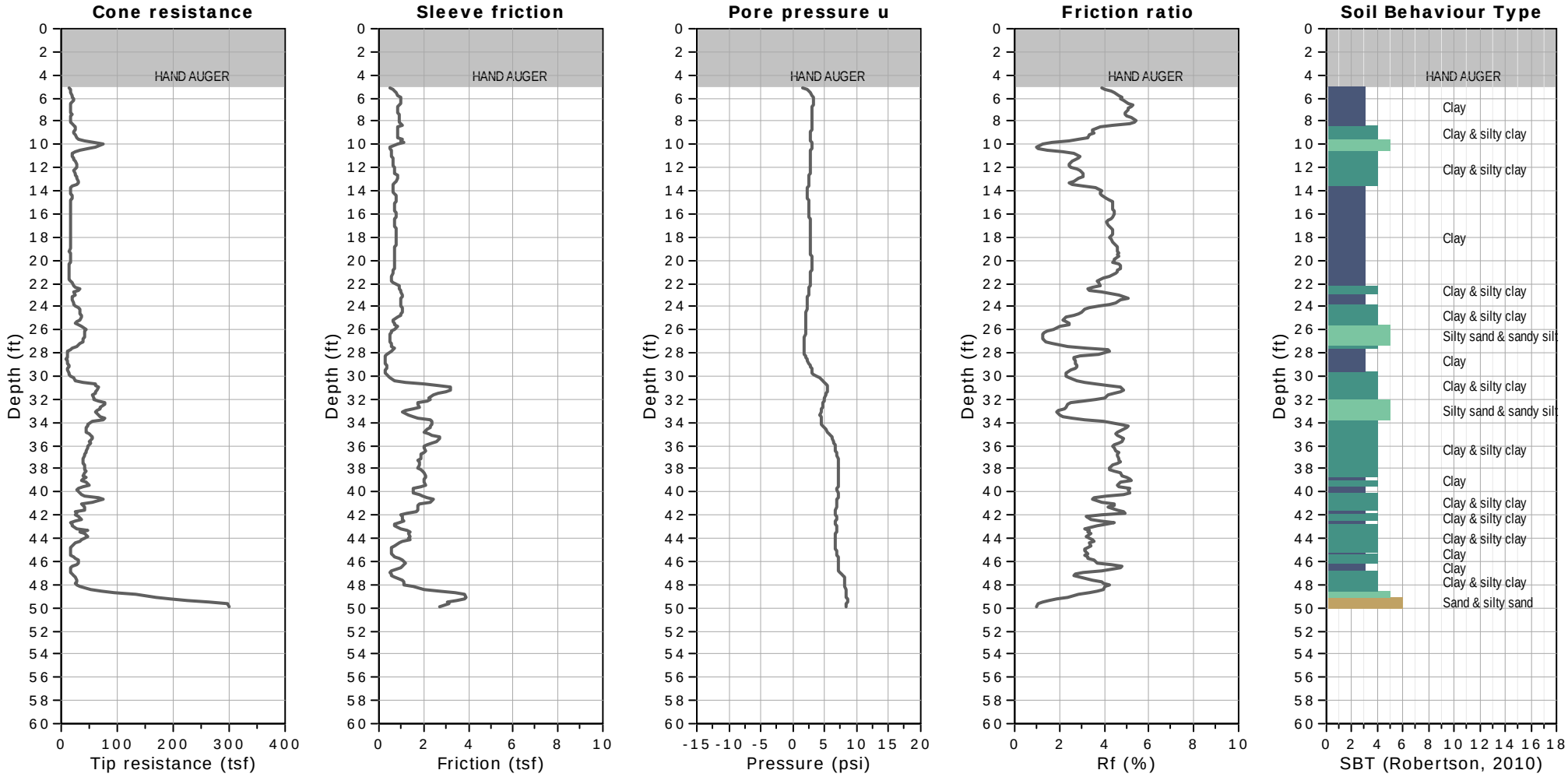


CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/31/2018



WATER TABLE FOR ESTIMATING PURPOSES ONLY

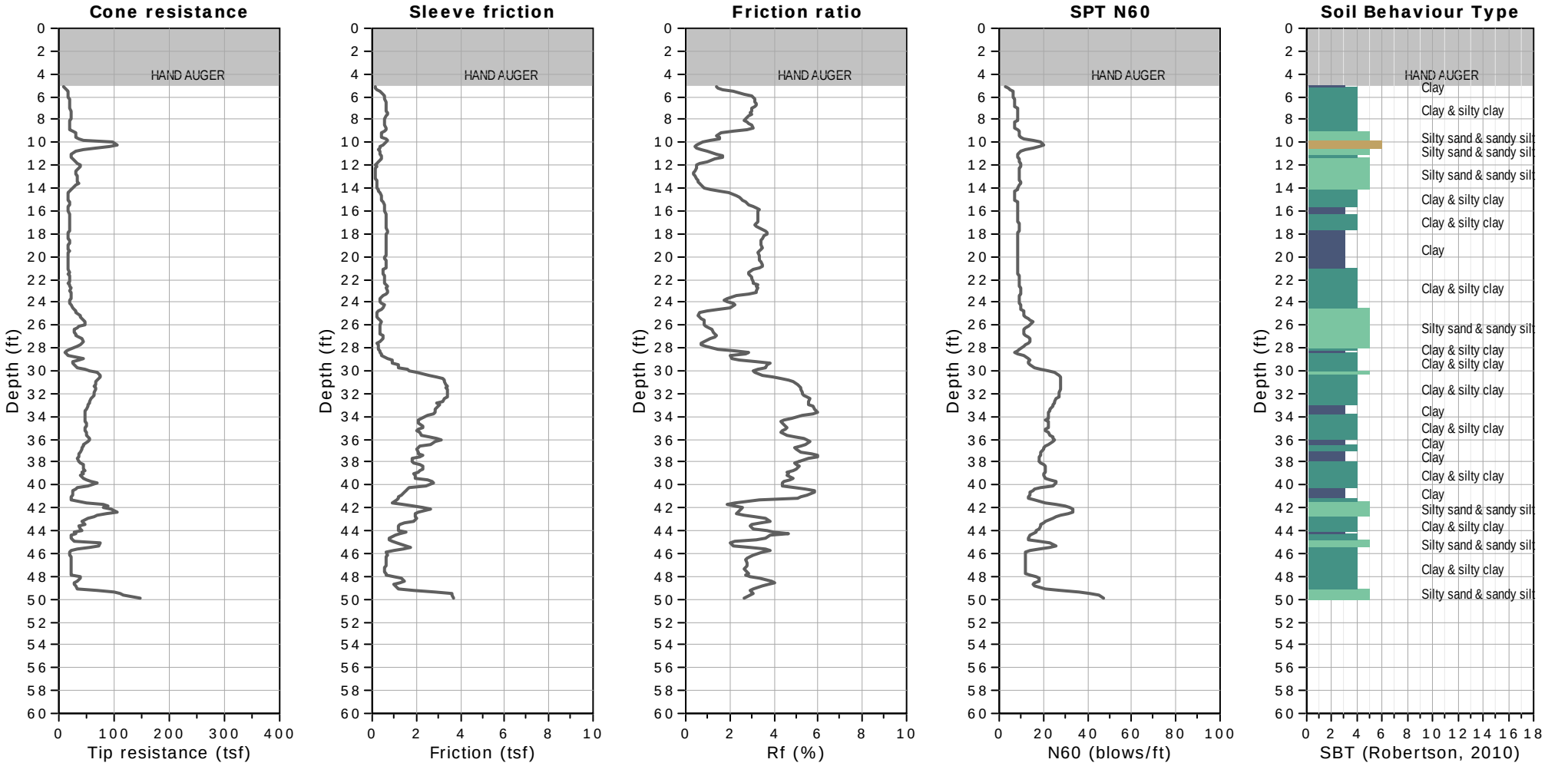
CPT: CPT-4

CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/31/2018

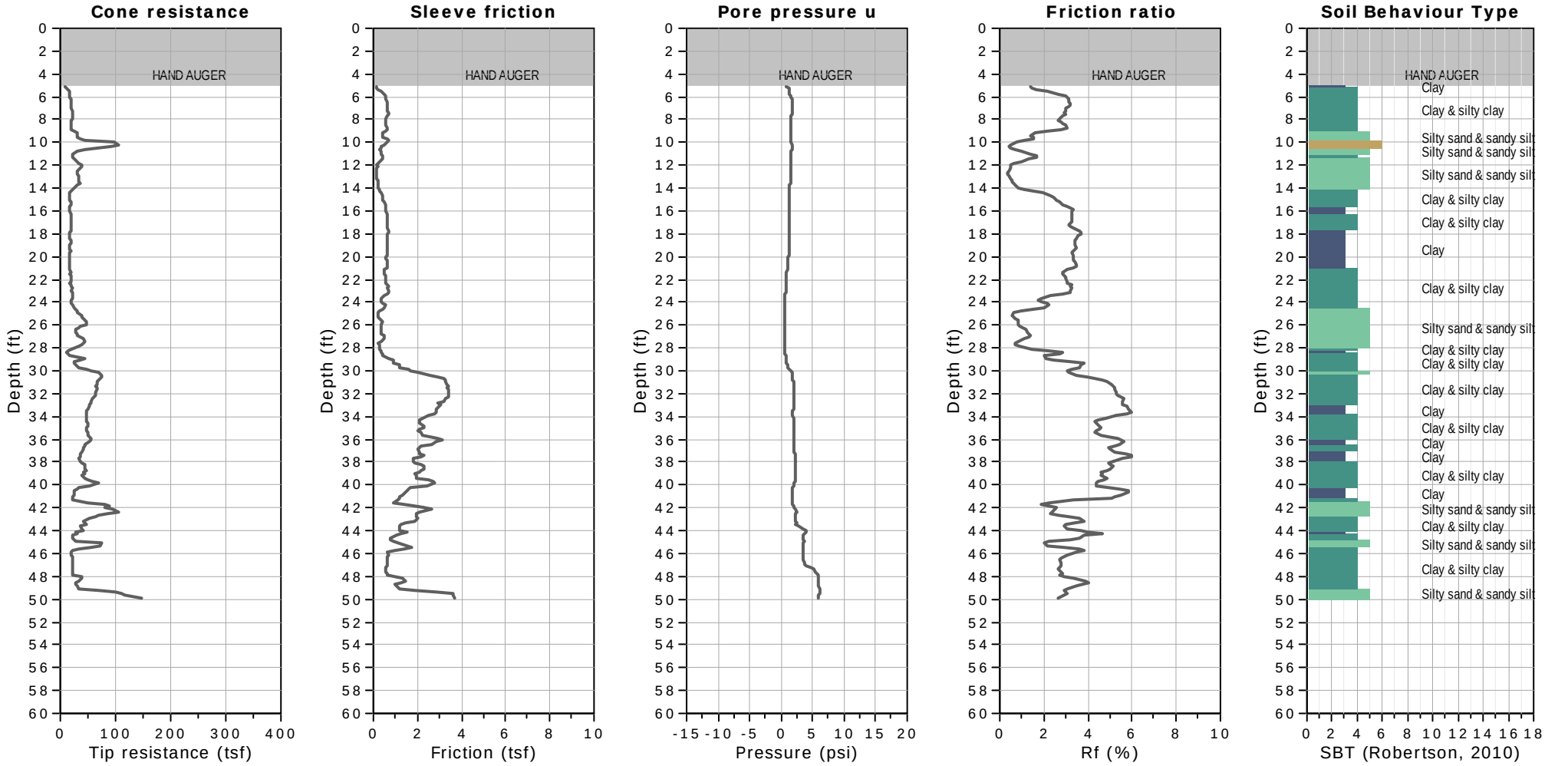


CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/31/2018



WATER TABLE FOR ESTIMATING PURPOSES ONLY

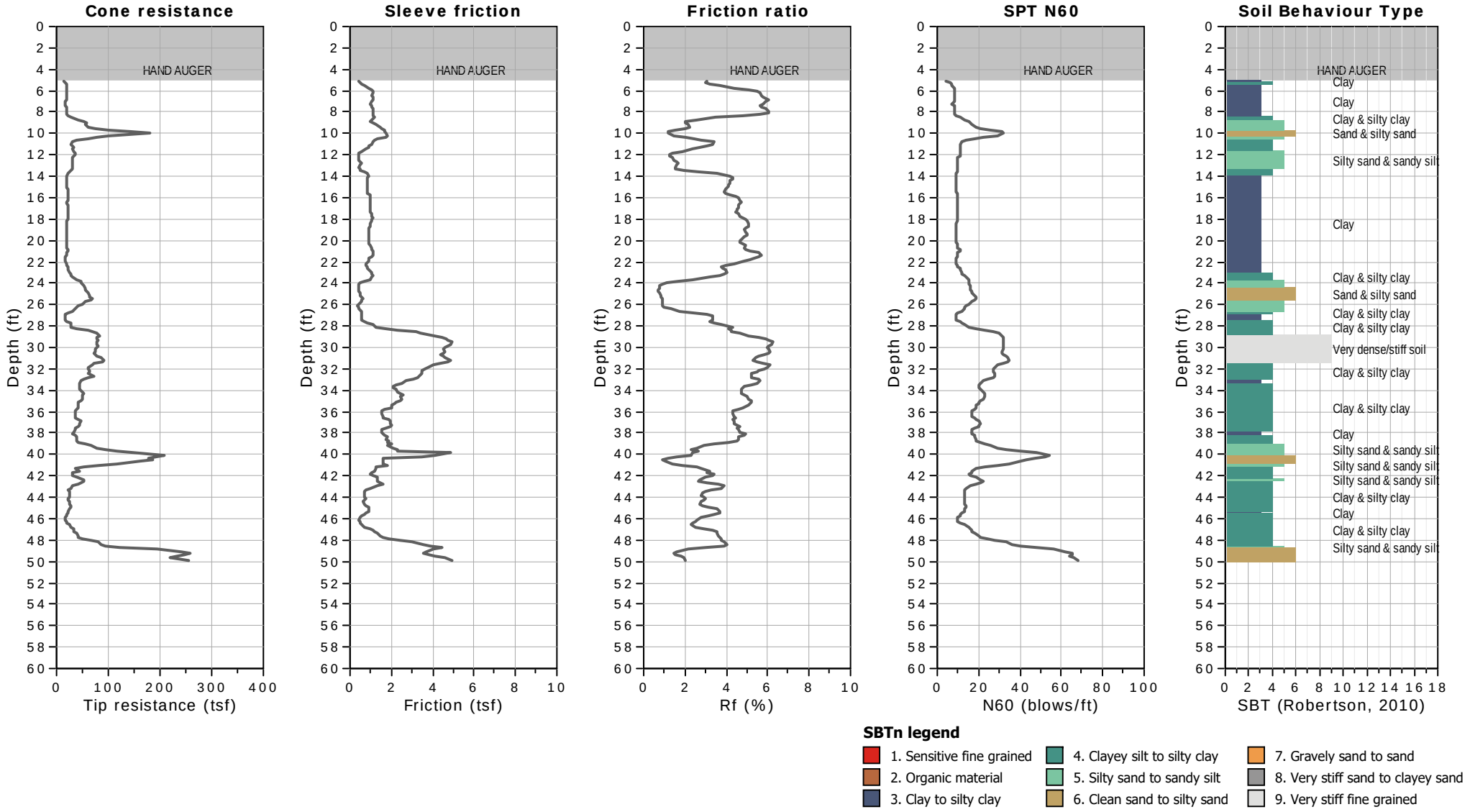
CPT: CPT-5

CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/31/2018

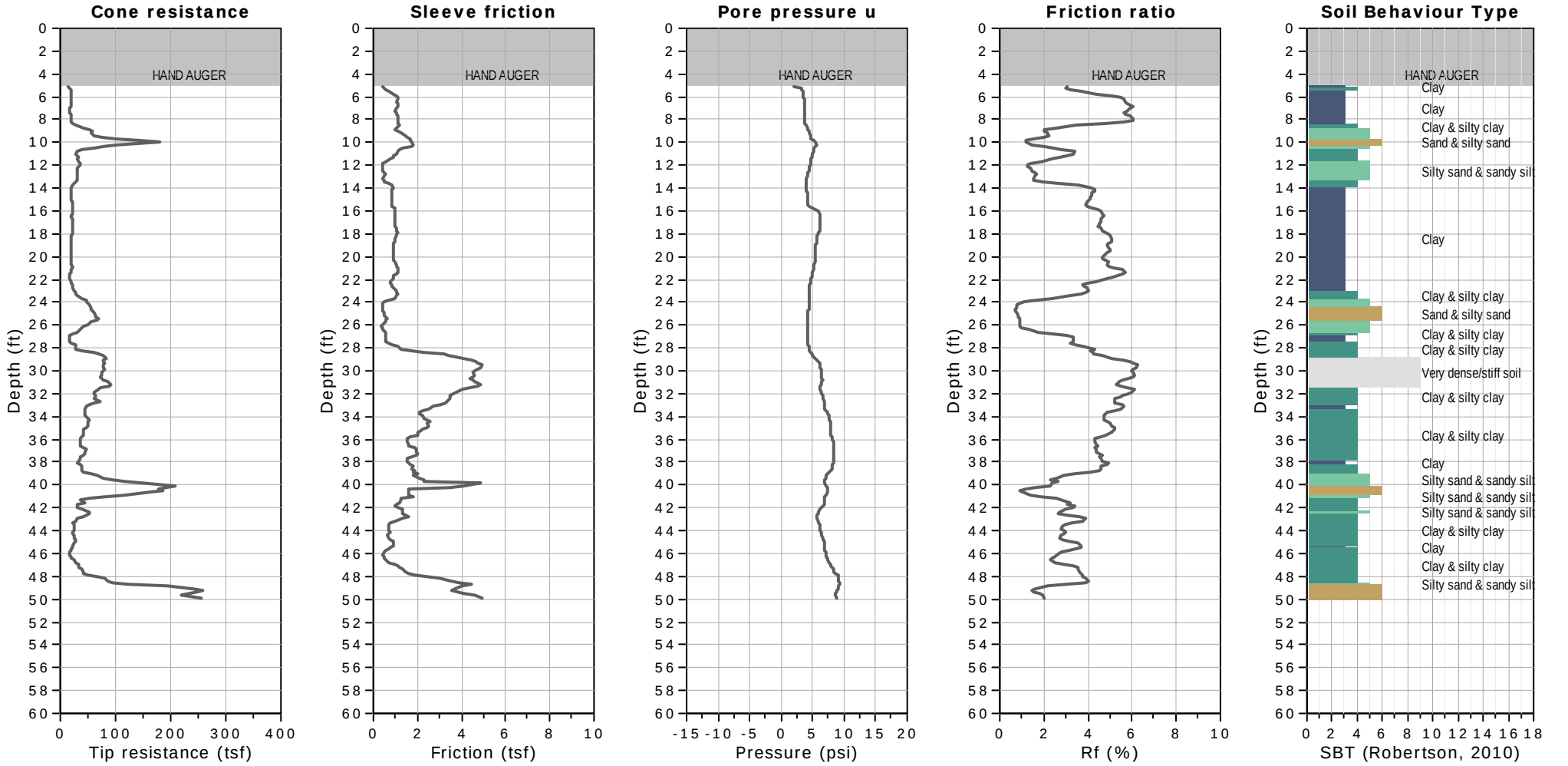


CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/31/2018



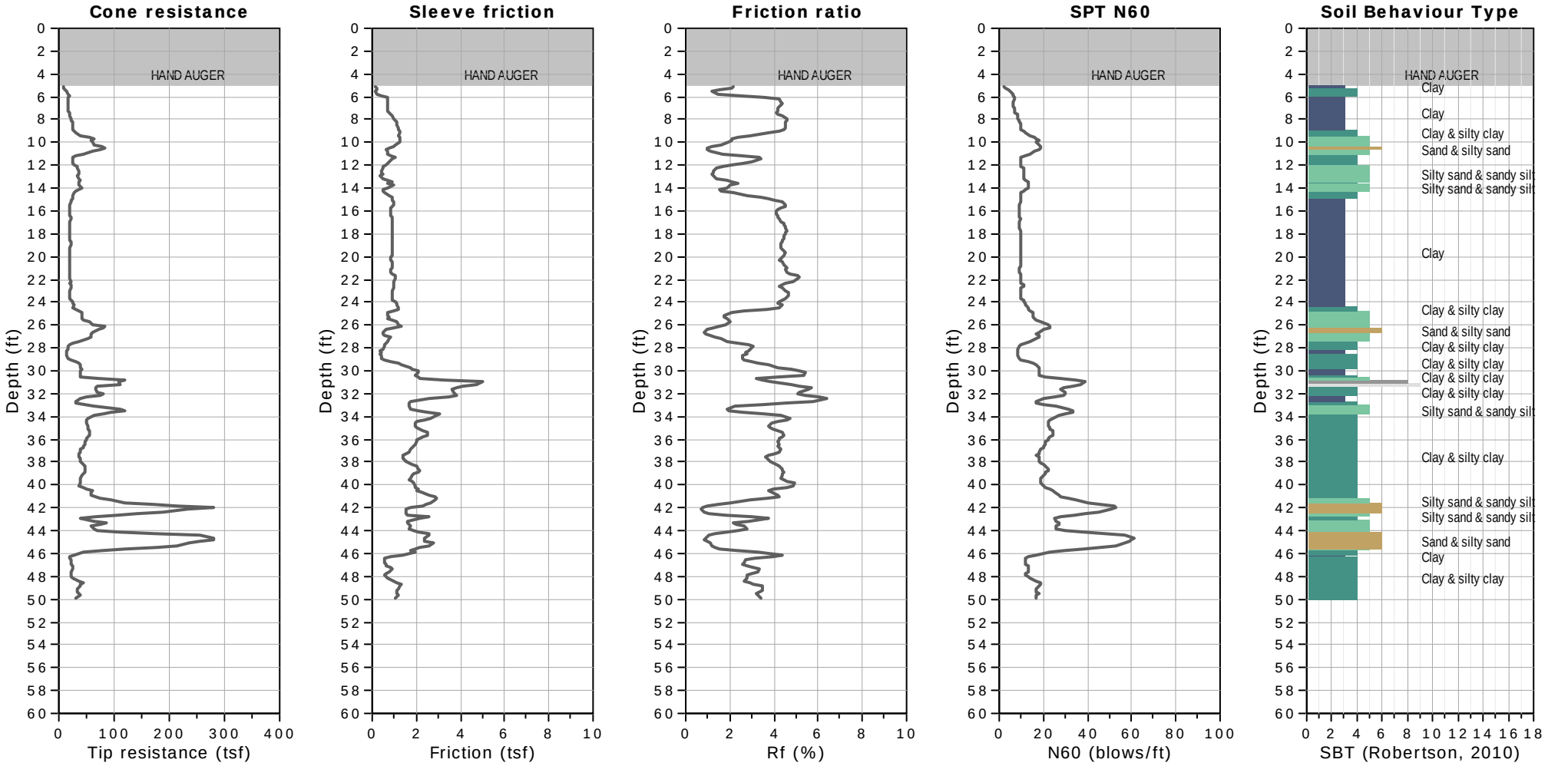
WATER TABLE FOR ESTIMATING PURPOSES ONLY

CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/31/2018

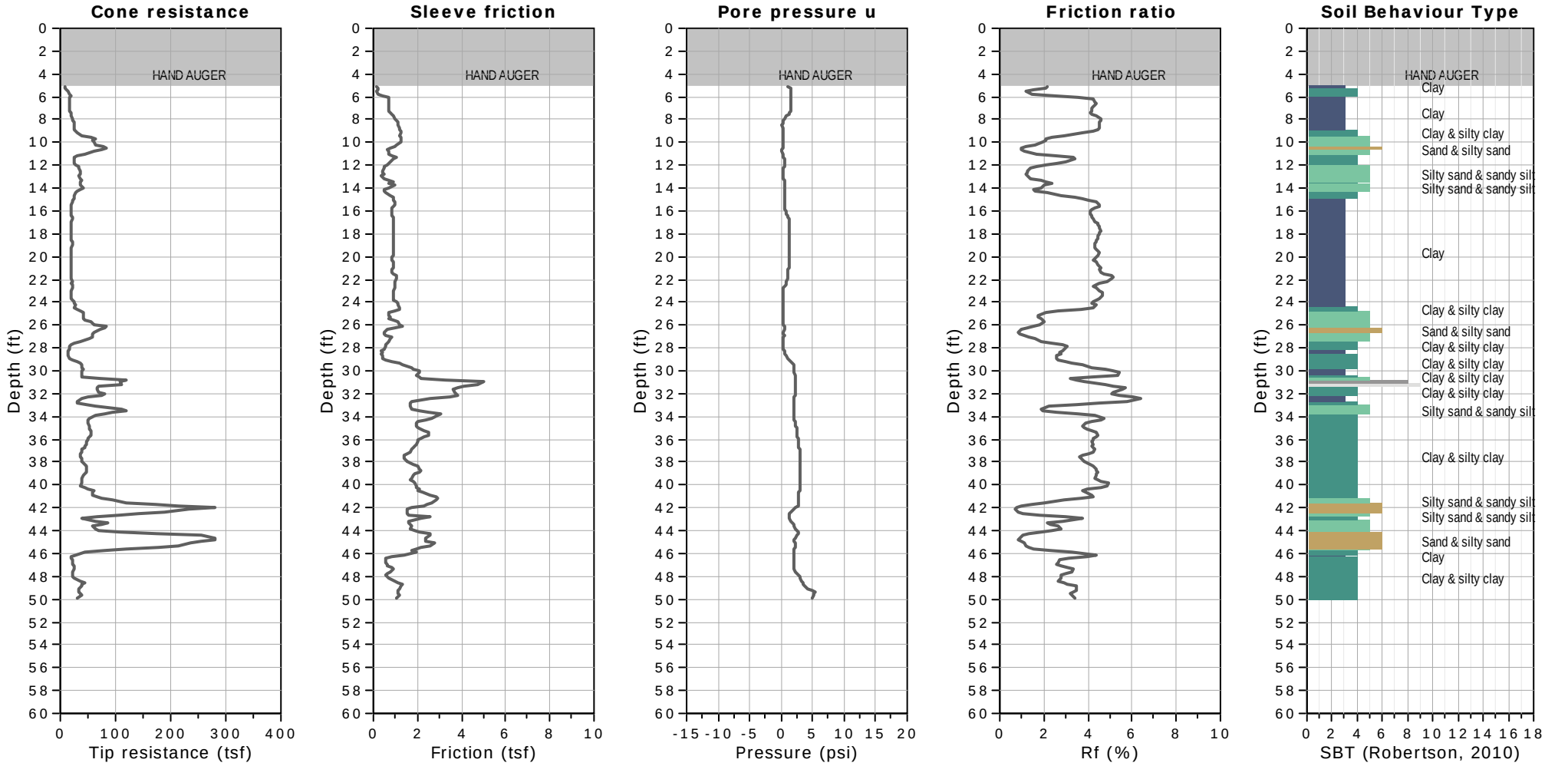


CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/31/2018



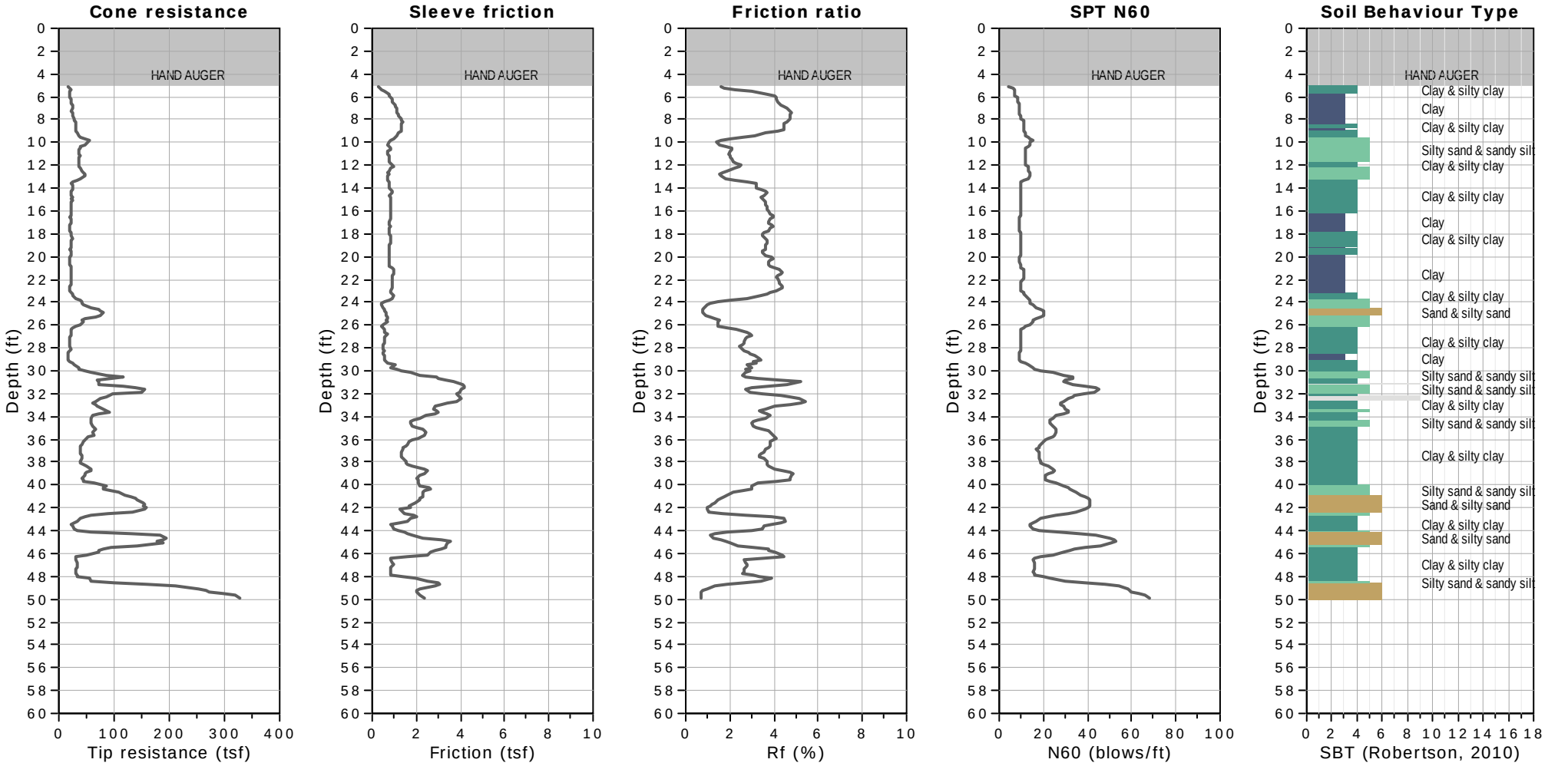
WATER TABLE FOR ESTIMATING PURPOSES ONLY

CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/30/2018

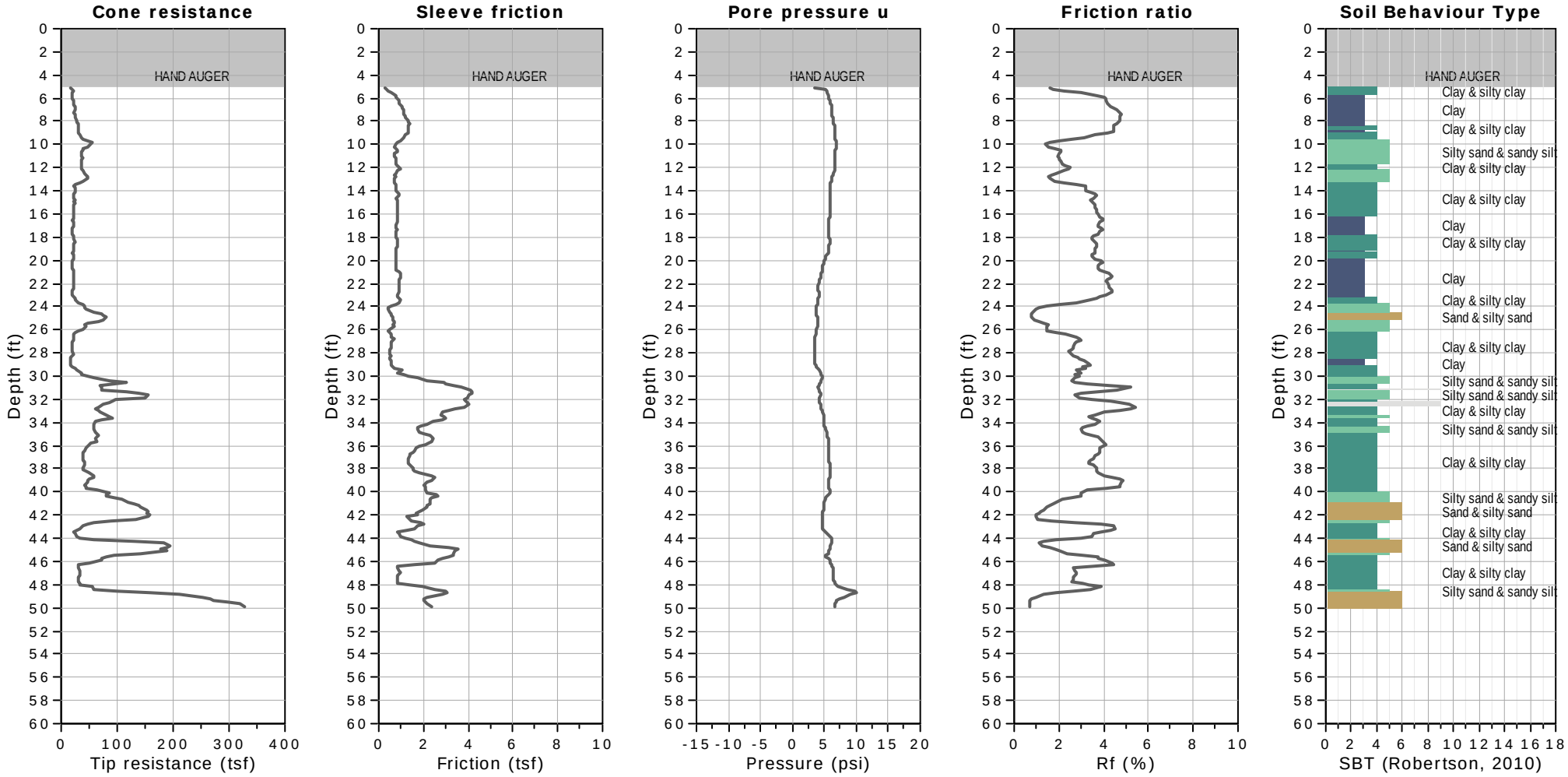


CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/30/2018



WATER TABLE FOR ESTIMATING PURPOSES ONLY

SUMMARY

OF

CONE PENETRATION TEST DATA

Project:

456 N. Rodeo Drive
Beverly Hills, CA
July 11-13, 2018

Prepared for:

Mr. Alexander Greene
Feffer Geological Consulting
1990 S. Bundy Drive, Ste 400
Los Angeles, CA 90025
Office (310) 207-5048 / Fax (310) 826-0182

Prepared by:



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

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3. **FIELD EQUIPMENT & PROCEDURES**
4. **CONE PENETRATION TEST DATA & INTERPRETATION**

APPENDIX

- CPT Plots
- CPT Classification/Soil Behavior Chart
- Interpretation Output (CPeT-IT)
- CPeT-IT Calculation Formulas

SUMMARY
OF
CONE PENETRATION TEST DATA

1. INTRODUCTION

This report presents the results of a Cone Penetration Test (CPT) program carried out for the project located at 456 N. Rodeo Drive in Beverly Hills, California. The work was performed by Kehoe Testing & Engineering (KTE) on July 11-13, 2018. The scope of work was performed as directed by Feffer Geological Consulting personnel.

2. SUMMARY OF FIELD WORK

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

LOCATION	DEPTH OF CPT (ft)	COMMENTS/NOTES:
CPT-5	39	Refusal, hole open to 36 ft (dry)
CPT-6	50	Hole open to 48 ft (dry)
CPT-7	50	Hole open to 46 ft (dry)
CPT-8	30	Refusal, hole open to 30 ft (dry)

TABLE 2.1 - Summary of CPT Soundings

3. FIELD EQUIPMENT & PROCEDURES

The CPT soundings were carried out by **KTE** using an integrated electronic cone system manufactured by Vertek. The CPT soundings were performed in accordance with ASTM standards (D5778). The cone penetrometers were pushed using a 30-ton CPT rig and a direct push rig anchored with an eight-inch diameter ground anchor. The direct push rig has a pushing capacity of approximately 15 tons. The cone used during the program was a 15 cm^2 cone and a 10 cm^2 was used with the direct push rig. Both recorded the following parameters at approximately 2.5 cm depth intervals:

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

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

4. CONE PENETRATION TEST DATA & INTERPRETATION

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

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

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

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

Sincerely,

KEHOE TESTING & ENGINEERING



Richard W. Koester, Jr.
General Manager

07/19/18-hh-9580

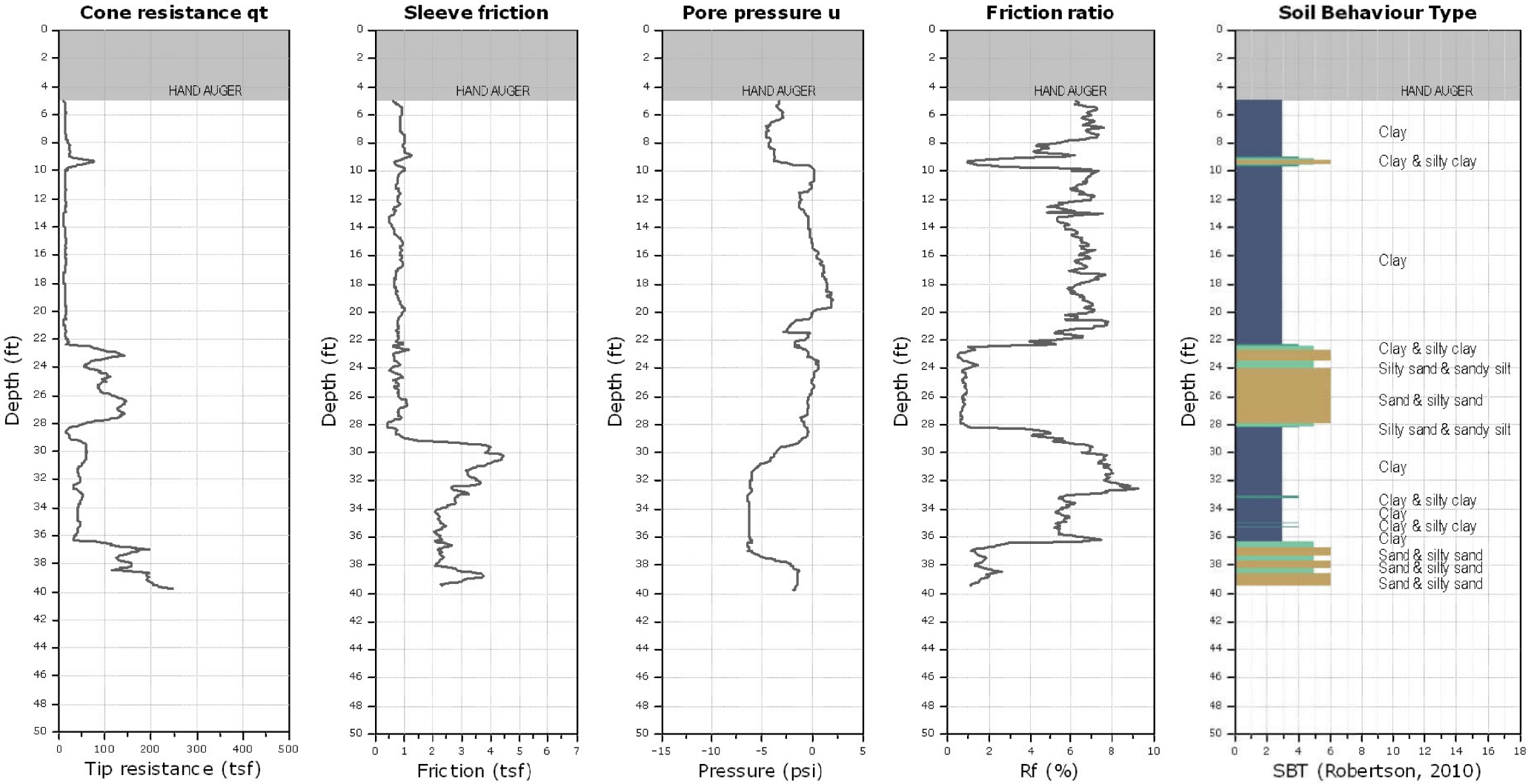
APPENDIX

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

CPT-5

Project: **Feffer Geological Consulting**
Location: **456 N. Rodeo Drive Beverly Hills, Ca**

Total depth: 39.77 ft, Date: 7/12/2018
Cone Type: Vertek

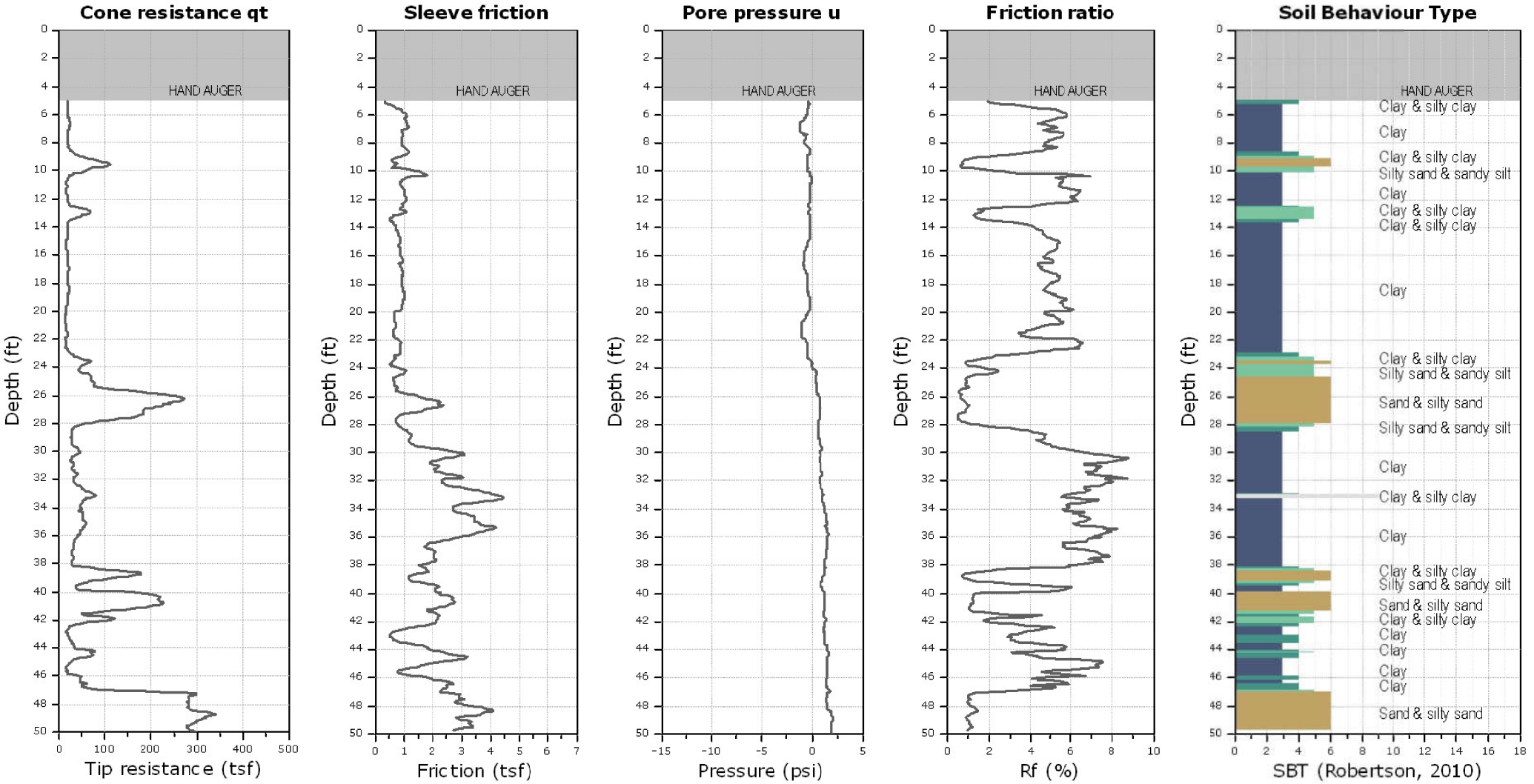


Kehoe Testing and Engineering
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

CPT-6

Project: **Feffer Geological Consulting**
Location: **456 N. Rodeo Drive Beverly Hills, Ca**

Total depth: 50.15 ft, Date: 7/11/2018
Cone Type: Vertek



Kehoe Testing and Engineering
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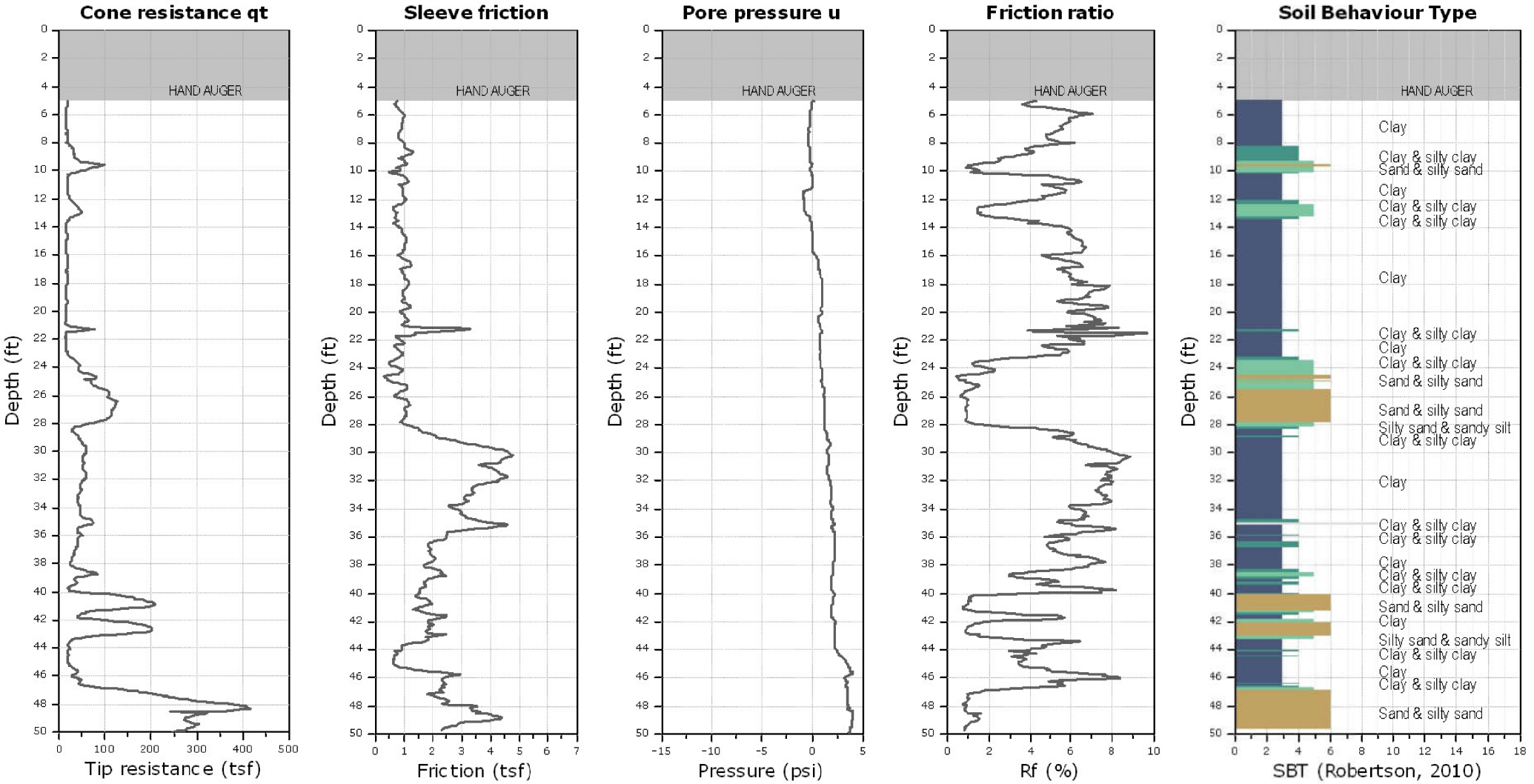
rich@kehoetesting.com
www.kehoetesting.com

CPT-7

Project: **Feffer Geological Consulting**
Location: **456 N. Rodeo Drive Beverly Hills, Ca**

Total depth: 50.07 ft, Date: 7/11/2018
Cone Type: Vertek



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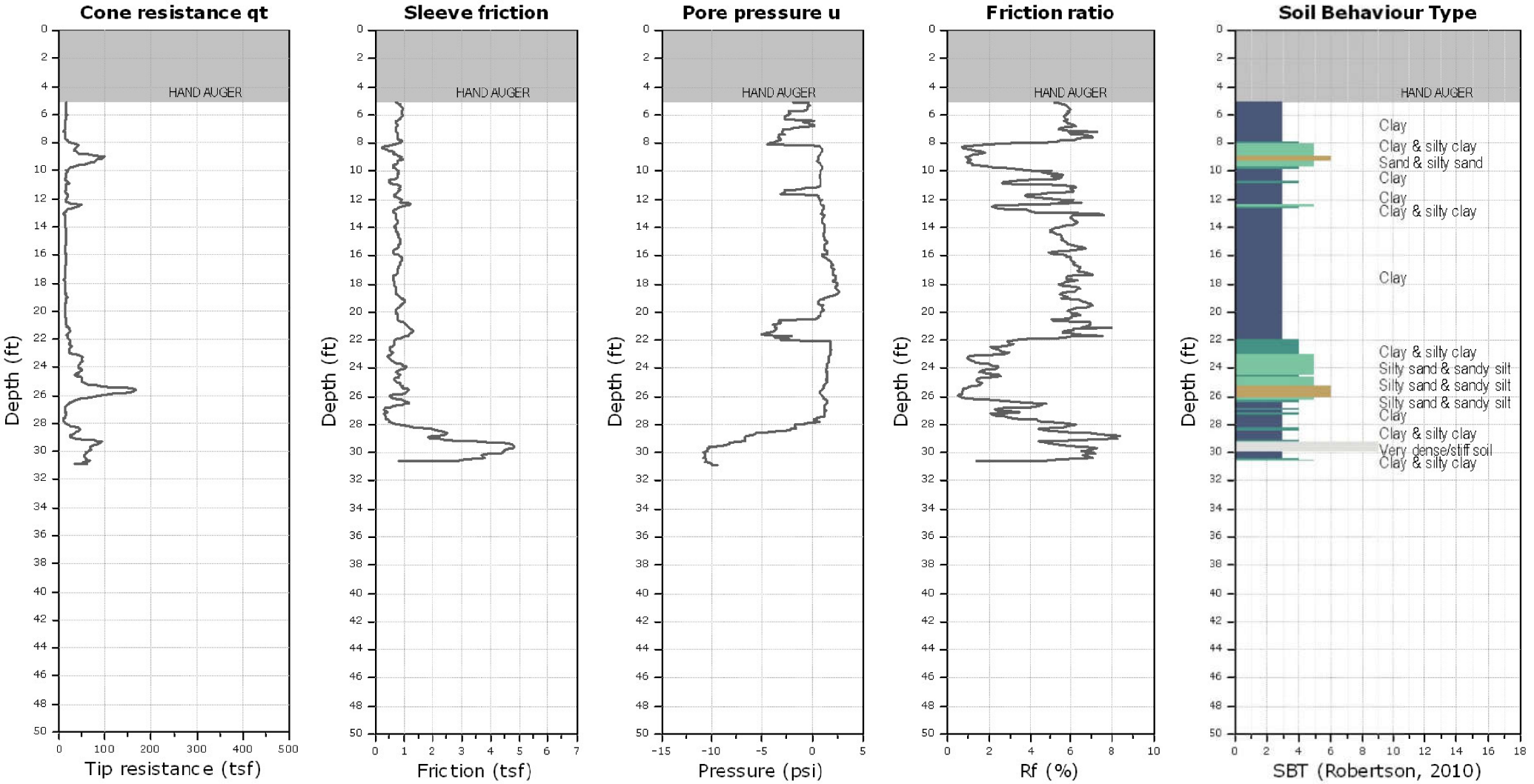
CPT-8

Project: **Feffer Geological Consulting**
Location: **456 N. Rodeo Drive Beverly Hills, Ca**

Total depth: 30.91 ft, Date: 7/12/2018
Cone Type: Vertek



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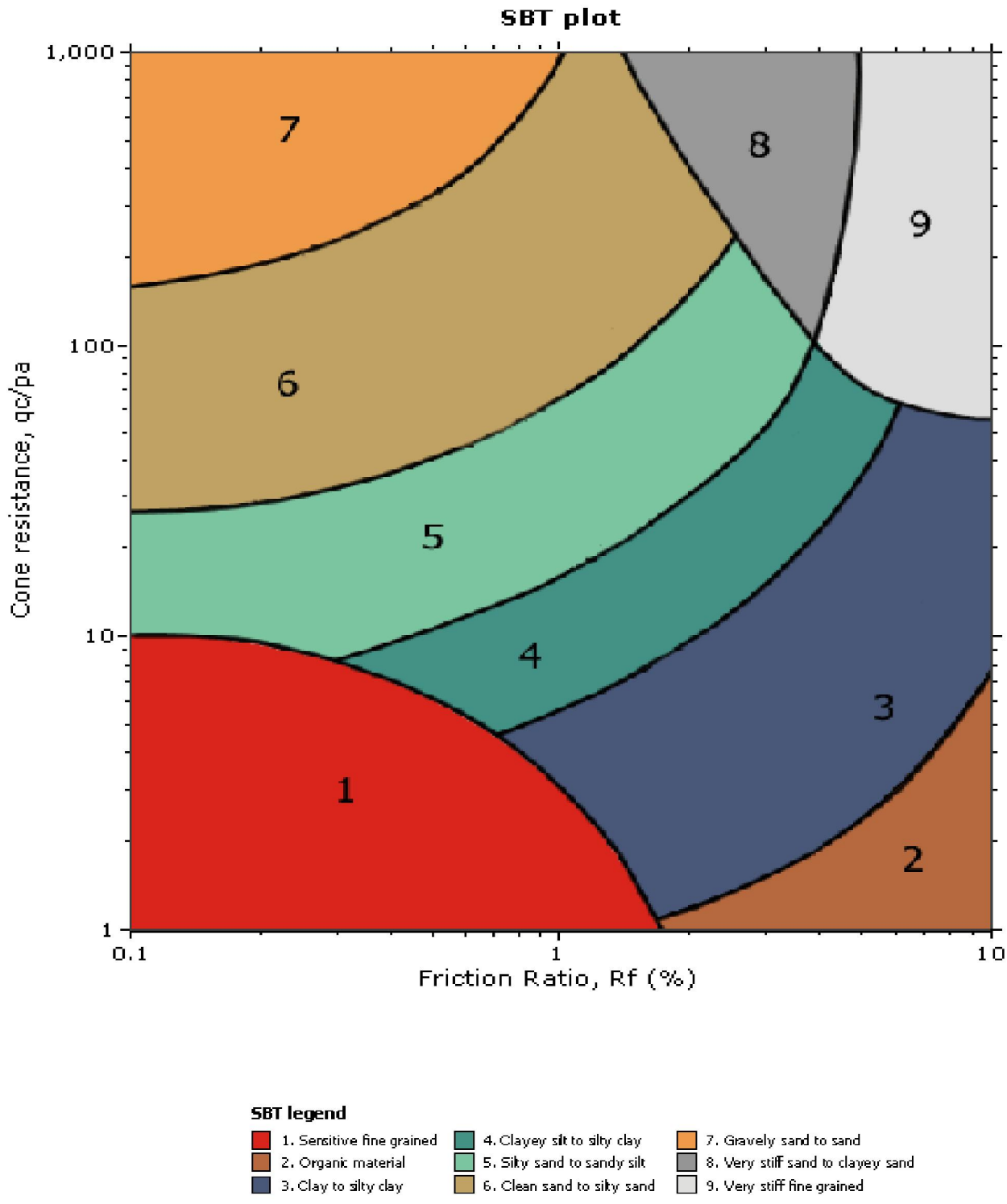

	CPT-5	In situ data							Basic output data													
Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ã (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn	U2	I(B)	Mod. SBTn
1	34.79	0.89	1.39	2.32	34.84	2.55	4	2.54	18.56	0.01	0	0.01	3750.4	2.55	0	8	0.54	13.2	1.83	434.32	10.78	37.75	7
2	6.88	0.55	-0.75	2.87	6.85	7.98	3	3.4	17.38	0.02	0	0.02	380.15	8	-0.01	9	0.79	25.06	2.47	161.88	-2.99	12.58	3
3	7.15	0.37	-0.53	2.47	7.14	5.14	3	3.27	16.93	0.03	0	0.03	268.99	5.16	-0.01	9	0.76	16.7	2.4	112.21	-1.44	18.84	3
4	8.08	0.44	-0.9	2.22	8.05	5.43	3	3.24	17.19	0.04	0	0.04	228.96	5.46	-0.01	9	0.78	14.1	2.43	106.87	-1.85	17.89	3
5	10.37	0.63	-3.21	2.47	10.27	6.09	3	3.19	17.69	0.04	0	0.04	233.17	6.11	-0.02	9	0.79	12.2	2.45	117.98	-5.27	16.17	3
6	13.39	0.9	-3	2.12	13.3	6.75	3	3.13	18.2	0.05	0	0.05	249.98	6.78	-0.02	9	0.79	10.61	2.45	132.82	-4.07	14.71	3
7	12.54	0.9	-4.5	1.7	12.4	7.27	3	3.18	18.18	0.06	0	0.06	198.79	7.31	-0.03	9	0.81	9.98	2.51	116.43	-5.22	13.72	3
8	20.02	1.03	-4.39	1.25	19.88	5.16	3	2.93	18.51	0.07	0	0.07	277.81	5.18	-0.02	9	0.75	7.51	2.34	140.52	-4.43	18.86	3
9	24.05	1.04	-3.75	1.37	23.93	4.33	3	2.81	18.6	0.08	0	0.08	295.87	4.35	-0.01	9	0.72	6.4	2.27	144.38	-3.35	22.13	5
10	13.29	0.89	0.11	1.68	13.29	6.68	3	3.13	18.19	0.09	0	0.09	147.11	6.73	0	9	0.82	7.58	2.54	94.54	0.09	14.81	3
11	11.29	0.79	-0.11	1.7	11.28	7.02	3	3.2	18	0.1	0	0.1	113.29	7.08	0	9	0.85	7.44	2.6	78.64	-0.08	14.15	3
12	11.33	0.79	-1.13	1.48	11.3	6.96	3	3.2	17.99	0.11	0	0.11	103.9	7.03	-0.01	9	0.85	6.96	2.62	73.64	-0.76	14.24	3
13	9.06	0.59	-0.62	2	9.05	6.55	3	3.25	17.58	0.12	0	0.12	76.65	6.63	0	3	0.87	6.8	2.66	57.35	-0.38	14.96	3
14	10.6	0.61	-0.32	2.61	10.59	5.75	3	3.17	17.67	0.13	0	0.13	83.49	5.82	0	4	0.85	6.09	2.61	60.24	-0.18	16.7	3
15	14.39	0.87	-0.11	2.53	14.38	6.05	3	3.08	18.2	0.13	0	0.13	105.99	6.11	0	9	0.83	5.56	2.56	74.82	-0.06	16.09	3
16	13.57	0.91	0.43	2.4	13.58	6.73	3	3.13	18.23	0.14	0	0.14	93.59	6.8	0	9	0.85	5.5	2.62	69.78	0.21	14.65	3
17	12.54	0.87	1.18	2.14	12.58	6.91	3	3.16	18.14	0.15	0	0.15	81.39	6.99	0.01	9	0.87	5.37	2.66	63.01	0.55	14.3	3
18	10.46	0.71	1.5	2.42	10.5	6.75	3	3.21	17.84	0.16	0	0.16	64.02	6.86	0.01	3	0.89	5.29	2.7	51.75	0.67	14.54	3
19	11.78	0.81	1.79	2.6	11.84	6.86	3	3.18	18.04	0.17	0	0.17	68.39	6.96	0.01	3	0.88	5.01	2.69	55.18	0.75	14.35	3
20	13.75	0.92	0	2.84	13.75	6.66	3	3.12	18.24	0.18	0	0.18	75.5	6.75	0	3	0.87	4.68	2.66	59.96	0	14.74	3
21	11.06	0.78	-2.21	2.68	10.99	7.09	3	3.21	17.97	0.19	0	0.19	57.26	7.21	-0.01	3	0.9	4.74	2.74	48.36	-0.84	13.94	3
22	16.79	0.9	-1.11	2.88	16.76	5.36	3	2.99	18.29	0.2	0	0.2	83.72	5.42	0	4	0.84	4.07	2.57	63.66	-0.4	17.74	3
23	125.41	1.09	-0.32	2.21	125.41	0.87	6	1.81	19.28	0.21	0	0.21	603.52	0.87	0	6	0.46	2.12	1.58	250.91	-0.11	90.7	7
24	54.66	0.9	0.54	2.47	54.67	1.65	5	2.27	18.75	0.22	0	0.22	251.15	1.66	0	6	0.61	2.63	1.97	135.29	0.18	49.35	7
25	101.32	0.82	-0.11	2.18	101.32	0.81	6	1.87	18.88	0.23	0	0.23	446.76	0.82	0	6	0.48	2.1	1.63	200.56	-0.03	90.19	7
26	114.6	0.87	-0.32	2.35	114.59	0.76	6	1.81	18.99	0.24	0	0.24	485.01	0.76	0	6	0.46	2.01	1.58	216.8	-0.1	96.71	7
27	125.53	0.92	-0.54	2.49	125.51	0.73	6	1.77	19.09	0.25	0	0.25	510.6	0.73	0	6	0.45	1.94	1.55	229.54	-0.16	100.72	7
28	57.9	0.66	-0.86	2.41	57.88	1.14	5	2.15	18.42	0.25	0	0.25	226.4	1.15	0	6	0.58	2.28	1.88	124.18	-0.24	63.09	7
29	20.01	1.7	-1.07	2.43	19.97	8.5	3	3.07	19.09	0.26	0	0.26	74.64	8.61	0	9	0.9	3.48	2.72	64.8	-0.29	11.91	3
30	58.85	3.95	-3.53	2.2	58.75	6.73	3	2.68	20.48	0.27	0	0.27	213.15	6.76	0	9	0.78	2.87	2.41	158.65	-0.93	14.77	3
31	46.93	3.79	-5.46	2.37	46.77	8.11	3	2.8	20.34	0.28	0	0.28	163.4	8.16	-0.01	9	0.83	2.96	2.53	129.97	-1.38	12.38	3
32	46.62	3.18	-6.21	2.91	46.43	6.84	3	2.75	20.14	0.29	0	0.29	156.61	6.88	-0.01	9	0.81	2.81	2.48	122.51	-1.52	14.51	3
33	47.87	2.74	-6.36	2.57	47.67	5.75	3	2.69	19.98	0.3	0	0.3	155.55	5.79	-0.01	9	0.79	2.67	2.42	119.34	-1.5	17	3
34	40.15	2.41	-6.31	2.31	39.96	6.04	3	2.75	19.76	0.31	0	0.31	126.09	6.09	-0.01	9	0.81	2.68	2.49	100.29	-1.45	16.2	3
35	44.24	2.14	-6.31	2.24	44.04	4.87	4	2.66	19.66	0.32	0	0.32	134.83	4.9	-0.01	9	0.78	2.51	2.4	103.88	-1.4	19.66	3
36	35.19	2.18	-6.28	0.91	35	6.24	3	2.8	19.6	0.33	0	0.33	103.76	6.3	-0.01	9	0.83	2.61	2.54	85.54	-1.35	15.7	3
37	180.86	2.37	-6.25	0.65	180.67	1.31	6	1.82	20.32	0.34	0	0.34	523.86	1.31	0	6	0.5	1.75	1.67	299.06	-1.31	66.78	7
38	156.79	2.66	-2.06	2.29	156.73	1.7	6	1.95	20.4	0.35	0	0.35	441.23	1.7	0	6	0.55	1.82	1.79	268.73	-0.42	52.79	7
39	194.2	0	-1.51	2.75	194.15	0	0	0	13.73	0.36	0	0.36	536.42	0	0	0	1	2.93	0	536.42	-0.3	780.59	0

	CPT-6	In situ data						Basic output data														
Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ã (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn	U2	I(B)	Mod. SBTn
1	13.89	0.06	0.19	0.79	13.89	0.41	5	2.5	15.06	0.01	0	0.01	1842.6	0.41	0	6	0.46	9.55	1.61	125.3	1.82	111.05	7
2	20.91	0.15	0.1	0.91	20.91	0.73	5	2.43	16.34	0.02	0	0.02	1330	0.73	0	6	0.49	7.94	1.67	156.69	0.44	90.42	7
3	14.3	0.18	0	0.93	14.3	1.25	4	2.68	16.37	0.02	0	0.02	597.9	1.25	0	6	0.58	8.95	1.91	120.76	0	59.15	7
4	14.12	0.28	-0.19	1.04	14.12	1.97	4	2.79	16.88	0.03	0	0.03	435.79	1.97	0	5	0.63	9.16	2.05	121.93	-0.42	42.49	7
5	18.6	0.54	-0.38	1.08	18.59	2.93	4	2.79	17.76	0.04	0	0.04	450.23	2.93	0	5	0.66	8.54	2.13	149.72	-0.67	31.37	5
6	18.5	0.98	-0.59	1.1	18.49	5.28	3	2.96	18.43	0.05	0	0.05	365.71	5.29	0	9	0.74	9.39	2.31	163.62	-0.85	18.56	3
7	21.07	1.05	-1.24	1.16	21.06	4.98	3	2.9	18.56	0.06	0	0.06	351.68	4.99	0	9	0.73	8.14	2.3	161.44	-1.49	19.57	3
8	19.23	1.02	-0.76	1.2	19.22	5.29	3	2.94	18.49	0.07	0	0.07	277.83	5.31	0	9	0.75	7.77	2.35	140.54	-0.8	18.46	3
9	52.05	0.97	-0.57	1.27	52.04	1.87	5	2.32	18.82	0.08	0	0.08	663.3	1.87	0	6	0.57	4.41	1.87	216.62	-0.53	47.64	7
10	57.86	0.73	-0.48	1.27	57.86	1.27	5	2.18	18.54	0.09	0	0.09	659.32	1.27	0	6	0.53	3.7	1.76	202.02	-0.39	64.89	7
11	16.74	0.96	-0.19	1.35	16.74	5.77	3	3.01	18.38	0.1	0	0.1	171.87	5.8	0	9	0.79	6.64	2.46	104.42	-0.14	16.94	3
12	17	0.96	-0.29	1.43	17	5.66	3	3	18.38	0.11	0	0.11	159.38	5.69	0	9	0.79	6.22	2.46	99.32	-0.19	17.21	3
13	65.84	0.77	-0.38	1.58	65.84	1.17	5	2.11	18.64	0.12	0	0.12	570.02	1.17	0	6	0.52	3.18	1.74	197.51	-0.24	68.8	7
14	17.02	0.69	-0.19	1.62	17.02	4.07	3	2.91	18	0.12	0	0.12	135.92	4.1	0	4	0.77	5.21	2.4	83.26	-0.11	22.65	5
15	16.21	0.85	-0.42	1.66	16.21	5.24	3	3	18.22	0.13	0	0.13	120.47	5.29	0	9	0.81	5.32	2.49	80.77	-0.23	18.26	3
16	18.93	0.86	-0.81	1.66	18.92	4.54	3	2.91	18.29	0.14	0	0.14	131.68	4.57	0	9	0.78	4.8	2.43	85.24	-0.41	20.72	3
17	20.1	0.88	-0.7	1.66	20.09	4.38	3	2.88	18.34	0.15	0	0.15	131.4	4.41	0	9	0.78	4.54	2.42	85.47	-0.33	21.36	3
18	18.59	0.95	-0.48	1.68	18.59	5.13	3	2.95	18.4	0.16	0	0.16	114.5	5.18	0	9	0.81	4.56	2.49	79.34	-0.21	18.58	3
19	18.01	0.97	-0.29	1.72	18.01	5.4	3	2.97	18.41	0.17	0	0.17	104.84	5.46	0	9	0.82	4.46	2.52	75.2	-0.12	17.74	3
20	14.16	0.82	-0.38	1.74	14.15	5.78	3	3.07	18.12	0.18	0	0.18	77.99	5.86	0	4	0.85	4.54	2.61	59.95	-0.15	16.61	3
21	15.47	0.65	-1.05	1.64	15.45	4.21	3	2.95	17.89	0.19	0	0.19	81.13	4.26	0	4	0.81	4.08	2.51	58.89	-0.4	21.46	3
22	13.3	0.72	-0.67	1.58	13.29	5.4	3	3.07	17.95	0.2	0	0.2	66.42	5.48	0	4	0.86	4.24	2.63	52.42	-0.24	17.48	3
23	25.72	0.76	-0.57	1.62	25.71	2.95	4	2.68	18.26	0.21	0	0.21	123.66	2.97	0	5	0.74	3.34	2.3	80.6	-0.2	29.26	5
24	44.92	0.61	0.05	1.56	44.92	1.36	5	2.29	18.23	0.22	0	0.22	207.59	1.37	0	6	0.61	2.64	1.97	111.49	0.02	54.64	7
25	71.81	0.68	0.29	1.58	71.81	0.95	6	2.03	18.53	0.22	0	0.22	318.7	0.95	0	6	0.53	2.27	1.76	153.85	0.09	75.74	7
26	246.04	1.31	0.67	1.31	246.05	0.53	6	1.45	19.75	0.23	0	0.23	1048.2	0.53	0	7	0.35	1.7	1.29	394.86	0.2	144.67	7
27	185.98	1.78	0.76	1.22	185.98	0.96	6	1.72	20.01	0.24	0	0.24	759.59	0.96	0	6	0.44	1.92	1.53	336.46	0.22	88.09	7
28	58.3	0.88	0.57	1.2	58.31	1.51	5	2.22	18.75	0.25	0	0.25	228.67	1.52	0	6	0.61	2.37	1.95	130.17	0.16	52.33	7
29	25.58	1.4	0.64	1.3	25.59	5.49	3	2.86	18.97	0.26	0	0.26	96.15	5.55	0	9	0.83	3.15	2.53	75.4	0.17	17.49	3
30	44.3	1.84	0.86	1.45	44.31	4.15	4	2.61	19.49	0.27	0	0.27	161.23	4.17	0	9	0.75	2.75	2.32	114.3	0.23	22.72	5
31	29.57	2.26	0.86	1.41	29.58	7.64	3	2.92	19.57	0.28	0	0.28	103.54	7.72	0	9	0.86	3.1	2.61	85.72	0.22	13.08	3
32	29.33	3.11	0.76	1.63	29.34	10.61	3	3.03	19.94	0.29	0	0.29	99.18	10.72	0	9	0.9	3.18	2.72	87.24	0.19	9.68	2
33	74.6	3.32	1.14	1.89	74.61	4.45	4	2.47	20.37	0.3	0	0.3	245.2	4.47	0	9	0.72	2.45	2.24	172.24	0.27	21.7	3
34	46.27	3.2	1.24	2.01	46.28	6.9	3	2.75	20.14	0.31	0	0.31	146.81	6.95	0	9	0.81	2.7	2.49	117.11	0.28	14.38	3
35	57.63	3.51	1.52	1.99	57.65	6.1	3	2.65	20.34	0.32	0	0.32	177.31	6.13	0	9	0.78	2.53	2.41	137.1	0.34	16.16	3
36	40.46	2.94	1.62	2.07	40.48	7.27	3	2.81	20	0.33	0	0.33	120.46	7.33	0	9	0.84	2.63	2.55	99.86	0.35	13.7	3
37	29.17	1.85	1.43	2.12	29.19	6.33	3	2.86	19.34	0.34	0	0.34	84.11	6.4	0	9	0.85	2.62	2.59	71.32	0.3	15.44	3
38	25.7	1.86	1.33	2.08	25.71	7.24	3	2.94	19.3	0.35	0	0.35	71.93	7.35	0	9	0.88	2.64	2.67	63.33	0.27	13.7	3
39	126.24	1.63	0.95	2.18	126.25	1.29	6	1.93	19.75	0.36	0	0.36	347.3	1.29	0	6	0.54	1.77	1.76	211.14	0.19	64.53	7
40	145.08	2.3	1.33	2.22	145.09	1.59	6	1.95	20.2	0.37	0	0.37	388.41	1.59	0	6	0.55	1.77	1.79	242.49	0.26	55.35	7
41	203.6	2.55	1.24	2.31	203.62	1.25	6	1.77	20.45	0.38	0	0.38	530.88	1.25	0	6	0.49	1.65	1.64	316.41	0.23	69.99	7
42	111.39	1.67	1.33	2.28	111.41	1.5	6	2.01	19.73	0.39	0	0.39	282.7	1.5	0	6	0.57	1.76	1.84	184.69	0.24	56.01	7
43	17.72	0.96	1.24	2.33	17.73	5.44	3	2.98	18.4	0.4	0	0.4	43.13	5.56	0.01	3	0.9	2.4	2.72	39.29	0.22	17.08	3
44	34.91	1.99	1.62	2.58	34.93	5.69	3	2.78	19.49	0.41	0	0.41	83.86	5.75	0	9	0.84	2.21	2.55	72.23	0.28	16.93	3
45	24.61	2.23	1.52	2.98	24.62	9.04	3	3.03	19.48	0.42	0	0.42	57.44	9.19	0	3	0.93	2.36	2.79	54.04	0.26	11.3	3
46	46.55	1.42	1.44	2.93	46.57	3.05	4	2.5	19.21	0.43	0	0.43	107.05	3.08	0	5	0.75	1.95	2.3	85.25	0.24	28.62	5
47	139.96	2.63	1.71	2.95	139.98	1.88	5	2.01	20.34	0.44	0	0.44	316.31	1.89	0	6	0.58	1.67	1.87	219.88	0.28	47.4	7
48	278.87	3.05	1.62	2.99	278.89	1.09	6	1.64	20.78	0.45	0	0.45	616.66	1.1	0	6	0.46	1.48	1.54	388.25	0.26	80.38	7
49	314.76	3.28	2.1	3.06	314.78	1.04	6	1.59	20.91	0.46	0	0.46	680.37	1.04	0	6	0.44	1.44	1.5	428.19	0.33	84.88	7
50	298.66	0	1.9	2.95	298.68	0	0	0	13.73	0.47	0	0.47	636.05	0	0	0	1	2.26	0	636.05	0.29	922.93	0

	CPT-7	In situ data						Basic output data														
Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ã (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn	U2	I(B)	Mod. SBTn
1	8.08	0.06	0.09	0.21	8.08	0.78	4	2.82	14.95	0.01	0	0.01	1079	0.78	0	6	0.54	14.24	1.81	108.6	0.91	76.86	7
2	13.47	0.21	0.03	0.44	13.47	1.54	4	2.75	16.53	0.02	0	0.02	854.55	1.54	0	6	0.58	11.47	1.92	145.94	0.15	52.8	7
3	10.22	0.29	0.09	0.42	10.22	2.88	3	3	16.82	0.02	0	0.02	422.52	2.89	0	5	0.68	12.84	2.17	123.74	0.28	31.3	5
4	10.75	0.38	0.18	0.5	10.75	3.55	3	3.03	17.14	0.03	0	0.03	327.66	3.56	0	8	0.71	11.74	2.25	118.9	0.4	26.15	5
5	17.87	0.6	0.18	0.54	17.87	3.36	3	2.84	17.85	0.04	0	0.04	428.08	3.37	0	8	0.68	8.98	2.17	151.23	0.31	27.83	5
6	15.38	0.85	-0.23	0.59	15.38	5.56	3	3.03	18.2	0.05	0	0.05	301.97	5.57	0	9	0.76	9.91	2.36	143.48	-0.33	17.65	3
7	16.38	0.88	-0.38	0.67	16.38	5.39	3	3	18.26	0.06	0	0.06	272.5	5.41	0	9	0.76	8.78	2.37	135.38	-0.46	18.13	3
8	16.78	0.98	-0.35	0.75	16.77	5.87	3	3.02	18.4	0.07	0	0.07	241.83	5.9	0	9	0.77	8.23	2.41	129.85	-0.36	16.74	3
9	32.52	1.16	-0.29	0.81	32.52	3.58	4	2.66	18.85	0.08	0	0.08	413.29	3.59	0	8	0.68	5.8	2.15	177.76	-0.26	26.52	5
10	48.74	0.98	-0.17	0.94	48.74	2.02	5	2.36	18.81	0.09	0	0.09	553.47	2.02	0	6	0.59	4.33	1.92	199.02	-0.14	44.21	7
11	18.19	1.08	0	0.91	18.19	5.93	3	2.99	18.53	0.1	0	0.1	186.14	5.96	0	9	0.79	6.57	2.45	112.26	0	16.55	3
12	22.86	0.86	-0.86	0.89	22.85	3.75	4	2.79	18.36	0.11	0	0.11	213.82	3.77	0	8	0.73	5.31	2.29	114.12	-0.58	24.81	5
13	47.63	0.62	-0.67	0.88	47.62	1.29	5	2.25	18.26	0.12	0	0.12	411.42	1.29	0	6	0.56	3.46	1.85	155.55	-0.42	61	7
14	14.68	0.75	-0.08	0.89	14.68	5.09	3	3.02	18.03	0.12	0	0.12	116.9	5.13	0	9	0.81	5.63	2.5	77.37	-0.05	18.71	3
15	16.14	1.01	0.09	0.89	16.14	6.26	3	3.05	18.41	0.13	0	0.13	119.69	6.32	0	9	0.82	5.51	2.55	83.27	0.05	15.65	3
16	17.42	1.07	0.29	0.91	17.42	6.16	3	3.02	18.51	0.14	0	0.14	120.84	6.21	0	9	0.82	5.18	2.54	84.52	0.14	15.89	3
17	16.62	1.17	0.66	0.95	16.63	7.01	3	3.07	18.59	0.15	0	0.15	108.19	7.07	0	9	0.84	5.14	2.6	80.09	0.31	14.15	3
18	17.99	1.01	0.95	0.98	18	5.59	3	2.98	18.45	0.16	0	0.16	110.47	5.64	0	9	0.82	4.65	2.52	78.41	0.42	17.25	3
19	15.15	1.05	0.95	1.04	15.17	6.92	3	3.1	18.43	0.17	0	0.17	87.85	7	0	9	0.86	4.81	2.63	68.16	0.4	14.29	3
20	14.85	1.18	0.95	1.06	14.86	7.95	3	3.14	18.56	0.18	0	0.18	81.58	8.04	0	9	0.88	4.78	2.69	66.26	0.38	12.65	3
21	17.69	1.19	0.76	1.14	17.7	6.73	3	3.04	18.64	0.19	0	0.19	92.5	6.8	0	9	0.85	4.34	2.61	71.8	0.29	14.66	3
22	14.56	1.12	0.67	3.02	14.57	7.66	3	3.14	18.49	0.2	0	0.2	72.37	7.76	0	9	0.89	4.43	2.7	60.1	0.24	13.07	3
23	17.47	0.68	0.76	3.14	17.48	3.87	3	2.89	17.98	0.21	0	0.21	83.24	3.91	0	4	0.8	3.7	2.48	60.33	0.26	22.99	5
24	42.59	0.44	0.92	3.26	42.6	1.03	5	2.24	17.83	0.22	0	0.22	195.84	1.04	0	6	0.59	2.55	1.91	102.17	0.3	63.74	7
25	70.47	0.56	0.95	3.31	70.48	0.79	6	1.99	18.29	0.23	0	0.23	311.42	0.79	0	6	0.52	2.22	1.72	147.24	0.3	84.34	7
26	108.08	0.98	1.15	3.43	108.09	0.91	6	1.88	19.11	0.24	0	0.24	458.67	0.91	0	6	0.49	2.08	1.64	212.12	0.35	84.51	7
27	116.18	1.09	1.25	3.35	116.2	0.94	6	1.86	19.26	0.24	0	0.24	473.68	0.94	0	6	0.49	2.04	1.64	223.2	0.37	83.27	7
28	67.24	1.26	1.33	3.41	67.26	1.87	5	2.24	19.21	0.25	0	0.25	263.4	1.87	0	6	0.61	2.4	1.97	151.84	0.38	45.66	7
29	42.96	2.6	1.53	3.47	42.98	6.06	3	2.73	19.88	0.26	0	0.26	161.6	6.1	0	9	0.79	3	2.44	120.93	0.42	16.22	3
30	57.8	4.12	1.62	3.43	57.82	7.13	3	2.7	20.52	0.27	0	0.27	209.57	7.17	0	9	0.79	2.9	2.43	157.87	0.42	13.97	3
31	49.92	4.41	1.59	3.22	49.94	8.84	3	2.81	20.54	0.28	0	0.28	174.32	8.89	0	9	0.83	2.98	2.54	139.73	0.4	11.41	3
32	54.16	4.14	1.81	3.12	54.18	7.64	3	2.74	20.5	0.3	0	0.3	182.6	7.68	0	9	0.81	2.81	2.48	143.13	0.44	13.1	3
33	43.57	3.21	1.91	2.98	43.59	7.37	3	2.79	20.13	0.31	0	0.31	141.84	7.42	0	9	0.83	2.79	2.52	114.16	0.45	13.53	3
34	44.65	3.08	2.1	2.85	44.67	6.89	3	2.76	20.09	0.32	0	0.32	140.72	6.94	0	9	0.82	2.69	2.5	112.85	0.48	14.4	3
35	73.3	3.02	2.1	2.81	73.33	4.11	4	2.45	20.25	0.33	0	0.33	224.4	4.13	0	8	0.71	2.32	2.23	160.25	0.47	23.26	5
36	48.33	2.28	2.19	2.62	48.36	4.72	4	2.62	19.77	0.34	0	0.34	143.26	4.75	0	9	0.77	2.42	2.37	110	0.47	20.25	3
37	35.46	1.9	2.29	2.58	35.49	5.36	3	2.75	19.44	0.34	0	0.34	101.88	5.41	0	9	0.82	2.5	2.49	82.93	0.48	17.91	3
38	24.56	2.14	2.1	2.54	24.59	8.72	3	3.02	19.44	0.35	0	0.35	68.33	8.85	0.01	9	0.91	2.71	2.74	61.98	0.43	11.64	3
39	39.54	2.08	1.91	2.31	39.56	5.26	3	2.71	19.59	0.36	0	0.36	107.56	5.31	0	9	0.81	2.37	2.47	87.75	0.38	18.23	3
40	35.43	1.67	2.12	2.2	35.45	4.72	4	2.71	19.3	0.37	0	0.37	93.77	4.77	0	9	0.81	2.32	2.47	76.91	0.41	19.9	3
41	200.44	2.07	2	2.12	200.47	1.04	6	1.72	20.21	0.38	0	0.38	520.74	1.04	0	6	0.47	1.61	1.58	304.41	0.38	81.52	7
42	95.74	2.16	2.36	2.1	95.77	2.26	5	2.18	19.97	0.39	0	0.39	241.93	2.27	0	5	0.63	1.87	2.01	168.39	0.43	39.48	7
43	139.15	1.47	2.28	2.1	139.18	1.06	6	1.84	19.68	0.4	0	0.4	343.48	1.06	0	6	0.51	1.64	1.69	214.62	0.41	75.37	7
44	22.67	0.86	2.42	1.98	22.7	3.8	3	2.79	18.36	0.41	0	0.41	53.92	3.87	0.01	4	0.84	2.21	2.55	46.47	0.42	22.62	5
45	18.75	1.25	3.48	1.92	18.79	6.67	3	3.02	18.72	0.42	0	0.42	43.47	6.82	0.01	3	0.93	2.34	2.77	40.65	0.59	14.58	3
46	27.94	2.37	3.24	1.85	27.98	8.48	3	2.97	19.61	0.43	0	0.43	63.7	8.61	0.01	9	0.92	2.27	2.74	59.12	0.54	11.93	3
47	151.88	2.47	3.43	1.72	151.92	1.63	6	1.94	20.3	0.44	0	0.44	342.29	1.63	0	6	0.56	1.63	1.81	233.12	0.56	53.98	7
48	370.03	3.1	3.62	1.72	370.07	0.84	6	1.47	20.91	0.45	0	0.45	815.98	0.84	0	6	0.4	1.4	1.38	489.87	0.58	103.91	7
49	273.45	3.45	3.94	1.75	273.5	1.26	6	1.69	20.91	0.46	0	0.46	589.16	1.26	0	6	0.48	1.48	1.59	382.88	0.61	70.99	7
50	247.87	0	3.64	1.85	247.92	0	0	0	13.73	0.47	0	0.47	526.14	0	0	0	1	2.25	0	526.14	0.56	765.91	0

	CPT-8	In situ data						Basic output data														
Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ã (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn	U2	I(B)	Mod. SBTn
1	22.94	0.5	1.61	0.31	22.99	2.19	4	2.64	17.75	0.01	0	0.01	2587.5	2.19	0.01	6	0.55	14.19	1.84	308.18	13.02	42.7	7
2	10.25	0.35	0.54	0.35	10.27	3.39	3	3.04	17.01	0.02	0	0.02	589.48	3.39	0	8	0.67	15.91	2.17	154.15	2.22	27.69	5
3	11.43	0.4	0	0.13	11.43	3.52	3	3.01	17.22	0.03	0	0.03	438.96	3.53	0	8	0.69	12.93	2.21	139.35	0	26.61	5
4	12.69	0.5	-0.28	0.29	12.68	3.95	3	3	17.52	0.03	0	0.03	363.94	3.96	0	8	0.71	11.32	2.26	135.32	-0.57	23.96	5
5	14.36	0.61	-0.69	0.03	14.34	4.25	3	2.98	17.79	0.04	0	0.04	327.49	4.27	0	9	0.72	10.08	2.28	136.1	-1.14	22.45	5
6	16.55	0.88	-2.29	-0.03	16.48	5.36	3	3	18.27	0.05	0	0.05	311.22	5.38	-0.01	9	0.75	9.43	2.35	146.34	-3.13	18.24	3
7	13.51	0.78	-2.51	0.33	13.43	5.82	3	3.09	18.05	0.06	0	0.06	216.31	5.85	-0.01	9	0.78	9.2	2.43	116.28	-2.92	16.83	3
8	24.43	0.74	-4.13	0.45	24.3	3.03	4	2.71	18.21	0.07	0	0.07	341.77	3.04	-0.01	5	0.68	6.21	2.15	142.22	-4.19	30.31	5
9	99.09	0.59	0.64	0.38	99.11	0.6	6	1.8	18.5	0.08	0	0.08	1235.6	0.6	0	6	0.4	2.83	1.45	264.87	0.58	120.07	7
10	16.74	0.62	0.86	0.41	16.76	3.71	3	2.89	17.87	0.09	0	0.09	187.16	3.73	0	5	0.74	6.24	2.32	98.41	0.69	24.82	5
11	14.76	0.54	0.86	0.26	14.78	3.64	3	2.93	17.66	0.1	0	0.1	149.97	3.67	0	4	0.76	6.04	2.36	83.84	0.63	24.85	5
12	16.2	0.69	0.81	0.58	16.23	4.25	3	2.94	17.98	0.11	0	0.11	150.78	4.28	0	9	0.77	5.83	2.4	88.81	0.55	21.95	5
13	10.96	0.71	0.89	0.37	10.98	6.48	3	3.19	17.86	0.12	0	0.12	93.83	6.55	0.01	9	0.85	6.55	2.62	67.33	0.55	15.13	3
14	12.97	0.78	1.29	0.67	13.01	6.01	3	3.11	18.04	0.12	0	0.12	103.19	6.07	0.01	9	0.83	5.93	2.57	72.25	0.74	16.17	3
15	14.77	0.77	1.5	0.86	14.82	5.22	3	3.03	18.07	0.13	0	0.13	109.67	5.27	0.01	9	0.81	5.39	2.51	74.75	0.81	18.27	3
16	15.11	0.68	1.03	0.74	15.14	4.49	3	2.98	17.93	0.14	0	0.14	104.95	4.53	0	4	0.8	4.98	2.48	70.61	0.52	20.66	3
17	12.13	0.79	2.17	0.82	12.19	6.46	3	3.15	18.02	0.15	0	0.15	79.28	6.54	0.01	3	0.86	5.34	2.64	60.76	1.03	15.14	3
18	12.13	0.67	2.46	0.67	12.2	5.49	3	3.1	17.84	0.16	0	0.16	74.89	5.57	0.01	4	0.85	4.97	2.61	56.52	1.1	17.29	3
19	16.68	0.74	1.17	0.49	16.72	4.45	3	2.94	18.08	0.17	0	0.17	97.45	4.5	0.01	4	0.8	4.35	2.49	68.09	0.49	20.75	3
20	11.82	0.83	0.98	0.5	11.85	7	3	3.18	18.07	0.18	0	0.18	65.25	7.1	0.01	3	0.89	4.85	2.71	53.53	0.4	14.11	3
21	16.44	0.98	-3.74	0.73	16.33	5.98	3	3.03	18.38	0.19	0	0.19	85.81	6.05	-0.02	9	0.85	4.32	2.6	65.83	-1.43	16.19	3
22	21.02	0.95	-3.07	1.35	20.93	4.55	3	2.87	18.45	0.2	0	0.2	105.08	4.59	-0.01	4	0.8	3.82	2.47	74.86	-1.12	20.5	3
23	22.93	0.63	1.82	1.31	22.99	2.74	4	2.7	18.01	0.21	0	0.21	110.44	2.77	0.01	5	0.74	3.36	2.31	72.42	0.64	30.47	5
24	43	0.82	1.51	1.28	43.05	1.91	5	2.39	18.56	0.22	0	0.22	198.71	1.92	0	5	0.65	2.8	2.07	113.41	0.5	42.83	7
25	48.74	0.86	1.44	1.41	48.78	1.77	5	2.33	18.66	0.22	0	0.22	215.9	1.78	0	5	0.63	2.65	2.02	121.8	0.46	45.98	7
26	84.14	1.02	1.07	1.51	84.17	1.21	6	2.04	19.06	0.23	0	0.23	358.05	1.22	0	6	0.54	2.26	1.78	179.34	0.33	65.69	7
27	13.18	0.58	1.36	1.37	13.22	4.42	3	3.02	17.71	0.24	0	0.24	53.33	4.5	0.01	4	0.86	3.54	2.62	43.36	0.4	20.13	3
28	13.3	1.02	-1.29	1.58	13.26	7.71	3	3.17	18.35	0.25	0	0.25	51.53	7.86	-0.01	3	0.92	3.75	2.78	46.05	-0.37	12.98	3
29	25.5	3.08	-6.74	1.73	25.3	12.17	3	3.11	19.87	0.26	0	0.26	95.43	12.3	-0.02	9	0.92	3.61	2.78	85.32	-1.85	8.52	2
30	63.27	0	-10.79	1.81	62.95	0	0	0	13.73	0.27	0	0.27	232.79	0	-0.01	0	1	3.93	0	232.79	-2.88	346.84	0

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

:: Unit Weight, g (kN/m³) ::

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

where g_w = water unit weight

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

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

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

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

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

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

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

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

(applicable only to $I_c < I_{c_cutoff}$)

:: Relative Density, Dr (%) ::

$100 \cdot \sqrt{\frac{Q_{tn}}{k_{DR}}}$ (applicable only to SBT_n: 5, 6, 7 and 8 or $I_c < I_{c_cutoff}$)

:: State Parameter, ψ ::

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

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

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

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

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

If $I_c > 2.20$

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

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

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

If $I_c \leq 2.20$

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

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

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

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

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

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

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

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

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

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

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

:: Overconsolidation Ratio, OCR ::

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

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

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

:: In situ Stress Ratio, Ko ::

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

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

:: Soil Sensitivity, S_t ::

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

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

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

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

(applicable for $0.10 < B_q < 1.00$)

References

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

ROY J. SHLEMON & ASSOCIATES, INC.

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Quaternary Geology
Economic Geomorphology
Soil Stratigraphy
Geoarchaeology
PG 2867; CPG 1766; CPESC 2167

RECOMMENDATION FOR ACCEPTANCE

REPORT FOR INVESTIGATION OF POTENTIAL SURFACE FAULT RUPTURE 456 N. Rodeo Drive, Beverly Hills, California 90210

As authorized by the City of Beverly Hills, this document summarizes technical (peer) reviews for a "Fault Hazard [Ground Rupture] Investigation" for proposed redevelopment of the 456 N. Rodeo property in the City of Beverly Hills, California. The investigations were carried by Feffer Geological Consulting, Inc. (FGC), the Consultants-of-Record, on behalf of the applicant, the 456 N. Rodeo Drive, LLC. The main purpose of the FGC investigation was to determine if possible splays of the Santa Monica fault zone potentially impact the site, and if such faults were "active" (defined by the California Geological Survey [CGS] as surface or near-surface displacement within the last 11,700 years).

The site is about 115 ft from the nearest, CGS-designated Earthquake Fault Zone (EFZ), the Santa Monica, and relatively near the Hollywood EFZ that extends into the City on the northeast and the West Pico EFZ that currently "stops" at the City limits on the southeast (see FGC Figs. 2 and 8 and related enlargements given in report pocket). The City requires independent fault-activity reviews in conformance with building codes, with current requirements of the CGS (2018, Special Publication 42) and with the necessity to ensure public health, safety and welfare.

The reviews included initial telephone and email discussions with applicant representatives, the consultants and City personnel about investigation requirements and scope of work. These were followed by on-site field observation of continuous cores, interpretations of FGC preliminary cross-sections, cone penetrometer tests and site-specific soil-stratigraphic correlations. Likewise reviewed was an FGC draft report, similarly followed by discussions with FGC personnel and the applicant, and ultimately acceptance of the final report.

The FGC final report, dated 18 December 2018, documents pertinent literature and maps, summarizes field investigation procedures, provides the regional geologic framework and tectonic setting, and expounds on specific investigation procedures and technical data supporting the professional conclusions and recommendations.

In sum, the fundamental conclusions of the Consultants-of-Record are:

1. That the FGC regional assessments and site-specific investigations meet current standards-of-practice for fault-activity assessments in southern California in general and to those specifically required by the City of Beverly Hills in particular;

2. That the FGC site-specific investigations and interpretations are sufficient to identify, date and correlate subsurface stratigraphic markers, which are unbroken and generally more than 11,700 years old;

3. That, despite diligent observation, no charcoal or other materials amenable to unequivocal radiocarbon or other numeric dating methods were recovered;

4. That, although site-specific trenching is preferable, the Consultants-of-Record find that existing structures prevent trench emplacement and therefore, as permitted in City Guidelines for “non-zone” areas, opted to date sediments by means of 11 cone-penetrometer tests and extraction and interpretation of 4, 50-ft deep continuous cores. These data were supplemented by cores and CPTs previously obtained from the adjacent 468 N. Rodeo Drive site.

5. That, lacking numeric ages, the on-site sediments were dated primarily by soil-stratigraphic techniques (Appendix B). Identified were multiple moderately to strongly developed buried paleosols locally replete with common to many, moderately thick illuvial clay films all indicating a pre-11,700-yr age; and that these soils and sediments are traced across the site and, in association with CPT “signature,” are unbroken.

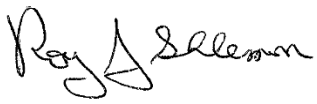
6. That, the 456 N. Rodeo Drive property is not subject to potential surface or near-surface displacement associated with the Santa Monica, the Hollywood, the West Pico or any other fault reasonably projected toward it.

Accordingly, based substantially on, and in reliance of their professional interpretations and conclusions, the FGC regional summaries and site-specific investigations are judged to meet current standards-of-practice for fault-activity

assessments in southern California in general and to those specifically required by the City of Beverly Hills in particular.

Please note that the FGC report focuses solely on potential surface or near-surface fault rupture and does not specifically address possible high seismic accelerations, ground deformation or other structural design and geotechnical investigations required by applicable building codes or by present professional engineering and geological standards of practice. It is therefore incumbent upon the applicant, FGC, or other consultants, to provide this information to the City of Beverly Hills for technical review and potential acceptance prior to issuance of building permits.

Recommended for Acceptance



_____

Roy J. Shlemon, Ph.D.
Technical Reviewer

20 December 2018

David Yelton, Deputy Building Official
Development Services Division
Community Development Department

February 14, 2019

456 N. Rodeo Drive LLC
Attn: Franklin E. Dickinson AIA
SVP Architecture & Construction
LVMH Moët Hennessy Louis Vuitton
19 E. 57th Street
New York, NY 10022

Subject: Acceptance letter of the report for the 456 N Rodeo Drive. Report For Investigation of Potential Surface Fault Rupture: 456 N. Rodeo Drive, Beverly Hills, CA 90210

Dear 456 N. Rodeo Drive LLC:

The Fault Hazard [Ground Rupture] Investigation" for the proposed redevelopment of the 456 N. Rodeo Drive property, in the City of Beverly Hills, California, 90210 were carried out by Feffer Geological Consulting, Inc. ("FGC"), the Consultants-of-Record, on behalf of the applicant, 456 N. Rodeo Drive LLC. The main purpose of the FGC investigation was to determine if possible splays of the Santa Monica fault zone potentially impact the site, and if such faults were "active" (defined by the California Geological Survey [CGS] having a surface or near- surface displacement within the last 11,700 years). The FGC investigation has been peer reviewed by the City's consultant, Roy J. Shlemon, Ph.D., PG2867; CPG 1766; CPESC 2167, of Roy J. Shlemon & Associates, Inc. ("RSA") and has been recommended for acceptance.

The peer review included critique of the Site-Specific Fault Rupture Investigation titled "INVESTIGATION OF POTENTIAL FAULTING" 456 N. Rodeo Dr., Beverly Hills, CA 90210 (FGC Project File No. 2176-85 dated December 18, 2018 attached).

The geologic investigation followed by a peer review are required by the City in conformance with the current building codes and with current geologic-standards-of practice to ensure public health, safety and welfare.

Accordingly, in reliance on the technical documentation and assurances provided by the Consultants-of-Record, including their opinions, and conclusions, the City of Beverly Hills now formally accepts the technical "Recommendation For Acceptance" of the Reviewer (attached).

Sincerely,

D. Yelton

Attachments: 1) Feffer Geological Consulting Fault Rupture Hazard Investigation Report, Project File No. 2176-85, dated December 18, 2018

2) Roy J. Shlemon, Ph.D., PG 2867; CPG 1766; CPESC 2167, of Roy J. Shlemon & Associates, Inc. "Recommendation For Acceptance," December 20, 2018

Appendix IS-3.2



Investigation of Potential Faulting:
468 North Rodeo

PD EXHIBIT 10

FEFFER
GEOLOGICAL CONSULTING

August 20, 2018 File No. 2188-85

468 N. Rodeo Drive LLC,
a California limited liability company
19 E. 57th St., New York, NY 10022

SUBJECT: **EVALUATION OF POTENTIAL FAULTING**
468 North Rodeo Drive, Beverly Hills, CA 90210

Dear 468 N. Rodeo Drive LLC:

We are pleased to submit this report summarizing our fault rupture hazard investigation for the subject site located on the northeast side of north Rodeo Drive at the corner of south Santa Monica Boulevard and north Rodeo Drive in the City of Beverly Hills, California. The subject site is not located within an area mapped as being potentially affected by surface faulting. Current published mapping by the State of California locates the northern edge of the Santa Monica Fault Zone approximately 170 feet to the southeast of the project site. The purpose of this investigation was to assess the potential for surface fault rupture at the site and determine if the area of the planned development is suitable for the construction of human-occupied structures.

This study consisted of a review of published and unpublished data, a geomorphic analysis, and subsurface exploration. The subsurface exploration program consisted of four continuously cored borings and eleven cone penetrometer soundings (CPTs) to check the continuity of the stratigraphy on and in the area of, the project site. The combination of continuous, unbroken late Pleistocene soil horizons and stratigraphy, and the lack of any near surface groundwater provides evidence to demonstrate the absence of active faulting beneath the entire project site.

Based on our site investigation we find no evidence of active faults traversing the project site. We therefore conclude that the project site is not exposed to the hazard of surface fault rupture. Accordingly, no fault setback distances or "no-build" zones are delineated that would impact or limit future development.

We appreciate this opportunity to be of service. Should you have any questions regarding the information contained in this report, please do not hesitate to contact us.

Sincerely,

FEFFER GEOLOGICAL CONSULTING, INC.



Joshua R. Feffer
Principal Engineering Geologist
C.E.G. 2138

INTRODUCTION AND BACKGROUND

The project site is located on the northeast side of north Rodeo Drive and consists of a commercial lot that is currently occupied by a two-story retail building within a highly developed portion of the City of Beverly Hills, CA. For purposes of description for this report it is assumed that Rodeo Drive is oriented in a north-south direction. The project site is bounded to the north by south Santa Monica Boulevard, to the east by an alley, and to the west by north Rodeo Drive. Commercial structures and office buildings are located adjacent to the site. A recent aerial photograph of the site is shown as Figure 1.

The original structure and facilities on this parcel were constructed prior to the development of the effecting Earthquake Fault Zone (EFZ). Thus, this property had not previously been investigated for the hazard of surface fault rupture. Currently published mapping by the State of California locates the nearest portion of the Santa Monica Fault Zone (SMFZ) to the south of Santa Monica Boulevard. The subject site is located entirely outside of this zone. The surface expression of the SMFZ (and the recently designated Santa Monica Boulevard Fault Zone, discussed below) is limited to fault-related geomorphic features, many which have been destroyed by urbanization and development within the greater Los Angeles area. This recent development and urbanization has resulted in a poor understanding of the lateral extent, location, and rupture history of faulting. Dolan et al. (2000) identified the fault location based on topographic scarps north of Santa Monica Boulevard in the Westwood area. Preliminary mapping presented by Olson (2015) refined the map representation of the fault scarps, but largely confirms the work by Dolan et al. (2000). The mapped location of the SMFZ in relation to the subject site was also obtained from the State of California's recent Earthquake Fault Zone Map (Olson, 2018) and is shown as Figure 2.

Development of this site is located outside of the current Earthquake Zones of Required Investigation (CGS, 2018a). However, it should be noted that the site is subject to the conditions of the Alquist-Priolo Special Studies Zone Act of 1972 (California Public Resources Code, Chapter 7.5, Division 2), and an investigation is required by the City of Beverly Hills. The AP Special Studies Zone Act is designed specifically to mitigate the hazard of surface fault rupture in future earthquakes and defines a fault as active if it has demonstrated surface displacement in Holocene time (past 11,700 years). The Alquist-Priolo Act mandates that sites located within "special studies zones", which are delineated by the California Geologic Survey (CGS) along active faults, require detailed geologic investigation to preclude the construction of human-occupied structures astride active fault strands. The 1994 Seismic Hazards Mapping Act changed the name of the zones from Special Studies Zones to Earthquake Fault Zones (EFZ).

The purpose of this investigation, therefore, was to assess the potential for surface fault rupture at the site and determine if the area of the proposed commercial development is suitable for construction of human-occupied structures.

SCOPE OF WORK

Typically, trenching is the preferred method for evaluating the presence or absence of faults because it offers a continuous, direct exposure of the fault zone or near surface stratigraphy. However, in this portion of the SMFZ, trenching would be difficult due to the dense urban cover and existing structures on site. Therefore, we proposed that this fault rupture hazard study consist of a series of strategically placed continuously cored borings in combination with cone penetrometer tests excavated deep enough

to resolve the issue of surface faulting hazard at the site. The scope of work for this fault rupture hazard investigation consisted of the following tasks:

- Review of published and unpublished geotechnical data in the site vicinity;
- Analysis of topographic maps of the site vicinity;
- Geologic reconnaissance of the site;
- Excavating and logging a total of 200 vertical feet of material in 4 borings across the site;
- Pushing through a total of 550 vertical feet of material in 11 CPT soundings across the site;
- Preparation of this report.

FAULT ACTIVITY CRITERIA

The criteria used in our investigation to evaluate fault activity is the same criteria used by the California Geological Survey (CGS), which defines active faults as those that have had surface displacement within Holocene time (about the last 11,700 years). This criteria for defining an active fault is based on standards developed by the CGS for the Alquist-Priolo Earthquake Fault Zoning Program (CGS, 2018a). Faults that have not moved in the last 11,700 years are not considered active.

In general, the activity rating of a fault is determined by establishing the age of the youngest materials displaced by the fault. According to the CGS (2018b), a discovered fault can be either age-undetermined, Holocene-active, or a pre-Holocene fault (see details below). If datable material is present, a numerical absolute age can sometimes be established; if no datable material exists, then only a relative age can be assigned to movement along the fault.

As discussed in the California Geological Survey's Special Publication 42 (2018b), a fault is defined as the following:

> *"A shear or zone of closely associated shears across which earth materials on one side have been displaced with respect to those on the other side because of tectonic forces. A fault is distinguished from those fractures or shears caused by landsliding or other gravity-driven surficial failures.*
>
> ***age-undetermined fault:*** *A fault whose age of most recent movement is not known or is unconstrained by dating methods or by limitations in stratigraphic resolution.*
>
> ***Holocene-active fault:*** *A fault that has had surface displacement within Holocene time (the last 11,700 years).*
>
> ***pre-Holocene fault:*** *A fault whose recency of past movement is older than 11,700 years, and thus does not meet the criteria of Holocene-active fault as defined in the State Mining and Geology Board regulations (California Code of Regulations, Title 14, Division 2, Section 3601.(a))." (CGS, 2018b, p. 1-2)*

REGIONAL AND LOCAL GEOLOGY

Regionally, the project site is located in the Los Angeles Basin, which makes up part of the Transverse Ranges Geomorphic province (Figure 3). The Los Angeles Basin lies within a transitional zone between the Transverse Ranges to the north and the Peninsular Ranges (Yerkes et. al., 1965). The basin is bounded on the north by the Santa Monica Mountains, on the east by the Elysian Hills, the west by the Newport-Inglewood Uplift and the south by the La Brea high, an area of shallow bedrock.

The predominate structure in the project site area is the east-west trending Malibu Coast-Santa Monica-Raymond-Cucamonga fault system (Crook et al., 1983), which extends for approximately 125 miles to form the southern boundary of the Transverse Ranges. This fault system is also referred to as the Transverse Ranges Southern Boundary fault system (TRSB) by Dolan et al. (2000). This complex system of east-west trending faults accommodates north-south shortening and uplift, and concurrent westward motion of the Western Transverse Ranges. Individual faults within the TRSB fault system exhibit varying degrees of both left-lateral strike-slip and contractional dip-slip faulting and related folding (Hill, 1979; Crook et al., 1983; Jones et al., 1990; Dolan et al., 2000). All faults within the system show evidence for Quaternary activity and several, including the Santa Monica and Hollywood faults, have been demonstrated by site-specific paleoseismic studies to be active during the Holocene (Jones et al., 1990; Weaver and Dolan, 2000; Dolan et al., 2000).

From a local perspective, the site is located within the uplifted and dissected Beverly Hills area. Geologic mapping of the area is fairly consistent and provides more accurate age constraints in later mapping. Yerkes and Campbell (2005) and Hoots and Kew (1931) mapped Holocene aged alluvium over older Pleistocene aged alluvial and fan deposits (Figure 4) while Dibblee (1991) mapped younger Holocene aged alluvial gravels at the surface overlying older Pleistocene age alluvial fan sediments (Figure 5). More recent mapping (Figure 6) from Campbell (2014) indicates that the sediments exposed in the area consist of primarily lower Holocene to upper Pleistocene age alluvium near the ground surface underlain by upper to lower Pleistocene aged alluvial fan deposits, and interbedded terrestrial fan and shallow marine sediments. None of these regional geologic maps show the SMFZ in the vicinity of the project site area.

Santa Monica Fault Zone

The SMFZ portion of the TRSB trends east-west from the Santa Monica coastline on the west to the Hollywood area on the east (see Figure 2). It is an oblique-reverse, left-lateral fault that is thought to be a surface expression of tectonic deformation related to Pliocene-Quaternary structural development of the Santa Monica Mountains. Integration of subsurface oil and gas exploration seismic data and well logs with surficial mapping indicate the mountains are underlain by a large southward-vergent asymmetric anticline formed over a regional north-dipping thrust ramp at a depth of 6 to 9 miles. Geophysical studies conducted at the Veteran's Administration (VA) property in West Los Angeles indicate the SMFZ is a gently dipping thrust fault with secondary near-vertical faults extending from the primary basal fault toward the ground surface (Pratt et al., 1998; Dolan et al., 2000).

The surface expression of the SMFZ is limited to fault-related geomorphic features, many of which have been destroyed by urbanization and development within the greater Los Angeles area (Figure 7). This has resulted in a poor understanding of the lateral extent, location, and rupture history of the SMFZ. Dolan et al. (2000) identified the fault location based on topographic scarps north of Santa Monica

Boulevard. The most prominent of these scarps is located at the base of a late to middle Pleistocene fan surface in west Los Angeles that extends from approximately University High School to the Mormon temple, juxtaposing older surficial deposits and relatively shallow bedrock to the north against younger surficial deposits and a thick expanse of old alluvium to the south. Both trenching studies and seismic reflections profiles reveal that, at the VA property, the SMFZ topographic scarp contains a series of steeply dipping to sub-vertical faults that offset late Quaternary sediments (Crook et al., 1983; Pratt et al., 1998; Dolan et al., 2000; Catchings et al., 2001). Radiometric dating of key stratigraphic horizons at the VA site indicate that five to six surface-rupturing events have occurred between approximately 50,000 and 1,000-3,000 years before present (Dolan et al., 2000).

To the west of the project site, the SMFZ has typically been mapped just north of and parallel to Santa Monica Boulevard, following a series of scarps at the base of late to middle Pleistocene fan surfaces (Dolan et al., 2000; Bedrossian et al., 2012; Olson, 2015). However, recent subsurface explorations and geophysical studies in Century City (e.g., Parsons, 2011) have interpreted the presence of a zone of faulting that extends south of Santa Monica Boulevard as well. Parsons (2011) interpreted these faults as active, however, a number of subsequent studies have refuted this interpretation. Kenney (2012; 2013) reviewed the data by Parsons (2011) and subsequent studies and supplemented them with his own geologic and geomorphic analysis. Kenney (2012) postulated that the data indicate that the primary basal SMFZ actually projects far to the south of the project site, and that faulting along and south of Santa Monica Boulevard should be attributed to the newly designated "Santa Monica Boulevard Fault Zone" (SMBFZ).

Faults associated with the SMBFZ dip steeply to the north and are thought to exhibit right-lateral displacement (Kenney, 2012), although a definitive sense of slip has not been established (Kenney, 2013). These faults are interpreted to be secondary structures related to the primary basal reverse SMFZ that is thought to underlie the Century City area at depth (Kenney, 2012; Lettis, 2013). Based on our review of the recent Century City studies (discussed in detail below), the faults subject to this investigation are part of the SMBFZ.

Both Kenney (2012) and Parsons (2011) indicate there is no direct evidence that SMBFZ faults along and south of Santa Monica Boulevard are active. To date, the only evidence of Holocene activity within the SMFZ and SMBFZ is for faults that are coincident with the topographic scarp north of Santa Monica Boulevard (e.g., Dolan et al., 2000; Geocon, 2014). Furthermore, it is important to reiterate that the SMBFZ postulated by Kenney (2012) or just the SMFZ as it is commonly referred to, is south of the subject site; and the subject site lies entirely outside of the newly delineated AP fault hazard zone (see Figure 2).

Newport-Inglewood Fault Zone

The Newport-Inglewood fault (NIFZ) zone is mapped across the western portion of the Los Angeles Basin and generally trends in a north to northwest direction. The Newport-Inglewood fault is topographically expressed onshore with elevated surfaces which extend from the Newport Mesa in the south to the Beverly Hills area in the north (Earth Consultants International, 2018). As it is currently mapped the northern portion of the Newport-Inglewood Fault ends near Pico Boulevard south of the Beverly Hills area (see Figure 2), however, the location of the northern fault strands has been debated widely in the geological literature. Multiple geologist have attempted to place the northern portion of the

Newport-Inglewood fault within a noticeable geomorphic break that is referred to as the West Beverly Hills Lineament (WBHL) (Earth Consultants International, 2018).

The WBHL is a north-south trending escarpment or topographic break. The WBHL has been interpreted as a tectonic feature (Dolan and Sieh, 1992), representing the northernmost step-over and expression of the Newport-Inglewood Fault Zone (NIFZ). According to this interpretation, the WBHL would connect the Santa Monica, Newport-Inglewood, and Hollywood fault zones. Distributed slip across this entire system would indicate an active fault zone of significant width. However, the relationships between these fault systems are poorly constrained at this time. In fact, the hypothesis that the WBHL is a tectonic feature had only recently been tested based on the wealth of data collected in the Century City area (discussed further below), and it is our understanding that the California Geological Survey is still evaluating whether or not the NIFZ should be zoned through Beverly Hills. In early 2018 the California Geological Survey placed a strand of the NIFZ known as the West Pico fault within an Alquist-Priolo Fault Zone. However, it is important to note that the WBHL is approximately one mile west of the subject site and the NIFZ and West Pico Fault are approximately 2 and 1.5 miles to the south-southeast of the subject site respectively (Figure 2).

TOPOGRAPHIC / GEOMORPHIC REVIEW

A combined review of previous geomorphic analyses (Earth Consultants International, 2018 and Lettis, 2013 and Dolan et. al., 2000) with a review of historical and US Geologic Survey topographic maps was performed (Figures 7 and 8). The topography was examined for recognizable scarps or breaks in slope that may suggest the location of faulting.

Geomorphically, the project site sits atop a degraded Holocene-aged alluvial fan surface that has been incised by numerous north-south to northwest-southeast trending drainages emanating from Benedict Canyon and Coldwater Canyon (Figure 8). Locally the area gently slopes to the east and southeast which is consistent with natural sedimentary and fluvial processes. The drainages to the south of the project site area are crosscut by a prominent southeast-facing escarpment, which has historically been used to locate the Santa Monica fault west of the subject site (e.g., Dolan et al., 2000). This scarp shown in Figure 7 is prominently expressed approximately 3 mi southwest of the site at the Mormon temple. However, from the Mormon temple to the site, this scarp becomes less pronounced in the landscape and unrecognizable in the vicinity of the subject site (see Figure 8), and highly urbanized which creates cover that masks geomorphic features related to faulting. Determining the location of fault related expressions through topographic analysis alone becomes increasingly difficult in the vicinity of the site due to these factors.

PREVIOUS INVESTIGATIONS

A review of previous geotechnical and fault rupture hazard investigations that have been completed in the area was conducted for any information that may be pertinent to the project site. The reports reviewed are summarized below.

In 2011, Parsons-Brinkerhoff (Parsons) completed a fault study for the METRO Westside Subway Extension for the purpose of locating potential subway station and tunnel alignments. Based on their interpretation of continuous-core borings, cone penetrometer tests (CPTs), and geophysical surveys, Parsons (2011) depicted two zones of faulting in the area: 1) a zone of northeast-southwest trending

faults, generally parallel to and south of Santa Monica Boulevard, which they attributed to the SMFZ and 2) a zone of northwest-southeast trending faults coincident with the West Beverly Hills Lineament (WBHL). These faults were considered active based on geomorphic evidence and interpreted association with known active faults. To the west of the project site, Parsons (2011) interpreted the SMFZ to span a width from the topographic scarp north of Santa Monica Boulevard to approximately 150 feet southeast of the boulevard. Parsons (2011) interpreted additional faults immediately to the southeast of this zone, but they were unable to determine whether these faults were active.

Leighton Consultants Inc. (Leighton, 2012) performed a fault investigation at Beverly Hills High School focused on the WBHL faults interpreted by Parsons (2011). Leighton (2012) advanced borings, CPTs, and excavated trenches along Parsons' (2011) borehole and CPT transects. Based on the observation of unbroken Pleistocene age soils across the grounds of the high school, Leighton concluded that the faults identified by Parsons (2011) were not active. Furthermore, Leighton (2012) provided geologic evidence that the WHBL scarp is an erosional feature, rather than a tectonic feature. The California Geological Survey (CGS) approved the Leighton report and agreed that none of the investigated faults were active (CGS, 2013).

Feffer Geological Consulting and Geocon, (2012) prepared a fault report for the 10000 Santa Monica project located immediately north of the BHHS campus and lies immediately adjacent to the MTA Santa Monica station site and between MTA Transects 2 and 4. The 10000 investigation included a trench across the entire site that paralleled the Leighton/MTA Transect 4 and the MTA Transect 2. The trench crossed the location of several fault strands proposed by MTA (Parsons, 2011) associated with their WBHL fault zone as well as the new WBHL fault location. No faults, active or otherwise, were found in the 10000 Santa Monica trench to depths of 30+ feet and ages of >300,000 years.

Kenney GeoScience (Kenney, 2012, 2013) performed geomorphic, structural, and stratigraphic analysis using the available subsurface data from the Metro investigation (Parsons, 2011), the Beverly Hills High School fault investigation (Leighton, 2012), and other data generated from recent fault studies in the Beverly Hills/Century City area (e.g., Feffer-Geocon, 2012; Legg, 2012). Based on these data, Kenney (2012) developed a tectonic and geologic history of the area, which included an evaluation of the location and activity of suspected faults. As discussed above, Kenney (2012, 2013) interpreted the faults along Santa Monica Boulevard as secondary upper plate structures, and referred to them as the SMBFZ. This interpretation is based on the observation that the SMBFZ faults are dominantly strike-slip (possibly right-lateral). Although individual faults within the SMBFZ may exhibit normal or reverse apparent displacement, there is little net vertical displacement across the zone (Kenney, 2013). This contrasts with the observations north of Santa Monica Boulevard, where oblique left-lateral reverse motion has produced net north-side-up displacement across the fault (e.g., Dolan et al., 2000; Geocon, 2014).

Kenney (2012) noted that multiple investigations and reevaluations of the faults first interpreted by Parsons (2011) along Santa Monica Boulevard had not produced any evidence of Holocene-age activity for the SMBFZ. In fact, the most recent data indicates that activity along these faults likely ceased approximately 40,000 to 50,000 years ago (Kenney, 2012). However, Kenney (2013) noted that additional study of these faults is needed in order to confidently assess their activity.

Subsequent to Kenney's (2012, 2013) reinterpretation of the SMFZ and the SMBFZ, Geocon West, Inc. (Geocon, 2013) conducted a fault study for Westfield at the Century City mall. This study was

specifically designed to identify the evidence for Holocene activity (or lack thereof) along the SMBFZ south of Santa Monica Boulevard. Geocon's (2013) study consisted of one boring transect along Avenue of the Stars, and another boring transect along Century Park West. Geocon (2013) documented a thick section of unfaulted Pleistocene-age alluvium overlying faulted sections of Lakewood Formation sediments. Based on the apparent continuation of the Pleistocene-age geologic units overlying several faults, Geocon (2013) concluded that no active faults were present at the Westfield site, and no restrictions on future development of the Westfield Site are necessary with respect to potential faulting.

The Los Angeles County Metropolitan Transit Authority prepared a report in 2017 for Transect 9 of Tunnel Reach 5 located approximately 1500 feet to the southwest of the subject site (MTA, 2017). The following is a summary from FER-259 (Olson, 2018):

"In 2017, AMEC Foster Wheeler performed a supplemental fault investigation for the planned LA Metro Westside Purple Line subway extension (Metro, 2017) to assess a strand of the Santa Monica Fault Zone encountered during the preliminary fault investigation report (Parsons Brinckerhoff, 2011), which trended northeasterly towards a section of the proposed subway alignment. To investigate for potential faulting, a series of continuous core borings and CPTs were drilled along Laskey Drive, turning east at Charleville Boulevard, and continuing north along Spaulding Drive (see Figure 14, locality 15). This was referred to as Transect 9, which continues the numbering sequence from Parsons Brinckerhoff (2011). The new subsurface profile was constructed using data collected from twenty new continuous core borings drilled from 110 to 245 feet deep and 34 CPTs advanced to depths ranging from 61 to 117 feet. Based on the subsurface data the consultants identify Holocene and Pleistocene alluvial units overlying bedrock of the Pleistocene Lakewood and San Pedro Formations." (Olson, 2018, p. 31-32)

"From their observations and interpretations of the subsurface data, AMEC Foster Wheeler identified a significant fault zone at depth between their stations 6+50 and 9+00 (Figure 19) consisting of up to three strands, which dip steeply to the north. The faults exhibited greater than 90 feet of apparent down-to-the-north vertical displacement of the contact between the older alluvium and the Lakewood Formation. From the southern end of the cross section, the depth to the Pleistocene bedrock units consistently increases to the north until they are abruptly truncated and no longer encountered north of the inferred fault zone. AMEC states these faults appear to extend up near the present-day ground surface and offset Holocene sediments dated between approximately 9,100 and 16,500 years old based on radiometric dating of charcoal samples. The locations of the fault traces in the near surface sediments is based on identifying the location where laterally persistent laminated fine-grained "sag deposits" to the north are abruptly missing in adjacent down-gradient borings. It is postulated these fine-grained silts and clays were deposited in depressions or impounded drainages formed by topographic scarps created by surface-rupturing events along faults in this zone. Additional faults were also interpreted between borings north and south of this main zone." (Olson, 2018, p. 32)

It should be noted that the interpretation of faulting by Metro, 2017 is similar to the previously identified activity of the Santa Monica Fault Zone by the MTA and has been questioned by many consultants. None of the purported active faults conclusively offset Holocene age soil. As discussed by Gath and Buresh (2014) "The interpretation of fault presence was conditioned by that paradigm: faults were expected in a certain location, so any evidence of faulting was presumed conclusive, with no effort to actually verify its presence; similarly, where faults were not anticipated, data that could be used to interpret the presence of faulting was ignored. The paradigm determined that active faulting must be

present, so almost every fault encountered was presumed to be active without any attempt at verification."

More recently Earth Consultants International (ECI), (2018) prepared a Fault Investigation Report for 322 N. Foothill Road in the City of Beverly Hills. Similar to the subject site, the site investigated by ECI was also located partially within the AP Fault Hazard zone. ECI performed an investigation by drilling two continuously cored borings, pushing 6 CPT soundings, and excavating one fault study trench. ECI performed an age assessment of the encountered soils and observed and documented un-broken pre-Holocene stratigraphy. ECI (2018) concluded that the site is not impacted by faulting and the potential for surface rupture is low.

METHODOLOGY

Approach

The subsurface investigation was designed to investigate across the subject site in a northwest-southeast oriented transect within the alley adjacent to the subject site. (see Figure 9). Typically, trenching is the preferred method for evaluating the presence or absence of faults because it offers a continuous, direct exposure of the fault zone or near surface stratigraphy. However, this portion of the SMBFZ has been difficult to expose in trenches due to the dense urban cover in the vicinity. Due to the site conditions (existing structures and dense underground utilities), it was proposed that this fault rupture hazard study consist of a transect of 4 continuously cored borings and 11 CPT soundings. The borings and CPT's are located on a 1 inch = 10 foot scale base map, and the subsurface data was plotted on a 1 inch = 10 foot scale cross section for interpretation (Figure 10).

Field Exploration

Prior to beginning the subsurface field exploration, a literature review, topographic analysis, and geologic reconnaissance of the site was performed. Following this general review, Underground Service Alert (USA) was notified to identify buried utilities in the vicinity of the proposed excavations, as required by law. An independent utility locating company was also contracted to verify "no-conflict" areas for the drilling/CPT locations.

Subsurface exploration at the subject site were completed on July 30, 2018 and included excavating and logging all four continuous borings, and the pushing of eleven total CPTs. The borings and CPT's were excavated to a maximum depth of 50 feet beneath the existing ground surface. The boring logs and soil descriptions, and CPT report are included in Appendices A, B, and C and Tables 1 and 2 respectively.

GEOLOGIC MATERIALS

The continuity of soil horizons and primary stratigraphic contacts provides essential data to evaluate the presence or absence of faulting. Five conformable stratigraphic units within the alluvium were encountered in each of the 4 borings and 11 CPT's. These units are described in detail below.

In general, these units consisted of a basal course-grained sediment, fining-upward to fine sand and silt and local clays, typically capped by a buried paleosol.

Holocene Alluvial Fan Deposit 1 (Qal1)

The uppermost unit in section A-A' (Figure 9) is composed of silty sand to silty sand with clay. Gravels are generally fine, sub angular to sub rounded fragments of slate. Hues are in the 7.5YR range (brown). We interpret this unit as a late Holocene age alluvial deposit (sheet flow), and designate it as Qal1. A thin veneer of artificial fill overlies this unit across a majority of the study area. Unit Qal1 includes both a surficial alluvial deposit and a weakly-developed and truncated argillic soil.

Holocene Alluvial Fan Deposit 2 (Qal2)

The lowest Holocene unit in section A-A' (Figure 9) is composed of sandy clay to clayey sand. Localized gravels at the base of this unit are generally massive and fine to medium grained, sub rounded fragments of slate. Hues are in the 7.5YR range (brown). We interpret this unit as an early Holocene to latest Pleistocene aged alluvial deposit (axial valley deposit), and designate it as Qal2. A thin scour deposit overlies and truncates this unit across a majority of the study area. Qal2 includes alluvial deposits with a thick, diffuse (cumlic), and weakly-developed argillic soil.

Pleistocene Alluvial Fan Deposit 1 (Qoa1)

The uppermost Pleistocene unit in section A-A' (Figure 9) is composed of gravelly clayey sand to sandy clay. Gravels are generally fine to medium grained, sub angular and highly weathered fragments of slate. Hues are in the 7.5 to 5YR range (brown to reddish brown). We interpret this unit as a late Pleistocene age alluvial fan deposit (debris flow), and designate it as Qoa1. A strong scour deposit overlies this unit across the entire study area. Unit Qoa1 includes alluvial deposits that contain a well-developed and truncated argillic soil. The contact between Qal2 and Qoa1 is found at a depth of approximately 26 feet across the entire study area.

Pleistocene Alluvial Fan Deposit 2 (Qoa2)

Beneath unit Qoa1, we encountered a unit composed of silty sand with gravel to sandy clay. Gravel is interbedded within this unit, and is composed of fine, medium and coarse-grained, rounded slate and sandstone. Hues are in the 7.5YR range (brown) with localized faint mottling with 2.5YR olive to grayish brown. This unit is interpreted as a highly weathered late Pleistocene braided stream channel deposit that contains two highly truncated, thin and moderately well-developed soil remnants and we designate it as unit Qoa2. The contact between Qoa1 and Qoa2 is found at a depth of approximately 34 feet across the entire study area.

Pleistocene Alluvial Fan Deposit 3 (Qoa3)

Beneath unit Qoa2, we encountered a unit composed of sandy clay to silty sand with gravel. Gravel is interbedded within this unit, and is composed of fine and medium-grained, highly weathered and sub rounded to sub angular slate and sandstone. Hues are in the 7.5YR range (brown) with faint localized mottling with 2.5YR olive to grayish brown. This unit is interpreted as a highly weathered late Pleistocene braided stream channel deposit that contains a highly truncated, stacked and well developed soil remnant designated as Qoa3. Unit Qoa3 is the oldest unit encountered during the subsurface

exploration. The contact between Qoa2 and Qoa3 is found at a depth of approximately 45 feet across the entire study area.

Soil Development/Soil Profiles

The borings (see Figure 9 and Appendix A) lie across a graded (or stripped) and artificially filled surface that is geomorphically inactive. The soil profile in each boring at depth consists of a truncated sequence of multiple stacked and truncated Alfisol soils (Qoa1, Qoa2, and Qoa3). The entire section in this locality is capped by 6 to 7 feet of artificial fill. Parent materials for these soils consist chiefly of slate-rich debris flow and/ or stream terrace deposits that have most likely emanated from Benedict Canyon. The deepest exposures contain faint mottling and gleying that increases with depth and may faintly overprint or mask some of the original soil properties (mainly soil color). Soil profiles in each boring contains a surface soil and 4 buried soils to depths of approximately 50 feet below the ground surface. This stratigraphic section tracks across the entire area investigated. The individual soil profile members and relative age estimates are briefly described below.

The uppermost or surface soil on site (Qal1) is a highly truncated soil remnant that consists of one weakly developed argillic diagnostic subsurface horizon (Bt – BC). The deposit consists of a crudely stratified fining upwards sequence. This soil member is characterized by a coarse-grained deposit with 7.5YR hues and few thin thick clay films on ped faces and coating gravel and has an estimated relative age of 4 – 8 ka (Appendix B).

The lowest Holocene soil on site (Qal2) is a diffuse and cumlic soil remnant that consists of a thick and weakly developed argillic diagnostic subsurface horizon (2Bt – 2BC – 2C). The deposit consists of a crudely stratified fining upwards sequence. This soil member is characterized by basal gravel and fine-grained deposit with 7.5YR hues and common thin thick clay films on ped faces and coating gravel. Qal2 has an estimated relative age of 12 – 21 ka (Appendix B).

The youngest Pleistocene aged soil on site (Qoa1) is the remnant of a strongly developed Alfisol soil. This is a highly truncated soil that consists of two moderately well-developed argillic diagnostic subsurface horizons (3Bt1 – 3Bt2 – 3BC). The deposit consists of a fining upwards to massive deposit and most likely represents the distal portion of a debris flow deposit. This soil member is characterized by a gravel-rich and fine-grained deposit with 5 to 7.5YR hues and many thin and common moderately thick clay films on ped faces and coating gravel. This soil member has a relative age estimate of 25 - 51 ka.

The third buried soil member on site (Qoa2) is a truncated and older cumlic soil remnant that consists of a thick and moderately well-developed argillic soil profile (4Btb – 4BC). The deposit consists of a crudely stratified fining upwards sequence. This soil member is characterized by a fine-grained deposit with 7.5YR hues locally mottled with 2.5YR hues, with common thin and few to common moderately thick clay films on ped faces and has an estimated relative age of 33 – 64 ka (Appendix B).

The oldest and lowest buried soil member on site (Qoa3) is a truncated and stacked soil remnant that consists of two moderately well-developed punctuated argillic soil profiles (5Btb – 5BC - 6Bt – 6BC). The deposit consists of two crudely stratified fining upwards sequences. This soil member is characterized by a stratified deposit with 7.5YR hues locally mottled with 2.5YR hues, with few to

common thin and few moderately thick clay films. Qoa3 and the entire stratigraphic section under study has an estimated relative age of 46 – 94 ka (Appendix B).

In conclusion, the entire stratigraphic sequence exposed at the project site is estimated to be in excess of 46 ka in age. The project site contains Pleistocene-aged materials at depth. The stratigraphic units encountered provide visually and texturally distinct, mappable contacts that are overlapping across the project site area and across the transect of borings. No features or structural characteristic of faulting, such as shear zones or high angle contacts between units, were observed within the core samples. The contacts between Qoa1 and Qoa2 and between Qoa2 and Qoa3 are observed to undulate and slope gently the south as would be expected by normal sedimentary processes.

EVIDENCE FOR THE ABSENCE OF FAULTING

Several subsurface geologic relationships at the 468 N. Rodeo Drive project site provide direct evidence to preclude the presence of Holocene faulting. The topographic analysis also provides indirect evidence that the site is not traversed by active faults. When these relationships are considered together, there is compelling evidence for the absence of faulting beneath the subject site. The primary lines of evidence that support the interpretation that no faults traverse the site are:

• **Continuous, unfaulted soil horizons and primary stratigraphy across the site.** The boring transect conducted on site exhibits multiple continuous stratigraphic horizons across the entire boring and CPT transect. All of the deposits encountered along the transect correlate well across the project site. If faults with a vertical slip component of slip were active in this area, they would have produced recognizable, vertical separations of these Pleistocene units. Similarly, active strike-slip faulting would have produced an apparent dip-slip component or truncation of units due to the juxtaposition of different Pleistocene strata or pedogenic horizons.

• **No faults were encountered in the subsurface exploration.** No features characteristic of faulting, such as shear zones or high angle contacts between units were observed within the collected continuously cored samples. This line of evidence by itself is not considered compelling enough to preclude the presence of faulting, but it is consistent with and corroborates the other lines of evidence.

• **No irregularities or topographic features indicative of faulting were observed in the project site area.** Geomorphically, the project site sits atop a well incised and degraded Holocene-aged alluvial fan surface. It lies north of the mapped trace of the Santa Monica Fault Zone.

CONCLUSIONS AND RECOMMENDATIONS

This fault rupture evaluation at 468 N. Rodeo Drive has observed continuous un-broken sediments aged greater than 11,700 ka (pre-Holocene) across the site. The observed continuous and un-broken stratigraphy implies that no active faults traverse the site within the limits investigated. Based on the findings of this report and the lack of supporting evidence for active faulting within the bounds of the investigation, the project site is not exposed to the hazard of surface fault rupture. Therefore, we have not delineated any ‘no-build’ zones or fault setback distances that would impact or limit future development of the site (Figure 11).

While the area explored in our study is not considered subject to the hazard of surface faulting, a future earthquake on the Santa Monica Boulevard, Santa Monica, Hollywood, or Newport - Inglewood fault zones will likely produce very strong, near-field ground motions at the project site that should be considered within a geotechnical evaluation of the site.

LIMITATIONS

The conclusions and recommendations presented herein are the results of an inherently limited scope. Specifically, the scope of services consisted of an assessment of whether or not active faults are present within the area explored at the site. The conclusions and recommendations contained in this report are professional opinions derived in accordance with current standards of professional practice. No warranty is expressed or implied.

This report has been prepared for the exclusive use of 468 N. Rodeo Drive LLC and applies only to potential future development at the site located at 468 N. Rodeo Drive in the City of Beverly Hills, California. In the event that significant changes in the development planning should occur, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed by Feffer Geological, and the conclusions and recommendations of this report are verified in writing.

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Figures

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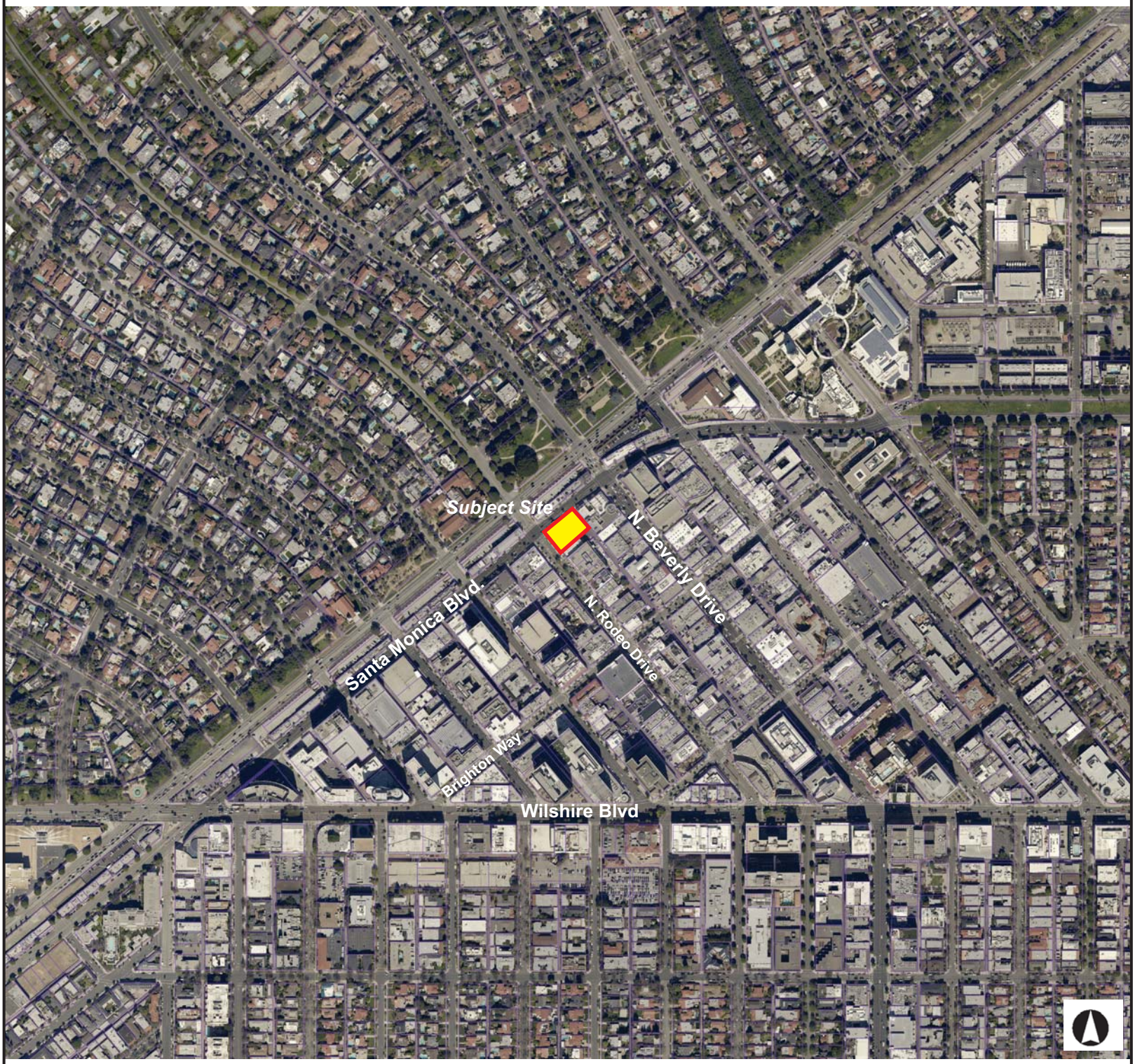
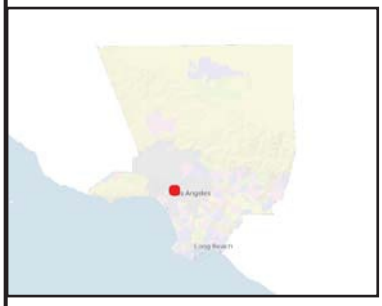
Tables

468 N. Rodeo Drive



This map is for reference only and should not be used for legal decisions. While the County of Los Angeles makes its best effort to ensure data is accurate, the County makes no representation or warranty of any kind.



FEFFER GEOLOGICAL CONSULTING

0.3 0 0.14 0.3 Miles

Figure 1

Site Location Map

Adopted From The LACounty.gov GIS Viewer

Figure 2

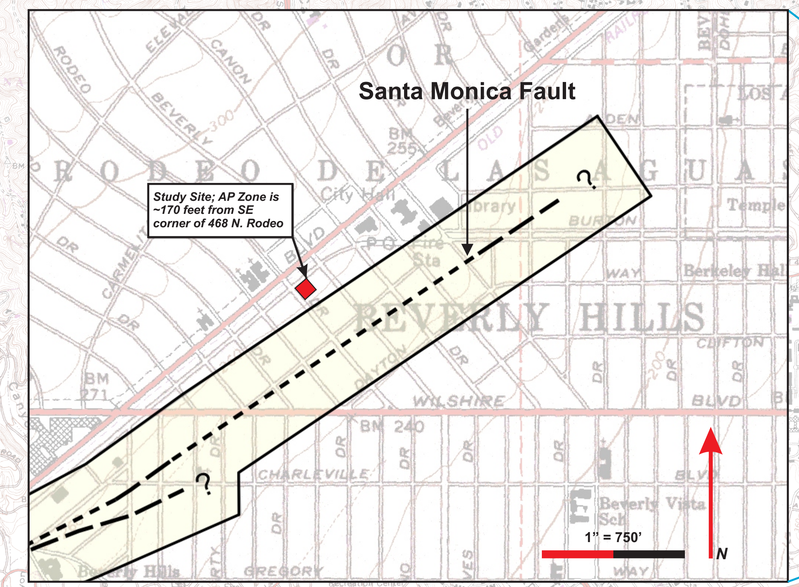
Modified from Plate 3 - FER 259

FAULTS RECOMMENDED FOR ZONING

EXPLANATION

- fault, approximately located
- fault, certain
- fault, concealed
- fault, inferred
- fault, inferred, queried
- Recommended Alquist-Priolo Earthquake Fault Zones
- Existing Alquist-Priolo Earthquake Fault Zones

FEFFER GEOLOGICAL CONSULTING



Hollywood Fault

Study Site

Santa Monica Fault

West Pico Fault

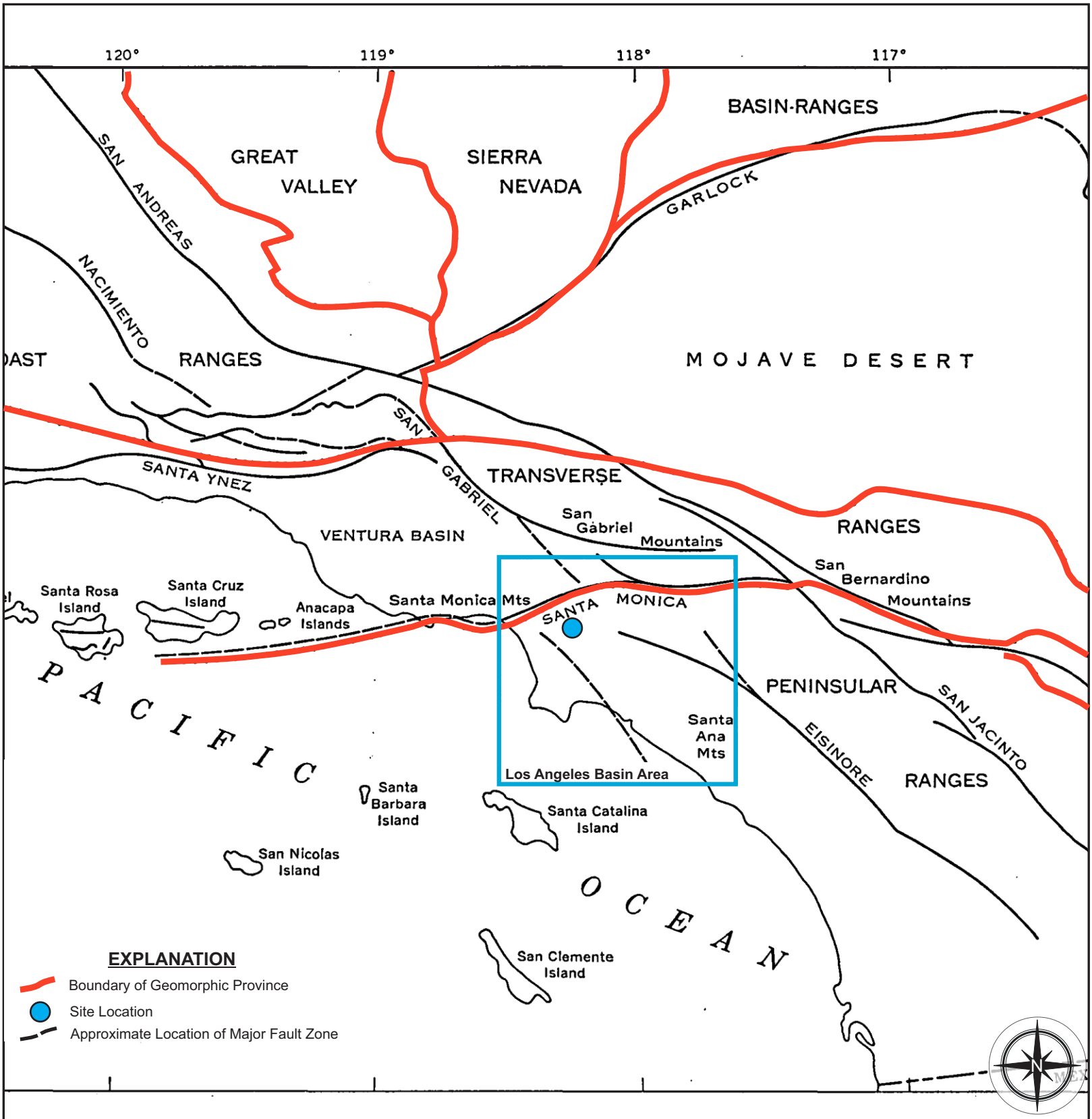
Newport-Inglewood Fault

Hollywood Quadrangle

Topanga Quadrangle

Beverly Hills Quadrangle

0 1,500 3,000 4,500 6,000 Feet





FEFFER GEOLOGICAL CONSULTING

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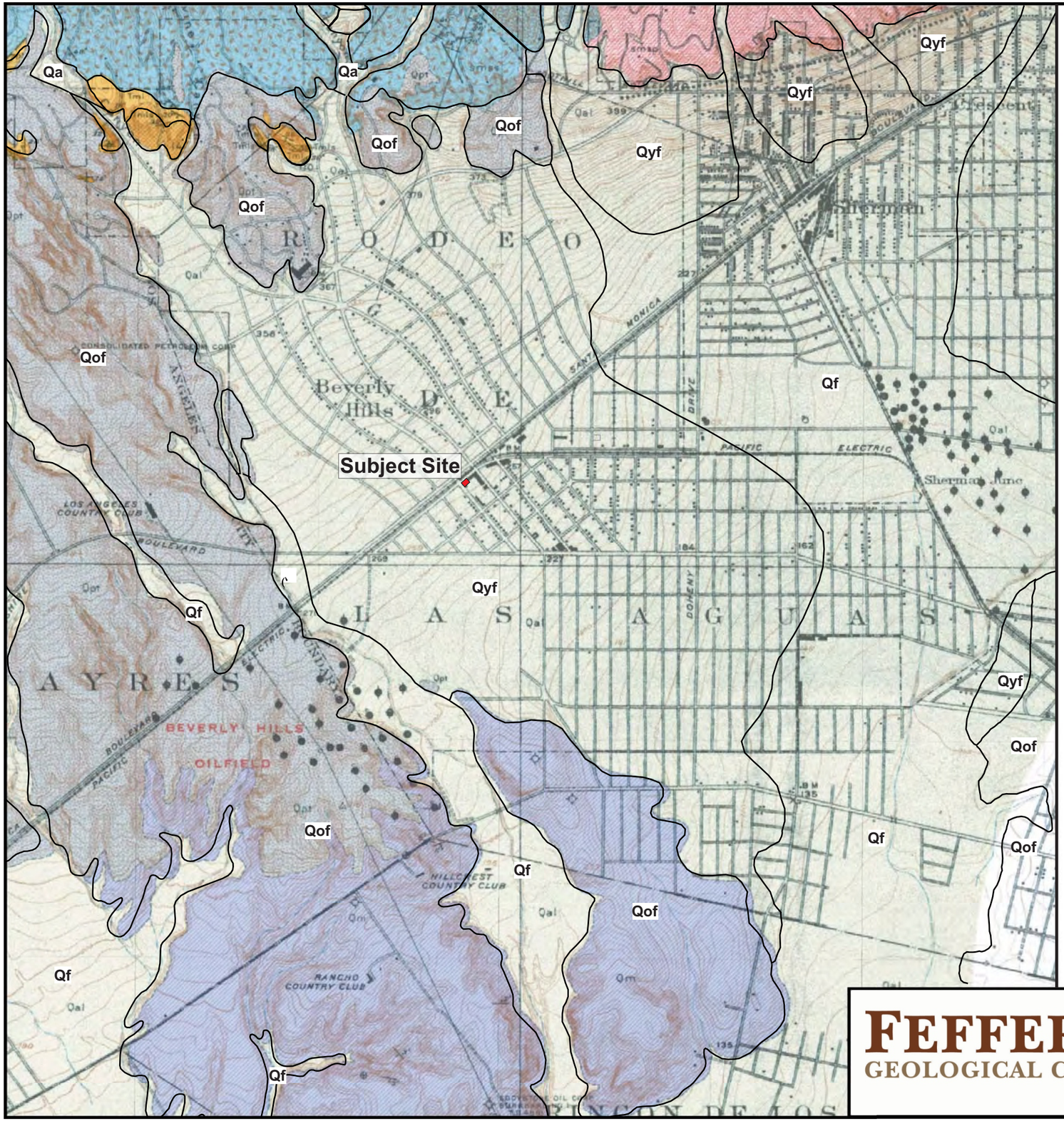
Figure 3

Regional Geomorphic Map

Modified from Yerkes et al., (1965)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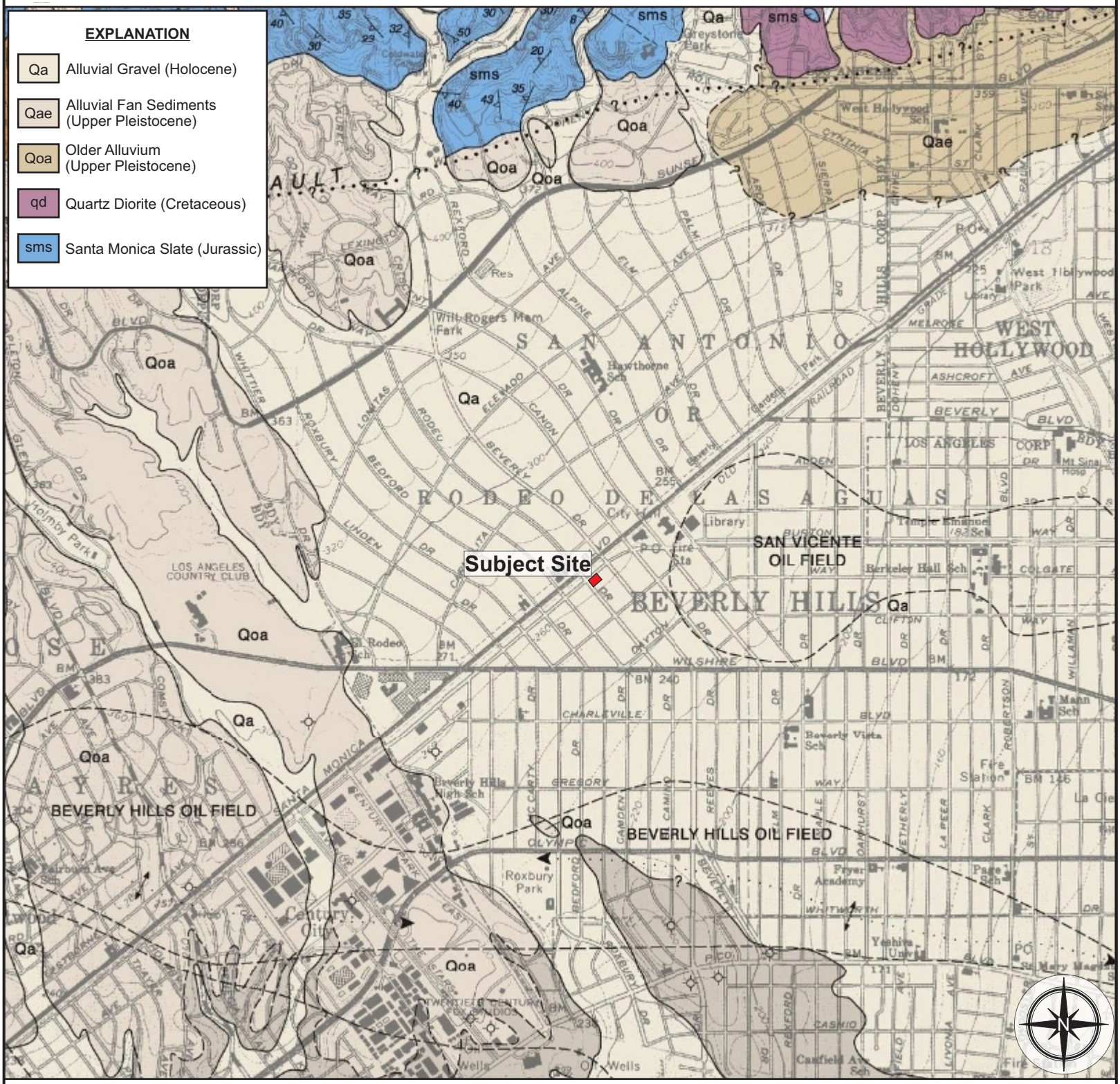




FEFFER GEOLOGICAL CONSULTING

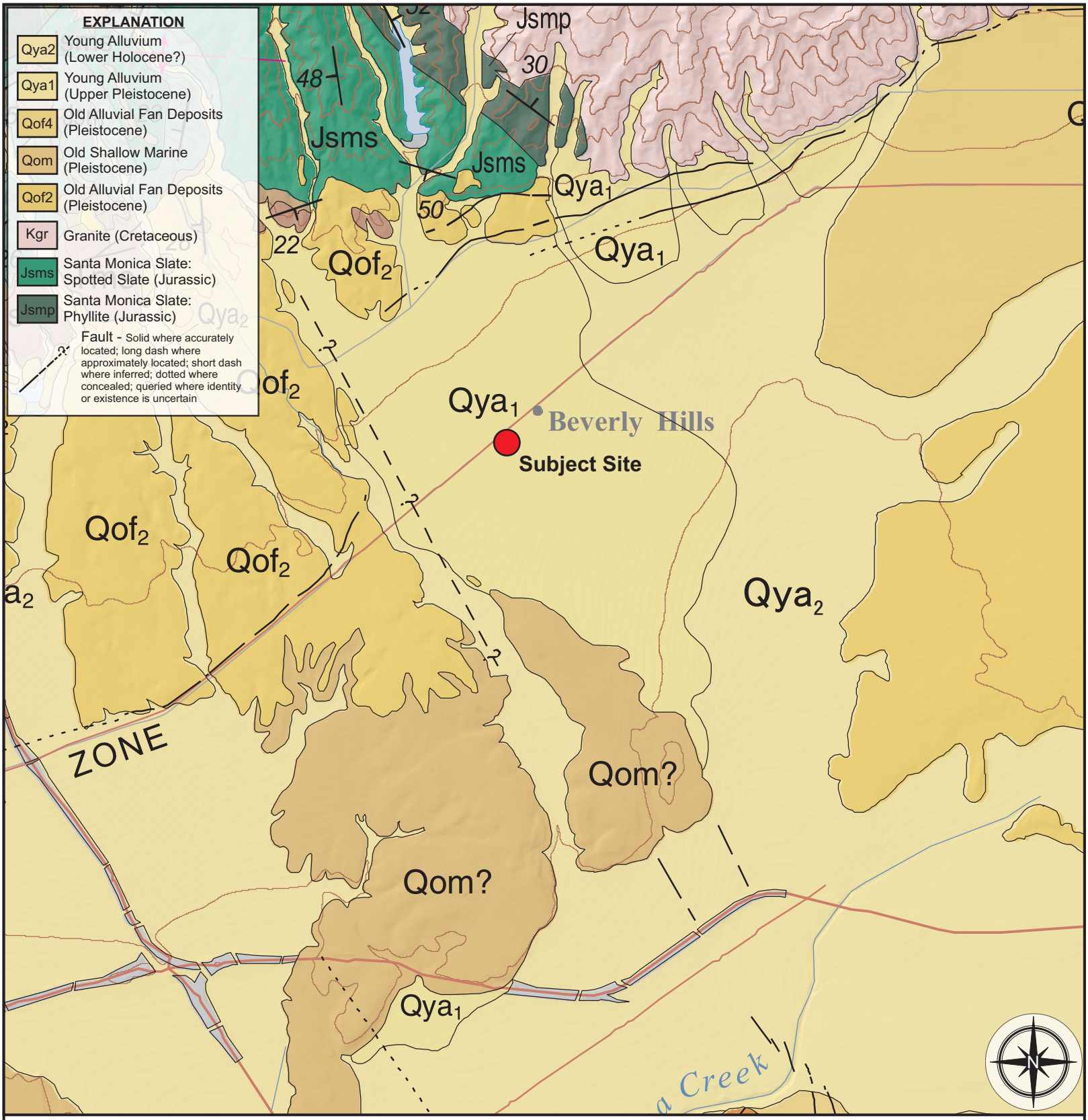
MILES
0 0.5 1

SCALE 1:24000

Figure 5

Regional Geologic Map

Modified from Dibblee & Ehrenspeck (1991)





FEFFER GEOLOGICAL CONSULTING

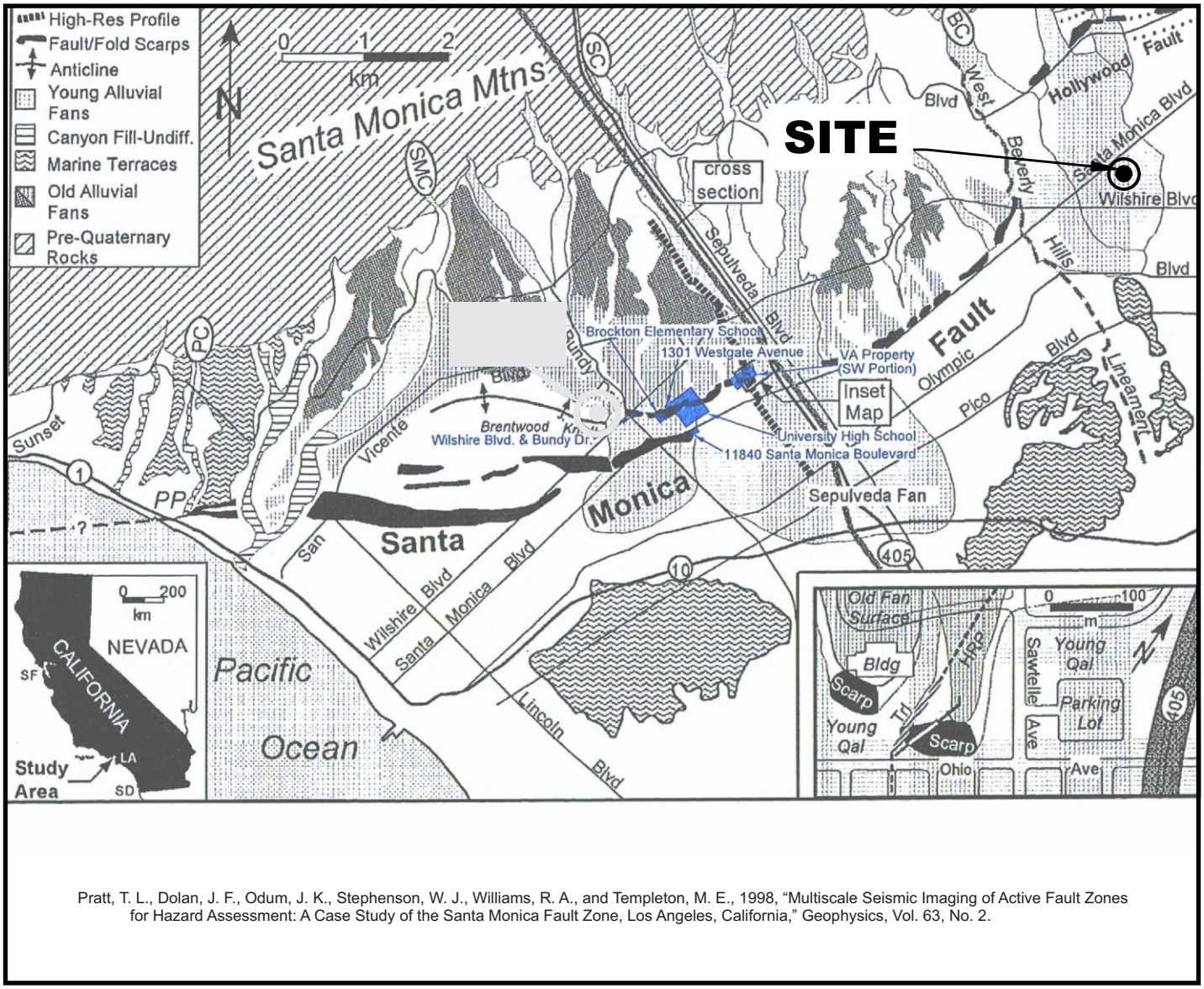
MILES
0 0.5 1

SCALE 1:100,000

Figure 6

Regional Quaternary Geologic Map

Modified from Campbell et. al., (2014)



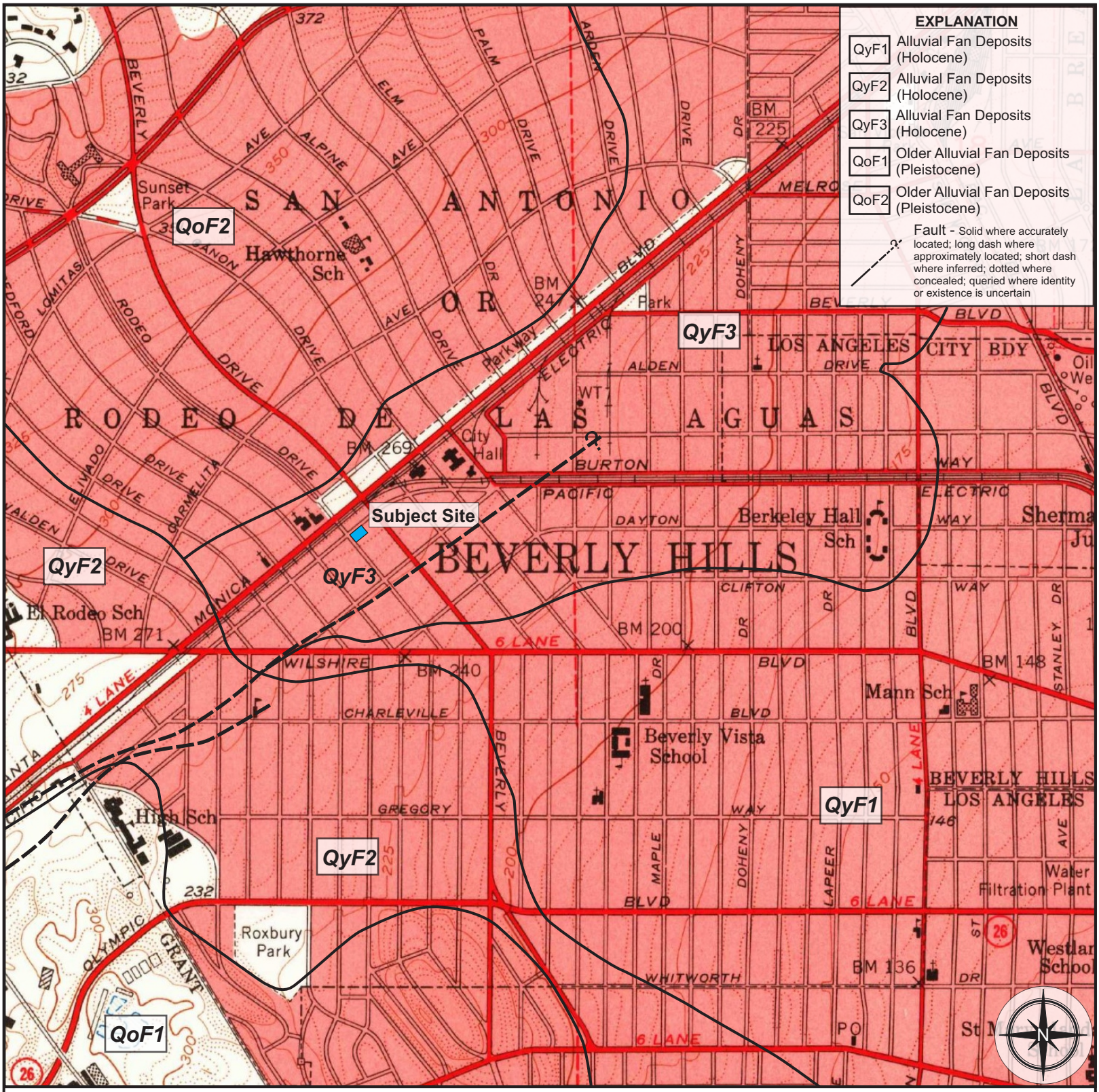
Pratt, T. L., Dolan, J. F., Odum, J. K., Stephenson, W. J., Williams, R. A., and Templeton, M. E., 1998, "Multiscale Seismic Imaging of Active Fault Zones for Hazard Assessment: A Case Study of the Santa Monica Fault Zone, Los Angeles, California," Geophysics, Vol. 63, No. 2.

FEFFER GEOLOGICAL CONSULTING

Figure 7

Regional Fault Scarp Map

Modified from Prat et al., (1998)





FEFFER GEOLOGICAL CONSULTING

MILES
0 0.5 1

SCALE 1:24000

Figure 8

Site Geomorphic Map

Modified from the LACounty.gov GIS Viewer (2018) and USGS (1950)

Figure 9

FEFFER GEOLOGICAL CONSULTING

GEOLOGIC MAP

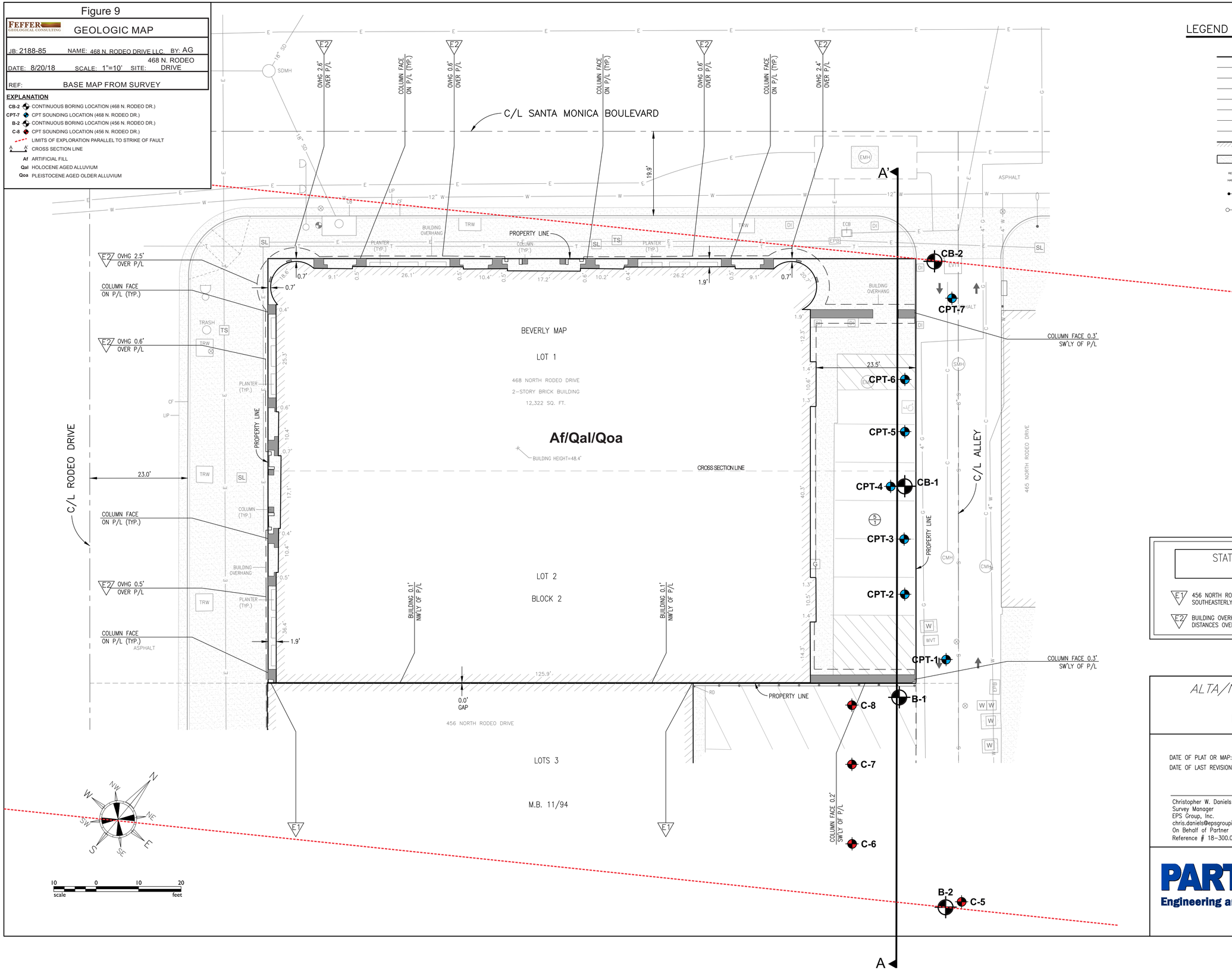
JB: 2188-85 NAME: 468 N. RODEO DRIVE LLC. BY: AG

DATE: 8/20/18 SCALE: 1"=10' SITE: 468 N. RODEO DRIVE

REF: BASE MAP FROM SURVEY

EXPLANATION

- CB-2 CONTINUOUS BORING LOCATION (468 N. RODEO DR.)
- CPT-7 CPT SOUNDING LOCATION (468 N. RODEO DR.)
- B-2 CONTINUOUS BORING LOCATION (456 N. RODEO DR.)
- C-8 CPT SOUNDING LOCATION (456 N. RODEO DR.)
- LIMITS OF EXPLORATION PARALLEL TO STRIKE OF FAULT
- A A' CROSS SECTION LINE
- Af ARTIFICIAL FILL
- Qal HOLOCENE AGED ALLUVIUM
- Qoa PLEISTOCENE AGED OLDER ALLUVIUM



LEGEND

- PROPERTY LINE
- CENTER LINE
- W WATER LINE
- G GAS LINE
- C COMMUNICATION LINE
- E ELECTRICAL LINE
- SD STORM DRAIN LINE
- T TELEPHONE LINE
- BUILDING PERIMETER
- CONCRETE
- PARKING COUNT (REGULAR / HANDICAP)
- STREET LIGHT
- TRAFFIC SIGNAL W/ARM
- TRAFFIC SIGNAL
- HANDICAP PARKING SPACE
- FIRE HYDRANT
- WATER VALVE
- BOLLARD
- W WATER METER
- SL STREET LIGHT PULLBOX
- G GAS METER
- TS TRAFFIC SIGNAL PULLBOX
- TRAFFIC DIRECTION
- CB CATCH BASIN
- CF CURB FACE
- CMH COMMUNICATION MANHOLE
- DI DROP INLET
- ECB ELECTRICAL CABINET
- EMH ELECTRICAL MANHOLE
- EPB ELECTRICAL PULLBOX
- EVT ELECTRICAL VAULT
- LIP EDGE OF GUTTER
- OVHG OVERHANG
- P/L PROPERTY LINE
- RD ROOF DRAIN
- SMH SEWER MANHOLE
- SDMH STORM DRAIN MANHOLE
- TRW TREE WELL
- WVT WATER VAULT

STATEMENT OF POTENTIAL ENCROACHMENTS

E1 456 NORTH RODEO BUILDING CROSSES 0.1' NORTHWESTERLY OVER THE SOUTHEASTERLY PROPERTY LINE.

E2 BUILDING OVERHANG CROSSES PROPERTY LINE IN MULTIPLE LOCATIONS. DISTANCES OVER PROPERTY LINE ARE NOTED HEREON.

ALTA/NSPS LAND TITLE SURVEY

468 NORTH RODEO DRIVE
BEVERLY HILLS, CA 90210

PARTNER PROJECT NUMBER 18-220933.2

DATE OF PLAT OR MAP: 08/01/2018
DATE OF LAST REVISION: N/A

Christopher W. Daniels
Survey Manager
EPS Group, Inc.
chris.daniels@epsgroupinc.com
On Behalf of Partner Engineering and Science
Reference # 18-300.015.44

LICENSED LAND SURVEYOR
CHRISTOPHER W DANIELS
Exp. 12/31/18
No. 6328
STATE OF CALIFORNIA

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sshore@partneresi.com

Figure 10

FEFFER GEOLOGICAL CONSULTING

CROSS SECTION A-A'

JB: 2188-85	NAME: 468 N. RODEO DRIVE LLC.	BY: AG	
DATE: 8/20/18	SCALE: 1"=10'	SITE: 468 N. RODEO DRIVE	
REF: TOPOGRAPHY FROM LA COUNTY GIS VIEWER			

SLEEVE FRICTION / CONE RESISTANCE

Depth

10 tsf 400

EXPLANATION

- **CB-2** CONTINUOUS BORING LOCATION (468 N. RODEO DR.)
- **CPT-7** CPT SOUNDING LOCATION (468 N. Rodeo DR.)
- **B-2** CONTINUOUS BORING LOCATION (456 N. RODEO DR.)
- **C-8** CPT SOUNDING LOCATION (456 N. Rodeo DR.)
- **Af** ARTIFICIAL FILL
- **Qal** HOLOCENE AGED ALLUVIUM
- **Qoa** PLEISTOCENE AGED ALLUVIUM

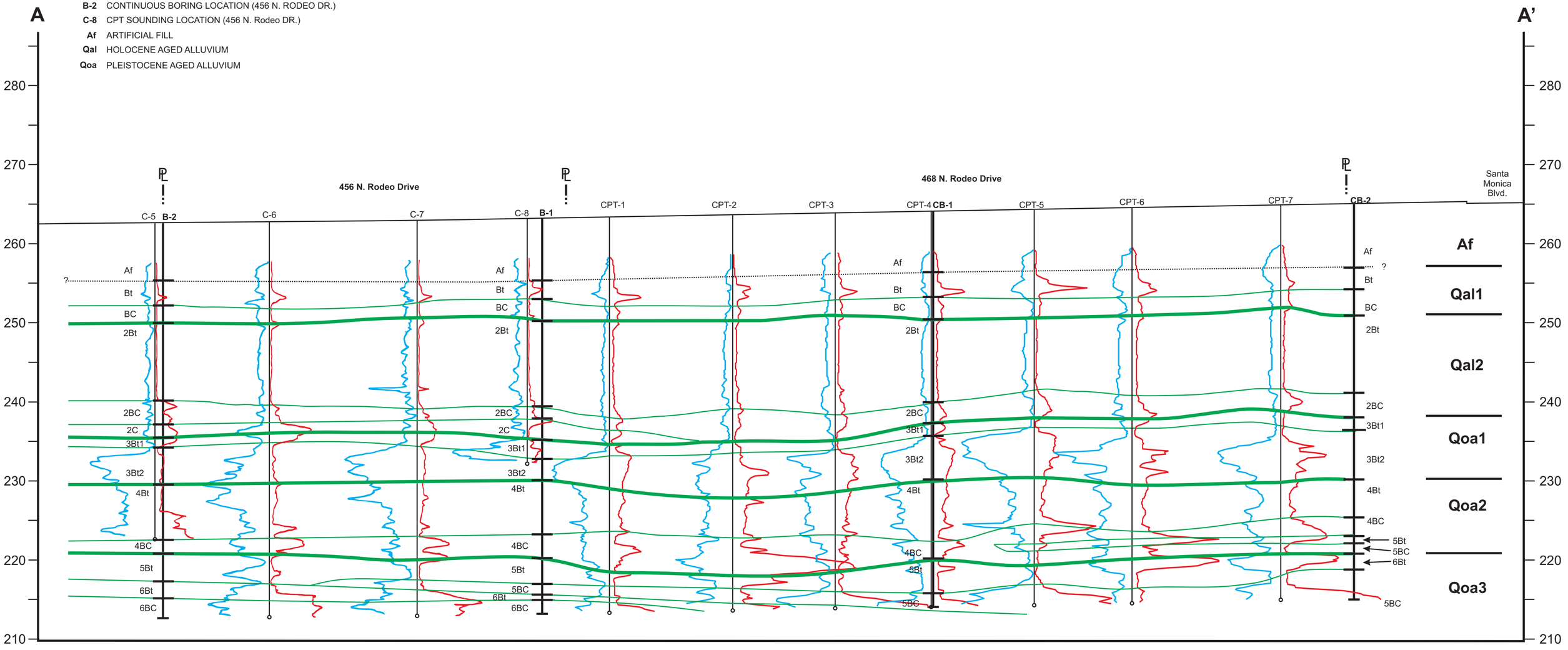

Figure 11

FEFFER GEOLOGICAL CONSULTING

FAULT SETBACK MAP

468 N. RODEO

JB: 2188-85 NAME: DRIVE LLC. BY: AG

468 N. RODEO

DATE: 8/20/18 SCALE: 1"=10' SITE: DRIVE

REF: BASE MAP FROM SURVEY

EXPLANATION

- CB-2 CONTINUOUS BORING LOCATION (468 N. RODEO DR.)
- CPT-7 CPT SOUNDING LOCATION (468 N. RODEO DR.)
- B-2 CONTINUOUS BORING LOCATION (456 N. RODEO DR.)
- C-8 CPT SOUNDING LOCATION (456 N. RODEO DR.)
- LIMITS OF EXPLORATION PARALLEL TO STRIKE OF FAULT
- CLEARED BUILD AREA

C/L SANTA MONICA BOULEVARD

E2 OVHG 2.6' OVER P/L

COLUMN FACE ON P/L (TYP.)

E2 OVHG 0.6' OVER P/L

E2 OVHG 2.4' OVER P/L

E2 OVHG 2.5' OVER P/L

E2 OVHG 0.5' OVER P/L

BEVERLY MAP

LOT 1

468 NORTH RODEO DRIVE

2-STORY BRICK BUILDING

12,322 SQ. FT.

BUILD OK

CROSS SECTION LINE

LOT 2

BLOCK 2

LOTS 3

M.B. 11/94

456 NORTH RODEO DRIVE

C/L RODEO DRIVE

C/L ALLEY

465 NORTH RODEO DRIVE

PROPERTY LINE

BUILDING OVERHANG

BUILDING 0.1' NW'LY OF P/L

0.0' GAP

COLUMN FACE 0.3' SW'LY OF P/L

COLUMN FACE 0.2' SW'LY OF P/L

CB-2 CPT-7 CPT-6 CPT-5 CPT-4 CB-1 CPT-3 CPT-2 CPT-1 B-1 C-8 C-7 C-6 B-2 C-5

A A'

ASPHALT

TRASH

PLANTER (TYP.)

BUILDING HEIGHT=48.4'

19.9'

1.9'

23.5'

23.0'

1.3'

125.9'

0 10 20 scale feet

LEGEND

- PROPERTY LINE
- CENTER LINE
- W WATER LINE
- G GAS LINE
- C COMMUNICATION LINE
- E ELECTRICAL LINE
- SD STORM DRAIN LINE
- T TELEPHONE LINE
- BUILDING PERIMETER
- CONCRETE
- PARKING COUNT (REGULAR / HANDICAP)
- STREET LIGHT
- TRAFFIC SIGNAL W/ARM
- TRAFFIC SIGNAL
- HANDICAP PARKING SPACE
- FIRE HYDRANT
- WATER VALVE
- BOLLARD
- W WATER METER
- SL STREET LIGHT PULLBOX
- G GAS METER
- TS TRAFFIC SIGNAL PULLBOX
- TRAFFIC DIRECTION
- CB CATCH BASIN
- CF CURB FACE
- CMH COMMUNICATION MANHOLE
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- RD ROOF DRAIN
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STATEMENT OF POTENTIAL ENCROACHMENTS

E1 456 NORTH RODEO BUILDING CROSSES 0.1' NORTHWESTERLY OVER THE SOUTHEASTERLY PROPERTY LINE.

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ALTA/NSPS LAND TITLE SURVEY

468 NORTH RODEO DRIVE
BEVERLY HILLS, CA 90210

PARTNER PROJECT NUMBER 18-220933.2

DATE OF PLAT OR MAP: 08/01/2018

DATE OF LAST REVISION: N/A

Christopher W. Daniels
Survey Manager
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LICENSED LAND SURVEYOR
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T 714-763-4656
sshore@partneresi.com

Table 1. Summary of Hollow Stem Auger Borings							
						Groundwater	
Boring No.	Boring Location (See Site Map)	Date Drilled	Total Depth (ft)	Boring G.S. Elevation (ft)	Boring Depth Elevation (ft)	Depth (ft)	Elevation (ft)
CB-1	468 N. Rodeo	7/30/2018	50	264.5	214.5	N.E.	--
CB-2	468 N. Rodeo	7/31/2018	50	265.5	215.5	N.E.	--
B-1	456 N. Rodeo	7/11/2018	50	263.8	213.8	N.E.	--
B-2	456 N. Rodeo	7/11/2018	50	262.5	212.5	N.E.	--

Table 2. Summary of CPT Soundings							
						Groundwater	
CPT No.	Boring Location (See Site Map)	Date	Total Depth (ft)	Boring G.S. Elevation (ft)	Boring Depth Elevation (ft)	Depth (ft)	Elevation (ft)
CPT-1	468 N. Rodeo	7/31/2018	49.87	264	214.13	N.E.	--
CPT-2	468 N. Rodeo	7/30/2018	49.87	264.2	214.33	N.E.	--
CPT-3	468 N. Rodeo	7/31/2018	49.87	264.3	214.43	N.E.	--
CPT-4	468 N. Rodeo	7/31/2018	49.87	264.5	214.63	N.E.	--
CPT-5	468 N. Rodeo	7/31/2018	49.87	264.7	214.83	N.E.	--
CPT-6	468 N. Rodeo	7/31/2018	49.87	265	215.13	N.E.	--
CPT-7	468 N. Rodeo	7/30/2018	49.87	265.4	215.53	N.E.	--
C-5	456 N. Rodeo	7/12/2018	39.77	262.5	222.73	N.E.	--
C-6	456 N. Rodeo	7/11/2018	50.15	263	212.85	N.E.	--
C-7	456 N. Rodeo	7/11/2018	50.07	263.5	213.43	N.E.	--
C-8	456 N. Rodeo	7/12/2018	30.91	263.8	232.89	N.E.	--

APPENDIX 'A'

Boring Logs

LOG OF EXPLORATORY BORING

Job Number: 2188-85
Project: 468 N. Rodeo Drive

Boring No: CB-1
Boring Location: See Site Map

Date Performed: 7/30/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
0	1			**0-7.5’:** Fill - Silty sand, scattered concrete and asphalt fragments Hand augered upper 7’ due to utilities	Brown	Medium Dense	Af
5	2	3/3		**Holocene Alluvium (Qal1)** **7.5-10.5’:** Clayey sand, massive, moderate to very sticky, very plastic, medium to coarse grained, poorly sorted, common thin and fine moderately thick clay films with basal scour, of sand with silt	Brown 7.5 YR 4/3	Hard, friable	Af Bt
10						Slightly Hard, friable	C
	3	3.6 /5		**10.5-13.3’:** Silty sand with clay, slightly sticky, moderately plastic, medium to coarse grained, poorly sorted sand, slightly to well oxidized, few common thin clay films	Brown 7.5 YR 5/4	Slightly Hard, friable	BC
15	4	5/5		**Holocene Alluvium (Qal2)** **13.3’:** Sandy clay, clayey sand, very sticky, very plastic, medium to coarse grained, poorly sorted sand, common $CaCO_3$ veinlets, many thin and few moderately thick clay films	Brown 7.5 YR 5/4	Hard, firm	2Bt
20							

Feffer Geological Consulting

Figure

LOG OF EXPLORATORY BORING

Job Number: 2188-85
Project: 468 N. Rodeo Drive

Boring No: CB-1
Boring Location: See Site Map

Date Performed: 7/30/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
20	5	4.3 /5		**13.3-24’:** Sandy clay, clayey sand, very sticky, very plastic, medium to coarse grained, poorly sorted sand, common $CaCO_3$ veinlets, many thin and few moderately thick clay films	Brown 7.5 YR 5/4	Hard to firm	2Bt
25				**24-26.5’:** Silty sand with clay and gravel, massive to crudely stratified, slightly to moderately sticky, slightly plastic, coarse grained, poorly sorted sand, common fine to medium gravel, few to common thin clay films,	Brown 7.5 YR 5/3	Soft, very friable	2BC
	6	4/5		**Pleistocene Older Alluvium (Qoa1)** **26.5-28’:** Clayey sand, massive, moderately well oxidized, med. - coarse grained sand, very sticky, very plastic, slight organics, common thin and few moderately thick clay films	Reddish Brown 5 YR 4/3	Firm to Very Hard	$3Bt_1$
30				**28-33.5’:** Clayey sand with gravel, massive, moderately well oxidized, coarse grained, poorly sorted sand with common to many thin and common moderately thick clay films	Reddish Brown 5 YR 4/4	Very Hard, friable	$3Bt_2$
	7	5/5		**Pleistocene Older Alluvium (Qoa2)** **33.5-42.5’:** Sandy clay, massive, faintly mottled, very sticky and very plastic, moderately well oxidized, medium grained, moderately well sorted sand	Brown 7.5 YR 5/4	Very Hard, firm	4Bt
35	8	5/5					
40							

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Figure

LOG OF EXPLORATORY BORING

Job Number: 2188-85
Project: 468 N. Rodeo Drive

Boring No: CB-1
Boring Location: See Site Map

Date Performed: 7/30/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
40				**33.5-42.5’:** Sandy clay, massive, faintly mottled, very sticky and very plastic, moderately well oxidized, medium grained, moderately well sorted sand	Brown 7.5 YR 5/4	Very Hard, firm	4Bt
	9	4.2 /5		**42.5-43.7’:** Silty sand with clay, massive, moderately well oxidized, coarse grained poorly sorted sand with common thin clay films, few fine to medium sub rounded slate gravels, slightly sticky, non to slightly plastic	Brown 7.5 YR 5/4	Slightly hard, friable	4BC
				Pleistocene Older Alluvium (Qoa3)	Strong Brown 7.5 YR 5/6	Very hard, firm	5Bt
45				**43.7-48.2’:** Sandy clay, massive, moderately well oxidized, fine grained well sorted sand, plugged with clay, many thin common moderately thick clay films, very sticky, very plastic			
	10	4.6 /5		**48.2’:** Silty sand with gravel, crudely stratified, slightly well oxidized, coarse grained poorly sorted sand, non to slightly sticky, non plastic, with common fine to medium slate gravels	Brown 7.5 YR 5/4	Soft, very friable	5BC
50				End at 50, Fill to 7.5’, No Water, No Caving			
55							
60							

LOG OF EXPLORATORY BORING

Job Number: 2188-85
Project: 468 N. Rodeo Drive

Boring No: CB-2
Boring Location: See Site Map

Date Performed: 7/31/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
0	1			**0-7.3’:** Fill - Silty sand, scattered concrete and asphalt fragments Hand augered upper 7’ due to utilities	Brown	Medium Dense	Af
5	2	2.8 /3		**Holocene Alluvium (Qal1)** **7.3-10.3’:** Silty sand with clay, massive, slightly to moderately sticky, slightly plastic, medium grained moderately well-sorted sand, slightly well oxidized, common fine clay films (7.5 YR 4/4), basal scour at top of run 2.	Brown 7.5 YR 4/3	Slightly Hard, friable	Af Bt C
10	3	4.9 /5		**10.3- 13.1’:** Silty sand, massive, slightly sticky, moderately to slightly plastic, medium grained moderately well-sorted sand, moderately well oxidized, few fine clay films (7.5 YR 4/4), sand scour deposit	Brown 7.5 YR 5/4	Slightly Hard, friable	BC
15	4	4.9 /5		**Holocene Alluvium (Qal2)** **13.5-23.2’:** Clayey sand grades to sandy clay with depth, massive, very sticky, very plastic, fine grained well-sorted sand, slightly well oxidized, plugged with clay	Brown 7.5 YR 4/2	Hard, firm	2Bt
20							

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Figure

LOG OF EXPLORATORY BORING

Job Number: 2188-85
Project: 468 N. Rodeo Drive

Boring No: CB-2
Boring Location: See Site Map

Date Performed: 7/31/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
20				**13.5-23.2’:** Clayey sand grades to sandy clay with depth, massive, very sticky, very plastic, fine grained well-sorted sand, slightly well oxidized, plugged with clay	Brown 7.5 YR 4/2	Hard to firm	2Bt
	5	3.6 /5					
				23.2-26.8’: Silty sand, massive, crudely stratified, slightly sticky, non-plastic, coarse grained with common fine and medium gravels	Brown 7.5 YR 5/4	Slightly hard, very friable	2BC
25							
				Pleistocene Older Alluvium (Qoa1)			
	6	2.7 /5		**26.8-28.2’:** Sandy clay with silt, massive, fine grained, very sticky, very plastic, slight organics	Reddish Brown 5 YR 4/3	Firm to Very Hard	$3Bt_1$
				28.2-33’: Clayey sand with gravel, massive, very sticky, very plastic	Reddish Brown 5 YR 4/4	Very Hard, friable	$3Bt_2$
30							
	7	4.3 /5		**33-35’:** Coarse grained to poorly sorted sand, scattered gravel, fine grained sand, plugged with clay			
35				**Pleistocene Older Alluvium (Qoa2)**			
	8	5/5		**34.8-39.4’:** Sandy clay, massive, very hard, very sticky, very plastic, fine grained well-sorted sand, moderately well oxidized, plugged with clay	Brown 7.5 YR 5/4	Very Hard, firm	4Bt
40				**39.4-41.8’: See next page**	Brown 7.5 YR 4/3	Hard, friable	4BC

LOG OF EXPLORATORY BORING

Job Number: 2188-85
Project: 468 N. Rodeo Drive

Boring No: CB-2
Boring Location: See Site Map

Date Performed: 7/31/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
40				**39.4-41.8’:** Silty sand with clay and gravel, stratified, slightly sticky, non to slightly plastic, coarse grained, poorly sorted sand, slightly well oxidized, common clay films	Brown 7.5 YR 4/3	Hard, friable	4BC
	9	4.2 /5		**41.8-42.8’:** Clayey sand, massive, moderately well oxidized, fine grained well-sorted sand, moderately sticky, moderately plastic, few moderately thick clay films	Brown 7.5 YR 5/4	Very Hard, friable	5Bt
				42.8-45’: Silty sand with gravel, massive, slightly well oxidized, coarse grained, poorly sorted sand, with common fine and medium gravel, slightly sticky, non plastic, common clay stains	Brown 7.5 YR 5/3	Slightly Hard, very friable	5BC
45				**Pleistocene Older Alluvium (Qoa3)** **45-46’:** Sandy clay, massive, very hard, moderately well oxidized, fine grained, very sticky, very plastic, plugged with clay	Brown 7.5 YR 5/4	Very Hard, firm	6Bt
	10	4.1 /5		**46-50’:** Silty sand with gravel, crudely stratified, slightly sticky, slightly plastic, slightly well oxidized, coarse grained with common fine and medium gravel	Brown 7.5 YR 5/3	Slightly Hard, very friable	6BC
50				End at 50, Fill to 7.3’, No Water, No Caving			
55							
60							

Feffer Geological Consulting

Figure

LOG OF EXPLORATORY BORING

Job Number: 2176-85
Project: 456 N. Rodeo Drive

Boring No: B-1
Boring Location: See Site Map

Date Performed: 7/11/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
0	1			**0-7.8’:** Fill - Silty sand, scattered concrete and asphalt fragments Hand augered upper 5’ due to utilities	Brown	Medium Dense	Af
5	2	5/5					Af
				Holocene Alluvium (Qal1) **7.8-10’:** Clayey sand, massive, slightly well oxidized, medium to coarse grained, moderately sticky and plastic, poorly sorted sand, common thin and few moderately thick clay films	Brown 7.5 YR 4/3	Hard, friable	Bt
10						Slightly Hard, friable	C
	3	3.7 /5		**10-12.7’:** Silty sand with clay, massive, slightly well oxidized, medium to coarse grained, slightly sticky, moderately plastic, few fine to medium slate gravels, few to common thin clay films	Brown 7.5 YR 5/3	Slightly Hard, friable	BC
				Holocene Alluvium (Qal2) **12.7-23.5’:** Clayey sand, massive, slightly well oxidized, fine to medium grained moderately well sorted sand, moderate to very sticky, very plastic, few localized fine $CaCO_3$ nodules, common thin and very few moderately thick clay films	Brown 7.5 YR 5/4	Hard, firm	2Bt
15	4	5/5					
20							

LOG OF EXPLORATORY BORING

Job Number: 2176-85
Project: 456 N. Rodeo Drive

Boring No: B-1
Boring Location: See Site Map

Date Performed: 7/11/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
20				**12.7-23.5’:** Clayey sand, massive, slightly well oxidized, fine to medium grained moderately well sorted sand, moderate to very sticky, very plastic, few localized fine $CaCO_3$ nodules, common thin and very few moderately thick clay films	Brown 7.5 YR 5/4	Hard, firm	2Bt
	5	4/5					
				23.5-25’: Silty sand with clay, massive, slightly well oxidized, coarse grained poorly sorted sand, common clay stains, slightly sticky, non-plastic	Brown 7.5 YR 5/4	Slightly Hard, friable	2BC
25				**25-27.7’:** Silty sand, massive, coarse grained poorly sorted sand, non-sticky, non-plastic	Brown 7.5 YR 5/3	Soft, friable	2C
	6	3.5 /5		**Pleistocene Older Alluvium (Qoa1)**			
				27.7 -30’: Clayey sand, massive, moderately well oxidized, slight organics, medium grained, moderately well sorted sand, common thin clay films, very sticky, very plastic	Reddish Brown 5 YR 4/3	Very Hard, firm	$3Bt_1$
30				**30-32.8’:** Sandy clay with gravel, massive, moderately well oxidized, coarse grained, poorly sorted sand, with common fine to medium highly weathered gravels, many thin and common moderately thick clay films	Reddish Brown 5 YR 4/4	Very Hard, friable	$3Bt_2$
	7	5/5		**Pleistocene Older Alluvium (Qoa2)**			
				32.8-39.5’: Clayey silt with sand - silty clay, moist, moderately oxidized, becoming fine to medium grained silty sand with clay, containing few scattered medium gravels	Strong Brown 7.5 YR 5/6	Very Hard, firm	4Bt
35							
	8	5/5					
40				**39.5-42.9’:** Becomes medium to coarse sand with scattered gravels, slightly moist	Brown 7.5 YR 5/4	Soft, friable	4BC

LOG OF EXPLORATORY BORING

Job Number: 2176-85
Project: 456 N. Rodeo Drive

Boring No: B-1
Boring Location: See Site Map

Date Performed: 7/11/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
40				**39.5-42.9’:** Becomes medium to coarse sand with scattered gravels, slightly moist	Brown 7.5 YR 5/4	Soft, friable	4BC
	9	3.3 /5		**42.9-46’:** Clayey sand, massive, moderately oxidized, fine to medium grained moderately well sorted sand, very sticky, very plastic, many thin and common moderately thick clay films	Brown 7.5 YR 4/4	Very hard, friable	5Bt
45				**46-47.2’:** Silty sand with gravel, massive, slightly well oxidized, slightly sticky, non-plastic, coarse grained poorly sorted sand common to many fine to medium, highly weathered slate gravel	Brown 7.5 YR 4/3	Slightly hard, friable	5BC
	10	4/5		**Pleistocene Older Alluvium (Qoa3)** **47.2-48’:** Silty sand with clay, massive, moderately well oxidized, highly truncated, medium to coarse grained poorly sorted sand, with few fine to medium gravels, few to common thin and few moderately thick clay films	Strong Brown 7.5 YR 4/6	Very hard, firm	6Bt
				48’: Silty sand with gravel, slightly oxidized, massive, coarse grained, with many fine to medium subangular and highly weathered gravel, non-sticky, non-plastic	Brown 7.5 YR 5/3	Hard, friable	6BC
50				End at 50, Fill to 7.8’, No Water, No Caving			
55							
60							

LOG OF EXPLORATORY BORING

Job Number: 2176-85
Project: 456 N. Rodeo Drive

Boring No: B-2
Boring Location: See Site Map

Date Performed: 7/11/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
0	1			**0-7.2’:** Fill - Silty sand, scattered concrete and asphalt fragments Hand augered upper 5’ due to utilities	Brown	Medium Dense	Af
5	2	5/5					Af
				Holocene Alluvium (Qal1) **7.2-10.2’:** Silty sand with clay, massive, slight organics, moderately sticky, very plastic, medium to coarse grained poorly sorted sand, common thin and few moderately thick clay films	Brown 7.5 YR 4/4	Hard, firm	Bt
10						Slightly Hard, friable	C
	3	3.9 /5		**10.2-12.5’:** Silty sand with clay, massive, medium to coarse grained poorly sorted sand, slightly well oxidized, few fine gravels, few thin clay films, slightly sticky, slightly plastic	Brown 7.5 YR 5/4	Slightly Hard, friable	BC
				Holocene Alluvium (Qal2) **12.5-22.2’:** Clayey sand, massive, medium grained moderately well sorted sand, very sticky, very plastic, slightly well oxidized	Brown 7.5 YR 4/3-4	Hard, firm	2Bt
15	4	5/5					
20							

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Figure

LOG OF EXPLORATORY BORING

Job Number: 2176-85
Project: 456 N. Rodeo Drive

Boring No: B-2
Boring Location: See Site Map

Date Performed: 7/11/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
20				**12.5-22.2’:** Clayey sand, massive, medium grained moderately well sorted sand, very sticky, very plastic, slightly well oxidized	Brown 7.5 YR 4/3-4	Hard, firm	2Bt
	5	4.5 /5		**22.2-25’:** Silty sand with clay, massive, moderately well oxidized slightly sticky, slightly plastic, coarse grained poorly sorted sand, few fine to medium slate gravels, common thin clay films	Brown 7.5 YR 4/3	Slightly Hard, friable	2BC
25				**25-26.7’:** Silty sand with gravel, massive, slightly well oxidized, coarse grained poorly sorted sand with common fine to medium gravel, non-sticky, non-plastic	Brown 7.5 YR 5/3	Soft, very friable	2C
	6	2.9 /5		**Pleistocene Older Alluvium (Qoa1)** **26.7-28’:** Clayey sand, massive, moderately oxidized, slight organics, medium grained, common thin and few moderately thick clay films	Reddish Brown 5 YR 4/3	Very Hard, firm	$3Bt_1$
				28-33’: Clayey sand with gravel, massive, moderately oxidized, coarse grained poorly sorted sand, common to many fine to medium slate rich gravels, moderately sticky, moderately plastic	Reddish Brown 5 YR 4/4	Very Hard, friable	$3Bt_2$
30	7	5/5		**Pleistocene Older Alluvium (Qoa2)** **33-39.7’:** Sandy clay, massive, faintly mottled, moderately well oxidized, fine to medium grained, moderately well sorted sand	Strong Brown 7.5 YR 4/4	Very Hard, firm	4Bt
35	8	5/5					
40				See Next Page	Brown 7.5 YR 5/4	Slightly Hard, friable	4BC

LOG OF EXPLORATORY BORING

Job Number: 2176-85
Project: 456 N. Rodeo Drive

Boring No: B-2
Boring Location: See Site Map

Date Performed: 7/11/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
40				**39.7-41.5’:** Silty sand with gravel, crudely stratified, coarse grained poorly sorted sand with common to many fine to medium gravels, non to slightly sticky, non-plastic, few clay stains on gravel	Brown 7.5 YR 5/4	Slightly Hard, friable	4BC
	9	3.4 /5		**41.5-45’:** Clayey sand, massive, moderately well oxidized, fine grained well sorted sand, moderately sticky, very plastic, common thin and few moderately thick clay films	Strong Brown 7.5 YR 4/6	Very hard, friable	5Bt
45				**Pleistocene Older Alluvium (Qoa3)** **45-47.5’:** Sandy clay, massive, moderately well oxidized, slight organics, medium to coarse grained poorly sorted sand with few fine to medium gravels, common thin clay films and common moderately thick clay films	Reddish Brown 5 YR 4/4	Very hard, firm	6Bt
	10	3.6 /5		**47.5’:** Silty sand with gravel, crudely stratified, coarse grained poorly sorted sand, slightly well oxidized, common to many fine to medium gravel, sub angular and highly weathered	Brown 7.5 YR 5/4	Hard, friable	5BC
50				End at 50, Fill to 7.2’, No Water, No Caving			
55							
60							

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Figure

APPENDIX ‘B’

Soil Stratigraphy & Soil Age Estimates

Soil Stratigraphy Study And Relative Age Estimates For A Fault Rupture Hazard Investigation At 468 Rodeo Drive, Beverly Hills, CA

Prepared by:

John Helms, CEG
40344 Wood Court, Palmdale, California 93551
Voice & FAX (661) 206-5860

Submitted to:

Mr. Josh Feffer, CEG
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August 20, 2018

John Helms, CEG

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Mr. Josh Feffer, CEG
Feffer Geological Consulting, Inc.
1990 South Bundy Drive, 4th Floor
Los Angeles, CA 91025

August 20, 2018

Subject: Soil Stratigraphy Study And Relative Age Estimates For A Fault Rupture Hazard Investigation At 468 Rodeo Drive, Beverly Hills, CA.

Dear Mr. Feffer:

I am pleased to present to you this soil stratigraphic study and relative-age determinations to be used with your fault rupture hazard assessment of the proposed development located at 468 Rodeo Drive in the City of Beverly Hills, California.

Feffer Geological retained John Helms CEG to describe and assist in correlations of the soil stratigraphy from continuously cored borehole samples and to assign relative age dates for the deposits identified across the site. The continuously cored bore hole samples were obtained from a single transect of borings, transect A. One borehole (CB-1) was completely described from transect A, and three additional boreholes (CB-2, B-1, and B-2) from transect A have been reviewed and summarized. The detailed soil descriptions are used to calculate various soil development indices (or SDIs). The SDI values were then compared to the SDI values from similar described soils with known ages to estimate age ranges for the soils understudy.

The attached report classifies the described soil profiles, identifies stratigraphic relationships, defines soil chronosequences, and estimates the relative ages for the two soil profiles described in detail. Calculated SDI's show strong correlations to the SDI values of other published, described, and dated soil profiles with similar parent materials.

Age estimates range from 46 to 94 ka for the stratigraphic section studied along transect A in boring CB-1. There are several distinctive buried soil units that can be correlated across the entire length of Transect A. One distinctive buried soil (buried soil 2, Qoa1) which can be correlated across the entire length of Transect A, is a truncated and well oxidized argillic soil profile that ranges in relative age from 25 – 51 ka. Please see Table 6 in the attached report for a summary listing of all of the determined relative ages at the study site.

Thank you for this opportunity to be of service. Should you have any questions or require additional information, please do not hesitate to contact me.

Sincerely,



John Helms, CEG 2272

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SOIL STRATIGRAPHY STUDY AND RELATIVE AGE ESTIMATES FOR A FAULT RUPTURE HAZARD STUDY FOR A PROPOSED DEVELOPMENT AT 468 RODEO DRIVE, BEVERLY HILLS, CALIFORNIA.

INTRODUCTION

Due to a repeating and consistent sequence of stratigraphy across the entire transect of borings, one soil profile has been studied for geomorphic characteristics and relative degrees of weathering to estimate deposit relative-age. Boring CB-1 was selected for this process due to it's position being located on the subject property as well as being located near the center of the transect of borings. The relative age estimate is based on index value comparisons with other published and dated soil profile descriptions. The comparative soils are from areas with a similar climate and similar parent material to this study area. The estimated relative ages in this report will be used by Feffer Geological, Inc. to assess the recency and recurrence of faulting across the study area. Alluvial units are assessed chronostratigraphically across four borehole locations from a single transect of borings and CPT's that shadow the area proposed for development. In this study, the soil stratigraphy is defined with soil field description data, and no laboratory data. This study identifies the soil stratigraphy across the area under study and estimates the relative age of one soil profile. Continuously cored and sampled borehole CB-1 has been described in detail, and three additional continuously cored and sampled boreholes (CB-2, B-1, and B-2) has been summarized or briefly described along Transect A. Transect A is located along a graded and stripped alluvial surface.

For the Quaternary geologist, a soil can be defined as a natural body that consists of horizons of organic and/or mineral constituents which differ from its parent material in some way (Birkland, 1984). A chronosequence is a group of soils for which all soil forming factors (such as topography, parent material, vegetation, and climate) except time is relatively equal (Jenny, 1941). Past geologic studies in the coastal region of southern California provide age constraints for several deposits and geomorphic surfaces ranging in age from middle Pleistocene to recent (McFadden, 1982; Rockwell, 1988; and WLA, 1998). Often it has proven difficult to date older deposits due to changes in past climatic regimes. Studies on the impacts of glacial to interglacial climatic changes on soil development in specific regions (McFadden, 1982; Birkland, 1984; McFadden, 1988) indicate that soil development has occurred throughout the Quaternary.

This study is concerned with a section of alluvium derived from the southern range front of the Santa Monica Mountains, which is within the Transverse Ranges Geomorphic Province. A series of stacked and truncated argillic soil subsurface horizons within all of the stratigraphic sections studied indicates that the alluvial stratigraphic section across the entire study area correlates well and is significantly old. Age estimates range from 46 to 94 ka for the stratigraphic section studied near the center portion of transect A in boring CB-1.

Soil relative age estimates have broad ranges, dependent upon the pool of comparative data used. Most of the buried soils across the study area fall into the Alfisol soil order (Soil Conservation Service, 1999). The soil profile that is described in detail is from boring CB-1 in Transect A and summary descriptions were generated for borings CB-2, B-1, and B-2 from Transect A. Boring locations are shown on the geologic map that is provided with the main fault rupture hazard report.

MATERIALS AND METHODS

Continuous core samples collected from boring CB-1 by Feffer Geological, Inc. were described in detail as part of this study. The soils were described using guidelines set by the Soil Survey Staff (1991 and 1999). Specific soil properties such as soil structure and soil horizon boundaries could not be accurately described from the core sample exposures. These soil qualifiers have not been described and do not factor into the estimated soil relative age comparisons.

Soil profile field description values quantify soil properties that are used to develop a soil development index (SDI) value as outlined by Harden (1982). Points are assigned to descriptive data for each of several observed soil properties, such as dry color, moist color, texture, dry and wet consistence, and clay film content, for each soil horizon in a soil profile relative to the soil horizon's thickness, and normalized to a common depth. The maturity of a soil profile is gauged through data collected from active wash deposits (or raw alluvium).

Table 1.1 lists the detailed soil description for the studied boring in longhand format. Table 1.2 lists the soil description using soil conservation service notation and shows the SDI calculations. Table 1.2 shows the calculated SDI values, the soil profile description, and the normalization values for raw alluvium. SDI values are calculated by assigning point values to each described soil properties. The points are summed for each soil horizon and divided by the total number of descriptive properties used. This equals the mean horizon index value (HI). HI values are multiplied by the corresponding soil horizon thickness. The SDI value equals the sum of the thickness normalized horizon indices. The maximum horizon index (MHI) is the value of the horizon with the largest summed descriptive value. MHI is independent of horizon thickness, and is usually the diagnostic subsurface soil horizon for most soil profiles. Tables 1.2 lists all of the determined HI, SDI, and MHI values for the soil profile under study.

SDI and MHI values have shown significant correlations to soil age in many past studies (Harden, 1982; Rockwell *et al.*, 1983; Reheis *et al*., 1989; Rockwell *et al.*, 1994). The soils described in this study are compared to soils described and dated by McFadden (1982 and 1988) in San Bernardino County near Mission Creek, by Rockwell (1983) in the Ventura River basin, and by William Lettis and Associates, Inc. (1998) in West Hollywood. SDI values have all calibrated to a common depth of 7 feet.

The changes in the subsurface pedogenic properties of the Alfisols soil order allows for relative age determinations by emphasizing specific soil properties (such as color and clay film content) that are most diagnostic. Soil properties that express themselves well through time are most often used in the assessment of soil relative ages through a specific soil property index such as the color or clay film index. The color index (Rockwell *et al.,* 1985, 1988) is used to quantify observed colors (in Munsell notation) of each profile in order to compare relative degrees of reddening. The color index is simply the summation of an entire profile's horizon index values for dry colors. The clay film index (Rockwell *et al.,* 1985, 1988) is used to quantify field descriptions of this soil property in order to compare relative profile maturity. The clay film index is simply the summation of an entire soil profile's horizon index values for clay films. MHI is a comparison of a soil pedons master (or diagnostic) subsurface horizon (typically an argillic or cambic horizon). Independent of horizon thickness, the MHI directly compares the properties of the soil profiles strongest soil horizon.

SOIL RELATIVE AGE METHODS

Soil relative ages are calculated and compared independently for each soil profile described. The soil profile described for this study is located across several buried alluvial surfaces that differ in relative age, facies of deposition, and degrees of preservation. A series of stacked, buried, and truncated hard, clayey soils with illuvial clays characterize a majority of the soil profiles described on this project site.

The soil profile described in detail has a surface age that is implied by estimating the time of inception for the exposed surficial soil. The soil profile described in detail for this study also contains a series of stacked and / or buried soil profiles. In this case, deposit age assessments are obtained by identifying and isolating the different parent materials (or deposits). Then comparing a set of abridged calculated indices to an additional suite of similar soils that have been radiometrically dated yields the equivalent to a buried surface age estimate. Such burial relationships are common along the southern Santa Monica Mountains range front; especially where soils that have developed into alluvial fan deposits which commonly bury or locally truncate older soils that have developed previously in older alluvial deposits. A cumlic soil profile estimated age can assess landform age, and has potential to assess rates of erosion, rates of landform evolution, and rates of tectonic activity across the study area.

The described soil profiles have an SDI value, which is used to estimate the soil relative age. Cumuli relative age estimates for a stacked or buried soil profiles are specifically referred to as “deposit ages”. The relative age estimate for the surface profile or modern soil is referred to as the “surface age”. All of the relative age estimates given are considered minimum ages given that an unknown amount of erosion has occurred after the formation of and before the burial of each truncated surface and buried soil studied.

SOIL SUMMARY DESCRIPTIONS

Soil summary descriptions were generated for borings CB-2, B-1, and B-2 in this study. The summary descriptions record diagnostic pedogenic features for each soil horizon identified. This was done in order to assist with establishing stratigraphic correlations across the site. Relative age estimates were not generated for any of the listed soil summary descriptions. The soil summary descriptions are listed in Tables 2.1, 2.2, and 2.3.

DISCUSSION AND RESULTS

This section contains a brief write up for the continuously cored boring described in detail with designated tables for the soil profile. The attached Table 1.1 presents the soil profile description in longhand format. Table 1.2 presents the results of the calculated SDI values. Table 3 is a summary of the soil relative age estimates for the soil profile under study. Table 4 is a compilation of the comparative data in a format that compares to the data generated for this study. Table 5 is a soil abbreviation key to be used in conjunction with the SDI calculation sheets. Table 6 lists the relative ages for each designated stratigraphic unit that is shown on the geologic cross section in the fault rupture hazard report.

Soil descriptions, SDI calculations, and relative age determinations follow for the soil profile studied.

TRANSECT A BORINGS

One soil profile was described in detail out of core samples from Transect A in boring CB-1. Age estimates range from 46 to 94 ka for the alluvial section studied in boring CB-1 of transect A.

Boring CB-1

The core samples from Transect A, Boring CB-1 were reviewed at the project site on 8/7/2018 and on 8/8/2018. This boring is located near the center of Transect A, and this alluvial section is characterized by a sequence of truncated argillic soils interbedded with massive and crudely stratified scour deposits. See Table 1.1 for a complete soil description of the continuously sampled boring, Table 1.2 for the SDI index value calculations and relative age estimates, and Feffer Geological Inc.'s cross section and geologic map for both the borehole and transect location.

The surface soil (Qal1) in boring CB-1 consists of a weakly-developed Alfisol that is characterized by a severely truncated and organic rich argillic horizon and has an estimated relative age of 4 – 8 ka. The uppermost buried soil (Buried Soil 1 / Qal2) that can be correlated across the entire length of Transect A is a truncated, thick, and diffuse weakly to moderately well-developed Alfisol soil with an estimated relative age value of 12 – 21 ka. The second buried soil in this alluvial sequence is the top of the Pleistocene in this stratigraphic section. This marker bed (Qoa1) can be correlated across the entire area investigated and is a truncated and moderately well-developed Alfisol soil that has an estimated relative age value of 25 – 51 ka. The third buried soil (Buried Soil 3 / Qoa2) also can be correlated across the entire length of Transect A is a truncated, thin and weakly to moderately well-developed Alfisol soil with an estimated relative age value of 33 – 64 ka. The forth buried soil (Qoa3) in Transect A, and the entire stratigraphic section studied has an estimated age that ranges from 46 – 94 ka. This lowest buried soil in this alluvial sequence can be correlated across the entire area investigated and is a truncated and moderately well-developed Alfisol soil.

Differences in the number of soils, depths of burial and unit thicknesses due to differential erosion / truncation laterally along Transect A may cause minor variances in relative age estimates between the individual borings. In order to control for this additional soil summary descriptions were generated across this transect which assesses the same buried surfaces at differing depths of burial and in differing states of preservation.

BORING SUMMARY DESCRIPTIONS

Soil summary descriptions generated for borings CB-1, B-1 , and B-2 are listed in Tables 2.1, 2.2, and 2.3. Relative age estimates were not generated for the soil summary descriptions. The summary descriptions were generated to assist with establishing stratigraphic correlations across the site. The observations for the soil summary descriptions along Transect A were made on 8/8/2018. All of the borings along Transect A appear to contain a thin veneer of artificial fill that is in contact with a sequence of Holocene- and Pleistocene-aged truncated argillic soils and nested sour deposits. Several of the Pleistocene-aged truncated and /stacked buried soils are maker units which can be correlated across the area investigated.

CONCLUSIONS

A majority of the soils observed across the study area are Alfisols that have developed in alluvial environments. All of the soil profiles across Transect A consist of a series of stacked, truncated, and buried argillic soil horizons. The truncated and buried soils with argillic sub surface soil horizons are weakly and moderately well developed. The Alfisol soils typically have 7.5YR to 5YR color hues with a modest amounts of secondary (pedogenic) clay in a series of argillic (Bt) diagnostic subsurface horizons.

The surface soil profile across the area investigated is laterally continuous across transect A. Lateral variability in observed in the buried soils across the site is due to localized erosion, scouring, infilling, and stacking of these materials in an alluvial environment. In this sedimentological environment surfaces that have been stable long enough to form a robust soil, can suddenly be buried by a new deposit, or scoured out (truncated) and possibly in-filled with younger material. The amount of erosion that has occurred with each truncated soil under study is unknown. Thus the relative age estimates given in this study are minimum ages.

These soil relative age determinations are consistent with the general geologic and pedogenic observations of soils in southern California. Strongly developed, well horizonated, thick, and oxidized Alfisols can be as much as 200 ka in age. Erosion tends to act as a rejuvenating aspect in soil development, by decreasing the strength of the soil development properties and the consequent age estimates are younger. In that past magnitudes and rates of erosion are difficult to assess, the soil relative age estimates are utilized as minimum ages.

The soils observed along Transect A are Holocene and Pleistocene in age. The buried and stacked soils display soil horizons that have weak to moderately strong argillic horizon development. Age estimates range from 46 to 94 ka for the entire alluvial stratigraphic section studied along transect A. The second buried soil (buried soil 2) (Qoa1) that can be correlated across the entire area investigated is a truncated and moderately well-developed argillic soil profile that ranges in relative age from 25 – 51 ka along the length of Transect A. The lowermost buried soil (buried soil 4) (Qoa4) that can be correlated across the entire area investigated is a truncated, stacked, and moderately well-developed argillic soil profile that ranges in relative age from 46 – 94 ka along the length of Transect A.

LIMITATIONS

The conclusions and recommendations presented herein are the results of an inherently limited scope. Specifically, the scope of services consisted of an assessment of relative age from core samples and did not participate in any drilling activities at the site. The conclusions and recommendations contained in this report are professional opinions derived in accordance with current standards of professional practice. No warranty is expressed or implied.

This report has been prepared for the exclusive use of Feffer Geological, Inc. and applies only to the Fault Rupture Hazard Study located at 468 Rodeo Drive. In the event that significant changes in the interpretations of this study are made, the conclusions and recommendations contained in this report shall not be considered valid unless the changes

are reviewed by John Helms, CEG, and the conclusions and recommendations of this report are verified in writing.

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Table 1.1

468 Rodeo Drive

Table 1.1 Soil Description - Transect A; Boring CB 1

Depth (Ft)	Horizon	Transect A; CB-1 Description
0 - 7.5	NR	No Recovery
7.5 - 10.2	Bt	Brown (7.5YR 4/3d, 7.5YR 3/2m), sandy clay loam, slight-organics, slightly well oxidized, hard, friable, moderately to very sticky, very plastic, medium- to coarse-grained poorly sorted sand with few fine sub rounded gravel, few fine and medium pores, clay films few thin on ped faces, clear lower boundary to;
10.5 -13.3	BC	Brown (7.5YR 5/4 d, 7.5YR 4/3 m), loam, slightly hard, friable, slightly well oxidized, slightly sticky, moderately plastic, medium- to coarse-grained poorly sorted sand with few fine sub rounded gravel, clear lower boundary to;
13.3 - 24.0	2Btb	Brown (7.4YR 4/3d, 7.5YR 3/2m), sandy clay loam, slightly oxidized, hard, firm, very sticky, very plastic, medium- to coarse-grained poorly sorted sand with few fine sub rounded gravel, few fine and medium pores, clay films few to common thin on ped faces, calcium carbonate stage 1-, few to common veinlets and slightly disseminated in soil matrix, gradational lower boundary to;
24.0 - 26.5	2BCb	Brown (7.5YR 5/3d, 7.5YR 4/2m), loam, slightly well oxidized, soft to slightly hard, friable, slightly to moderately sticky, slightly plastic, coarse-grained poorly sorted sand with common to many fine, medium, and large sub rounded gravel, common clay stains on gravel, abrupt lower boundary to;
26.5 - 28.0	3Btb1	Reddish brown (5YR 4/3d, 5YR 3/2m), clay loam, well oxidized, slight organics, very hard, firm, very sticky, very plastic, fine- to medium-grained moderately well sorted sand, clay films common thin and few moderately thick on ped faces, gradational lower boundary to;
28.0 - 33.5	3Btb2	Reddish brown (5YR 4/4d, 5YR 3/3m), clay loam to clay, well oxidized, very hard, firm, very sticky, very plastic, medium- to coarse-grained poorly sorted sand with few medium and large high weathered sub angular gravel, clay films common to many thin and few to common moderately thick on ped faces and coating clasts, gradational lower boundary to;
33.5 - 42.5	4Btb	Brown (7.5YR 4/4d, 7.5YR 3/3m), sandy clay loam, faintly mottled, moderately well oxidized, very hard, firm, very sticky, very plastic, medium-grained moderately well sorted sand, clay films few to common thin on ped faces, calcium carbonate stage 1, common veinlets and fine nodules and slightly well disseminated in soil matrix, gradational lower boundary to;
42.5 - 43.7	4BCb	Brown (7.5YR 5/4d, 7.5YR 4/3m), loam, moderately well oxidized, slightly hard, friable, slightly sticky, non- to slightly plastic, coarse-grained poorly sorted sand with common to many fine and medium, sub rounded slate rich gravel, few clay stains on gravel, abrupt lower boundary to;
43.7 - 48.2	5Btb	Strong brown (7.5YR 5/6d, 7.5YR 4/4m), clay, moderately well oxidized, very hard, firm, very sticky, very plastic, fine-grained well sorted sand, clay films common to many thin and common moderately thick on ped faces, gradational lower boundary to;
48.2 - 50.0+	5BCb	Brown (7.5YR 5/4d, 7.5YR 4/3m), loam, stratified, slightly well oxidized, soft to slightly hard, very friable, non- to slightly sticky, non-plastic, coarse-grained poorly sorted sand with common fine and medium sub rounded slate rich gravel, common clay stains coating clasts, undetermined lower boundary.

Table 1.2

Soil Development Index Calculation Sheet
468 Rodeo Drive Transect A; Boring CB 1

Unit	Thickness	Color				Texture		Consistence				Clay Films		Horizon	Mean Hor.
	(Feet)	Dry		Moist				Dry		Wet				Values	Values
Raw Alluvium	*3*	*2.5Y 7/3*	*X/10*	*10YR 6/2*	*X/10*	*s*	*X/6*	*lo*	*X/5*	*so, po*	*X/6*	*0*	*X/15*		
Transect A; Boring 1															
Bt	2.7	7.5YR 4/3	0.2	7.5YR 3/2	0.1	scl	0.67	h	0.60	s-vs, vp	0.92	1npf	0.2	0.45	1.21
BC	2.8	7.5YR 5/4	0.3	7.5YR 4/3	0.2	l	0.5	sh	0.40	ss, p	0.50			0.32	0.89
2Btb	10.7	7.5YR 4/3	0.2	7.5YR 3/2	0.1	scl	0.67	h	0.60	vs, vp	1.00	1-2npf	0.23	0.47	5.00
2BCb	2.5	7.5YR 5/3	0.2	7.5YR 4/2	0.1	l	0.5	so - sh	0.35	ss-s, ps	0.42	2vncl	0.2	0.29	0.74
3Btb1	1.5	5YR 4/3	0.3	5YR 3/2	0.2	cl	0.67	vh	0.80	vs, vp	1.00	2npf, 1mkpf	0.4	0.56	0.84
3Btb2	5.5	5YR 4/4	0.4	5YR 3/3	0.3	cl - c	0.92	vh	0.80	vs, vp	1.00	2-3npf, 1-2mkpf	0.45	0.65	3.55
4Btb	9	7.5YR 4/4	0.3	7.5YR 3/3	0.2	scl	0.67	vh	0.80	vs, vp	1.00	1-2npf	0.23	0.53	4.80
4BCb	1.2	7.5YR 5/4	0.3	7.5YR 4/3	0.2	l	0.5	sh	0.40	ss, po-ps	0.25	1vncl	0.17	0.30	0.36
5Btb	4.5	7.5YR 5/6	0.5	7.5YR 4/4	0.3	c	1	vh	0.80	vs, vp	1.00	2-3npf, 2mkpf	0.43	0.67	3.03
5BCb	1.8	7.5YR 5/4	0.3	7.5YR 4/3	0.2	l	0.5	sh	0.40	so-ss, po	0.08	2vnpf	0.23	0.29	0.51

INDEX VALUES AND DETERMINED AGES (ka)

Soil Member	MHI	Mean Soil Index	SDI @ 7 feet	Color Index	Clay Film Index	Soil Age Estimate ka	Section Age Estimate ka	Stratigraphic Unit
Surface Soil	**0.45**	**2.10**	**2.67**	**0.80**	**0.20**	**4 - 8**	**4 - 8**	**Qal1**
Buried Soil 1	**0.47**	**5.74**	**3.04**	**0.60**	**0.43**	**8 - 13**	**12 - 21**	**Qal2**
Buried Soil 2	**0.65**	**4.39**	**4.39**	**1.20**	**0.85**	**13 - 30**	**25 - 51**	**Qoa1**
Buried Soil 3	**0.53**	**5.16**	**3.54**	**1.00**	**0.40**	**8 - 13**	**33 - 64**	**Qoa2**
Buried Soil 4	**0.67**	**3.54**	**3.93**	**1.30**	**0.66**	**13 - 30**	**46 - 94**	**Qoa3**

Table 2.1 - Soil Summary Sheet
468 Rodeo Drive Transect A - Boring CB 2

Depth (Ft)	Horizon	Summary Description of Transect A; Boring CB 2
0 - 7.3	NR & Af	No Recovery and Artificial Fill
7.3 - 10.3	Bt	truncated weakly developed argillic with slight organics, slightly hard, medium-grained, few thin clay films
10.3 - 13.1	BC	transitional horizon, massive, medium-grained, sandy basal scour deposit
13.1 - 23.2	2Btb	truncated weak to moderate argillic, fine-grained, few to common thin clay films
23.2 - 26.8	2BCb	transitional horizon, massive, coarse-grained with gravel, basal scour deposit
26.8 - 28.2	3Btb1	truncated, moderately strong argillic, well oxidized, slight organics, medium-grained, common thin and few moderately thick clay films
28.2 - 34.8	3Btb2	strongly developed sub surface argillic horizon, well oxidized, very hard, medium to coarse-grained, common to many thin and common moderately thick clay films
34.8 - 39.4	4Btb	truncated weak to moderate argillic, fine-grained, few to common thin clay films
39.4 - 41.8	4BCb	transitional horizon, massive, coarse-grained with gravel, basal scour deposit
41.8 - 42.8	5Btb	truncated weak to moderate argillic, fine-grained, few to common thin clay films
42.8 - 45.0	5BCb	transitional horizon, massive, coarse-grained with gravel, basal scour deposit
45.0 - 46.0	6Btb	truncated, moderately strong argillic, well oxidized, fine-grained, many thin and common to many moderately thick clay films
46.0 - 50.0+	6BCb	transitional horizon, crudely stratified, coarse-grained with gravel, basal scour deposit

Table 2.2 - Soil Summary Sheet
456 Rodeo Drive Transect A - Boring B - 1

Depth (Ft)	Horizon	Summary Description of Transect A; Boring 1
0 - 7.8	NR & Af	No Recovery and Artificial Fill
7.8 - 10.0	Bt	truncated weakly developed argillic with slight organics, slightly hard, medium-grained, few thin clay films
10.0 - 12.7	BC	transitional horizon, massive, medium-grained, sandy basal scour deposit
12.7 - 23.5	2Btb	truncated weak to moderate argillic, fine-grained, few to common thin clay films
23.5 - 25.0	2BCb	transitional horizon, massive, coarse-grained with gravel,
25.0 - 27.7	2Cb	parent material, basal scour deposit
27.7 - 30.0	3Btb1	truncated, moderately strong argillic, well oxidized, slight organics, medium-grained, common thin and few moderately thick clay films
30.0 - 32.8	3Btb2	strongly developed sub surface argillic horizon, well oxidized, very hard, medium to coarse-grained, common to many thin and common moderately thick clay films
32.8 - 39.5	4Btb	truncated weak to moderate argillic, fine-grained, few to common thin clay films
39.5 - 42.9	4BCb	transitional horizon, massive, coarse-grained with gravel, basal scour deposit
42.9 - 46.0	5Btb	truncated weak to moderate argillic, fine-grained, few to common thin clay films
46.0 - 47.2	5BCb	transitional horizon, massive, coarse-grained with gravel, basal scour deposit
47.2 - 48.0	6Btb	truncated, moderately strong argillic, well oxidized, fine-grained, many thin and common to many moderately thick clay films
48.0 - 50.0+	6BCb	transitional horizon, crudely stratified, coarse-grained with gravel, basal scour deposit

Table 2.3 - Soil Summary Sheet
456 Rodeo Drive Transect A - Boring B - 2

Depth (Ft)	Horizon	Summary Description of Transect A; Boring B - 2
0 - 7.2	NR & Af	No Recovery and Artificial Fill
7.2 - 10.2	Bt	truncated weakly developed argillic with slight organics, slightly hard, medium-grained, few thin clay films
10.2 - 12.5	BC	transitional horizon, massive, medium-grained, sandy basal scour deposit
12.5 - 22.2	2Btb	truncated weak to moderate argillic, fine-grained, few to common thin clay films
22.2 - 25.0	2BCb	transitional horizon, massive, coarse-grained with gravel,
25.0 - 26.7	2Cb	parent material, basal scour deposit
26.7 - 28.0	3Btb1	truncated, moderately strong argillic, well oxidized, slight organics, medium-grained, common thin and few moderately thick clay films
28.0 - 33.0	3Btb2	strongly developed sub surface argillic horizon, well oxidized, very hard, medium to coarse-grained, common to many thin and common moderately thick clay films
33.0 - 39.7	4Btb	truncated weak to moderate argillic, fine-grained, few to common thin clay films
39.7 - 41.5	4BCb	transitional horizon, massive, coarse-grained with gravel, basal scour deposit
41,5 - 45.0	5Btb	truncated weak to moderate argillic, fine-grained, few to common thin clay films
45.0 - 47.5	6Btb	truncated, moderately strong argillic, well oxidized, fine-grained, many thin and common to many moderately thick clay films
47.5 - 50.0+	6BCb	transitional horizon, crudely stratified, coarse-grained with gravel, basal scour deposit

Table 3. Soil Surface Relative-Age Estimates
468 Rodeo Drive - Summary Age Table

Profile Number	Soil Member	Stratigraphic Unit	MHI Value	SDI Value	Clay Film	Relative Age (ka)
Transect A Boring CB-1	Surface Soil	Qal1	0.45	2.67	0.20	4 - 8
	Buried Soil 1	Qal2	0.47	3.04	0.43	12 - 21
	Buried Soil 2	Qoa1	0.65	4.39	0.85	25 - 51
	Buried Soil 3	Qoa2	0.53	3.54	0.40	33 - 64
	Buried Soil 4	Qoa3	0.67	3.93	0.66	46 - 94

Table 4. Comparison Soil Data Indices Value Summary

(McFadden) Mission Creek Soils	SDI At 7'	MHI	Reddening Index	Clay Film Index
S7 0-1000 yrbp	0.59	0.12	0	0
S5 4-13 ka	1.02	0.3	0.1	0
S4 13-70 ka	3.14	0.37	3.94	7.37
S2 70-250 ka	5.61	0.61	4.80	6.24
S2 250-700 ka	2.57	0.39	6.20	10.31

(Rockwell) Ventura River Basin Soils	SDI At 7'	MHI	Reddening Index	Clay Film Index
Qt3 4 - 8 ka	1.7	0.17	0.5	0
Qt4 10 -15 ka	2.7	0.43	2	4
Qt5a 15 – 20 ka	2.8	0.37	3.5	4.2
Qt5b 30 ka	3.2	0.46	5	7

(WLA) West Hollywood Buried Soils	SDI At 7'	MHI	Reddening Index	Clay Film Index
Qol1 100 ka	2.1	0.42	1.05	1.99
Qol2 100-300 ka	7.3	0.8	8.2	13.2

TABLE 5. Soil Field Description Abbreviation Key

Texture		Structure		Consistence						Clay Films		Calcium Carbonate	
				Dry		Moist		Wet				(Pedogenic CaCO3)	
S	- sand	m	- massive	l	- loose	vfr	-very friable	so	non stickey	v1	veryfew	sl dis	slightly dissemenated
LS	- loamy sand	sg	- single grained	so	-soft	fr	-friable	ss	slightly stickey	1	few	I	slight coatings common on clast bottoms
SL	- sandy loam	**OR**		sh	-slightly hard	fi	-firm	s	moderately siteckey	2	common	II	moderately thick coatings on clast bottoms; few medium common fine nooduses
L	- loam	1	- weak	h	-hard	vfi	-very firm	vs	very stickey	3	continuous	III	thick coatings common on clast bottoms, common medium nodules, common fine pendants, many fine nodules
CL	- clay loam	2	- moderate	vh	-very hard			**AND**		**AND**		VI	many thick coatings on clasts bottoms common coarse pendants few clasts completely enveloped
SCL	- sandy clay loam	3	- strong	eh	-extremely hard			po	non plastci	vn	stains	V	many thick coatings on clasts bottoms, many coarse pendants common clasts completely enveloped- petrocalcic
C	- clay	**AND**						ps	slightly plastic	n	thin	V+	many thick coatings on clasts bottoms, many coarse pendants many clasts completely enveloped, completely disseminated in matrix - petrocalcic
Si	- silt	vf	- very fine					p	moderately plastic	mk	moderately thick		
SiL	- silt loam	f	- fine					vp	very plastic	k	thick		
SiCL	- silt clay loam	m	- medium							**AND**			
SiC	- silty clay	c	- coarse							cl	coating clasts		
		vc	- very coarse							pf	ped faces		
		AND								br	brodgeing sand grains		
		gr	- granular							po	lining pores		
		pl	- platty										
		pr	-prismatic										
		abk	-angular blockey										
		sbk	- sub angular blockey										

Table 6. Geological Cross Section Unit Age

Cross Sec. Unit	Description	Age (ka)
Qal1	Truncated surficial weakly developed thin Alfisol soil	4 - 8
Qal2	Truncated thick diffuse moderately well to weakly developed Alfisol soil (Buried Soil 1)	12 - 21
Qoa1	Truncated thick moderately well developed Alfisol soil (Buried Soil 2)	25 - 51
Qoa2	Truncated thin weakly to moderately well developed Alfisol soil (Buried soil 3)	33 - 64
Qoa3	Truncated moderately well developed Alfisol soil (Buried soil 4)	46 - 94

APPENDIX 'C'

CPT Reporting

8/3/18

Feffer Geological Consulting
Attn: Alexander Greene

Subject: CPT Site Investigation
468 Rodeo Drive
Beverly Hills, California
GREGG Project Number: 180590SH

Dear Mr. Greene:

The following report presents the results of GREGG Drilling & Testing's Cone Penetration Test investigation for the above referenced site. The following testing services were performed:

1	Cone Penetration Tests	(CPTU)	☒
2	Pore Pressure Dissipation Tests	(PPD)	☐
3	Seismic Cone Penetration Tests	(SCPTU)	☐
4	UVOST Laser Induced Fluorescence	(UVOST)	☐
5	Groundwater Sampling	(GWS)	☐
6	Soil Sampling	(SS)	☐
7	Vapor Sampling	(VS)	☐
8	Pressuremeter Testing	(PMT)	☐
9	Vane Shear Testing	(VST)	☐
10	Dilatometer Testing	(DMT)	☐

A list of reference papers providing additional background on the specific tests conducted is provided in the bibliography following the text of the report. If you would like a copy of any of these publications or should you have any questions or comments regarding the contents of this report, please do not hesitate to contact our office at (562) 427-6899.

Sincerely,
GREGG Drilling & Testing, Inc.



Frank Stolfi
HRSC Division Manager, Gregg Drilling & Testing, Inc.

Cone Penetration Test Sounding Summary

-Table 1-

CPT Sounding Identification	Date	Termination Depth (feet)	Depth of Groundwater Samples (feet)	Depth of Soil Samples (feet)	Depth of Pore Pressure Dissipation Tests (feet)
CPT-1	7/31/2018	49.87	-	-	-
CPT-2	7/30/2018	49.87	-	-	-
CPT-3	7/31/2018	49.87	-	-	-
CPT-4	7/31/2018	49.87	-	-	-
CPT-5	7/31/2018	49.87	-	-	-
CPT-6	7/31/2018	49.87	-	-	-
CPT-7	7/30/2018	49.87	-	-	-

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Copies of ASTM Standards are available through www.astm.org

Cone Penetration Testing Procedure (CPT)

Gregg Drilling carries out all Cone Penetration Tests (CPT) using an integrated electronic cone system, *Figure CPT*.

The cone takes measurements of tip resistance (q_c), sleeve resistance (f_s), and penetration pore water pressure (u_2). Measurements are taken at either 2.5 or 5 cm intervals during penetration to provide a nearly continuous profile. CPT data reduction and basic interpretation is performed in real time facilitating on-site decision making. The above mentioned parameters are stored electronically for further analysis and reference. All CPT soundings are performed in accordance with revised ASTM standards (D 5778-12).

The 5mm thick porous plastic filter element is located directly behind the cone tip in the u_2 location. A new saturated filter element is used on each sounding to measure both penetration pore pressures as well as measurements during a dissipation test (*PPDT*). Prior to each test, the filter element is fully saturated with oil under vacuum pressure to improve accuracy.

When the sounding is completed, the test hole is backfilled according to client specifications. If grouting is used, the procedure generally consists of pushing a hollow tremie pipe with a "knock out" plug to the termination depth of the CPT hole. Grout is then pumped under pressure as the tremie pipe is pulled from the hole. Disruption or further contamination to the site is therefore minimized.

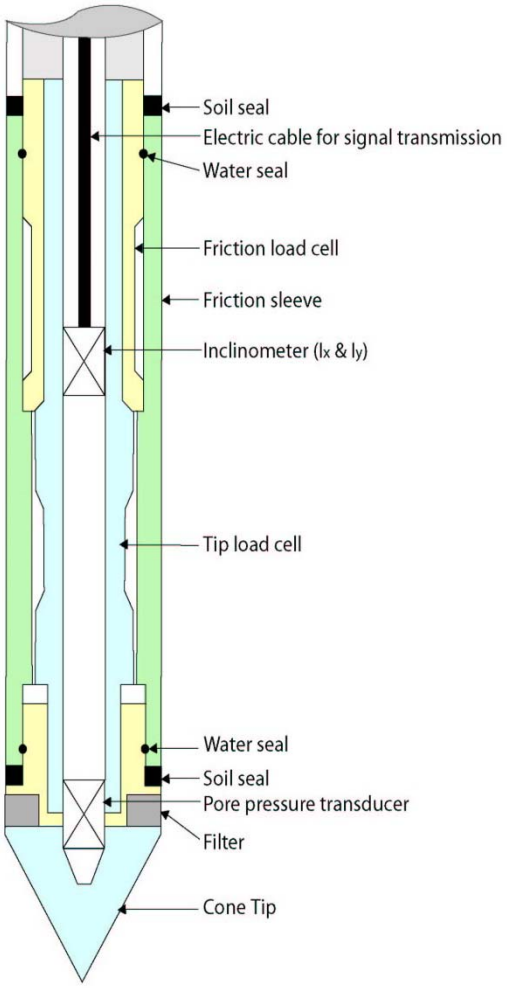


Figure CPT

Gregg 15cm^2 Standard Cone Specifications

Dimensions	
Cone base area	15 cm^2
Sleeve surface area	225 cm^2
Cone net area ratio	0.80
Specifications	
Cone load cell	
Full scale range	180 kN (20 tons)
Overload capacity	150%
Full scale tip stress	120 MPa (1,200 tsf)
Repeatability	120 kPa (1.2 tsf)
Sleeve load cell	
Full scale range	31 kN (3.5 tons)
Overload capacity	150%
Full scale sleeve stress	1,400 kPa (15 tsf)
Repeatability	1.4 kPa (0.015 tsf)
Pore pressure transducer	
Full scale range	7,000 kPa (1,000 psi)
Overload capacity	150%
Repeatability	7 kPa (1 psi)

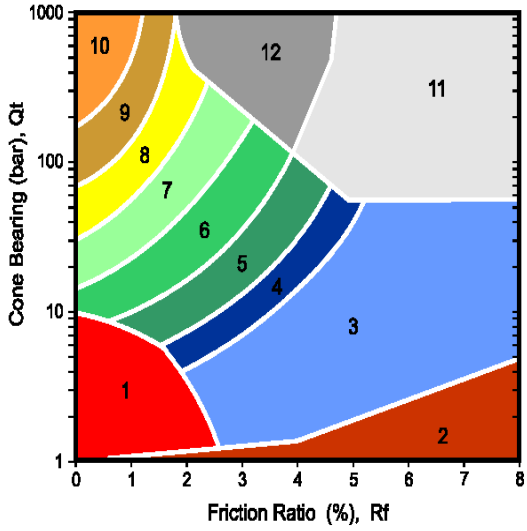
Note: The repeatability during field use will depend somewhat on ground conditions, abrasion, maintenance and zero load stability.

Cone Penetration Test Data & Interpretation

The Cone Penetration Test (CPT) data collected are presented in graphical and electronic form in the report. The plots include interpreted Soil Behavior Type (SBT) based on the charts described by Robertson (1990). Typical plots display SBT based on the non-normalized charts of Robertson et al (1986). For CPT soundings deeper than 30m, we recommend the use of the normalized charts of Robertson (1990) which can be displayed as SBTn, upon request. The report also includes spreadsheet output of computer calculations of basic interpretation in terms of SBT and SBTn and various geotechnical parameters using current published correlations based on the comprehensive review by Lunne, Robertson and Powell (1997), as well as recent updates by Professor Robertson (Guide to Cone Penetration Testing, 2015). The interpretations are presented only as a guide for geotechnical use and should be carefully reviewed. Gregg Drilling & Testing Inc. does not warranty the correctness or the applicability of any of the geotechnical parameters interpreted by the software and does not assume any liability for use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used in the software. Some interpretation methods require input of the groundwater level to calculate vertical effective stress. An estimate of the in-situ groundwater level has been made based on field observations and/or CPT results, but should be verified by the user.

A summary of locations and depths is available in Table 1. Note that all penetration depths referenced in the data are with respect to the existing ground surface.

Note that it is not always possible to clearly identify a soil type based solely on q_t, f_s, and u_2. In these situations, experience, judgment, and an assessment of the pore pressure dissipation data should be used to infer the correct soil behavior type.



ZONE		SBT
1		Sensitive, fine grained
2		Organic materials
3		Clay
4		Silty clay to clay
5		Clayey silt to silty clay
6		Sandy silt to clayey silt
7		Silty sand to sandy silt
8		Sand to silty sand
9		Sand
10		Gravely sand to sand
11		Very stiff fine grained*
12		Sand to clayey sand*

*over consolidated or cemented

Figure SBT (After Robertson et al., 1986) – Note: Colors may vary slightly compared to plots

Cone Penetration Test (CPT) Interpretation

Gregg uses a proprietary CPT interpretation and plotting software. The software takes the CPT data and performs basic interpretation in terms of soil behavior type (SBT) and various geotechnical parameters using current published empirical correlations based on the comprehensive review by Lunne, Robertson and Powell (1997). The interpretation is presented in tabular format using MS Excel. The interpretations are presented only as a guide for geotechnical use and should be carefully reviewed. Gregg does not warranty the correctness or the applicability of any of the geotechnical parameters interpreted by the software and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used in the software.

The following provides a summary of the methods used for the interpretation. Many of the empirical correlations to estimate geotechnical parameters have constants that have a range of values depending on soil type, geologic origin and other factors. The software uses 'default' values that have been selected to provide, in general, conservatively low estimates of the various geotechnical parameters.

Input:

1 Units for display (Imperial or metric) (atm. pressure, p_a = 0.96 tsf or 0.1 MPa)
2 Depth interval to average results (ft or m). Data are collected at either 0.02 or 0.05m and can be averaged every 1, 3 or 5 intervals.
3 Elevation of ground surface (ft or m)
4 Depth to water table, z_w (ft or m) – input required
5 Net area ratio for cone, a (default to 0.80)
6 Relative Density constant, C_{Dr} (default to 350)
7 Young's modulus number for sands, α (default to 5)
8 Small strain shear modulus number
  a. for sands, S_G (default to 180 for SBT_n 5, 6, 7)
  b. for clays, C_G (default to 50 for SBT_n 1, 2, 3 & 4)
9 Undrained shear strength cone factor for clays, N_{kt} (default to 15)
10 Over Consolidation ratio number, k_{ocr} (default to 0.3)
11 Unit weight of water, (default to γ_w = 62.4 lb/ft^3 or 9.81 kN/m^3)

Column

1 Depth, z, (m) – CPT data is collected in meters
2 Depth (ft)
3 Cone resistance, q_c (tsf or MPa)
4 Sleeve resistance, f_s (tsf or MPa)
5 Penetration pore pressure, u (psi or MPa), measured behind the cone (i.e. u_2)
6 Other – any additional data
7 Total cone resistance, q_t (tsf or MPa) $q_t = q_c + u\,(1-a)$

8	Friction Ratio, R_f (%)	$R_f = (f_s/q_t) \times 100\%$
9	Soil Behavior Type (non-normalized), SBT	see note
10	Unit weight, γ (pcf or kN/m^3)	based on SBT, see note
11	Total overburden stress, σ_v (tsf)	$\sigma_{vo} = \sigma\, z$
12	In-situ pore pressure, u_o (tsf)	$u_o = \gamma_w (z - z_w)$
13	Effective overburden stress, σ'_{vo} (tsf)	$\sigma'_{vo} = \sigma_{vo} - u_o$
14	Normalized cone resistance, Q_{t1}	$Q_{t1} = (q_t - \sigma_{vo}) / \sigma'_{vo}$
15	Normalized friction ratio, F_r (%)	$F_r = f_s / (q_t - \sigma_{vo}) \times 100\%$
16	Normalized Pore Pressure ratio, B_q	$B_q = u - u_o / (q_t - \sigma_{vo})$
17	Soil Behavior Type (normalized), SBT_n	see note
18	SBT_n Index, I_c	see note
19	Normalized Cone resistance, Q_{tn} (n varies with I_c)	see note
20	Estimated permeability, k_{SBT} (cm/sec or ft/sec)	see note
21	Equivalent SPT N_{60}, blows/ft	see note
22	Equivalent SPT $(N_1)_{60}$ blows/ft	see note
23	Estimated Relative Density, D_r, (%)	see note
24	Estimated Friction Angle, ϕ', (degrees)	see note
25	Estimated Young's modulus, E_s (tsf)	see note
26	Estimated small strain Shear modulus, Go (tsf)	see note
27	Estimated Undrained shear strength, s_u (tsf)	see note
28	Estimated Undrained strength ratio	s_u/σ_v'
29	Estimated Over Consolidation ratio, OCR	see note

Notes:

1 Soil Behavior Type (non-normalized), SBT (Lunne et al., 1997 and table below)

2 Unit weight, γ either constant at 119 pcf or based on Non-normalized SBT (Lunne et al., 1997 and table below)

3 Soil Behavior Type (Normalized), SBT_n Lunne et al. (1997)

4 SBT_n Index, I_c $I_c = ((3.47 - \log Q_{t1})^2 + (\log F_r + 1.22)^2)^{0.5}$

5 Normalized Cone resistance, Q_{tn} (n varies with Ic)

$Q_{tn} = ((q_t - \sigma_{vo})/pa)\ (pa/(\sigma'_{vo})^n$ and recalculate I_c, then iterate:

When $I_c < 1.64$, n = 0.5 (clean sand)
When $I_c > 3.30$, n = 1.0 (clays)
When $1.64 < I_c < 3.30$, $n = (I_c - 1.64)0.3 + 0.5$
Iterate until the change in n, $\Delta n < 0.01$

6 Estimated permeability, k_{SBT} based on Normalized SBT_n (Lunne et al., 1997 and table below)

7 Equivalent SPT N_{60}, blows/ft Lunne et al. (1997)

$$\frac{(q_t/p_a)}{N_{60}} = 8.5\left(1 - \frac{I_c}{4.6}\right)$$

8 Equivalent SPT $(N_1)_{60}$ blows/ft $(N_1)_{60} = N_{60}\, C_N$,
where $C_N = (pa/\sigma'_{vo})^{0.5}$

9 Relative Density, D_r, (%) $D_r^2 = Q_{tn} / C_{Dr}$
Only SBT_n 5, 6, 7 & 8 *Show 'N/A' in zones 1, 2, 3, 4 & 9*

10 Friction Angle, ϕ', (degrees) $\tan\phi' = \frac{1}{2.68}\left[\log\left(\frac{q_c}{\sigma'_{vo}}\right) + 0.29\right]$
Only SBT_n 5, 6, 7 & 8 *Show'N/A' in zones 1, 2, 3, 4 & 9*

11 Young's modulus, E_s $E_s = \alpha\, q_t$
Only SBT_n 5, 6, 7 & 8 *Show 'N/A' in zones 1, 2, 3, 4 & 9*

12 Small strain shear modulus, Go

a. $G_o = S_G\,(q_t\ \sigma'_{vo}\ pa)^{1/3}$ *For SBT_n 5, 6, 7*

b. $G_o = C_G\, q_t$ *For SBT_n 1, 2, 3& 4*

Show 'N/A' in zones 8 & 9

13 Undrained shear strength, s_u $s_u = (q_t - \sigma_{vo}) / N_{kt}$
Only SBT_n 1, 2, 3, 4 & 9 *Show 'N/A' in zones 5, 6, 7 & 8*

14 Over Consolidation ratio, OCR $OCR = k_{ocr}\, Q_{t1}$
Only SBT_n 1, 2, 3, 4 & 9 *Show 'N/A' in zones 5, 6, 7 & 8*

The following updated and simplified SBT descriptions have been used in the software:

SBT Zones		**SBT_n Zones**	
1	sensitive fine grained	1	sensitive fine grained
2	organic soil	2	organic soil
3	clay	3	clay
4	clay & silty clay	4	clay & silty clay
5	clay & silty clay		
6	sandy silt & clayey silt		

7	silty sand & sandy silt	5	silty sand & sandy silt
8	sand & silty sand	6	sand & silty sand
9	sand		
10	sand	7	sand
11	very dense/stiff soil*	8	very dense/stiff soil*
12	very dense/stiff soil*	9	very dense/stiff soil*

*heavily overconsolidated and/or cemented

Track when soils fall with zones of same description and print that description (i.e. if soils fall only within SBT zones 4 & 5, print 'clays & silty clays')

Estimated Permeability (see Lunne et al., 1997)

SBT_n	Permeability (ft/sec)	(m/sec)
1	$3x\ 10^{-8}$	$1x\ 10^{-8}$
2	$3x\ 10^{-7}$	$1x\ 10^{-7}$
3	$1x\ 10^{-9}$	$3x\ 10^{-10}$
4	$3x\ 10^{-8}$	$1x\ 10^{-8}$
5	$3x\ 10^{-6}$	$1x\ 10^{-6}$
6	$3x\ 10^{-4}$	$1x\ 10^{-4}$
7	$3x\ 10^{-2}$	$1x\ 10^{-2}$
8	$3x\ 10^{-6}$	$1x\ 10^{-6}$
9	$1x\ 10^{-8}$	$3x\ 10^{-9}$

Estimated Unit Weight (see Lunne et al., 1997)

SBT	Approximate Unit Weight (lb/ft^3)	(kN/m^3)
1	111.4	17.5
2	79.6	12.5
3	111.4	17.5
4	114.6	18.0
5	114.6	18.0
6	114.6	18.0
7	117.8	18.5
8	120.9	19.0
9	124.1	19.5
10	127.3	20.0
11	130.5	20.5
12	120.9	19.0

Pore Pressure Dissipation Tests (PPDT)

Pore Pressure Dissipation Tests (PPDT's) conducted at various intervals can be used to measure equilibrium water pressure (at the time of the CPT). If conditions are hydrostatic, the equilibrium water pressure can be used to determine the approximate depth of the ground water table. A PPDT is conducted when penetration is halted at specific intervals determined by the field representative. The variation of the penetration pore pressure (*u)* with time is measured behind the tip of the cone and recorded.

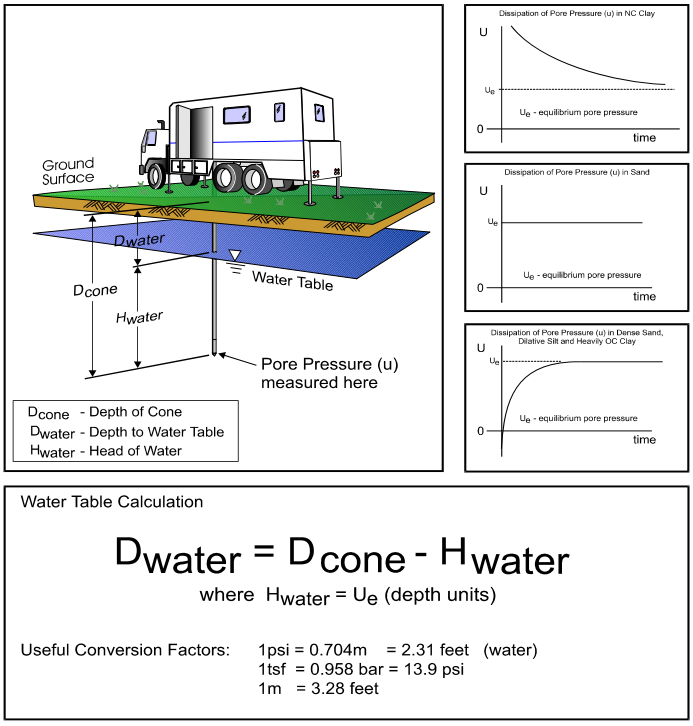
Pore pressure dissipation data can be interpreted to provide estimates of:

- Equilibrium piezometric pressure
- Phreatic Surface
- In situ horizontal coefficient of consolidation (c_h)
- In situ horizontal coefficient of permeability (k_h)

In order to correctly interpret the equilibrium piezometric pressure and/or the phreatic surface, the pore pressure must be monitored until it reaches equilibrium, *Figure PPDT*. This time is commonly referred to as t_{100}, the point at which 100% of the excess pore pressure has dissipated.

A complete reference on pore pressure dissipation tests is presented by Robertson et al. 1992 and Lunne et al. 1997.

A summary of the pore pressure dissipation tests are summarized in Table 1.



Water Table Calculation

$$D_{water} = D_{cone} - H_{water}$$

where $H_{water} = U_e$ (depth units)

Useful Conversion Factors: 1psi = 0.704m = 2.31 feet (water)
1tsf = 0.958 bar = 13.9 psi
1m = 3.28 feet

Figure PPDT

Seismic Cone Penetration Testing (SCPT)

Seismic Cone Penetration Testing (SCPT) can be conducted at various intervals during the Cone Penetration Test. Shear wave velocity (Vs) can then be calculated over a specified interval with depth. A small interval for seismic testing, such as 1-1.5m (3-5ft) allows for a detailed look at the shear wave profile with depth. Conversely, a larger interval such as 3-6m (10-20ft) allows for a more average shear wave velocity to be calculated. Gregg's cones have a horizontally active geophone located 0.2m (0.66ft) behind the tip.

To conduct the seismic shear wave test, the penetration of the cone is stopped and the rods are decoupled from the rig. An automatic hammer is triggered to send a shear wave into the soil. The distance from the source to the cone is calculated knowing the total depth of the cone and the horizontal offset distance between the source and the cone. To calculate an interval velocity, a minimum of two tests must be performed at two different depths. The arrival times between the two wave traces are compared to obtain the difference in time (Δt). The difference in depth is calculated (Δd) and velocity can be determined using the simple equation: $v = \Delta d/\Delta t$

Multiple wave traces can be recorded at the same depth to improve quality of the data.

A complete reference on seismic cone penetration tests is presented by Robertson et al. 1986 and Lunne et al. 1997.

A summary the shear wave velocities, arrival times and wave traces are provided with the report.

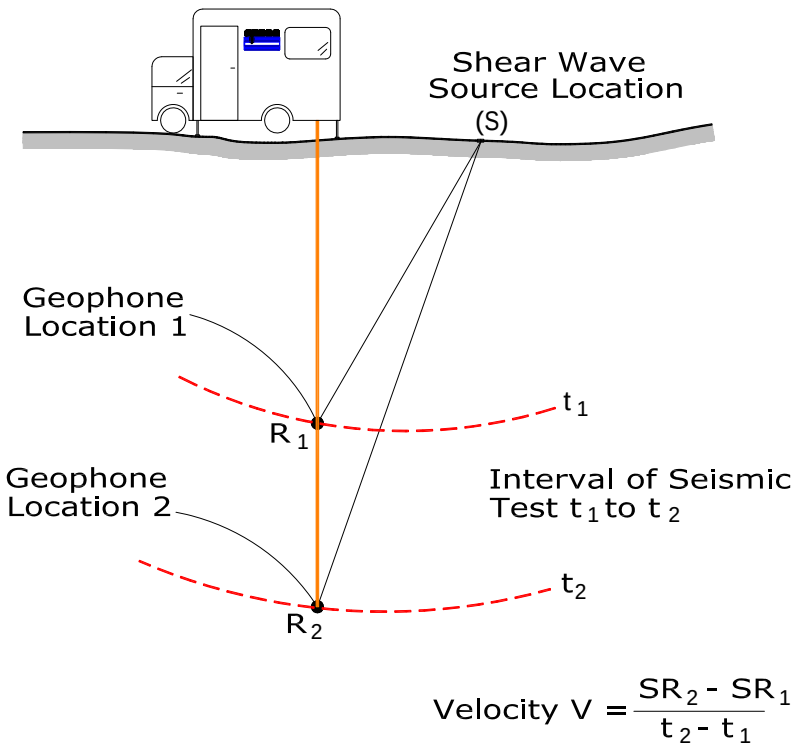


Figure SCPT

Groundwater Sampling

Gregg Drilling & Testing, Inc. conducts groundwater sampling using a sampler as shown in *Figure GWS*. The groundwater sampler has a retrievable stainless steel or disposable PVC screen with steel drop off tip. This allows for samples to be taken at multiple depth intervals within the same sounding location. In areas of slower water recharge, provisions may be made to set temporary PVC well screens during sampling to allow the pushing equipment to advance to the next sample location while the groundwater is allowed to infiltrate.

The groundwater sampler operates by advancing 44.5mm (1¾ inch) hollow push rods with the filter tip in a closed configuration to the base of the desired sampling interval. Once at the desired sample depth, the push rods are retracted; exposing the encased filter screen and allowing groundwater to infiltrate hydrostatically from the formation into the inlet screen. A small diameter bailer (approximately ½ or ¾ inch) is lowered through the push rods into the screen section for sample collection. The number of downhole trips with the bailer and time necessary to complete the sample collection at each depth interval is a function of sampling protocols, volume requirements, and the yield characteristics and storage capacity of the formation. Upon completion of sample collection, the push rods and sampler, with the exception of the PVC screen and steel drop off tip are retrieved to the ground surface, decontaminated and prepared for the next sampling event.

For a detailed reference on direct push groundwater sampling, refer to Zemo et. al., 1992.

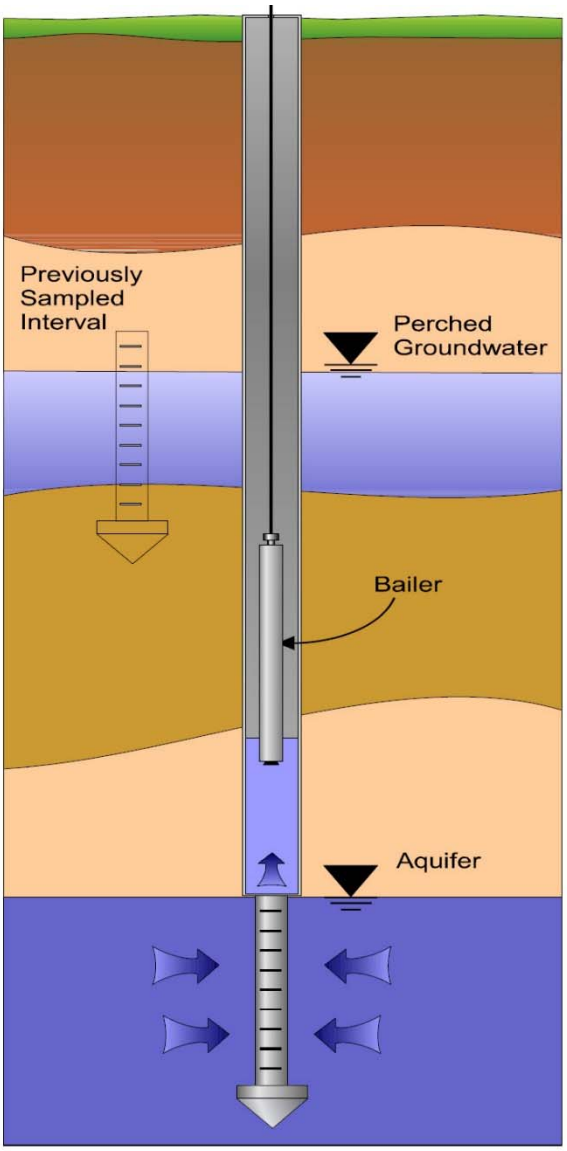


Figure GWS

Soil Sampling

Gregg Drilling & Testing, Inc. uses a piston-type push-in sampler to obtain small soil samples without generating any soil cuttings, *Figure SS*. Two different types of samplers (12 and 18 inch) are used depending on the soil type and density. The soil sampler is initially pushed in a "closed" position to the desired sampling interval using the CPT pushing equipment. Keeping the sampler closed minimizes the potential of cross contamination. The inner tip of the sampler is then retracted leaving a hollow soil sampler with inner 1¼" diameter sample tubes. The hollow sampler is then pushed in a locked "open" position to collect a soil sample. The filled sampler and push rods are then retrieved to the ground surface. Because the soil enters the sampler at a constant rate, the opportunity for 100% recovery is increased. For environmental analysis, the soil sample tube ends are sealed with Teflon and plastic caps. Often, a longer "split tube" can be used for geotechnical sampling.

For a detailed reference on direct push soil sampling, refer to Robertson et al, 1998.

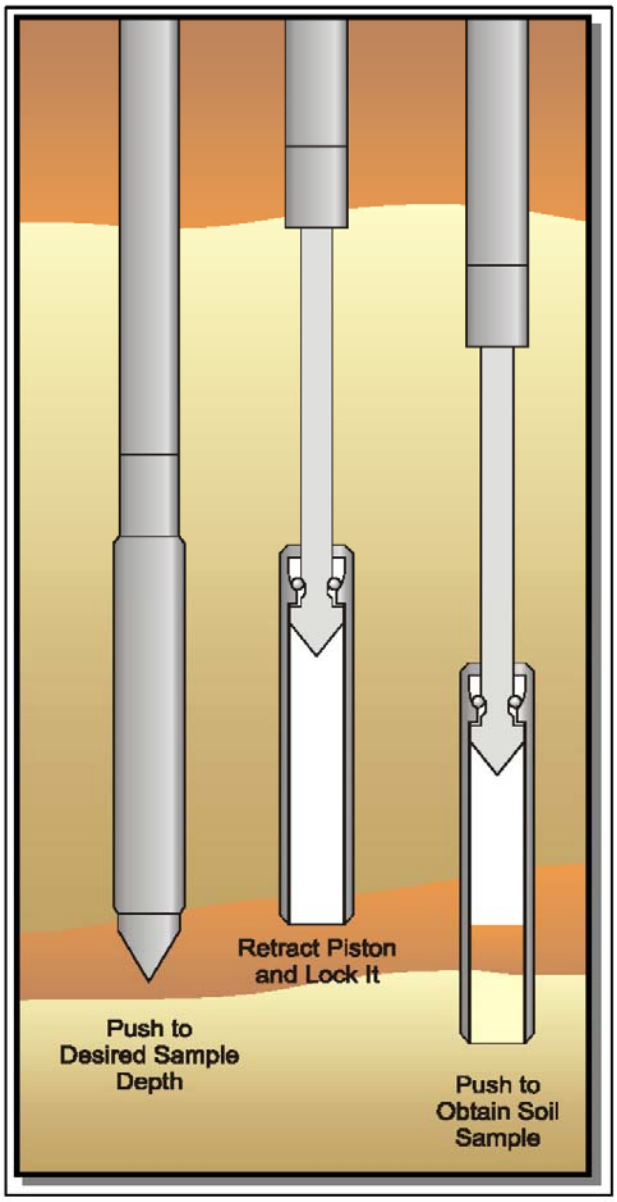


Figure SS

GREGG DRILLING, INC.
www.greggdrilling.com

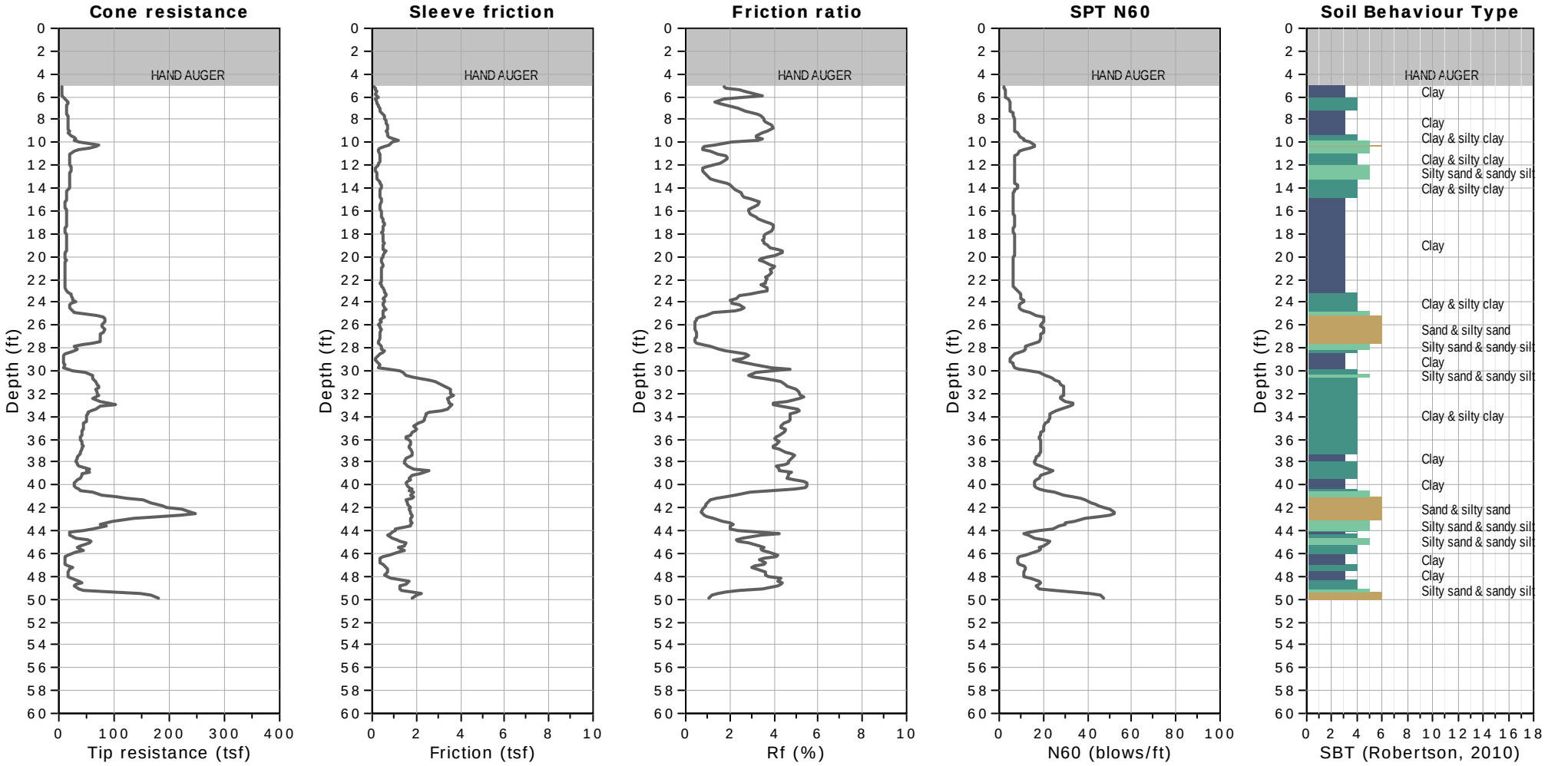
CPT: CPT-1

CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/31/2018

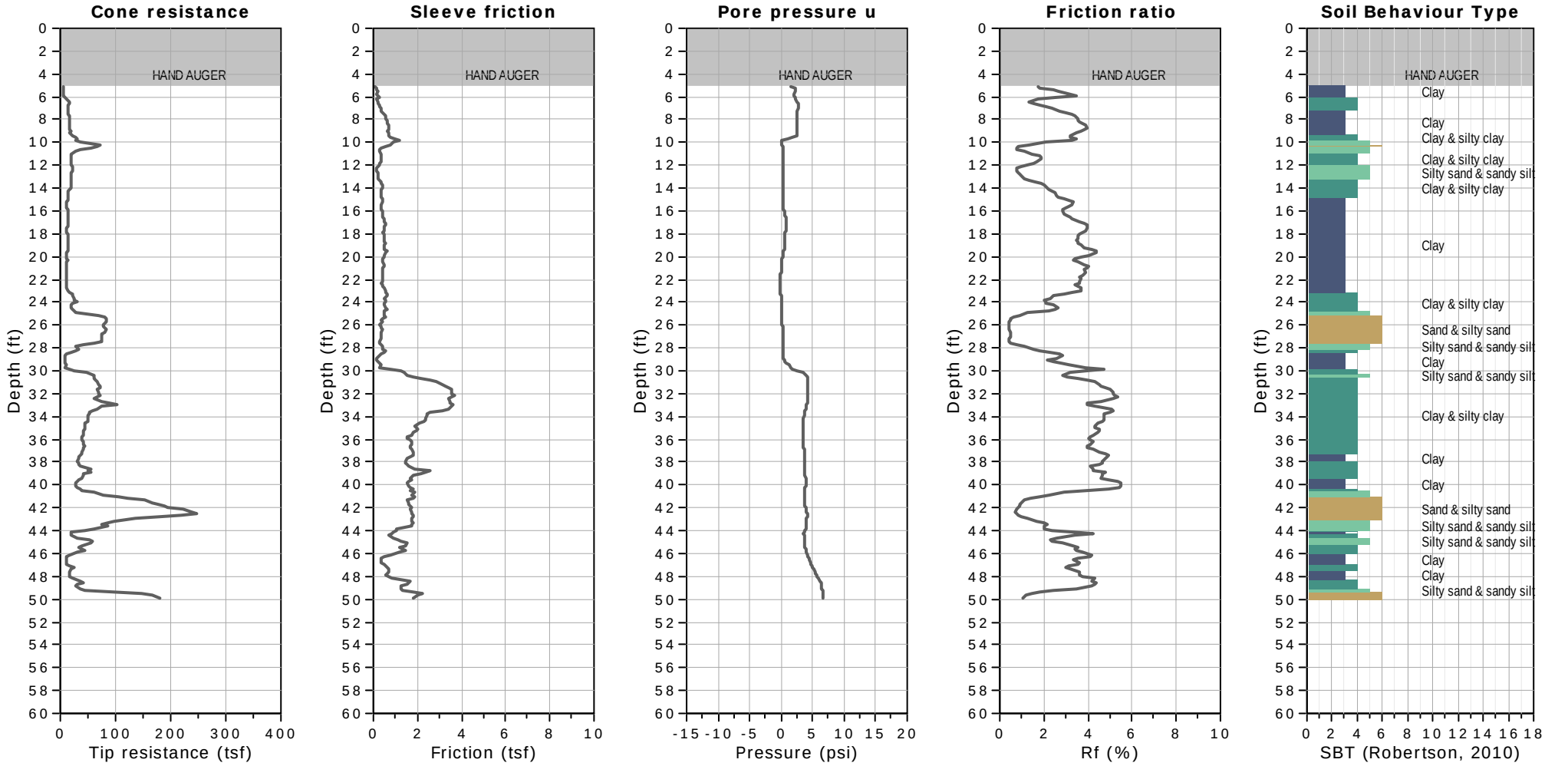


CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/31/2018



WATER TABLE FOR ESTIMATING PURPOSES ONLY

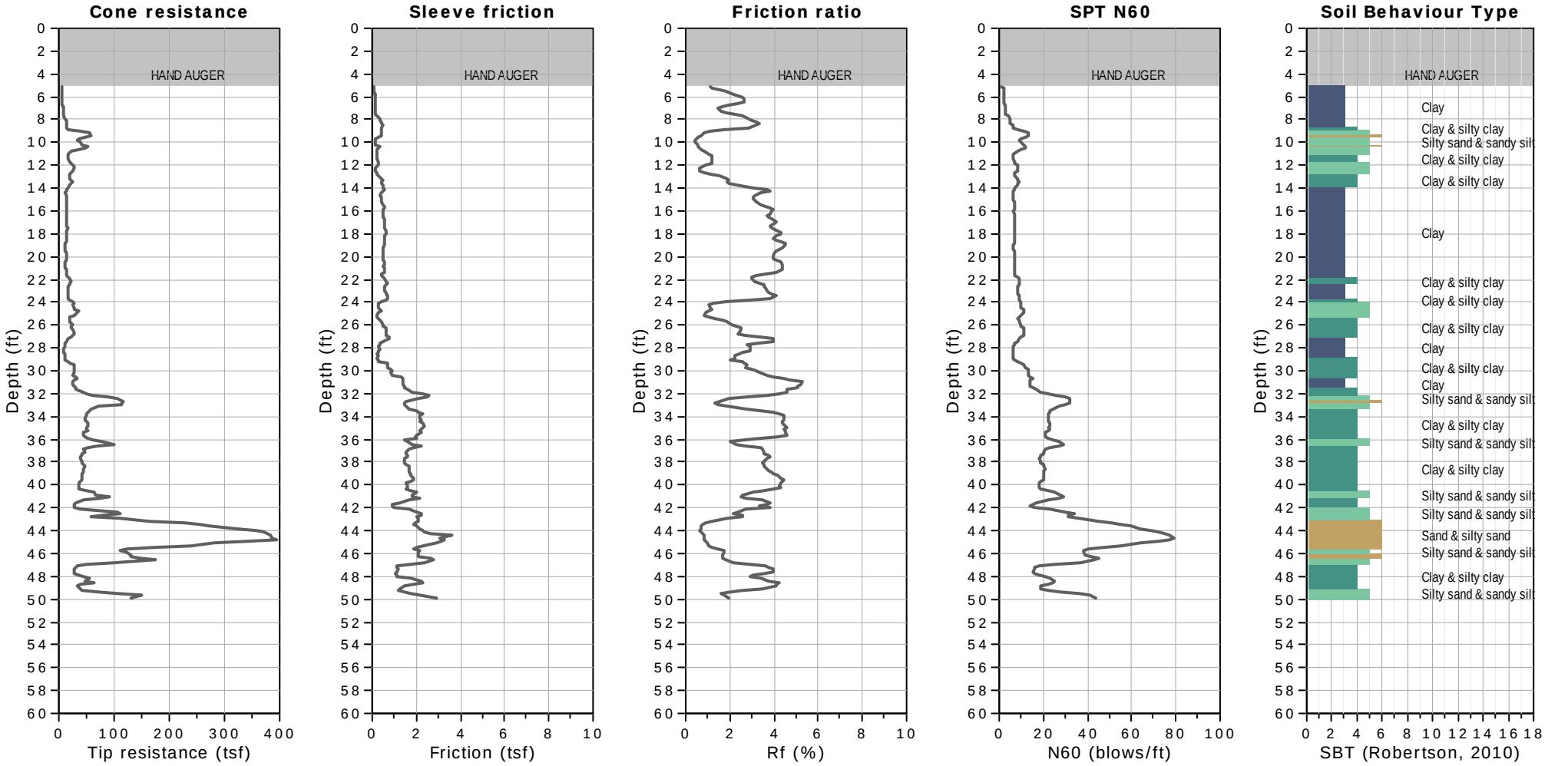
CPT: CPT-2

CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/30/2018

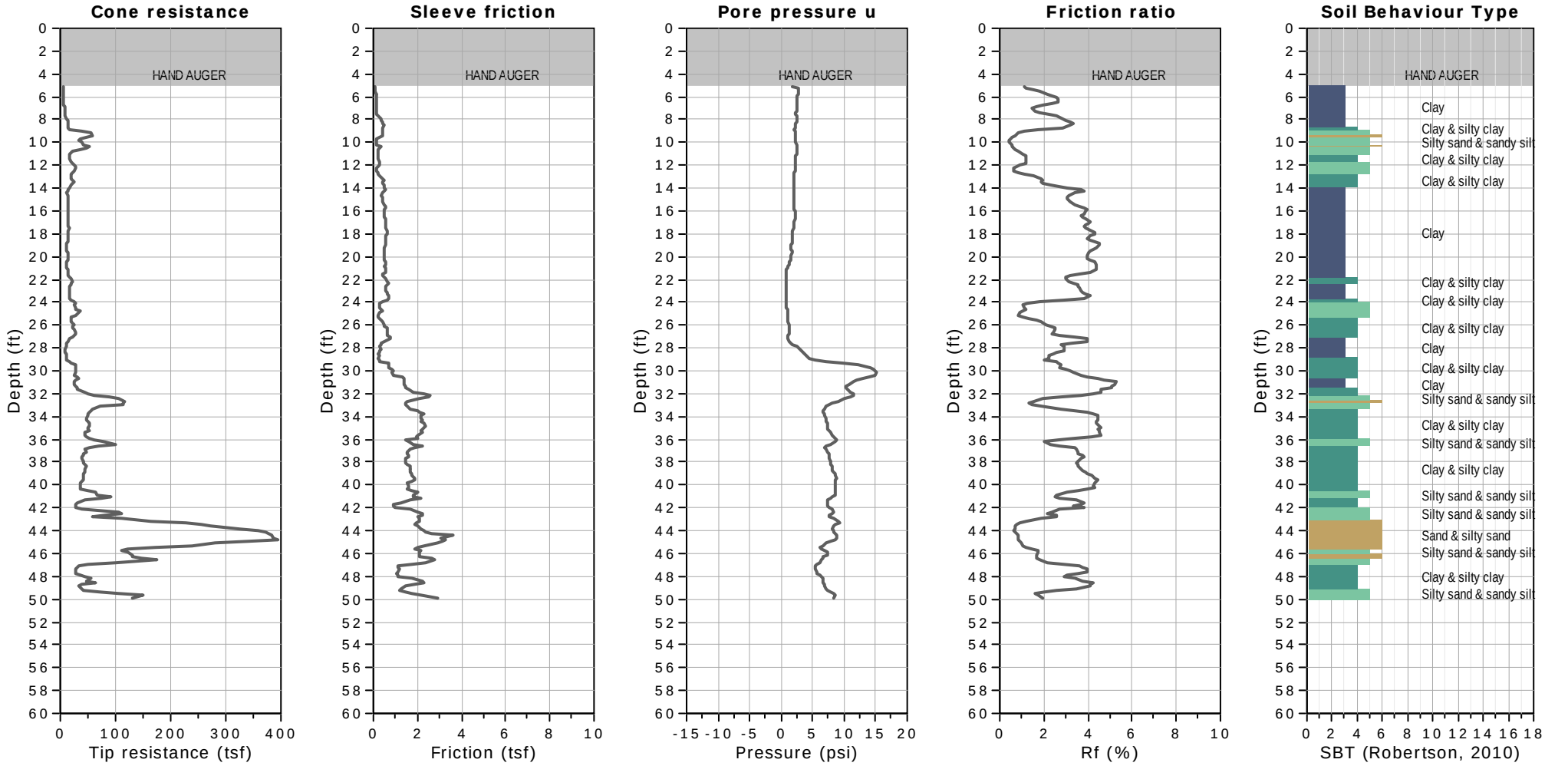


CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/30/2018



WATER TABLE FOR ESTIMATING PURPOSES ONLY

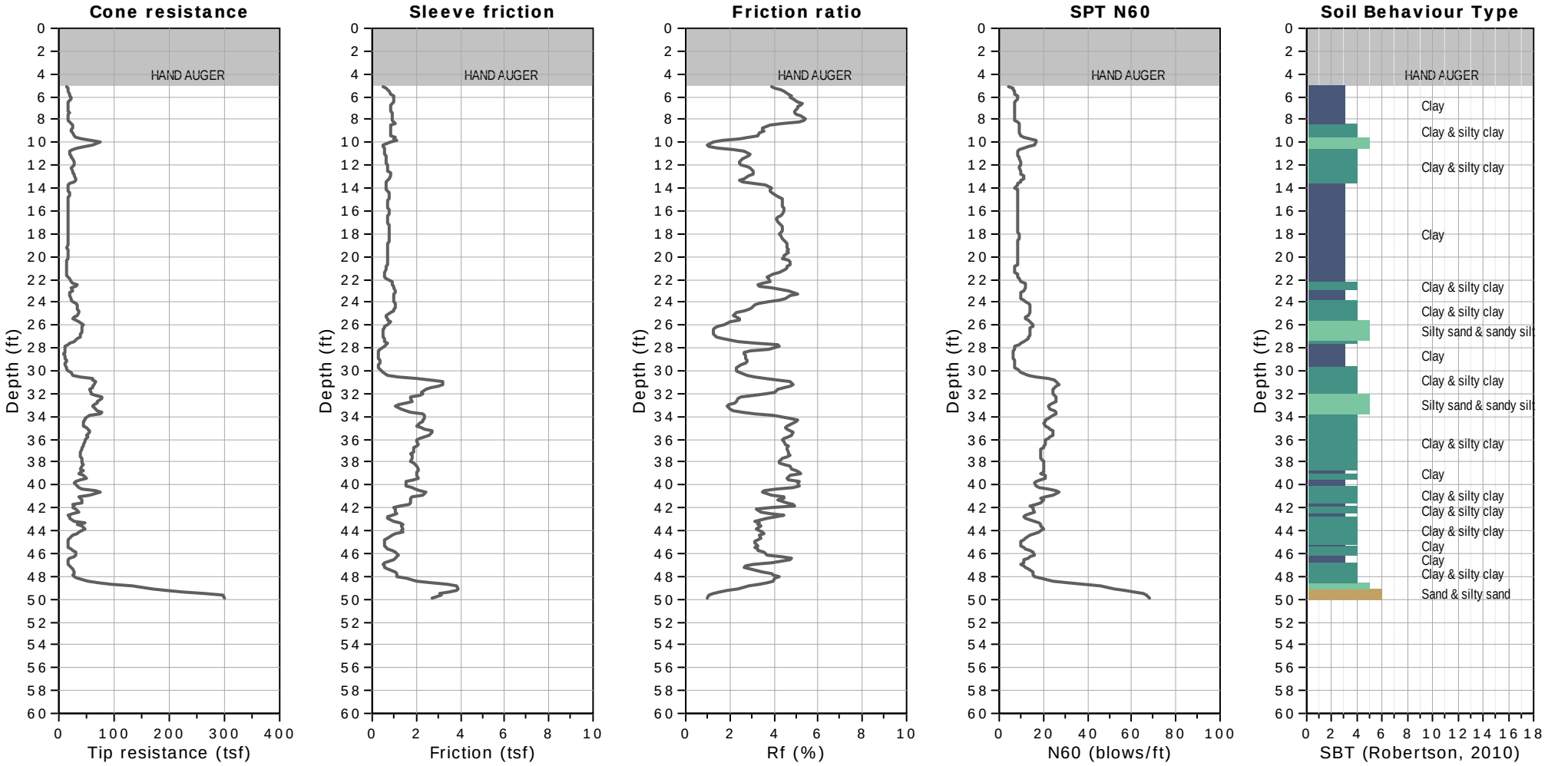
CPT: CPT-3

CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/31/2018

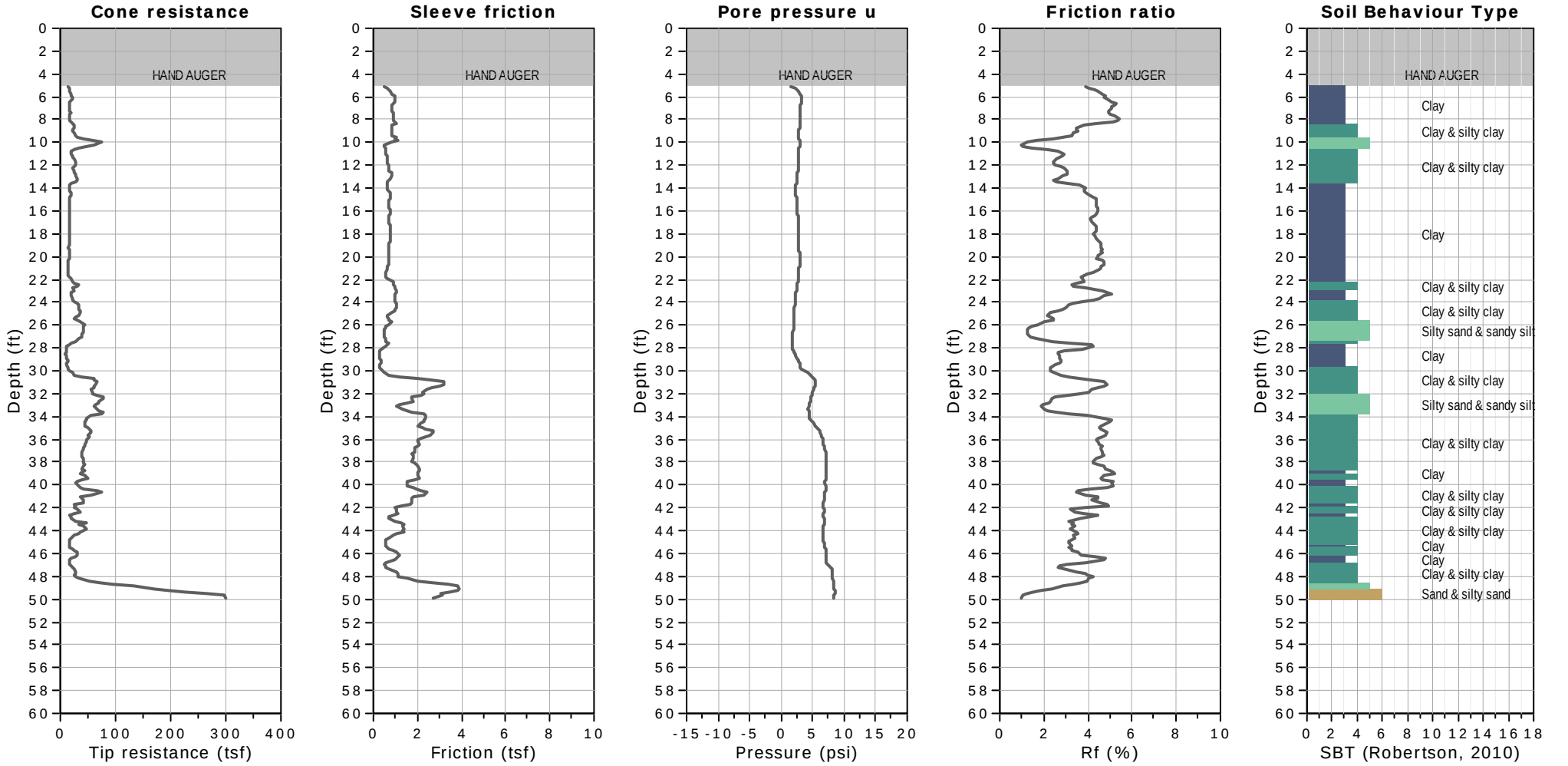


CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/31/2018



WATER TABLE FOR ESTIMATING PURPOSES ONLY

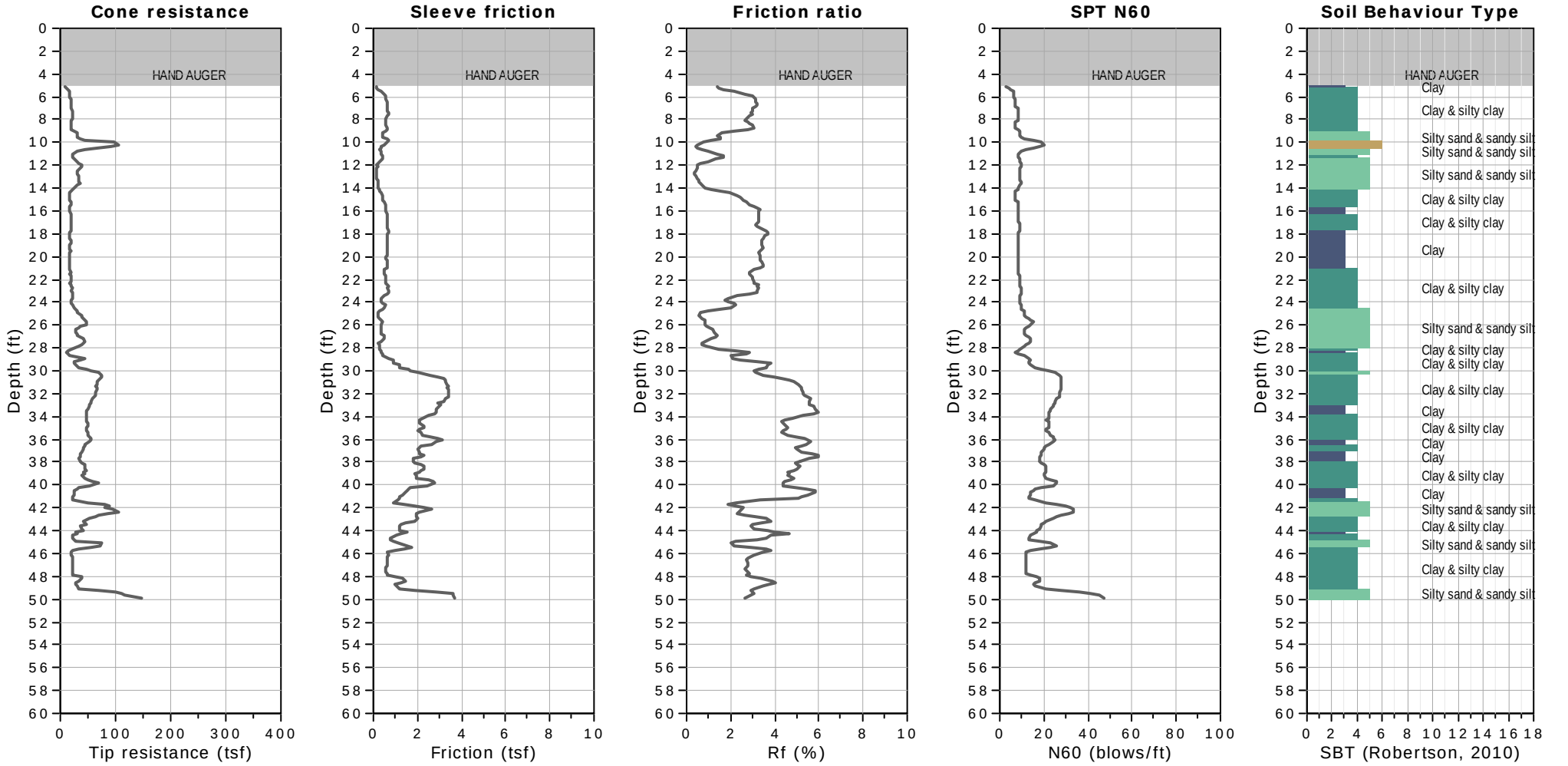
CPT: CPT-4

CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/31/2018

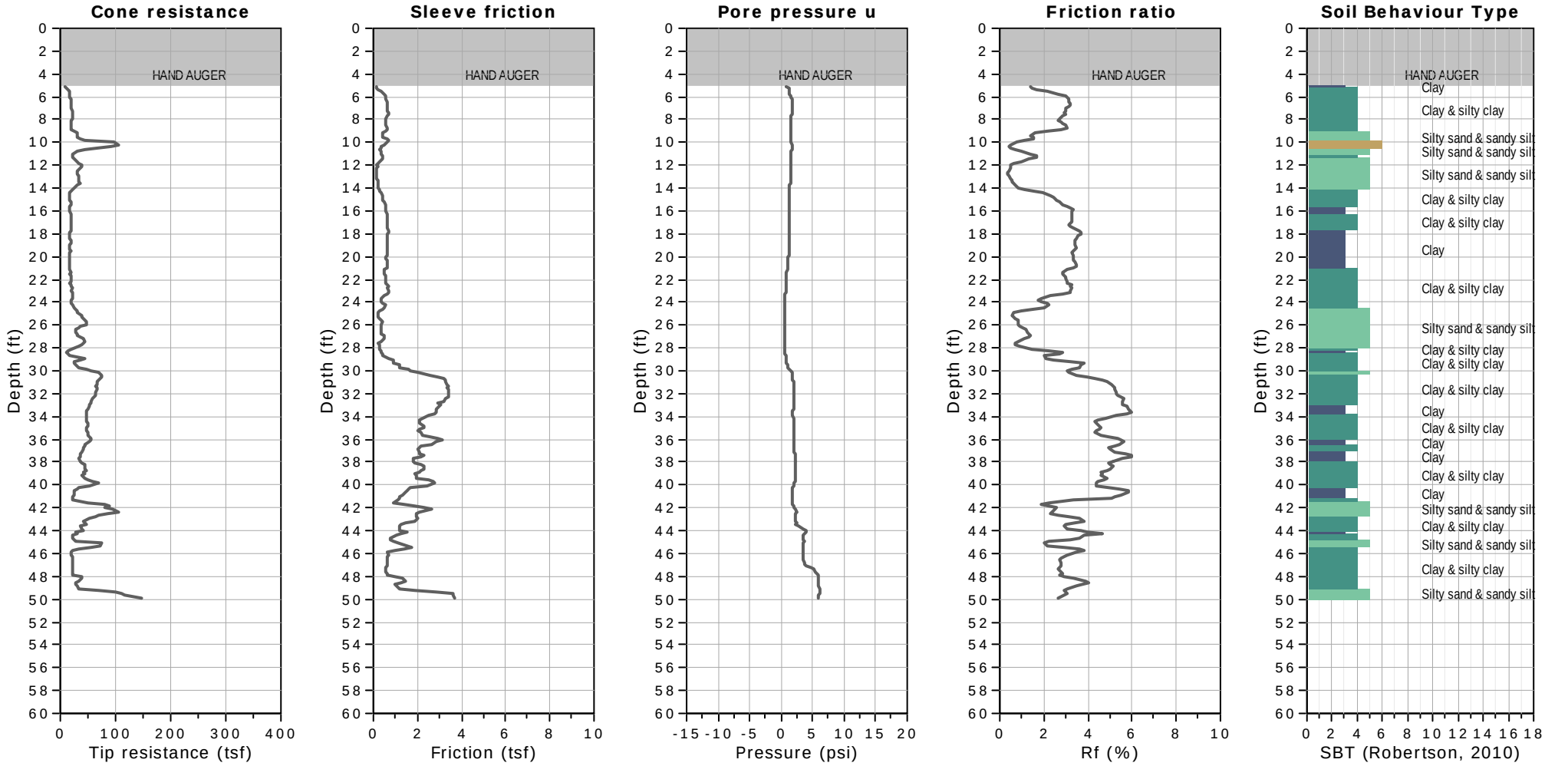


CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/31/2018



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

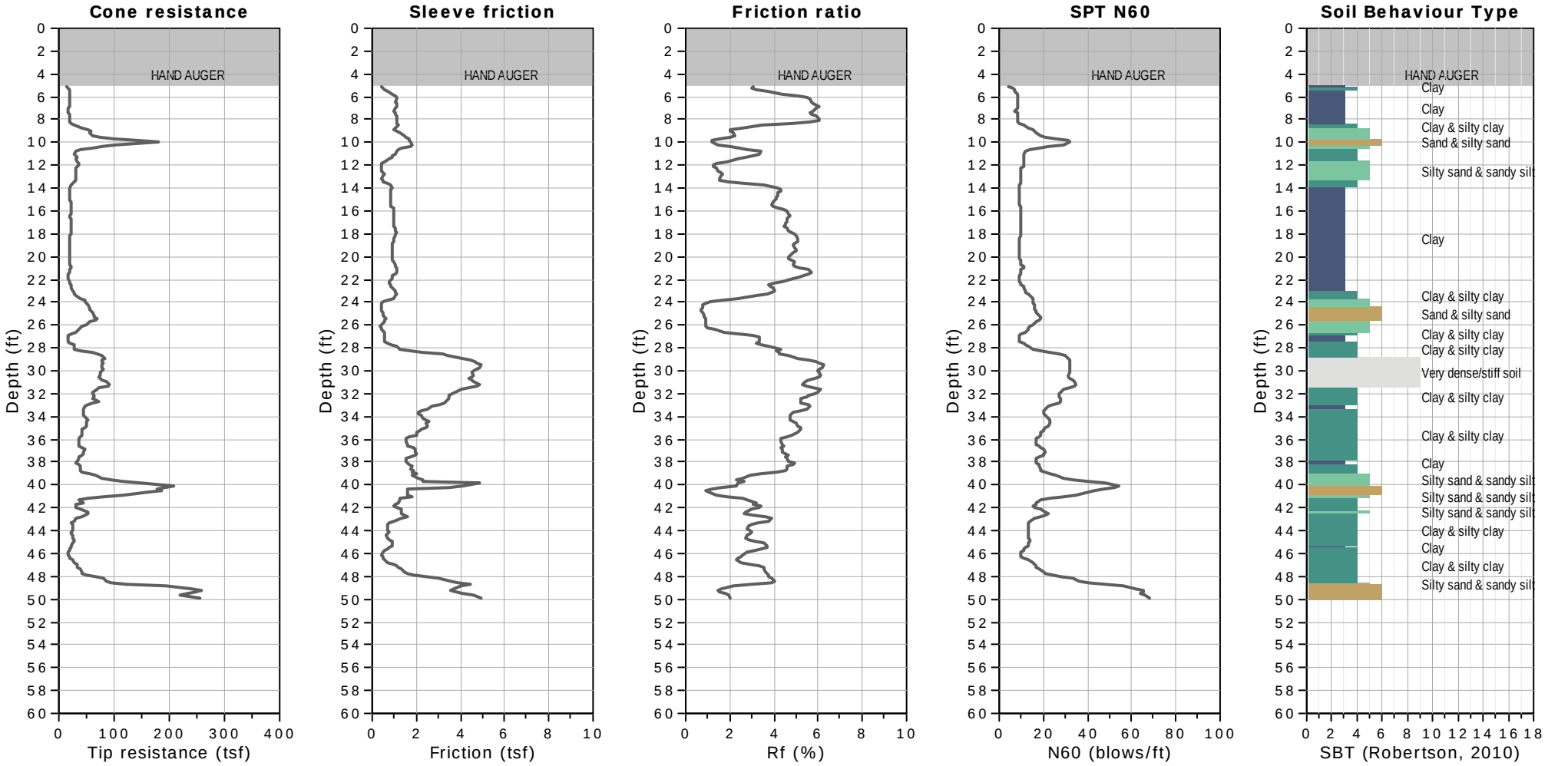
WATER TABLE FOR ESTIMATING PURPOSES ONLY

CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/31/2018



SBTn legend

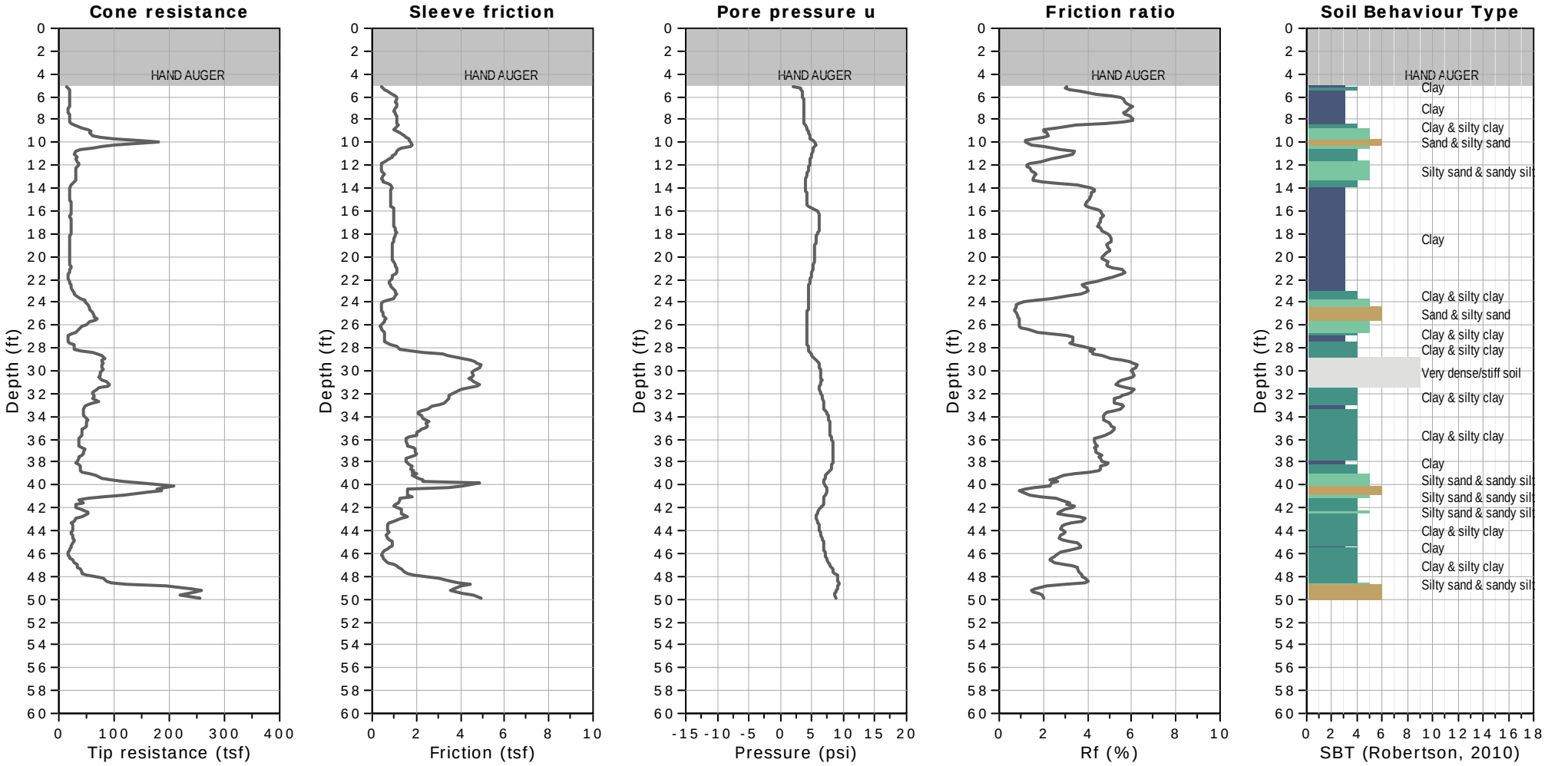
1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/31/2018



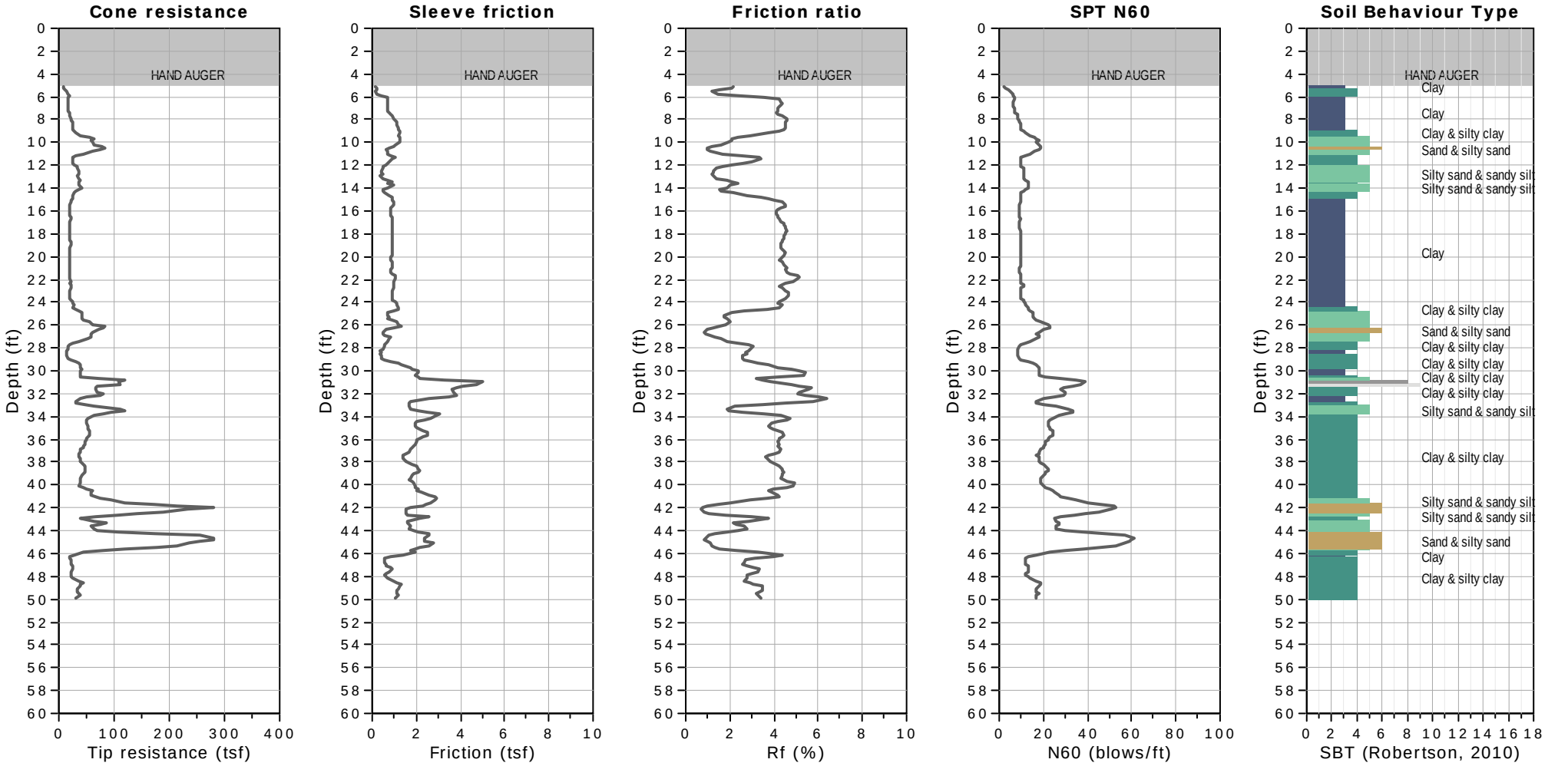
WATER TABLE FOR ESTIMATING PURPOSES ONLY

CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/31/2018

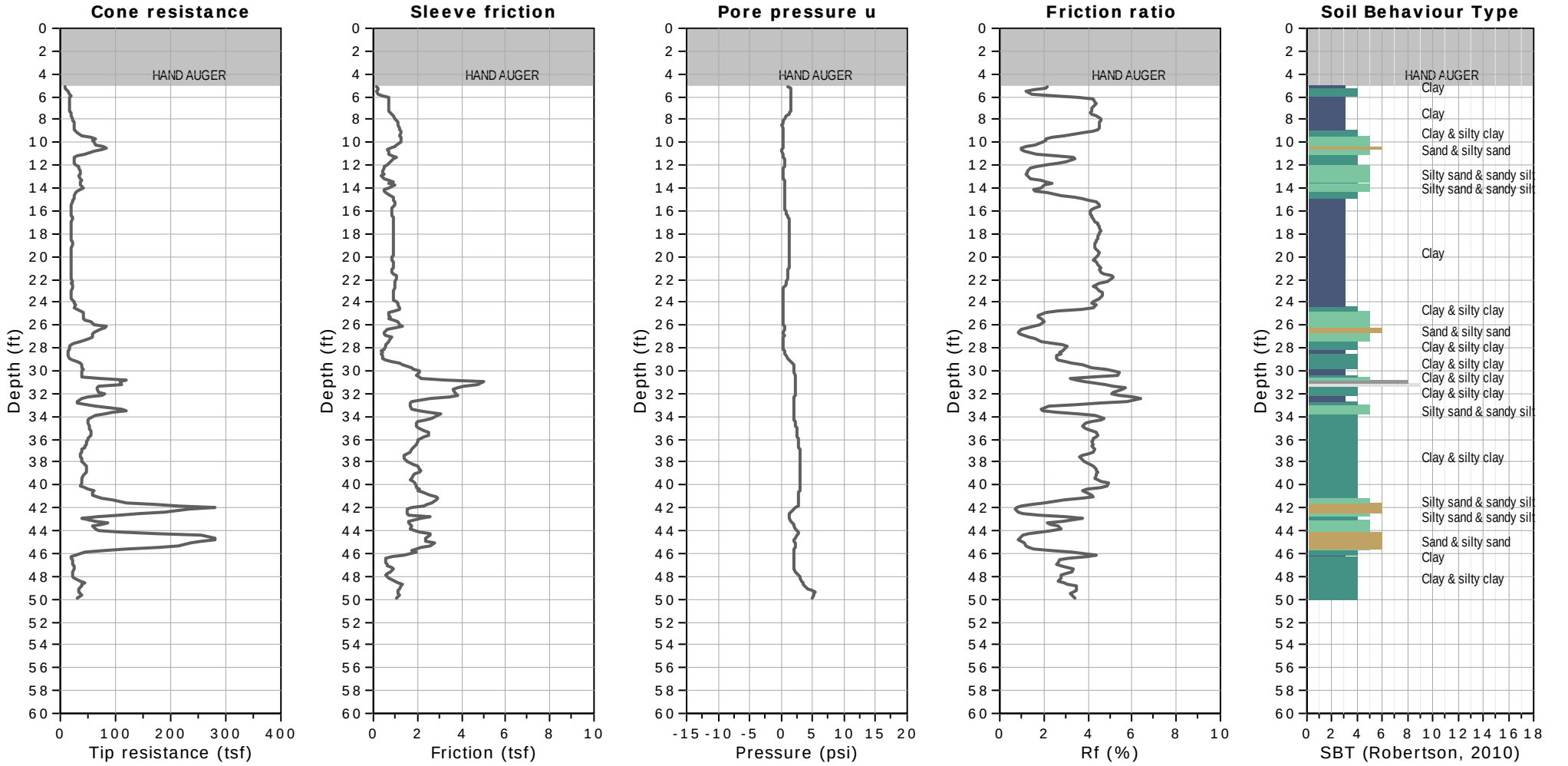


CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/31/2018



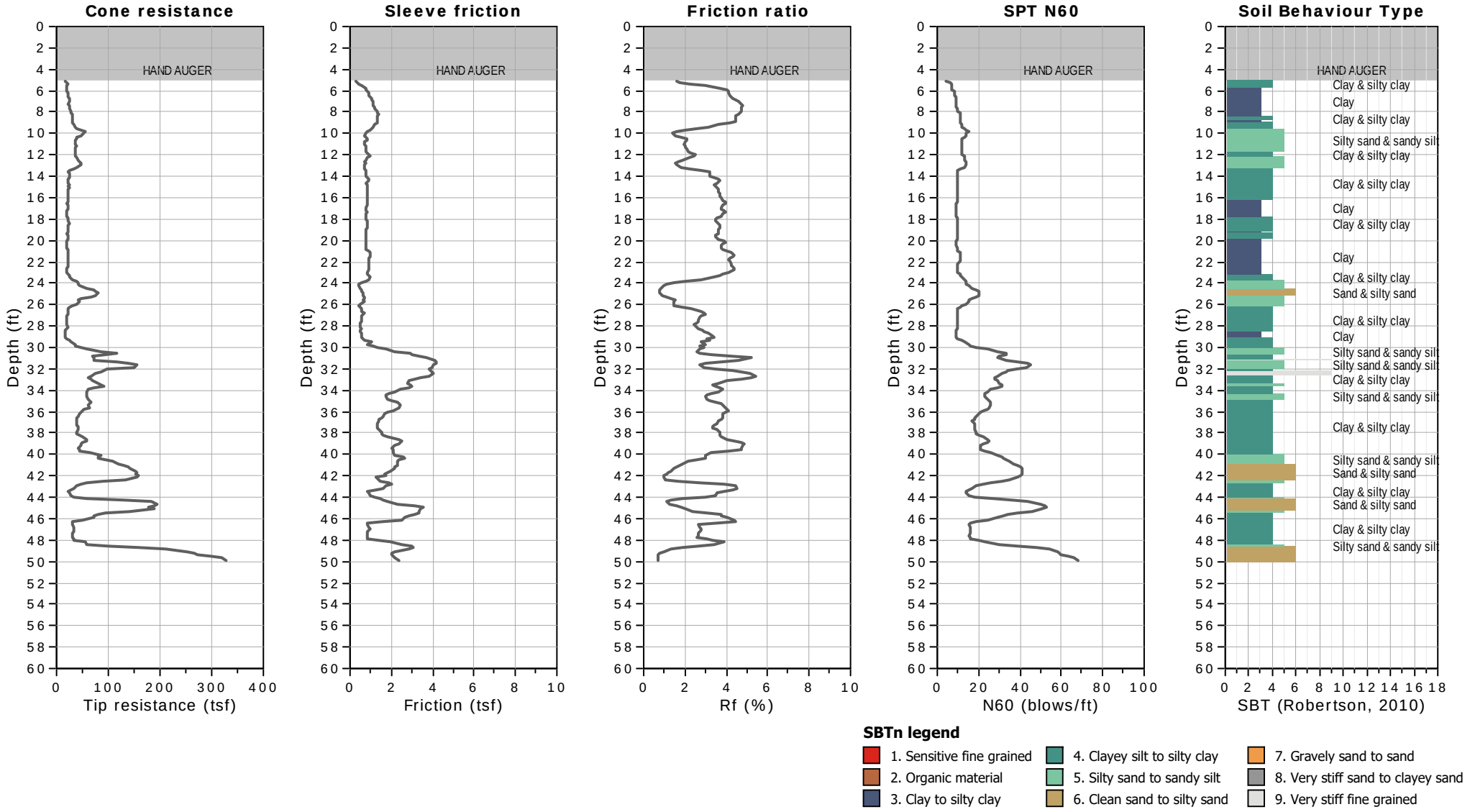
WATER TABLE FOR ESTIMATING PURPOSES ONLY

CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/30/2018

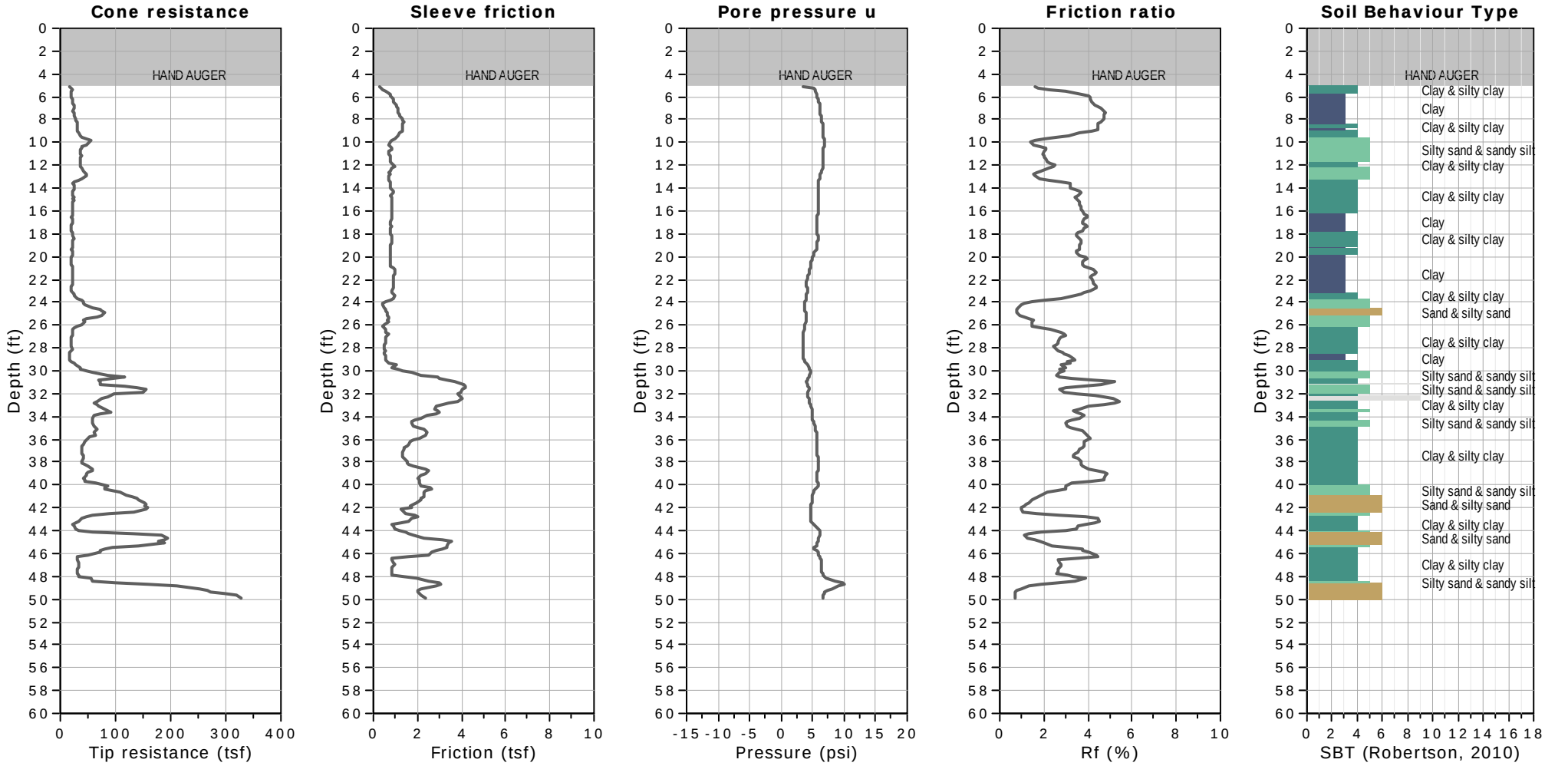


CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/30/2018



WATER TABLE FOR ESTIMATING PURPOSES ONLY

SUMMARY

OF

CONE PENETRATION TEST DATA

Project:

456 N. Rodeo Drive
Beverly Hills, CA
July 11-13, 2018

Prepared for:

Mr. Alexander Greene
Feffer Geological Consulting
1990 S. Bundy Drive, Ste 400
Los Angeles, CA 90025
Office (310) 207-5048 / Fax (310) 826-0182

Prepared by:



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

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3. **FIELD EQUIPMENT & PROCEDURES**
4. **CONE PENETRATION TEST DATA & INTERPRETATION**

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- CPT Plots
- CPT Classification/Soil Behavior Chart
- Interpretation Output (CPeT-IT)
- CPeT-IT Calculation Formulas

SUMMARY
OF
CONE PENETRATION TEST DATA

1. INTRODUCTION

This report presents the results of a Cone Penetration Test (CPT) program carried out for the project located at 456 N. Rodeo Drive in Beverly Hills, California. The work was performed by Kehoe Testing & Engineering (KTE) on July 11-13, 2018. The scope of work was performed as directed by Feffer Geological Consulting personnel.

2. SUMMARY OF FIELD WORK

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

LOCATION	DEPTH OF CPT (ft)	COMMENTS/NOTES:
CPT-5	39	Refusal, hole open to 36 ft (dry)
CPT-6	50	Hole open to 48 ft (dry)
CPT-7	50	Hole open to 46 ft (dry)
CPT-8	30	Refusal, hole open to 30 ft (dry)

TABLE 2.1 - Summary of CPT Soundings

3. FIELD EQUIPMENT & PROCEDURES

The CPT soundings were carried out by **KTE** using an integrated electronic cone system manufactured by Vertek. The CPT soundings were performed in accordance with ASTM standards (D5778). The cone penetrometers were pushed using a 30-ton CPT rig and a direct push rig anchored with an eight-inch diameter ground anchor. The direct push rig has a pushing capacity of approximately 15 tons. The cone used during the program was a 15 cm^2 cone and a 10 cm^2 was used with the direct push rig. Both recorded the following parameters at approximately 2.5 cm depth intervals:

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

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

4. CONE PENETRATION TEST DATA & INTERPRETATION

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

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

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

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

Sincerely,

KEHOE TESTING & ENGINEERING



Richard W. Koester, Jr.
General Manager

07/19/18-hh-9580

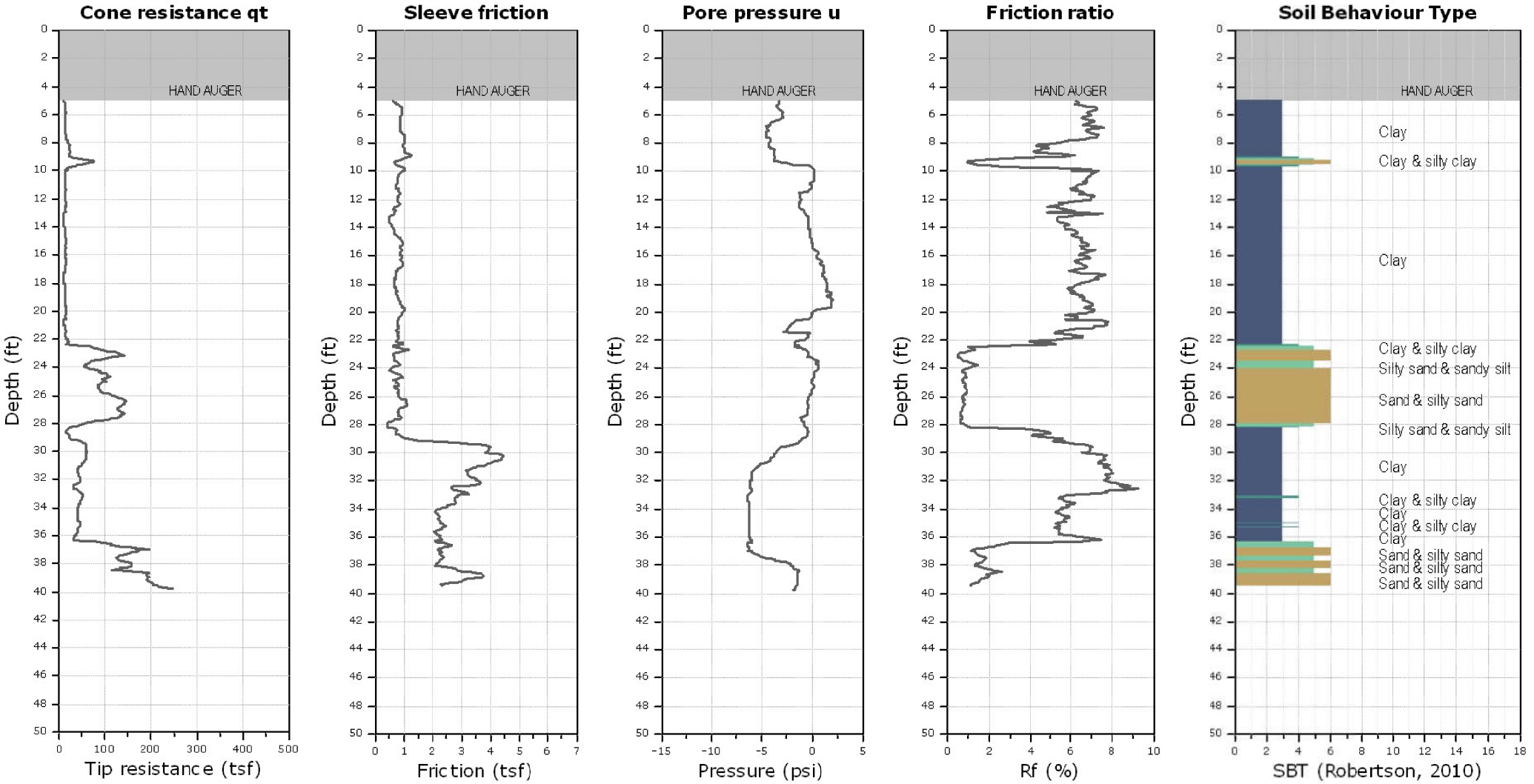
APPENDIX

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

CPT-5

Project: **Feffer Geological Consulting**
Location: **456 N. Rodeo Drive Beverly Hills, Ca**

Total depth: 39.77 ft, Date: 7/12/2018
Cone Type: Vertek



Kehoe Testing and Engineering
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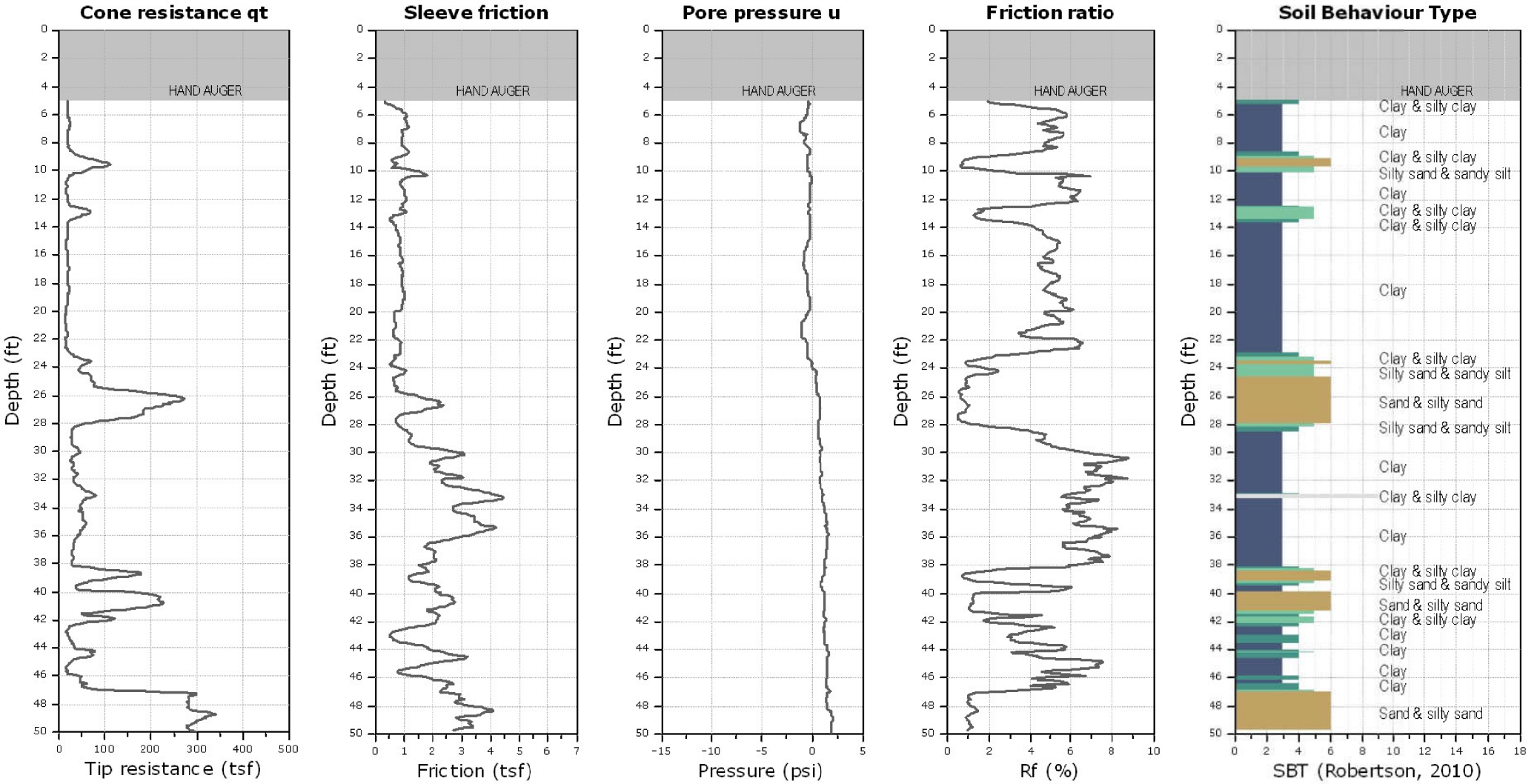
CPT-6

Project: **Feffer Geological Consulting**
Location: **456 N. Rodeo Drive Beverly Hills, Ca**

Total depth: 50.15 ft, Date: 7/11/2018
Cone Type: Vertek



Kehoe Testing and Engineering
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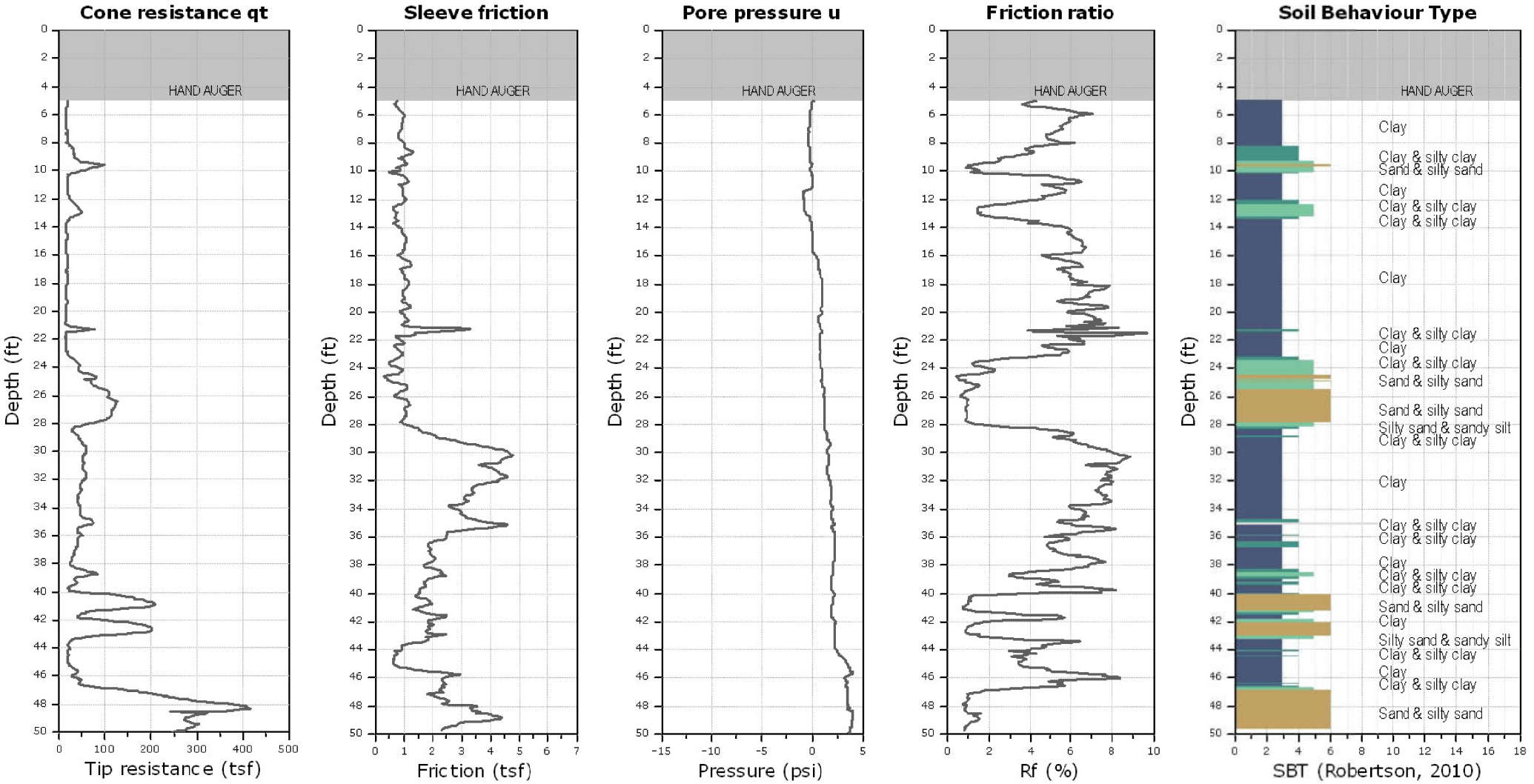
CPT-7

Project: **Feffer Geological Consulting**
Location: **456 N. Rodeo Drive Beverly Hills, Ca**

Total depth: 50.07 ft, Date: 7/11/2018
Cone Type: Vertek



Kehoe Testing and Engineering
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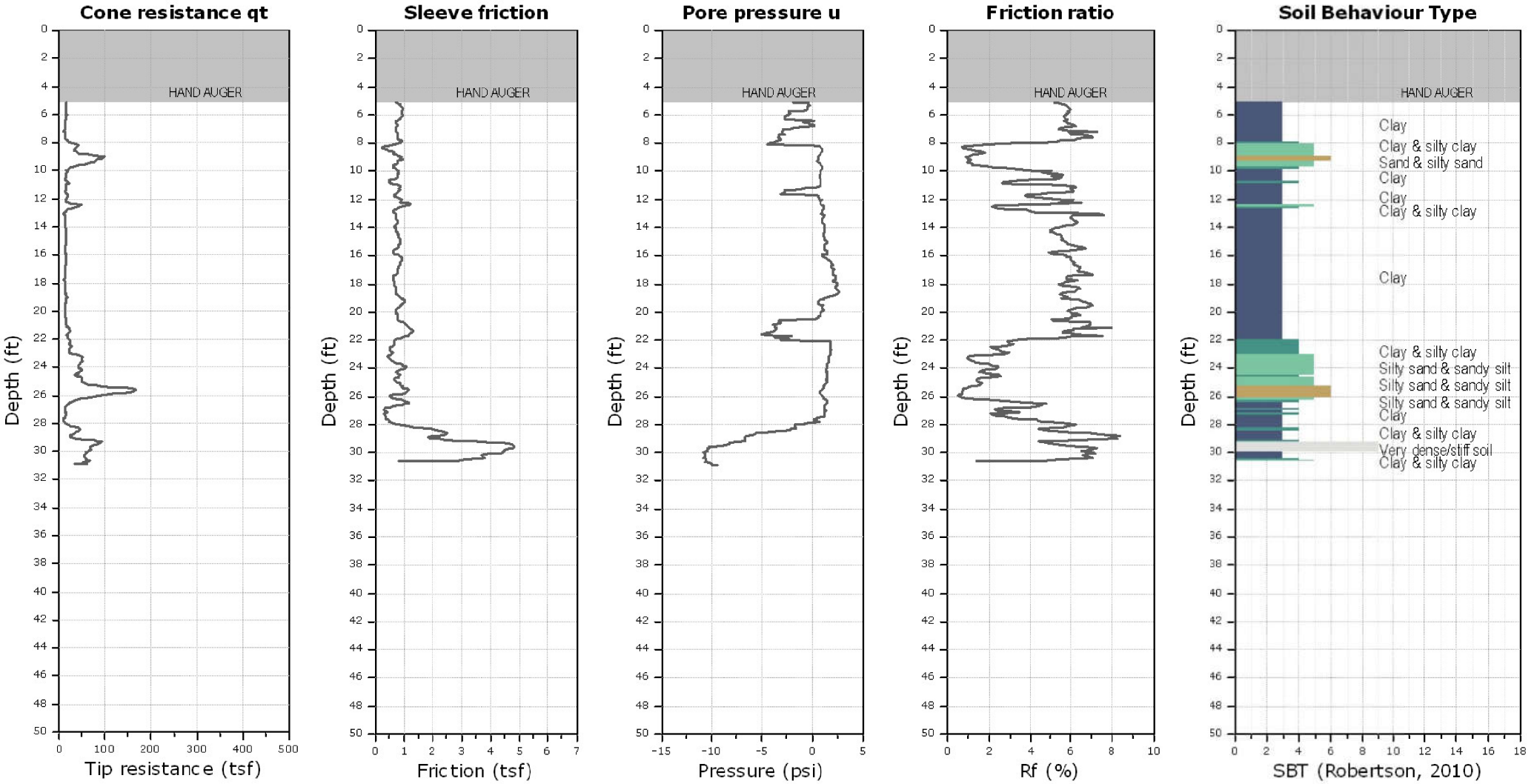
CPT-8

Project: **Feffer Geological Consulting**
Location: **456 N. Rodeo Drive Beverly Hills, Ca**

Total depth: 30.91 ft, Date: 7/12/2018
Cone Type: Vertek



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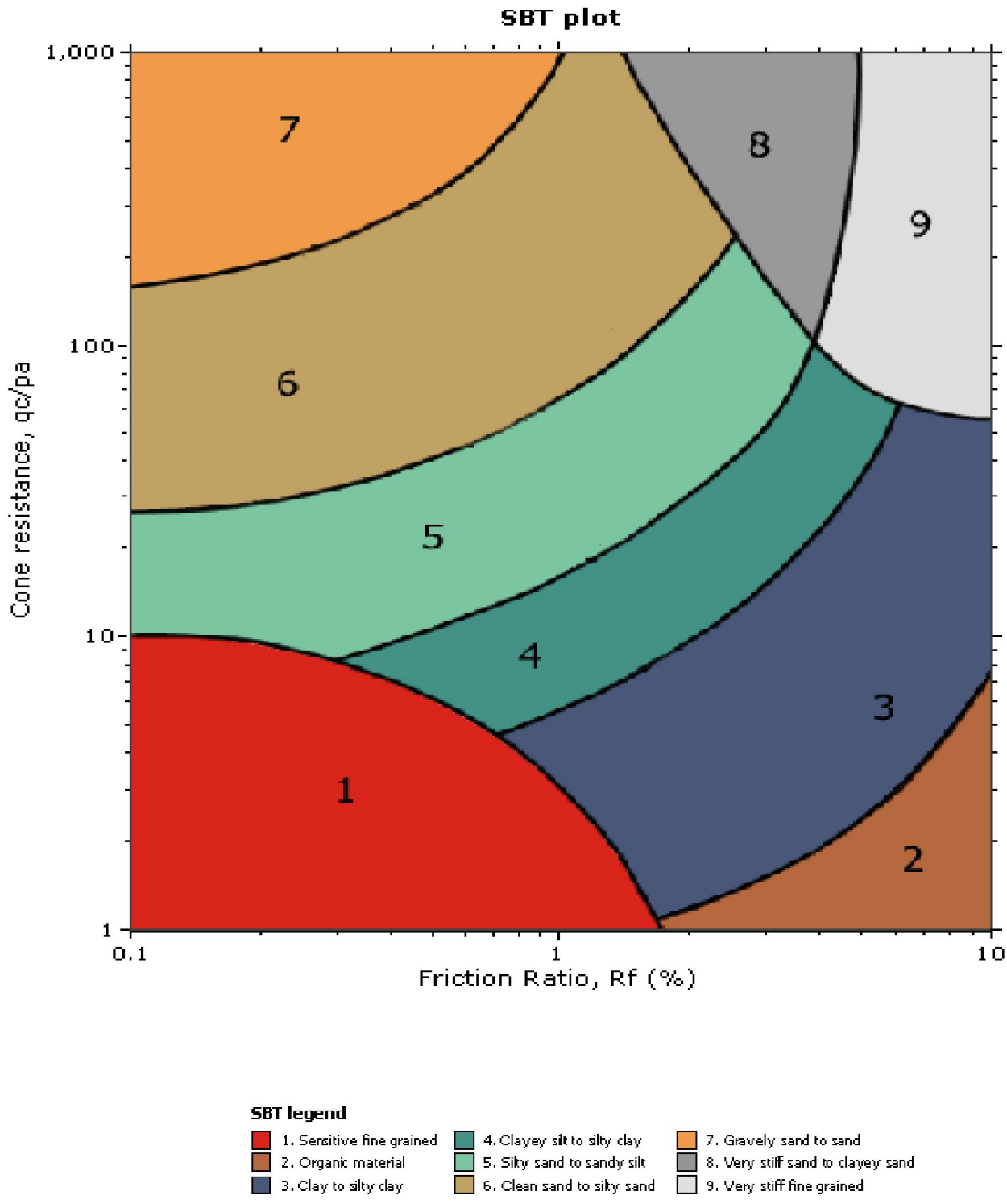

	CPT-5	In situ data							Basic output data													
Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ã (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn	U2	I(B)	Mod. SBTn
1	34.79	0.89	1.39	2.32	34.84	2.55	4	2.54	18.56	0.01	0	0.01	3750.4	2.55	0	8	0.54	13.2	1.83	434.32	10.78	37.75	7
2	6.88	0.55	-0.75	2.87	6.85	7.98	3	3.4	17.38	0.02	0	0.02	380.15	8	-0.01	9	0.79	25.06	2.47	161.88	-2.99	12.58	3
3	7.15	0.37	-0.53	2.47	7.14	5.14	3	3.27	16.93	0.03	0	0.03	268.99	5.16	-0.01	9	0.76	16.7	2.4	112.21	-1.44	18.84	3
4	8.08	0.44	-0.9	2.22	8.05	5.43	3	3.24	17.19	0.04	0	0.04	228.96	5.46	-0.01	9	0.78	14.1	2.43	106.87	-1.85	17.89	3
5	10.37	0.63	-3.21	2.47	10.27	6.09	3	3.19	17.69	0.04	0	0.04	233.17	6.11	-0.02	9	0.79	12.2	2.45	117.98	-5.27	16.17	3
6	13.39	0.9	-3	2.12	13.3	6.75	3	3.13	18.2	0.05	0	0.05	249.98	6.78	-0.02	9	0.79	10.61	2.45	132.82	-4.07	14.71	3
7	12.54	0.9	-4.5	1.7	12.4	7.27	3	3.18	18.18	0.06	0	0.06	198.79	7.31	-0.03	9	0.81	9.98	2.51	116.43	-5.22	13.72	3
8	20.02	1.03	-4.39	1.25	19.88	5.16	3	2.93	18.51	0.07	0	0.07	277.81	5.18	-0.02	9	0.75	7.51	2.34	140.52	-4.43	18.86	3
9	24.05	1.04	-3.75	1.37	23.93	4.33	3	2.81	18.6	0.08	0	0.08	295.87	4.35	-0.01	9	0.72	6.4	2.27	144.38	-3.35	22.13	5
10	13.29	0.89	0.11	1.68	13.29	6.68	3	3.13	18.19	0.09	0	0.09	147.11	6.73	0	9	0.82	7.58	2.54	94.54	0.09	14.81	3
11	11.29	0.79	-0.11	1.7	11.28	7.02	3	3.2	18	0.1	0	0.1	113.29	7.08	0	9	0.85	7.44	2.6	78.64	-0.08	14.15	3
12	11.33	0.79	-1.13	1.48	11.3	6.96	3	3.2	17.99	0.11	0	0.11	103.9	7.03	-0.01	9	0.85	6.96	2.62	73.64	-0.76	14.24	3
13	9.06	0.59	-0.62	2	9.05	6.55	3	3.25	17.58	0.12	0	0.12	76.65	6.63	0	3	0.87	6.8	2.66	57.35	-0.38	14.96	3
14	10.6	0.61	-0.32	2.61	10.59	5.75	3	3.17	17.67	0.13	0	0.13	83.49	5.82	0	4	0.85	6.09	2.61	60.24	-0.18	16.7	3
15	14.39	0.87	-0.11	2.53	14.38	6.05	3	3.08	18.2	0.13	0	0.13	105.99	6.11	0	9	0.83	5.56	2.56	74.82	-0.06	16.09	3
16	13.57	0.91	0.43	2.4	13.58	6.73	3	3.13	18.23	0.14	0	0.14	93.59	6.8	0	9	0.85	5.5	2.62	69.78	0.21	14.65	3
17	12.54	0.87	1.18	2.14	12.58	6.91	3	3.16	18.14	0.15	0	0.15	81.39	6.99	0.01	9	0.87	5.37	2.66	63.01	0.55	14.3	3
18	10.46	0.71	1.5	2.42	10.5	6.75	3	3.21	17.84	0.16	0	0.16	64.02	6.86	0.01	3	0.89	5.29	2.7	51.75	0.67	14.54	3
19	11.78	0.81	1.79	2.6	11.84	6.86	3	3.18	18.04	0.17	0	0.17	68.39	6.96	0.01	3	0.88	5.01	2.69	55.18	0.75	14.35	3
20	13.75	0.92	0	2.84	13.75	6.66	3	3.12	18.24	0.18	0	0.18	75.5	6.75	0	3	0.87	4.68	2.66	59.96	0	14.74	3
21	11.06	0.78	-2.21	2.68	10.99	7.09	3	3.21	17.97	0.19	0	0.19	57.26	7.21	-0.01	3	0.9	4.74	2.74	48.36	-0.84	13.94	3
22	16.79	0.9	-1.11	2.88	16.76	5.36	3	2.99	18.29	0.2	0	0.2	83.72	5.42	0	4	0.84	4.07	2.57	63.66	-0.4	17.74	3
23	125.41	1.09	-0.32	2.21	125.41	0.87	6	1.81	19.28	0.21	0	0.21	603.52	0.87	0	6	0.46	2.12	1.58	250.91	-0.11	90.7	7
24	54.66	0.9	0.54	2.47	54.67	1.65	5	2.27	18.75	0.22	0	0.22	251.15	1.66	0	6	0.61	2.63	1.97	135.29	0.18	49.35	7
25	101.32	0.82	-0.11	2.18	101.32	0.81	6	1.87	18.88	0.23	0	0.23	446.76	0.82	0	6	0.48	2.1	1.63	200.56	-0.03	90.19	7
26	114.6	0.87	-0.32	2.35	114.59	0.76	6	1.81	18.99	0.24	0	0.24	485.01	0.76	0	6	0.46	2.01	1.58	216.8	-0.1	96.71	7
27	125.53	0.92	-0.54	2.49	125.51	0.73	6	1.77	19.09	0.25	0	0.25	510.6	0.73	0	6	0.45	1.94	1.55	229.54	-0.16	100.72	7
28	57.9	0.66	-0.86	2.41	57.88	1.14	5	2.15	18.42	0.25	0	0.25	226.4	1.15	0	6	0.58	2.28	1.88	124.18	-0.24	63.09	7
29	20.01	1.7	-1.07	2.43	19.97	8.5	3	3.07	19.09	0.26	0	0.26	74.64	8.61	0	9	0.9	3.48	2.72	64.8	-0.29	11.91	3
30	58.85	3.95	-3.53	2.2	58.75	6.73	3	2.68	20.48	0.27	0	0.27	213.15	6.76	0	9	0.78	2.87	2.41	158.65	-0.93	14.77	3
31	46.93	3.79	-5.46	2.37	46.77	8.11	3	2.8	20.34	0.28	0	0.28	163.4	8.16	-0.01	9	0.83	2.96	2.53	129.97	-1.38	12.38	3
32	46.62	3.18	-6.21	2.91	46.43	6.84	3	2.75	20.14	0.29	0	0.29	156.61	6.88	-0.01	9	0.81	2.81	2.48	122.51	-1.52	14.51	3
33	47.87	2.74	-6.36	2.57	47.67	5.75	3	2.69	19.98	0.3	0	0.3	155.55	5.79	-0.01	9	0.79	2.67	2.42	119.34	-1.5	17	3
34	40.15	2.41	-6.31	2.31	39.96	6.04	3	2.75	19.76	0.31	0	0.31	126.09	6.09	-0.01	9	0.81	2.68	2.49	100.29	-1.45	16.2	3
35	44.24	2.14	-6.31	2.24	44.04	4.87	4	2.66	19.66	0.32	0	0.32	134.83	4.9	-0.01	9	0.78	2.51	2.4	103.88	-1.4	19.66	3
36	35.19	2.18	-6.28	0.91	35	6.24	3	2.8	19.6	0.33	0	0.33	103.76	6.3	-0.01	9	0.83	2.61	2.54	85.54	-1.35	15.7	3
37	180.86	2.37	-6.25	0.65	180.67	1.31	6	1.82	20.32	0.34	0	0.34	523.86	1.31	0	6	0.5	1.75	1.67	299.06	-1.31	66.78	7
38	156.79	2.66	-2.06	2.29	156.73	1.7	6	1.95	20.4	0.35	0	0.35	441.23	1.7	0	6	0.55	1.82	1.79	268.73	-0.42	52.79	7
39	194.2	0	-1.51	2.75	194.15	0	0	0	13.73	0.36	0	0.36	536.42	0	0	0	1	2.93	0	536.42	-0.3	780.59	0

	CPT-6	In situ data						Basic output data														
Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ã (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn	U2	I(B)	Mod. SBTn
1	13.89	0.06	0.19	0.79	13.89	0.41	5	2.5	15.06	0.01	0	0.01	1842.6	0.41	0	6	0.46	9.55	1.61	125.3	1.82	111.05	7
2	20.91	0.15	0.1	0.91	20.91	0.73	5	2.43	16.34	0.02	0	0.02	1330	0.73	0	6	0.49	7.94	1.67	156.69	0.44	90.42	7
3	14.3	0.18	0	0.93	14.3	1.25	4	2.68	16.37	0.02	0	0.02	597.9	1.25	0	6	0.58	8.95	1.91	120.76	0	59.15	7
4	14.12	0.28	-0.19	1.04	14.12	1.97	4	2.79	16.88	0.03	0	0.03	435.79	1.97	0	5	0.63	9.16	2.05	121.93	-0.42	42.49	7
5	18.6	0.54	-0.38	1.08	18.59	2.93	4	2.79	17.76	0.04	0	0.04	450.23	2.93	0	5	0.66	8.54	2.13	149.72	-0.67	31.37	5
6	18.5	0.98	-0.59	1.1	18.49	5.28	3	2.96	18.43	0.05	0	0.05	365.71	5.29	0	9	0.74	9.39	2.31	163.62	-0.85	18.56	3
7	21.07	1.05	-1.24	1.16	21.06	4.98	3	2.9	18.56	0.06	0	0.06	351.68	4.99	0	9	0.73	8.14	2.3	161.44	-1.49	19.57	3
8	19.23	1.02	-0.76	1.2	19.22	5.29	3	2.94	18.49	0.07	0	0.07	277.83	5.31	0	9	0.75	7.77	2.35	140.54	-0.8	18.46	3
9	52.05	0.97	-0.57	1.27	52.04	1.87	5	2.32	18.82	0.08	0	0.08	663.3	1.87	0	6	0.57	4.41	1.87	216.62	-0.53	47.64	7
10	57.86	0.73	-0.48	1.27	57.86	1.27	5	2.18	18.54	0.09	0	0.09	659.32	1.27	0	6	0.53	3.7	1.76	202.02	-0.39	64.89	7
11	16.74	0.96	-0.19	1.35	16.74	5.77	3	3.01	18.38	0.1	0	0.1	171.87	5.8	0	9	0.79	6.64	2.46	104.42	-0.14	16.94	3
12	17	0.96	-0.29	1.43	17	5.66	3	3	18.38	0.11	0	0.11	159.38	5.69	0	9	0.79	6.22	2.46	99.32	-0.19	17.21	3
13	65.84	0.77	-0.38	1.58	65.84	1.17	5	2.11	18.64	0.12	0	0.12	570.02	1.17	0	6	0.52	3.18	1.74	197.51	-0.24	68.8	7
14	17.02	0.69	-0.19	1.62	17.02	4.07	3	2.91	18	0.12	0	0.12	135.92	4.1	0	4	0.77	5.21	2.4	83.26	-0.11	22.65	5
15	16.21	0.85	-0.42	1.66	16.21	5.24	3	3	18.22	0.13	0	0.13	120.47	5.29	0	9	0.81	5.32	2.49	80.77	-0.23	18.26	3
16	18.93	0.86	-0.81	1.66	18.92	4.54	3	2.91	18.29	0.14	0	0.14	131.68	4.57	0	9	0.78	4.8	2.43	85.24	-0.41	20.72	3
17	20.1	0.88	-0.7	1.66	20.09	4.38	3	2.88	18.34	0.15	0	0.15	131.4	4.41	0	9	0.78	4.54	2.42	85.47	-0.33	21.36	3
18	18.59	0.95	-0.48	1.68	18.59	5.13	3	2.95	18.4	0.16	0	0.16	114.5	5.18	0	9	0.81	4.56	2.49	79.34	-0.21	18.58	3
19	18.01	0.97	-0.29	1.72	18.01	5.4	3	2.97	18.41	0.17	0	0.17	104.84	5.46	0	9	0.82	4.46	2.52	75.2	-0.12	17.74	3
20	14.16	0.82	-0.38	1.74	14.15	5.78	3	3.07	18.12	0.18	0	0.18	77.99	5.86	0	4	0.85	4.54	2.61	59.95	-0.15	16.61	3
21	15.47	0.65	-1.05	1.64	15.45	4.21	3	2.95	17.89	0.19	0	0.19	81.13	4.26	0	4	0.81	4.08	2.51	58.89	-0.4	21.46	3
22	13.3	0.72	-0.67	1.58	13.29	5.4	3	3.07	17.95	0.2	0	0.2	66.42	5.48	0	4	0.86	4.24	2.63	52.42	-0.24	17.48	3
23	25.72	0.76	-0.57	1.62	25.71	2.95	4	2.68	18.26	0.21	0	0.21	123.66	2.97	0	5	0.74	3.34	2.3	80.6	-0.2	29.26	5
24	44.92	0.61	0.05	1.56	44.92	1.36	5	2.29	18.23	0.22	0	0.22	207.59	1.37	0	6	0.61	2.64	1.97	111.49	0.02	54.64	7
25	71.81	0.68	0.29	1.58	71.81	0.95	6	2.03	18.53	0.22	0	0.22	318.7	0.95	0	6	0.53	2.27	1.76	153.85	0.09	75.74	7
26	246.04	1.31	0.67	1.31	246.05	0.53	6	1.45	19.75	0.23	0	0.23	1048.2	0.53	0	7	0.35	1.7	1.29	394.86	0.2	144.67	7
27	185.98	1.78	0.76	1.22	185.98	0.96	6	1.72	20.01	0.24	0	0.24	759.59	0.96	0	6	0.44	1.92	1.53	336.46	0.22	88.09	7
28	58.3	0.88	0.57	1.2	58.31	1.51	5	2.22	18.75	0.25	0	0.25	228.67	1.52	0	6	0.61	2.37	1.95	130.17	0.16	52.33	7
29	25.58	1.4	0.64	1.3	25.59	5.49	3	2.86	18.97	0.26	0	0.26	96.15	5.55	0	9	0.83	3.15	2.53	75.4	0.17	17.49	3
30	44.3	1.84	0.86	1.45	44.31	4.15	4	2.61	19.49	0.27	0	0.27	161.23	4.17	0	9	0.75	2.75	2.32	114.3	0.23	22.72	5
31	29.57	2.26	0.86	1.41	29.58	7.64	3	2.92	19.57	0.28	0	0.28	103.54	7.72	0	9	0.86	3.1	2.61	85.72	0.22	13.08	3
32	29.33	3.11	0.76	1.63	29.34	10.61	3	3.03	19.94	0.29	0	0.29	99.18	10.72	0	9	0.9	3.18	2.72	87.24	0.19	9.68	2
33	74.6	3.32	1.14	1.89	74.61	4.45	4	2.47	20.37	0.3	0	0.3	245.2	4.47	0	9	0.72	2.45	2.24	172.24	0.27	21.7	3
34	46.27	3.2	1.24	2.01	46.28	6.9	3	2.75	20.14	0.31	0	0.31	146.81	6.95	0	9	0.81	2.7	2.49	117.11	0.28	14.38	3
35	57.63	3.51	1.52	1.99	57.65	6.1	3	2.65	20.34	0.32	0	0.32	177.31	6.13	0	9	0.78	2.53	2.41	137.1	0.34	16.16	3
36	40.46	2.94	1.62	2.07	40.48	7.27	3	2.81	20	0.33	0	0.33	120.46	7.33	0	9	0.84	2.63	2.55	99.86	0.35	13.7	3
37	29.17	1.85	1.43	2.12	29.19	6.33	3	2.86	19.34	0.34	0	0.34	84.11	6.4	0	9	0.85	2.62	2.59	71.32	0.3	15.44	3
38	25.7	1.86	1.33	2.08	25.71	7.24	3	2.94	19.3	0.35	0	0.35	71.93	7.35	0	9	0.88	2.64	2.67	63.33	0.27	13.7	3
39	126.24	1.63	0.95	2.18	126.25	1.29	6	1.93	19.75	0.36	0	0.36	347.3	1.29	0	6	0.54	1.77	1.76	211.14	0.19	64.53	7
40	145.08	2.3	1.33	2.22	145.09	1.59	6	1.95	20.2	0.37	0	0.37	388.41	1.59	0	6	0.55	1.77	1.79	242.49	0.26	55.35	7
41	203.6	2.55	1.24	2.31	203.62	1.25	6	1.77	20.45	0.38	0	0.38	530.88	1.25	0	6	0.49	1.65	1.64	316.41	0.23	69.99	7
42	111.39	1.67	1.33	2.28	111.41	1.5	6	2.01	19.73	0.39	0	0.39	282.7	1.5	0	6	0.57	1.76	1.84	184.69	0.24	56.01	7
43	17.72	0.96	1.24	2.33	17.73	5.44	3	2.98	18.4	0.4	0	0.4	43.13	5.56	0.01	3	0.9	2.4	2.72	39.29	0.22	17.08	3
44	34.91	1.99	1.62	2.58	34.93	5.69	3	2.78	19.49	0.41	0	0.41	83.86	5.75	0	9	0.84	2.21	2.55	72.23	0.28	16.93	3
45	24.61	2.23	1.52	2.98	24.62	9.04	3	3.03	19.48	0.42	0	0.42	57.44	9.19	0	3	0.93	2.36	2.79	54.04	0.26	11.3	3
46	46.55	1.42	1.44	2.93	46.57	3.05	4	2.5	19.21	0.43	0	0.43	107.05	3.08	0	5	0.75	1.95	2.3	85.25	0.24	28.62	5
47	139.96	2.63	1.71	2.95	139.98	1.88	5	2.01	20.34	0.44	0	0.44	316.31	1.89	0	6	0.58	1.67	1.87	219.88	0.28	47.4	7
48	278.87	3.05	1.62	2.99	278.89	1.09	6	1.64	20.78	0.45	0	0.45	616.66	1.1	0	6	0.46	1.48	1.54	388.25	0.26	80.38	7
49	314.76	3.28	2.1	3.06	314.78	1.04	6	1.59	20.91	0.46	0	0.46	680.37	1.04	0	6	0.44	1.44	1.5	428.19	0.33	84.88	7
50	298.66	0	1.9	2.95	298.68	0	0	0	13.73	0.47	0	0.47	636.05	0	0	0	1	2.26	0	636.05	0.29	922.93	0

	CPT-7	In situ data						Basic output data														
Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ã (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn	U2	I(B)	Mod. SBTn
1	8.08	0.06	0.09	0.21	8.08	0.78	4	2.82	14.95	0.01	0	0.01	1079	0.78	0	6	0.54	14.24	1.81	108.6	0.91	76.86	7
2	13.47	0.21	0.03	0.44	13.47	1.54	4	2.75	16.53	0.02	0	0.02	854.55	1.54	0	6	0.58	11.47	1.92	145.94	0.15	52.8	7
3	10.22	0.29	0.09	0.42	10.22	2.88	3	3	16.82	0.02	0	0.02	422.52	2.89	0	5	0.68	12.84	2.17	123.74	0.28	31.3	5
4	10.75	0.38	0.18	0.5	10.75	3.55	3	3.03	17.14	0.03	0	0.03	327.66	3.56	0	8	0.71	11.74	2.25	118.9	0.4	26.15	5
5	17.87	0.6	0.18	0.54	17.87	3.36	3	2.84	17.85	0.04	0	0.04	428.08	3.37	0	8	0.68	8.98	2.17	151.23	0.31	27.83	5
6	15.38	0.85	-0.23	0.59	15.38	5.56	3	3.03	18.2	0.05	0	0.05	301.97	5.57	0	9	0.76	9.91	2.36	143.48	-0.33	17.65	3
7	16.38	0.88	-0.38	0.67	16.38	5.39	3	3	18.26	0.06	0	0.06	272.5	5.41	0	9	0.76	8.78	2.37	135.38	-0.46	18.13	3
8	16.78	0.98	-0.35	0.75	16.77	5.87	3	3.02	18.4	0.07	0	0.07	241.83	5.9	0	9	0.77	8.23	2.41	129.85	-0.36	16.74	3
9	32.52	1.16	-0.29	0.81	32.52	3.58	4	2.66	18.85	0.08	0	0.08	413.29	3.59	0	8	0.68	5.8	2.15	177.76	-0.26	26.52	5
10	48.74	0.98	-0.17	0.94	48.74	2.02	5	2.36	18.81	0.09	0	0.09	553.47	2.02	0	6	0.59	4.33	1.92	199.02	-0.14	44.21	7
11	18.19	1.08	0	0.91	18.19	5.93	3	2.99	18.53	0.1	0	0.1	186.14	5.96	0	9	0.79	6.57	2.45	112.26	0	16.55	3
12	22.86	0.86	-0.86	0.89	22.85	3.75	4	2.79	18.36	0.11	0	0.11	213.82	3.77	0	8	0.73	5.31	2.29	114.12	-0.58	24.81	5
13	47.63	0.62	-0.67	0.88	47.62	1.29	5	2.25	18.26	0.12	0	0.12	411.42	1.29	0	6	0.56	3.46	1.85	155.55	-0.42	61	7
14	14.68	0.75	-0.08	0.89	14.68	5.09	3	3.02	18.03	0.12	0	0.12	116.9	5.13	0	9	0.81	5.63	2.5	77.37	-0.05	18.71	3
15	16.14	1.01	0.09	0.89	16.14	6.26	3	3.05	18.41	0.13	0	0.13	119.69	6.32	0	9	0.82	5.51	2.55	83.27	0.05	15.65	3
16	17.42	1.07	0.29	0.91	17.42	6.16	3	3.02	18.51	0.14	0	0.14	120.84	6.21	0	9	0.82	5.18	2.54	84.52	0.14	15.89	3
17	16.62	1.17	0.66	0.95	16.63	7.01	3	3.07	18.59	0.15	0	0.15	108.19	7.07	0	9	0.84	5.14	2.6	80.09	0.31	14.15	3
18	17.99	1.01	0.95	0.98	18	5.59	3	2.98	18.45	0.16	0	0.16	110.47	5.64	0	9	0.82	4.65	2.52	78.41	0.42	17.25	3
19	15.15	1.05	0.95	1.04	15.17	6.92	3	3.1	18.43	0.17	0	0.17	87.85	7	0	9	0.86	4.81	2.63	68.16	0.4	14.29	3
20	14.85	1.18	0.95	1.06	14.86	7.95	3	3.14	18.56	0.18	0	0.18	81.58	8.04	0	9	0.88	4.78	2.69	66.26	0.38	12.65	3
21	17.69	1.19	0.76	1.14	17.7	6.73	3	3.04	18.64	0.19	0	0.19	92.5	6.8	0	9	0.85	4.34	2.61	71.8	0.29	14.66	3
22	14.56	1.12	0.67	3.02	14.57	7.66	3	3.14	18.49	0.2	0	0.2	72.37	7.76	0	9	0.89	4.43	2.7	60.1	0.24	13.07	3
23	17.47	0.68	0.76	3.14	17.48	3.87	3	2.89	17.98	0.21	0	0.21	83.24	3.91	0	4	0.8	3.7	2.48	60.33	0.26	22.99	5
24	42.59	0.44	0.92	3.26	42.6	1.03	5	2.24	17.83	0.22	0	0.22	195.84	1.04	0	6	0.59	2.55	1.91	102.17	0.3	63.74	7
25	70.47	0.56	0.95	3.31	70.48	0.79	6	1.99	18.29	0.23	0	0.23	311.42	0.79	0	6	0.52	2.22	1.72	147.24	0.3	84.34	7
26	108.08	0.98	1.15	3.43	108.09	0.91	6	1.88	19.11	0.24	0	0.24	458.67	0.91	0	6	0.49	2.08	1.64	212.12	0.35	84.51	7
27	116.18	1.09	1.25	3.35	116.2	0.94	6	1.86	19.26	0.24	0	0.24	473.68	0.94	0	6	0.49	2.04	1.64	223.2	0.37	83.27	7
28	67.24	1.26	1.33	3.41	67.26	1.87	5	2.24	19.21	0.25	0	0.25	263.4	1.87	0	6	0.61	2.4	1.97	151.84	0.38	45.66	7
29	42.96	2.6	1.53	3.47	42.98	6.06	3	2.73	19.88	0.26	0	0.26	161.6	6.1	0	9	0.79	3	2.44	120.93	0.42	16.22	3
30	57.8	4.12	1.62	3.43	57.82	7.13	3	2.7	20.52	0.27	0	0.27	209.57	7.17	0	9	0.79	2.9	2.43	157.87	0.42	13.97	3
31	49.92	4.41	1.59	3.22	49.94	8.84	3	2.81	20.54	0.28	0	0.28	174.32	8.89	0	9	0.83	2.98	2.54	139.73	0.4	11.41	3
32	54.16	4.14	1.81	3.12	54.18	7.64	3	2.74	20.5	0.3	0	0.3	182.6	7.68	0	9	0.81	2.81	2.48	143.13	0.44	13.1	3
33	43.57	3.21	1.91	2.98	43.59	7.37	3	2.79	20.13	0.31	0	0.31	141.84	7.42	0	9	0.83	2.79	2.52	114.16	0.45	13.53	3
34	44.65	3.08	2.1	2.85	44.67	6.89	3	2.76	20.09	0.32	0	0.32	140.72	6.94	0	9	0.82	2.69	2.5	112.85	0.48	14.4	3
35	73.3	3.02	2.1	2.81	73.33	4.11	4	2.45	20.25	0.33	0	0.33	224.4	4.13	0	8	0.71	2.32	2.23	160.25	0.47	23.26	5
36	48.33	2.28	2.19	2.62	48.36	4.72	4	2.62	19.77	0.34	0	0.34	143.26	4.75	0	9	0.77	2.42	2.37	110	0.47	20.25	3
37	35.46	1.9	2.29	2.58	35.49	5.36	3	2.75	19.44	0.34	0	0.34	101.88	5.41	0	9	0.82	2.5	2.49	82.93	0.48	17.91	3
38	24.56	2.14	2.1	2.54	24.59	8.72	3	3.02	19.44	0.35	0	0.35	68.33	8.85	0.01	9	0.91	2.71	2.74	61.98	0.43	11.64	3
39	39.54	2.08	1.91	2.31	39.56	5.26	3	2.71	19.59	0.36	0	0.36	107.56	5.31	0	9	0.81	2.37	2.47	87.75	0.38	18.23	3
40	35.43	1.67	2.12	2.2	35.45	4.72	4	2.71	19.3	0.37	0	0.37	93.77	4.77	0	9	0.81	2.32	2.47	76.91	0.41	19.9	3
41	200.44	2.07	2	2.12	200.47	1.04	6	1.72	20.21	0.38	0	0.38	520.74	1.04	0	6	0.47	1.61	1.58	304.41	0.38	81.52	7
42	95.74	2.16	2.36	2.1	95.77	2.26	5	2.18	19.97	0.39	0	0.39	241.93	2.27	0	5	0.63	1.87	2.01	168.39	0.43	39.48	7
43	139.15	1.47	2.28	2.1	139.18	1.06	6	1.84	19.68	0.4	0	0.4	343.48	1.06	0	6	0.51	1.64	1.69	214.62	0.41	75.37	7
44	22.67	0.86	2.42	1.98	22.7	3.8	3	2.79	18.36	0.41	0	0.41	53.92	3.87	0.01	4	0.84	2.21	2.55	46.47	0.42	22.62	5
45	18.75	1.25	3.48	1.92	18.79	6.67	3	3.02	18.72	0.42	0	0.42	43.47	6.82	0.01	3	0.93	2.34	2.77	40.65	0.59	14.58	3
46	27.94	2.37	3.24	1.85	27.98	8.48	3	2.97	19.61	0.43	0	0.43	63.7	8.61	0.01	9	0.92	2.27	2.74	59.12	0.54	11.93	3
47	151.88	2.47	3.43	1.72	151.92	1.63	6	1.94	20.3	0.44	0	0.44	342.29	1.63	0	6	0.56	1.63	1.81	233.12	0.56	53.98	7
48	370.03	3.1	3.62	1.72	370.07	0.84	6	1.47	20.91	0.45	0	0.45	815.98	0.84	0	6	0.4	1.4	1.38	489.87	0.58	103.91	7
49	273.45	3.45	3.94	1.75	273.5	1.26	6	1.69	20.91	0.46	0	0.46	589.16	1.26	0	6	0.48	1.48	1.59	382.88	0.61	70.99	7
50	247.87	0	3.64	1.85	247.92	0	0	0	13.73	0.47	0	0.47	526.14	0	0	0	1	2.25	0	526.14	0.56	765.91	0

	CPT-8	In situ data						Basic output data														
Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ã (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn	U2	I(B)	Mod. SBTn
1	22.94	0.5	1.61	0.31	22.99	2.19	4	2.64	17.75	0.01	0	0.01	2587.5	2.19	0.01	6	0.55	14.19	1.84	308.18	13.02	42.7	7
2	10.25	0.35	0.54	0.35	10.27	3.39	3	3.04	17.01	0.02	0	0.02	589.48	3.39	0	8	0.67	15.91	2.17	154.15	2.22	27.69	5
3	11.43	0.4	0	0.13	11.43	3.52	3	3.01	17.22	0.03	0	0.03	438.96	3.53	0	8	0.69	12.93	2.21	139.35	0	26.61	5
4	12.69	0.5	-0.28	0.29	12.68	3.95	3	3	17.52	0.03	0	0.03	363.94	3.96	0	8	0.71	11.32	2.26	135.32	-0.57	23.96	5
5	14.36	0.61	-0.69	0.03	14.34	4.25	3	2.98	17.79	0.04	0	0.04	327.49	4.27	0	9	0.72	10.08	2.28	136.1	-1.14	22.45	5
6	16.55	0.88	-2.29	-0.03	16.48	5.36	3	3	18.27	0.05	0	0.05	311.22	5.38	-0.01	9	0.75	9.43	2.35	146.34	-3.13	18.24	3
7	13.51	0.78	-2.51	0.33	13.43	5.82	3	3.09	18.05	0.06	0	0.06	216.31	5.85	-0.01	9	0.78	9.2	2.43	116.28	-2.92	16.83	3
8	24.43	0.74	-4.13	0.45	24.3	3.03	4	2.71	18.21	0.07	0	0.07	341.77	3.04	-0.01	5	0.68	6.21	2.15	142.22	-4.19	30.31	5
9	99.09	0.59	0.64	0.38	99.11	0.6	6	1.8	18.5	0.08	0	0.08	1235.6	0.6	0	6	0.4	2.83	1.45	264.87	0.58	120.07	7
10	16.74	0.62	0.86	0.41	16.76	3.71	3	2.89	17.87	0.09	0	0.09	187.16	3.73	0	5	0.74	6.24	2.32	98.41	0.69	24.82	5
11	14.76	0.54	0.86	0.26	14.78	3.64	3	2.93	17.66	0.1	0	0.1	149.97	3.67	0	4	0.76	6.04	2.36	83.84	0.63	24.85	5
12	16.2	0.69	0.81	0.58	16.23	4.25	3	2.94	17.98	0.11	0	0.11	150.78	4.28	0	9	0.77	5.83	2.4	88.81	0.55	21.95	5
13	10.96	0.71	0.89	0.37	10.98	6.48	3	3.19	17.86	0.12	0	0.12	93.83	6.55	0.01	9	0.85	6.55	2.62	67.33	0.55	15.13	3
14	12.97	0.78	1.29	0.67	13.01	6.01	3	3.11	18.04	0.12	0	0.12	103.19	6.07	0.01	9	0.83	5.93	2.57	72.25	0.74	16.17	3
15	14.77	0.77	1.5	0.86	14.82	5.22	3	3.03	18.07	0.13	0	0.13	109.67	5.27	0.01	9	0.81	5.39	2.51	74.75	0.81	18.27	3
16	15.11	0.68	1.03	0.74	15.14	4.49	3	2.98	17.93	0.14	0	0.14	104.95	4.53	0	4	0.8	4.98	2.48	70.61	0.52	20.66	3
17	12.13	0.79	2.17	0.82	12.19	6.46	3	3.15	18.02	0.15	0	0.15	79.28	6.54	0.01	3	0.86	5.34	2.64	60.76	1.03	15.14	3
18	12.13	0.67	2.46	0.67	12.2	5.49	3	3.1	17.84	0.16	0	0.16	74.89	5.57	0.01	4	0.85	4.97	2.61	56.52	1.1	17.29	3
19	16.68	0.74	1.17	0.49	16.72	4.45	3	2.94	18.08	0.17	0	0.17	97.45	4.5	0.01	4	0.8	4.35	2.49	68.09	0.49	20.75	3
20	11.82	0.83	0.98	0.5	11.85	7	3	3.18	18.07	0.18	0	0.18	65.25	7.1	0.01	3	0.89	4.85	2.71	53.53	0.4	14.11	3
21	16.44	0.98	-3.74	0.73	16.33	5.98	3	3.03	18.38	0.19	0	0.19	85.81	6.05	-0.02	9	0.85	4.32	2.6	65.83	-1.43	16.19	3
22	21.02	0.95	-3.07	1.35	20.93	4.55	3	2.87	18.45	0.2	0	0.2	105.08	4.59	-0.01	4	0.8	3.82	2.47	74.86	-1.12	20.5	3
23	22.93	0.63	1.82	1.31	22.99	2.74	4	2.7	18.01	0.21	0	0.21	110.44	2.77	0.01	5	0.74	3.36	2.31	72.42	0.64	30.47	5
24	43	0.82	1.51	1.28	43.05	1.91	5	2.39	18.56	0.22	0	0.22	198.71	1.92	0	5	0.65	2.8	2.07	113.41	0.5	42.83	7
25	48.74	0.86	1.44	1.41	48.78	1.77	5	2.33	18.66	0.22	0	0.22	215.9	1.78	0	5	0.63	2.65	2.02	121.8	0.46	45.98	7
26	84.14	1.02	1.07	1.51	84.17	1.21	6	2.04	19.06	0.23	0	0.23	358.05	1.22	0	6	0.54	2.26	1.78	179.34	0.33	65.69	7
27	13.18	0.58	1.36	1.37	13.22	4.42	3	3.02	17.71	0.24	0	0.24	53.33	4.5	0.01	4	0.86	3.54	2.62	43.36	0.4	20.13	3
28	13.3	1.02	-1.29	1.58	13.26	7.71	3	3.17	18.35	0.25	0	0.25	51.53	7.86	-0.01	3	0.92	3.75	2.78	46.05	-0.37	12.98	3
29	25.5	3.08	-6.74	1.73	25.3	12.17	3	3.11	19.87	0.26	0	0.26	95.43	12.3	-0.02	9	0.92	3.61	2.78	85.32	-1.85	8.52	2
30	63.27	0	-10.79	1.81	62.95	0	0	0	13.73	0.27	0	0.27	232.79	0	-0.01	0	1	3.93	0	232.79	-2.88	346.84	0

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

:: Unit Weight, g (kN/m³) ::

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

where g_w = water unit weight

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

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

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

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

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

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

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

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

(applicable only to $I_c < I_{c_cutoff}$)

:: Relative Density, Dr (%) ::

$100 \cdot \sqrt{\frac{Q_{tn}}{k_{DR}}}$ (applicable only to SBT_n: 5, 6, 7 and 8 or $I_c < I_{c_cutoff}$)

:: State Parameter, ψ ::

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

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

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

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

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

If $I_c > 2.20$

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

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

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

If $I_c \leq 2.20$

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

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

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

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

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

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

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

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

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

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

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

:: Overconsolidation Ratio, OCR ::

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

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

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

:: In situ Stress Ratio, Ko ::

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

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

:: Soil Sensitivity, S_t ::

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

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

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

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

(applicable for $0.10 < B_q < 1.00$)

References

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

ROY J. SHLEMON & ASSOCIATES, INC.

Geologic and Environmental Consultants

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Quaternary Geology
Economic Geomorphology
Soil Stratigraphy
Geoarchaeology
PG 2867; CPG 1766; CPESC 2167

RECOMMENDATION FOR ACCEPTANCE

REPORT FOR INVESTIGATION OF POTENTIAL SURFACE FAULT RUPTURE 468 N. Rodeo Drive, Beverly Hills, California 90210

As authorized by the City of Beverly Hills, this document summarizes technical (peer) reviews for a "Fault Hazard [Ground Rupture] Investigation" for proposed redevelopment of the 468 N. Rodeo property in the City of Beverly Hills, California. The investigations were carried by Feffer Geological Consulting, Inc. (FGC), the Consultants-of-Record, on behalf of the applicant, the 468 N. Rodeo Drive, LLC. The main purpose of the FGC investigation was to determine if possible splays of the Santa Monica fault zone potentially impact the site, and if such faults were "active" (defined by the California Geological Survey [CGS] as surface or near-surface displacement within the last 11,700 years).

The site is about 170 ft from the nearest, CGS-designated Earthquake Fault Zone (EFZ), the Santa Monica, and relatively near the Hollywood EFZ that extends into the City on the northeast and the West Pico EFZ that currently "stops" at the City limits on the southeast (see various regional maps in the FGC report). The City requires independent fault-activity reviews in conformance with building codes, with current requirements of the CGS (2018, Special Pub. 42) and to ensure public health, safety and welfare.

The reviews included initial telephone and email discussions with applicant representatives, the consultants and City personnel about investigation requirements and scope of work. These were followed by on-site field observation of continuous cores, interpretations of FGC preliminary cross-sections, cone penetrometer tests and site-specific soil-stratigraphic correlations. Likewise reviewed was an FGC draft report, similarly followed by discussions with FGC personnel and the applicant, and ultimately acceptance of the final report.

The FGC final report, dated 28 August 2018, documents pertinent literature and maps, summarizes field investigation procedures, provides the regional geologic framework and tectonic setting, and expounds on specific investigation procedures and technical data supporting the professional conclusions and recommendations.

In sum, the fundamental conclusions of the Consultants-of-Record are:

1. That the FGC regional assessments and site-specific investigations meet current standards-of-practice for fault-activity assessments in southern California in general and to those specifically required by the City of Beverly Hills in particular;

2. That the FGC site-specific investigations and interpretations are sufficient to identify, date and correlated subsurface stratigraphic markers, which are unbroken and generally more than 11,700 years old;

3. That, despite diligent observation, no charcoal or other materials amenable to unequivocal radiocarbon or other numeric dating methods were recovered;

4. That the on-site sediments were dated primarily by soil-stratigraphic techniques (Appendix A). Identified were multiple moderately to strongly developed buried paleosols locally replete with common to many, moderately thick illuvial clay films all indicating a pre-11,700-yr age; and that these soils and sediments are traced across the site and, in association with CPT “signature,” are unbroken.

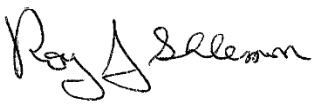
5. That, the 468 N. Rodeo Drive property is not subject to potential surface or near-surface displacement associated with the Santa Monica, the Hollywood, the West Pico or any other fault reasonably projected toward it.

Accordingly, based substantially on, and in reliance of their professional interpretations and conclusions, the FGC regional summaries and site-specific investigations are judged to meet current standards-of-practice for fault-activity assessments in southern California in general and to those specifically required by the City of Beverly Hills in particular.

Please note that the ECI report focuses solely on potential surface or near-surface fault rupture and does not specifically address possible high seismic accelerations, ground deformation or other structural design and geotechnical investigations required by applicable building codes or by present professional engineering and

geological standards of practice. It is therefore incumbent upon the applicant, FGC, or other consultants, to provide this information to the City of Beverly Hills for technical review and potential acceptance prior to issuance of building permits.

Recommended for Acceptance



_____

Roy J. Shlemon, Ph.D.
Technical Reviewer

29 August 2018

David Yelton, Deputy Building Official
Development Services Division
Community Development Department

August 29, 2018

468 N. Rodeo Drive LLC,
A California limited liability company
Attention: Mr. Joseph Fallas
19 E. 57th Street
New York, NY 10022

Subject: Acceptance of City's Peer-Reviewer Recommendation For Acceptance: "Report For Investigation Of Potential Surface Fault Rupture:" 468 North Rodeo Drive, Beverly Hills, California 90210

Dear 468 N. Rodeo Drive LLC:

The "Fault Hazard [Ground Rupture] Investigation" (Investigation) for the proposed redevelopment of the 468 N. Rodeo Drive property, in the City of Beverly Hills, California. The investigations were carried out by Feffer Geological Consulting, Inc. ("FGC"), the Consultants-of-Record, on behalf of the applicant, the 468 N. Rodeo Drive LLC. The main purpose of the FGC investigation was to determine if possible splays of the Santa Monica fault zone potentially impact the site, and if such faults were "active" (defined by the California Geological Survey [CGS] as surface or near-surface displacement within the last 11,700 years). The FGC investigation has been peer reviewed by the City's consultant, Roy J. Shlemon, Ph.D., PG 2867; CPG 1766; CPESC 2167, of Roy J. Shlemon & Associates, Inc. ("RSA").

The peer review included critique of the Site-Specific Fault Rupture Investigation titled "Report on a Fault Hazard Investigation for the Property Located at 468 N. Rodeo Drive, Beverly Hills, California, 90210" (FGC Project File No. 2188-85 dated August 20, 2018 attached).

The geologic investigation and peer review are required by the City in conformance with the current building codes and with current geologic-standards-of practice that ensure public health, safety and welfare.

Accordingly, in reliance on the technical documentation and assurances provided by the Consultants-of-Record, including their opinions and conclusions, the City of Beverly Hills now formally accepts the technical "Recommendation For Acceptance" of the Reviewer (attached).

Sincerely,

D. Yelton

Attachments: 1) Roy J. Shlemon, Ph.D., PG 2867; CPG 1766; CPESC 2167, of Roy J. Shlemon & Associates, Inc., "Recommendation For Acceptance," August 29, 2018
2) Feffer Geological Consulting Fault Rupture Hazard Investigation Report, Project File No. 2188-85, dated August 20, 2018

Appendix IS-3.3



Investigation of Potential Faulting:
449 North Rodeo

PD EXHIBIT 13

FEFFER
GEOLOGICAL CONSULTING

January 16, 2020 File No. 2387-95

449 N. Beverly Drive LLC,
a California limited liability company
19 E. 57th St., New York, NY 10022
Attn: Mr. Franklin Dickinson

SUBJECT: **INVESTIGATION OF POTENTIAL FAULTING**
449 North Beverly Drive, Beverly Hills, CA 90210
APN: 4343-016-019

Dear Mr. Dickinson:

We are pleased to submit this report summarizing our fault rupture hazard investigation for 449 N. Beverly Drive in the City of Beverly Hills, California. This investigation assesses the potential for surface fault rupture and determines if the area of 449 N. Beverly Drive is suitable for the construction of human-occupied structures. 449 N. Beverly Drive is currently not mapped as being potentially affected by surface faulting and is approximately 75 feet to the northwest of the currently mapped Santa Monica Fault Zone (SMFZ).

The investigation consisted of reviewing pertinent published and unpublished reports, assessing the site geomorphology, and drilling one continuously cored boring to determine underlying stratigraphy. The combination of continuous, unbroken late Pleistocene soil horizons and stratigraphy demonstrates the absence of active faulting beneath the site.

We therefore conclude that the project site is not impacted by state-defined active faults. Accordingly, no fault setback distances or "no-build" zones impact or limit future development.

We appreciate this opportunity to be of service. Should you have any questions regarding the information contained in this report, please do not hesitate to contact us.

Sincerely,

FEFFER GEOLOGICAL CONSULTING, INC.

PROFESSIONAL GEOLOGIST
JOSHUA FEFFER
No. 2138
Certified Engineering Geologist
STATE OF CALIFORNIA

Joshua R. Feffer
Principal Engineering Geologist
C.E.G. 2138

INTRODUCTION AND BACKGROUND

The project site is located on the southwest side of north Beverly Drive near the corner of south Santa Monica Boulevard and north Beverly Drive, and consists of a commercial lot that is currently occupied by two single-story buildings within a developed portion of the City of Beverly Hills, CA (Figure 1). For the purpose of description, it is assumed that Beverly Drive is oriented in a north-south direction. The site is bounded to the north by 461 N. Beverly Drive, to the west by an alley, and to the east by north Beverly Drive. Commercial structures and office buildings are located adjacent to the site.

The existing 449 N. Beverly Drive structure was constructed prior to the establishment of the State-mandated Santa Monica Earthquake Fault Zone (SMFZ) (Figure 2). The subject site is entirely outside of this zone and is about 75 feet to the northwest from the northernmost edge of the zone. To ensure public health and safety, a fault investigation is required by the City of Beverly Hills. The surface expression of fault-related geomorphic features has been destroyed by urbanization and development within the greater Los Angeles area which has obscured the lateral extent, location, and rupture history of faulting. Dolan et al. (2000) identified the fault based on topographic scarps north of Santa Monica Boulevard in the Westwood area. Additional work (Olson, 2015) refined the map representation of the fault scarps, and largely confirms the work by Dolan et al. (2000). The mapped location of the SMFZ in relation to the subject site was also obtained from the State of California's recent Earthquake Fault Zone Map (Olson, 2018) (Figure 2).

The site is outside of the current Earthquake Zones of Required Investigation (CGS, 2018a). However, it is subject to the Alquist-Priolo Special Studies Zone Act of 1972 (California Public Resources Code, Chapter 7.5, Division 2), and an investigation is required by the City of Beverly Hills. The AP Special Studies Zone Act specifically defines a fault as active if it demonstrates surface displacement that has occurred within the Holocene (past 11,700 years). This investigation specifically assesses the potential for surface fault rupture at 449 N. Beverly Drive.

SCOPE OF WORK

Trenching is the preferred method for evaluating the presence or absence of faults because it offers a continuous, direct exposure of the fault zone or near surface stratigraphy. However, in this portion of the SMFZ, trenching is difficult due to existing structures. Therefore, this fault rupture hazard study consists of one continuously cored boring drilled to 50 feet in depth and incorporates CPT and continuous core data collected from the adjacent sites located at 456 and 468 N. Rodeo Drive. The scope of work consists of:

- Review of published and unpublished geotechnical data in the site vicinity;
- Analysis of topographic maps of the site vicinity;
- Obtaining drilling permits and marking of underground utilities;
- Excavating and logging one fifty foot deep boring;
- Continuous core/data review with Dr. Roy J. Shlemon;
- Preparation of this report;

FAULT ACTIVITY CRITERIA

In general, fault activity is based on the age of displaced and undisturbed sediment. According to the CGS (2018b), a fault can be either age-undetermined, Holocene-active, or a pre-Holocene fault (see details below). If charcoal or other numerically datable specimens are present, a numeric age can be established. If no datable material exists, then a relative age can be assigned to movement along the fault usually based on the relative development of buried paleosols.

According to CGS Special Publication 42 (2018b), a fault is defined as the following:

> *"A shear or zone of closely associated shears across which earth materials on one side have been displaced with respect to those on the other side because of tectonic forces. A fault is distinguished from those fractures or shears caused by landsliding or other gravity-driven surficial failures.*
>
> ***age-undetermined fault:*** *A fault whose age of most recent movement is not known or is unconstrained by dating methods or by limitations in stratigraphic resolution.*
>
> ***Holocene-active fault:*** *A fault that has had surface displacement within Holocene time (the last 11,700 years)**.***
>
> ***pre-Holocene fault:*** *A fault whose recency of past movement is older than 11,700 years, and thus does not meet the criteria of Holocene-active fault as defined in the State Mining and Geology Board regulations (California Code of Regulations, Title 14, Division 2, Section 3601.(a)).*" (CGS, 2018b, p. 1-2)

REGIONAL AND LOCAL GEOLOGY

The site is located in the Los Angeles Basin, a part of the Transverse Ranges Geomorphic province (Figure 3). The Los Angeles Basin lies within a transitional zone between the Transverse Ranges to the north and the Peninsular Ranges (Yerkes et. al., 1965). The basin is bounded on the north by the Santa Monica Mountains, on the east by the Elysian Hills, the west by the Newport-Inglewood Uplift and the south by the La Brea high, an area of shallow bedrock.

The predominate structure in the project site area is the east-west trending Malibu Coast-Santa Monica-Raymond-Cucamonga fault system (Crook et al., 1983), which extends for approximately 125 miles to form the southern boundary of the Transverse Ranges. This fault system is also referred to as the Transverse Ranges Southern Boundary fault system (TRSB) by Dolan et al. (2000). This complex system of east-west trending faults accommodates north-south shortening and uplift, and concurrent westward motion of the Western Transverse Ranges. Individual faults within the TRSB fault system exhibit varying degrees of both left-lateral strike-slip and contractional dip-slip faulting and related folding (Hill, 1979; Crook et al., 1983; Jones et al., 1990; Dolan et al., 2000). All faults within the system show evidence for Quaternary activity and several, including the Santa Monica and Hollywood faults, have been demonstrated by site-specific paleoseismic studies to be active during the Holocene (Jones et al., 1990; Weaver and Dolan, 2000; Dolan et al., 2000).

From a local perspective, the site is located within the uplifted and dissected Beverly Hills area. Geologic mapping of the area is consistent and provides more accurate age constraints in later mapping.

Yerkes and Campbell (2005) and Hoots and Kew (1931) mapped Holocene aged alluvium over older Pleistocene aged alluvial and fan deposits (Figure 4) while Dibblee (1991) mapped younger Holocene aged alluvial gravels at the surface overlying older Pleistocene age alluvial fan sediments (Figure 5). More recent mapping (Figure 6) from Campbell (2014) indicates that the sediments exposed in the area consist of primarily lower Holocene to upper Pleistocene age alluvium near the ground surface underlain by upper to lower Pleistocene aged alluvial fan deposits, and interbedded terrestrial fan and shallow marine sediments. None of these regional geologic maps delineate the SMFZ in the vicinity of the project site area.

Santa Monica Fault Zone

The SMFZ portion of the TRSB trends east-west from the Santa Monica coastline on the west to the Hollywood area on the east (see Figure 2). It is an oblique-reverse, left-lateral fault that is thought to be a surface expression of tectonic deformation related to Pliocene-Quaternary structural development of the Santa Monica Mountains. Integration of subsurface oil and gas exploration seismic data and well logs with surficial mapping indicate the mountains are underlain by a large southward-vergent asymmetric anticline formed over a regional north-dipping thrust ramp at a depth of 6 to 9 miles. Geophysical studies conducted at the Veteran's Administration (VA) property in West Los Angeles indicate the SMFZ is a gently dipping thrust fault with secondary near-vertical faults extending from the primary basal fault toward the ground surface (Pratt et al., 1998; Dolan et al., 2000).

The surface expression of the SMFZ is limited to fault-related geomorphic features, many of which have been destroyed by urbanization and development within the greater Los Angeles area (Figure 7). This has resulted in a poor understanding of the lateral extent, location, and rupture history of the SMFZ. Dolan et al. (2000) identified the fault location based on topographic scarps north of Santa Monica Boulevard. The most prominent of these scarps is located at the base of a late to middle Pleistocene fan surface in west Los Angeles that extends from approximately University High School to the Mormon Temple, juxtaposing older surficial deposits and relatively shallow bedrock to the north against younger surficial deposits and a thick expanse of old alluvium to the south. Both trenching studies and seismic reflections profiles reveal that, at the VA property, the SMFZ topographic scarp contains a series of steeply dipping to sub-vertical faults that offset late Quaternary sediments (Crook et al., 1983; Pratt et al., 1998; Dolan et al., 2000; Catchings et al., 2001). Radiometric dating of key stratigraphic horizons at the VA site indicate that five to six surface-rupturing events have occurred between approximately 50,000 and 1,000-3,000 years before present (Dolan et al., 2000).

West of the project site, the SMFZ has typically been mapped just north of and parallel to Santa Monica Boulevard, following a series of scarps at the base of late to middle Pleistocene fan surfaces (Dolan et al., 2000; Bedrossian et al., 2012; Olson, 2015). However, recent subsurface explorations and geophysical studies in Century City (e.g., Parsons, 2011) have inferred the presence of a zone of faulting that extends south of Santa Monica Boulevard as well. Parsons (2011) interpreted these faults as active, however, subsequent studies have refuted this interpretation. Kenney (2012; 2013) reviewed the data by Parsons (2011) and subsequent studies and supplemented them with his own geologic and geomorphic analysis. Kenney (2012) interpreted the data to indicate that the primary basal SMFZ actually projects far to the south of the project site, and that faulting along and south of Santa Monica Boulevard should be attributed to the newly designated "Santa Monica Boulevard Fault Zone" (SMBFZ).

Faults associated with the SMBFZ dip steeply to the north and are thought to exhibit right-lateral displacement (Kenney, 2012), although a definitive sense of slip has not been established (Kenney,

2013). These faults are interpreted to be secondary structures related to the primary basal reverse SMFZ that is thought to underlie the Century City area at depth (Kenney, 2012; Lettis, 2013). Based on our review of the recent Century City studies (discussed in detail below), the faults subject to this investigation are part of the SMBFZ.

Both Kenney (2012) and Parsons (2011) indicate there is no direct evidence that SMBFZ faults along and south of Santa Monica Boulevard are active. To date, the only evidence of Holocene activity within the SMFZ and SMBFZ is for faults that are coincident with the topographic scarp north of Santa Monica Boulevard (e.g., Dolan et al., 2000; Geocon, 2014). Updated mapping of the SMBFZ (Figure 8) provided by the City of Beverly Hills, based on mapping by the CGS, locates the fault zone as extending from the beyond the western city boundary trending northeastward and terminating near north Maple Drive and Alden Drive (City of Beverly Hills, 2018). Furthermore, the SMBFZ postulated by Kenney (2012) or just the SMFZ as it is commonly referred to, is approximately 130 feet south of the subject site (see Figure 2 and Figure 8).

Newport-Inglewood Fault Zone

The Newport-Inglewood fault (NIFZ) zone is mapped across the western portion of the Los Angeles Basin and generally trends north to northwest. The faulting is topographically expressed onshore by elevated surfaces which extend from the Newport Mesa in the south to the Beverly Hills area in the north (Earth Consultants International, 2018). As currently mapped, the northern portion of the Newport-Inglewood Fault ends near Pico Boulevard south of the Beverly Hills area (see Figure 2 and Figure 8); however, the location of the northern fault strands has been debated widely in the geological literature.

TOPOGRAPHIC / GEOMORPHIC REVIEW

Existing topography was examined for recognizable scarps or breaks in slope that may suggest the location of faulting through a combined review of previous geomorphic analyses (Earth Consultants International, 2018 and Lettis, 2013 and Dolan et. al., 2000) and historical U.S. Geologic Survey topographic maps (Figures 7 and 9).

Geomorphically, the site is on a degraded Holocene-aged alluvial fan surface that has been incised by north-south to northwest-southeast trending drainages (Figures 4, 5, 6, 7, and 9). Locally, the area gently slopes to the east and southeast which is consistent with natural sedimentary and fluvial processes. To the southwest of the site a prominent southeast-facing escarpment, which has historically been used to locate the Santa Monica fault, is crosscut by multiple northwest trending drainages (e.g., Dolan et al., 2000). This scarp shown in Figure 7 is prominently expressed approximately 3 mi southwest of the site at the Mormon Temple. However, from the Mormon Temple to the site, this scarp becomes less pronounced in the landscape and unrecognizable in the vicinity of the subject site (see Figure 9) where urbanization masks geomorphic features related to faulting.

PREVIOUS INVESTIGATIONS

Three Fault Investigation Reports within the immediate vicinity of 449 N. Rodeo Drive were completed by this firm at 456 and 468 N. Rodeo Drive, and 461 N. Beverly Drive. Data from the surrounding reports have been reviewed, compared, and incorporated into this report where appropriate and used to support the conclusions herein. Figure 11 illustrates the location of each investigation completed by this

firm in relation to 449 N. Beverly Drive. A short summary of each approved report and work within the immediate area is provided below (Figure 11a, Table 3):

468 N. Rodeo Drive

This firm prepared a Fault Investigation Report for 468 N. Rodeo Drive, located approximately 50 feet northwest of the subject site, dated August 20, 2018 (FGC, 2018a). The subsurface investigation consisted of drilling 2 continuously cored borings and 7 CPT soundings within the alley to the west of 449 N. Beverly Drive (Figure 11). The investigation also incorporated 2 borings and 4 CPTs from work conducted at 456 N. Rodeo Drive (See below). The investigation concluded that no faults traverse the subject property and that the underlying sediment exhibited multiple continuous stratigraphic horizons across the entire boring and CPT transect. The Fault Investigation report was reviewed by Roy J. Shlemon and Associates and recommended for approval on August 29th, 2018. The City of Beverly Hills issued a formal approval for the referenced site on August 29th, 2018. Data from the approved report for 468 north Rodeo Drive has been utilized to support the findings and conclusion of this report.

456 N. Rodeo Drive

This firm prepared a Fault Investigation Report for 456 N. Rodeo Drive, located approximately 20 feet directly west of the subject site, dated December 18, 2018 (FGC, 2018b). The subsurface investigation consisted of drilling 2 continuously cored borings and 4 CPT soundings within the alley to the west of 449 N. Beverly Drive (Figure 11). The investigation also incorporated 2 borings and 7 CPTs from work conducted at 468 N. Rodeo Drive. The investigation concluded that no faults traverse the subject property and that the underlying sediment exhibited multiple continuous stratigraphic horizons across the entire boring and CPT transect. The Fault Investigation report was reviewed by Roy J. Shlemon and Associates and recommended for approval on December 20th, 2018. The City of Beverly Hills issued a formal approval for the referenced site on February 14th, 2018. Data from the approved report for 456 N. Rodeo Drive has been utilized to support the findings and conclusion of this report.

461 N. Beverly Drive

This firm prepared a Fault Investigation Report for 461 N. Beverly Drive, located directly adjacent to 449 N. Beverly Drive, dated September 20, 2018 (FGC, 2018c). The subsurface investigations consisted of a transect of 5 continuously cored borings drilled to a maximum depth of 50 feet below the ground surface (Figure 11). The investigation concluded that no faults traverse the subject property and that the underlying sediment across the site exhibits multiple continuous stratigraphic horizons across the entire boring transect. The Fault Investigation report was reviewed by Roy J. Shlemon and Associates and recommended for acceptance on October 2nd, 2018. The City of Beverly Hills issued a formal approval for the referenced site on October 8th, 2018. Data from the approved report for 461 N. Beverly Drive are used to support the findings and conclusion of this report.

Los Angeles County Metropolitan Transportation Authority – (Metro/MTA)

In 2011, Parsons-Brinkerhoff (Parsons) completed a fault study for the Metro Westside Subway Extension for the purpose of locating potential subway station and tunnel alignments. Based on their interpretation of continuous-core borings, cone penetrometer tests (CPTs), and geophysical surveys, Parsons (2011) depicted two zones of faulting in the area: 1) a zone of northeast-southwest trending faults, generally parallel to and south of Santa Monica Boulevard, which they attributed to the SMFZ

and 2) a zone of northwest-southeast trending faults coincident with the West Beverly Hills Lineament (WBHL). These faults were considered active based on geomorphic evidence and interpreted association with known active faults. To the west of the project site, Parsons (2011) interpreted the SMFZ to span a width from the topographic scarp north of Santa Monica Boulevard to approximately 150 feet southeast of the boulevard. Parsons (2011) interpreted additional faults immediately to the southeast of this zone, but they were unable to determine whether these faults were active.

The Los Angeles County Metropolitan Transportation Authority (Metro) prepared a report in 2017 for Transect 9 (Figure 8) of Tunnel Reach 5 located approximately 1500 feet to the southwest of the subject site (Metro, 2017). The following is a summary from FER-259 (Olson, 2018):

"In 2017, AMEC Foster Wheeler performed a supplemental fault investigation for the planned LA Metro Westside Purple Line subway extension (Metro, 2017) to assess a strand of the Santa Monica Fault Zone encountered during the preliminary fault investigation report (Parsons Brinckerhoff, 2011), which trended northeasterly towards a section of the proposed subway alignment. To investigate for potential faulting, a series of continuous core borings and CPTs were drilled along Laskey Drive, turning east at Charleville Boulevard, and continuing north along Spaulding Drive (see Figure 14, locality 15). This was referred to as Transect 9, which continues the numbering sequence from Parsons Brinckerhoff (2011). The new subsurface profile was constructed using data collected from twenty new continuous core borings drilled from 110 to 245 feet deep and 34 CPTs advanced to depths ranging from 61 to 117 feet. Based on the subsurface data the consultants identify Holocene and Pleistocene alluvial units overlying bedrock of the Pleistocene Lakewood and San Pedro Formations." (Olson, 2018, p. 31-32)

"From their observations and interpretations of the subsurface data, AMEC Foster Wheeler identified a significant fault zone at depth between their stations 6+50 and 9+00 (Figure 19) consisting of up to three strands, which dip steeply to the north. The faults exhibited greater than 90 feet of apparent down-to-the-north vertical displacement of the contact between the older alluvium and the Lakewood Formation. From the southern end of the cross section, the depth to the Pleistocene bedrock units consistently increases to the north until they are abruptly truncated and no longer encountered north of the inferred fault zone. AMEC states these faults appear to extend up near the present-day ground surface and offset Holocene sediments dated between approximately 9,100 and 16,500 years old based on radiometric dating of charcoal samples. The locations of the fault traces in the near surface sediments is based on identifying the location where laterally persistent laminated fine-grained "sag deposits" to the north are abruptly missing in adjacent down-gradient borings. It is postulated these fine-grained silts and clays were deposited in depressions or impounded drainages formed by topographic scarps created by surface-rupturing events along faults in this zone. Additional faults were also interpreted between borings north and south of this main zone." (Olson, 2018, p. 32)

Fugro (2019) completed a "Geotechnical Fault Investigation" report for Metro as part of the Westside Purple Line Section 2 Project along Wilshire Boulevard (Transect 10) (Figure 8) through the City of Beverly Hills. The investigation was conducted in order to determine if and where fault strands associated with the SMFZ cross the project tunnel alignment, and to estimate the age of fault rupture using radiocarbon age dating techniques. Based on their exploration of continuous core borings, Fugro (2019) primarily identified four nearly vertical to vertical (dipping 70° to 90°) faults associated with the SMFZ that define a 250 ft. zone of faulting. The inferred faulting by Fugro (2019) is estimated to strike between N46° and 54° E and is described as Holocene-active. Based on Fugro's (2019) investigation the defined boundaries of faulting is narrower than the SMFZ as mapped by the CGS (2018a). The 449 N.

Beverly Drive site is located well north of the 250 ft. zone of faulting inferred by Fugro (2019) and is outside of the projection of this inferred faulting zone.

Fugro (2019) identified the presence of faulting primarily based on offset of the San Pedro Formation at depths of hundreds of feet below the ground surface and structural features observed within the continuous borings. No clear evidence of near surface faulting at the Holocene/Pleistocene boundary was identified in the study. Fugro (2019) interprets Holocene fault activity based on a slight thickening of Holocene age material across the identified fault zone, and the presence of fine-grained laminated sediments that are common to sag ponds near strike-slip fault zones around the world.

Fugro (2019) states that the exact locations of the faults are not precisely constrained due to the wide spacing (42 to 95 feet) between borings, suggesting the zone of faulting could be narrower than concluded. The large spacings used in between the individual borings along the Transect 10 does not allow for the reliable assessment of lateral continuity for the underlying materials. Although Fugro (2019) conservatively interprets the inferred faults to be Holocene-active, they provide multiple Pleistocene age radiocarbon dates for the near surface soils (~25 to 35 ft. below the ground surface) without providing an interpretation of subsurface paleosols (pedogenic horizons) or primary stratigraphy at or near this critical Holocene-Pleistocene boundary depth.

10000 Santa Monica Boulevard

Feffer Geological Consulting and Geocon, (2012) prepared a fault report for the 10000 Santa Monica project located immediately north of the BHHS campus and lies immediately adjacent to the Metro Santa Monica station site and between Metro Transects 2 and 4. The 10000 investigation included a trench across the entire site that paralleled the Leighton/Metro Transect 4 and the Metro Transect 2. The trench crossed the location of several fault strands proposed by Metro (Parsons, 2011) associated with their WBHL fault zone as well as the new WBHL fault location. No faults, active or otherwise, were found in the 10000 Santa Monica trench to depths of 30+ feet and ages of >300,000 years.

Kenney GeoScience

Kenney GeoScience (Kenney, 2012, 2013) performed geomorphic, structural, and stratigraphic analysis using the available subsurface data from the Metro investigation (Parsons, 2011), the Beverly Hills High School fault investigation (Leighton, 2012), and other data generated from recent fault studies in the Beverly Hills/Century City area (e.g., Feffer-Geocon, 2012; Legg, 2012). Based on these data, Kenney (2012) developed a tectonic and geologic history of the area, which included an evaluation of the location and activity of suspected faults. Kenney (2012, 2013) interpreted the faults along Santa Monica Boulevard as secondary upper plate structures and referred to them as the Santa Monica Boulevard Fualt zone (SMBFZ). This interpretation is based on the observation that the SMBFZ faults are dominantly strike-slip (possibly right-lateral). Although individual faults within the SMBFZ may exhibit normal or reverse apparent displacement, there is little net vertical displacement across the zone (Kenney, 2013). This contrasts with the observations north of Santa Monica Boulevard, where oblique left-lateral reverse motion has produced net north-side-up displacement across the fault (e.g., Dolan et al., 2000; Geocon, 2014).

Kenney (2012) noted that multiple investigations and reevaluations of the faults first interpreted by Parsons (2011) along Santa Monica Boulevard had not produced any evidence of Holocene-age activity for the SMBFZ. In fact, the most recent data indicates that activity along these faults likely ceased

approximately 40,000 to 50,000 years ago (Kenney, 2012). However, Kenney (2013) noted that additional study of these faults is needed in order to confidently assess their activity.

Westfield - Century City Mall

Subsequent to Kenney's (2012, 2013) reinterpretation of the SMFZ and the SMBFZ, Geocon West, Inc. (Geocon, 2013) conducted a fault study for Westfield at the Century City mall. This study was specifically designed to identify the evidence for Holocene activity (or lack thereof) along the SMBFZ south of Santa Monica Boulevard. Geocon's (2013) study consisted of one boring transect along Avenue of the Stars, and another boring transect along Century Park West. Geocon (2013) documented a thick section of un-faulted Pleistocene age alluvium overlying faulted sections of Lakewood Formation sediments. Based on the apparent continuation of the Pleistocene age geologic units overlying several faults, Geocon (2013) concluded that no active faults were present at the Westfield site, and no restrictions on future development of the Westfield Site are necessary with respect to potential faulting.

Beverly Hills High School

Leighton Consultants Inc. (Leighton, 2012) performed a fault investigation at Beverly Hills High School focused on the WBHL faults interpreted by Parsons (2011). Leighton (2012) advanced borings, CPTs, and excavated trenches along Parsons' (2011) borehole and CPT transects. Based on the observation of unbroken Pleistocene age soils across the grounds of the high school, Leighton concluded that the faults identified by Parsons (2011) were not active. Furthermore, Leighton (2012) provided geologic evidence that the WHBL scarp is an erosional feature, rather than a tectonic feature. The California Geological Survey (CGS) approved the Leighton report and agreed that none of the investigated faults were active (CGS, 2013).

322 N. Foothill Road

Earth Consultants International (ECI), (2018) prepared a Fault Investigation Report for 322 N. Foothill Road in the City of Beverly Hills. The site is located partially within the AP Fault Hazard zone. To resolve the issue of Holocene time faulting, ECI drilled two continuously cored borings, pushed 6 CPT soundings, and excavated one trench. The consultant estimated the age of subsurface paleosols and observed and documented un-broken pre-Holocene stratigraphy and concluded that the site is not impacted by faulting.

Additional Investigations Within the Site Vicinity

According to the City of Beverly Hills (2020), there are numerous on-going site-specific fault investigations being performed within the City (Figure 11a, Table 3). The closest of which are located at 420, 400, 370, 319, and 315 N. Rodeo Drive, and entirely within the state defined SMFZ. However, the results of these studies remain unpublished and are not currently available for review.

METHODOLOGY

Approach

The subsurface investigation was designed to investigate across the subject site in a northwest-southeast oriented transect within the alley adjacent to the subject site (see Figure 10, 11). Typically, trenching is

the preferred method for evaluating the presence or absence of faults because it offers a continuous, direct exposure of the fault zone or near surface stratigraphy. However, this portion of the SMBFZ is difficult to expose in trenches due to dense urban cover. Because of existing structures, underground utilities, and the extent of data collected from the neighboring sites, this fault study consists of one 50 foot deep continuously cored boring. Additional borings and CPT's (Cone Penetrometer Soundings) located to the west within the adjacent alleyway (Figure 10, 11, Table 1, 2), were utilized to support the findings of this report. The evaluated transect (A-A') is located on a 1 inch = 10 foot scale base map, and the subsurface data is plotted on 1 inch = 10 foot scale cross sections for interpretation (see Figures 12 and 13).

Field Exploration

Prior to beginning the subsurface field exploration, work permits were obtained from the City of Beverly Hills. Underground Service Alert (USA) was notified to identify buried utilities in the vicinity of the proposed excavations, and an independent utility locating company was also contracted to verify "no-conflict" areas for the drilling.

The subsurface exploration of the continuously cored boring within the alley adjacent to 449 N. Beverly Drive was completed on December 2nd, 2019. The boring was excavated to a maximum depth of 50 feet beneath the existing ground surface (Table 1, 2). The boring logs, soil descriptions, and supporting CPT reports are included in Appendices A, B, and C respectively.

GEOLOGIC MATERIALS

The continuity of soil (pedogenic) horizons and primary stratigraphic contacts provides data to evaluate the presence or absence of faulting. Five conformable stratigraphic units within the alluvium were encountered in the single boring drilled at 449 N. Beverly Drive and correlate well with the borings drilled previously at 456 and 468 N. Rodeo Drive (Appendix B). Generally, these units consist of basal coarse-grained sediments, fining-upward to fine sand and silt and local clays, typically capped by a buried paleosol.

Holocene Alluvial Fan Deposit 1 and 2 (Qal 1): *4 – 8 ka*

The uppermost unit in section A-A' (Figures 12, 13) consists of a weakly developed soil profile composed of silty sand to silty sand with clay with interbedded gravels that consist of sub angular to sub rounded fragments of slate. We interpret this unit as late Holocene age alluvial deposits (sheet flows) and designate it as Qal1. An approximately 6 to 8 foot layer of artificial fill overlies this unit across the entire study area. Unit Qal1 includes a surficial soil with a basal scour deposit and is interpreted as a Holocene aged sheet flow alluvial deposit.

Holocene Alluvial Fan Deposit 2 (Qal 2): *12 – 21 ka*

The lowest Holocene unit in section A-A' (Figures 12, 13) is composed of sandy clay to clayey sand with basal gravels. The unit is generally massive with fine to medium grained sand and sub rounded fragments of slate. Soil color hues are in the 10YR to 7.5YR range (brown). We interpret this unit as a latest Pleistocene alluvial deposit (axial valley deposit), but conservatively designate it as Qal2. A scour deposit overlies and truncates this unit across the entire study area. Qal2 includes alluvial deposits with a diffuse (cumulic), and weakly- to moderately well-developed argillic soil.

Pleistocene Alluvial Fan Deposit 3 (Qoa 1): *25 – 51 ka*

The interpreted uppermost Pleistocene unit in section A-A' (Figures 12, 13) is an organic-rich truncated argillic horizon remnant over a gravelly clayey sand to sandy clay. Gravels are sub angular and highly weathered fragments of slate. Illuvial clay film hues are in the 7.5YR range (brown). We interpret this unit as a Pleistocene alluvial fan deposit (debris flow) and designate it as Qoa1. A scour deposit overlies this unit across the entire study area. Unit Qoa1 includes alluvial deposits that contain a moderately well-developed, moderately well oxidized, and truncated argillic soil. The contact between Qal2 and Qoa1 occurs at a depth of approximately 27 feet across the entire study area.

Pleistocene Alluvial Fan Deposit 4 (Qoa 2): *33 – 64 ka*

Beneath unit Qoa1, we encountered a unit composed of silty sand with gravel to sandy clay (Figures 12, 13). The interbedded gravels within this unit are composed of sub rounded slate and sandstone. Illuvial clay film hues are in the 7.5YR range (brown). This unit is interpreted as a highly weathered late Pleistocene braided stream channel deposit that contains a highly truncated, moderately well-developed soil remnant designated as unit Qoa2. The contact between Qoa1 and Qoa2 is at approximately 35 feet across the entire study area. The Qoa2 basal scour is well stratified and has incised across the northern portion of Transect A where the underlying unit Qoa3 has been eroded.

Pleistocene Alluvial Fan Deposit 5 and 6 (Qoa 3): *59 – 124 ka*

Beneath unit Qoa2, we encountered a unit composed of sandy clay to silty sand with interbedded gravel that is composed of highly weathered and sub rounded to sub angular slate and sandstone (Figures 12, 13). Soil color clay film hues are in the 7.5YR range (brown). This unit is interpreted as a stacked sequence of two strongly weathered late Pleistocene braided stream channel / alluvial fan debris flow deposits that contain two truncated, stacked, and moderately well developed soil remnants designated as Qoa3. Unit Qoa3 is the oldest unit encountered during the subsurface exploration. The contact between Qoa2 and Qoa3 occurs at a depth of approximately 45 feet across the entire study area.

Soil Development/Soil Profiles

The borings drilled at 449 N. Beverly Drive, 456 and 468 N. Rodeo Drive (see Figures 11, 12, 13 and Appendix A) are located on a graded (or stripped) and artificially filled surface that is geomorphically inactive. The soil profile in each boring at depth consists of a truncated sequence of multiple stacked and truncated Pleistocene aged soils (Qal2, Qoa1, Qoa2, and Qoa3). The entire section in this locality is capped by 6 to 8 feet of artificial fill. Parent materials for these soils originate north of the site in the Santa Monica mountains and primarily consist of slate-rich debris flow and or stream terrace deposits that have emanated from drainages to the north of the site (primarily Benedict and Coldwater Canyons). The soil profiles along section A-A' contain a surface deposit that overlies 4 to 5 buried soils to depths of approximately 50 feet below the ground surface. This stratigraphic section occurs across the entire area investigated. The individual soil profiles and relative age estimates are summarized below.

The uppermost soil on site (Qal1) consists of a highly truncated soil remnant that consists of a weakly developed cambic or juvenile argillic diagnostic subsurface horizon (Bt – BC). The deposit consists of a crudely stratified fining upwards sequence. This soil unit is characterized by a coarse-grained deposit with few clay stains on ped faces and has an estimated relative age of 4 - 8 ka (Appendix B).

The uppermost Pleistocene soil on site (Qal2) is a diffuse and cumulic soil remnant that consists of a thick and weakly developed argillic diagnostic subsurface horizon (2Bt1 – 2Bt2 – 2BC). The deposit consists of a crudely stratified fining upwards to massive deposit. This soil unit is characterized by basal gravel and fine-grained deposit with 7.5YR hues and common thin clay films on ped faces and coating gravel. Qal2 has an estimated relative age of 12 – 21 ka (Appendix B).

A conservative pick for the top of Pleistocene soil Qoa1 is the remnant of a moderately well-developed Alfisol soil. This is a truncated soil that consists of a sequence of two moderately well-developed argillic diagnostic subsurface horizons over a crudely stratified scour deposit (3Bt1 – 3Bt2 – 3BC). The deposit is a fining upwards sequence and most likely represents the distal portion of a debris flow deposit. This soil unit is characterized by a highly weathered, moderately well oxidized, gravel-rich and fine-grained deposit with 7.5 YR hues on common thin clay films on ped faces and coating gravel. This soil unit has a relative age estimate of 25 - 51 ka (Appendix B).

The third buried soil profile on site (Qoa2) is a truncated and older cumulic soil remnant that consists of a thick and moderately well-developed argillic soil profile (4Bt1 – 4Bt2 – 4BC). The deposit consists of a crudely stratified fining upwards sequence. This soil profile is characterized by a fine-grained deposit with 7.5YR hues on common thin clay films on ped faces. This deposit locally scours into the underlying unit Qoa3 across the southern portion of Transect A and has an estimated relative age of 33 – 64 ka (Appendix B).

The oldest and lowest buried soil profiles on site (Qoa3) are a series of two truncated and stacked soil remnants that consists of two moderately well-developed argillic soil profiles (5Bt - 6Bt). The deposit consists of two crudely stratified fining upwards sequences. This soil unit is characterized by a stratified deposit with 7.5YR hues on common thin and few moderately thick clay films. Qoa3 and the entire stratigraphic section under study has an estimated relative age of 59 – 124 ka (Appendix B).

In summary, the entire stratigraphic sequence examined at the project site is estimated to be greater than 59 ka in age. The stratigraphic units encountered provide visually and texturally distinct, mappable contacts that are overlapping across the project site area and across the transect of borings. No features or structural characteristic of faulting, such as shear zones or high angle contacts between units were observed. The contacts between Qoa1, Qoa2 and Qoa3 undulate and slope gently south as expected by normal sedimentary processes.

EVIDENCE FOR THE ABSENCE OF FAULTING

Several subsurface geologic relationships at 449 N. Beverly Drive provide direct evidence that preclude Holocene faulting. When these relationships are considered together, there is compelling evidence for the absence of faulting beneath the subject site. The primary lines of evidence that support the interpretation that no faults traverse the site are:

• **Continuous, un-faulted soil horizons and primary stratigraphy across the site:** The transects of borings and CPTs conducted to the east and west of the subject site (456, 468 N. Rodeo Drive and 461 N. Beverly Drive) exhibits multiple continuous and unbroken stratigraphic horizons. All deposits encountered correlate well across the project site. If faults with a vertical slip component of slip were active in this area, they would have produced recognizable, vertical separations or displacements of the Pleistocene units. Similarly, active strike-slip faulting would have produced an apparent dip-slip

component or truncation of units due to the juxtaposition of different Pleistocene strata or pedogenic horizons.

• **No faults were encountered in the subsurface exploration:** No features characteristic of faulting, such as shear zones or high angle contacts between units were observed within the collected continuously cored samples. Though not compelling enough to preclude the presence of faulting, it is consistent with and corroborates other lines of evidence.

• **No irregularities or topographic features indicative of faulting were observed:** Geomorphically, the project site exists on an incised and degraded Holocene-aged alluvial fan deposit. Mapping by Campbell at al., (2014), Yerkes and Campbell (2005), Dibblee and Ehrenspeck (1991) and Hoots and Kew (1931) also confirm this conclusion. Moreover, the site lies north of the eastward projection of the existing Santa Monica Fault Zone, and no escarpments are apparent on historic topographic maps.

• **Supporting evidence from neighboring and recent investigations:** The data collected and conclusions reached within the approved and referenced reports at 456, 468 N. Rodeo Drive and 461 N. Beverly Drive reinforce the conclusions and overall findings of this report (FGC, 2018a, 2018b, 2018c). Additionally, the 449 N. Beverly Drive site is located well north of the 250 ft. zone of faulting inferred by Fugro (2019) based on the estimated strike, and the nearly vertical to vertical dip of the identified faults.

CONCLUSIONS AND RECOMMENDATIONS

The fault investigation for 449 N. Beverly Drive documents continuous unbroken, pre-Holocene sediments across the entire site. The observed continuous and un-broken stratigraphy implies that no active faults traverse the site. The project site is not exposed to the hazard of surface fault rupture which would impact or limit future development of the site.

While the area explored in our study is not likely subject to surface faulting, a future earthquake on the Santa Monica Boulevard, Santa Monica, Hollywood, or Newport - Inglewood fault zones will likely produce very strong, near-field ground motions at the project site that must be assessed by an appropriate geotechnical evaluation of the site.

LIMITATIONS

The conclusions and recommendations presented herein are the results of an inherently limited scope. Specifically, the scope of services consisted of an assessment of whether or not Holocene-active faults are present within the area explored at the site. The conclusions and recommendations contained in this report are professional opinions derived in accordance with current standards of professional practice. No warranty is expressed or implied.

This report has been prepared for the exclusive use of 449 N. Beverly Drive LLC and applies only to potential future development at the site located at 449 N. Beverly Drive in the City of Beverly Hills, California. In the event that significant changes in the development planning should occur, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed by Feffer Geological, and the conclusions and recommendations of this report are verified in writing.

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Figures

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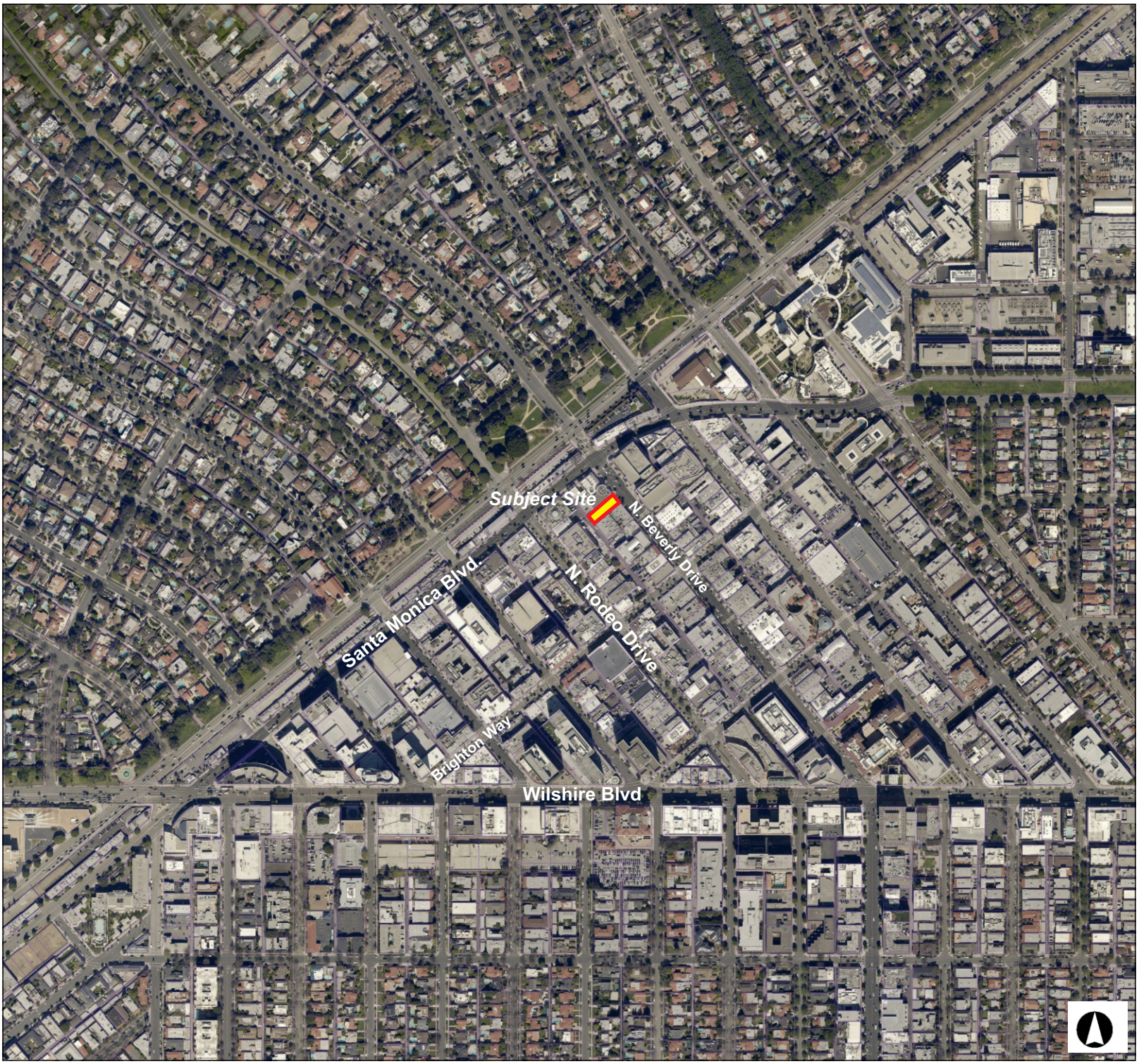
Tables

449 N. Beverly Drive



This map is for reference only and should not be used for legal decisions. While the County of Los Angeles makes its best effort to ensure data is accurate, the County makes no representation or warranty of any kind.



FEFFER GEOLOGICAL CONSULTING

Approximate Scale (*Feet*)

1,600 0 800 1,600

Figure 1

Site Location Map

Modified From The LACounty.gov GIS Viewer

Figure 2

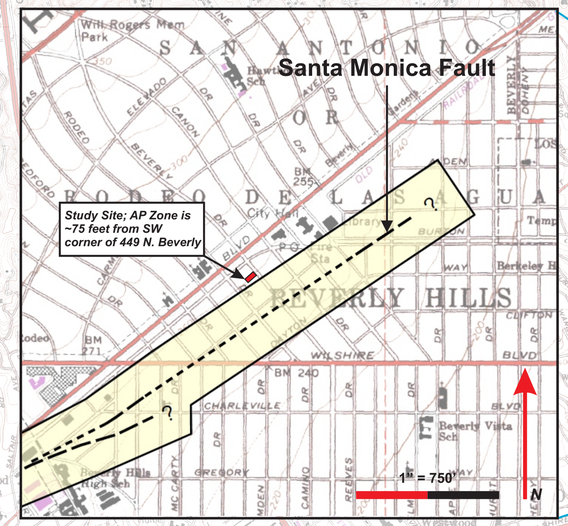
Modified from Plate 3 - FER 259

FAULTS RECOMMENDED FOR ZONING

EXPLANATION

- fault, approximately located
- fault, certain
- fault, concealed
- fault, inferred
- fault, inferred, queried
- Recommended Alquist-Priolo Earthquake Fault Zones
- Existing Alquist-Priolo Earthquake Fault Zones

FEFFER GEOLOGICAL CONSULTING



Hollywood Fault

Hollywood Quadrangle

449 N. Beverly

Santa Monica Fault

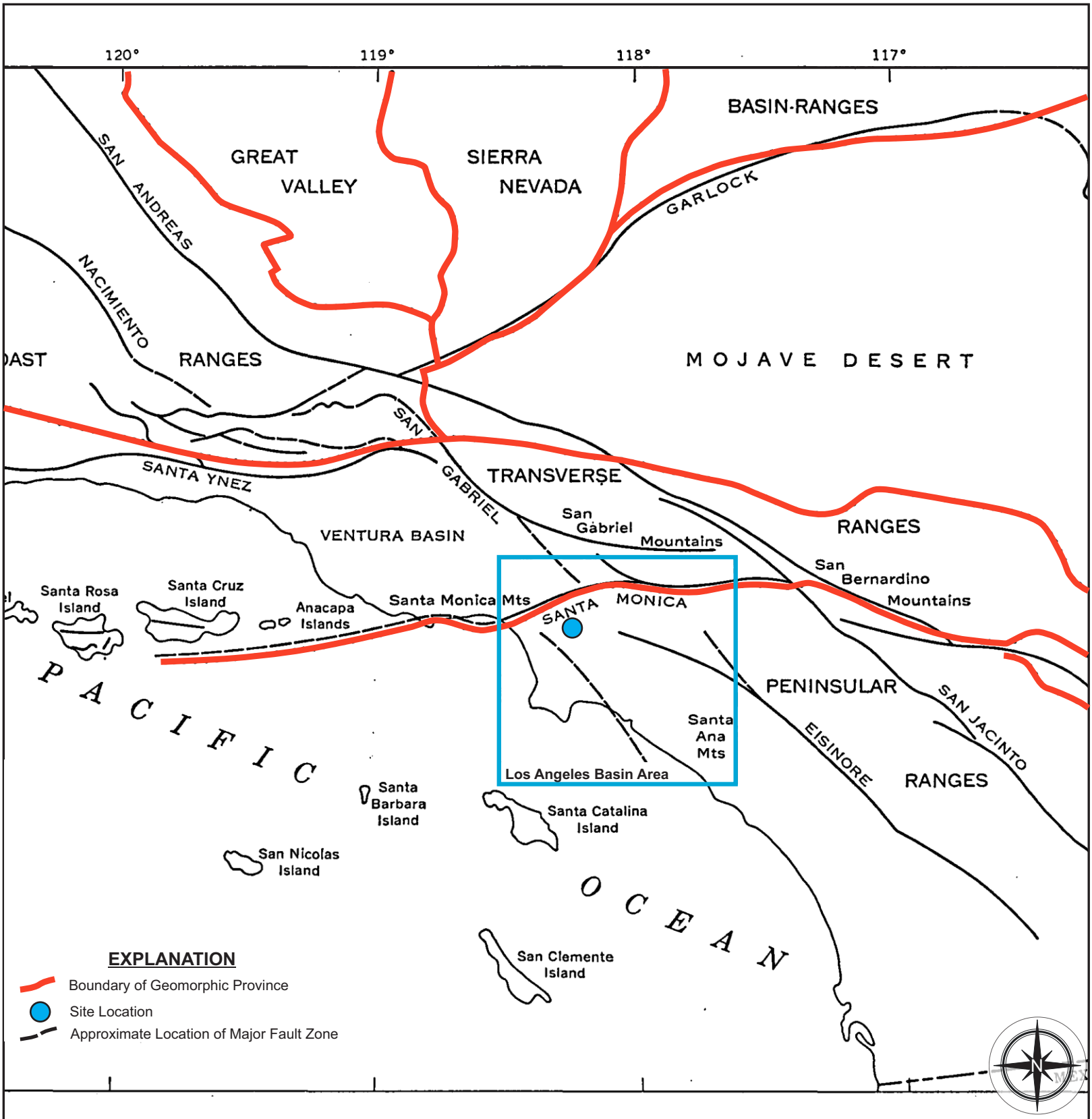
West Pico Fault

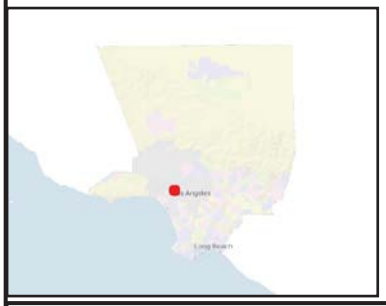
Newport-Inglewood Fault

Topanga Quadrangle

Beverly Hills Quadrangle

0 1,500 3,000 4,500 6,000 Feet





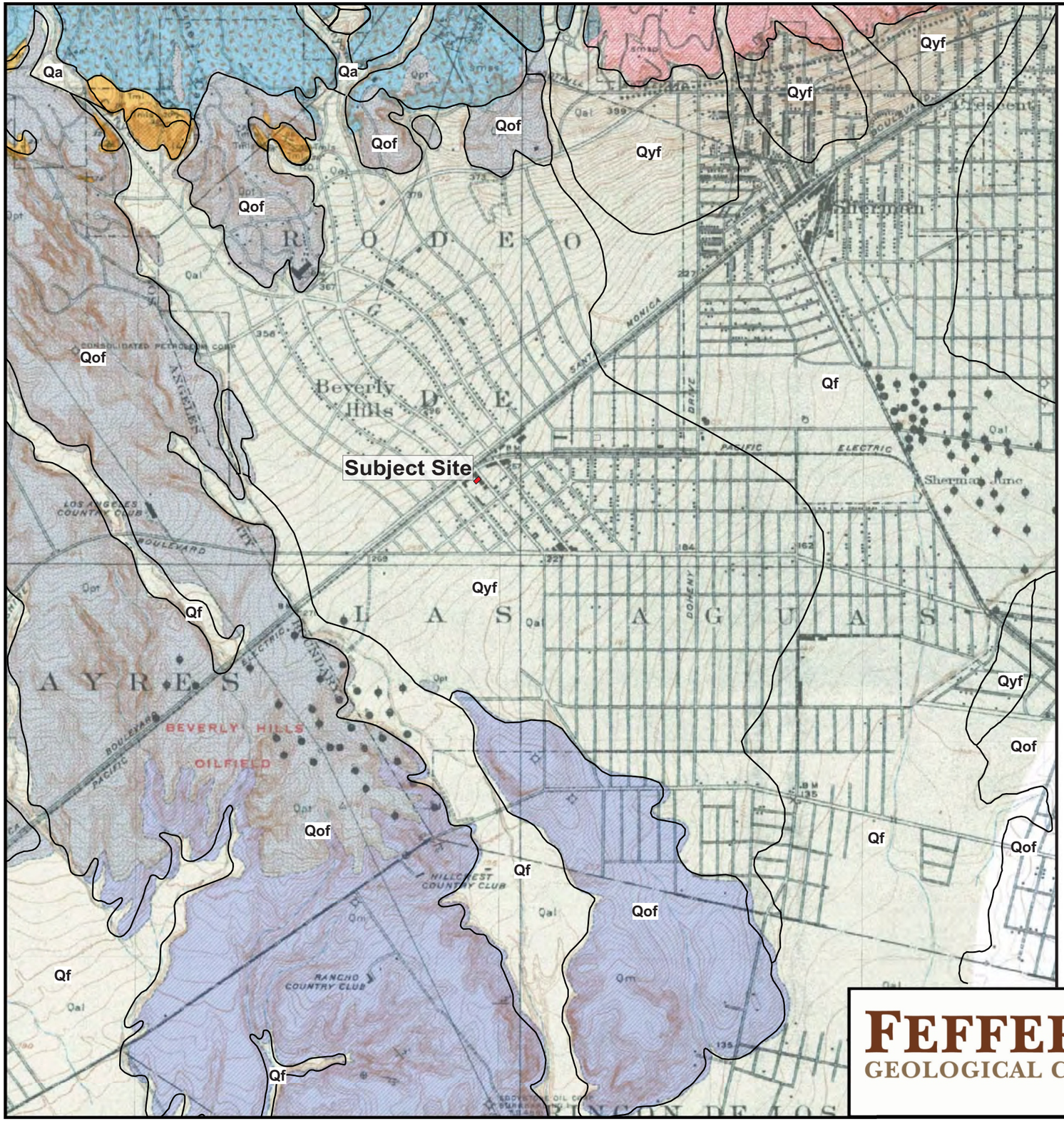
FEFFER GEOLOGICAL CONSULTING

MILES
0 40 80

Figure 3

Regional Geomorphic Province Map

Modified from Yerkes et al., (1965)



EXPLANATION

Geomorphic surfaces which include active channels (Qa), active alluvial fan deposits (Qf), young alluvial fan deposits (Qyf), and old alluvial fan deposits (Qof). (Yerkes and Campbell, 2005)

Sedimentary Deposits

Qal — Alluvium: Coarse unconsolidated deposits in valleys and stream channels (Holocene)

Qpt — Alluvial plain, stream, and marine terrace deposits (Upper Pleistocene)

Sedimentary Rocks

Qm — Marine deposits: Marine sandstone, conglomerate, and clay shale (Upper Pleistocene).

Tml — Modelo Formation: Marine; lower member; consisting of interbedded, hard, platy siliceous shale and softer brown shale (Miocene).

Tmls — Modelo Formation: Marine; lower member; consisting of lenticular beds of coarse grained sandstone (Miocene).

Metamorphic Rocks

smss — Santa Monica Slate: Dark gray to blue-black slate (Triassic).

smsp — Santa Monica Slate: Dark gray mica schist and phyllite cut by white quartz veins (Triassic).

Igneous Rocks

g — Granite and granodorite (Jurrasic).

N

2000 1000 0 2000 4000

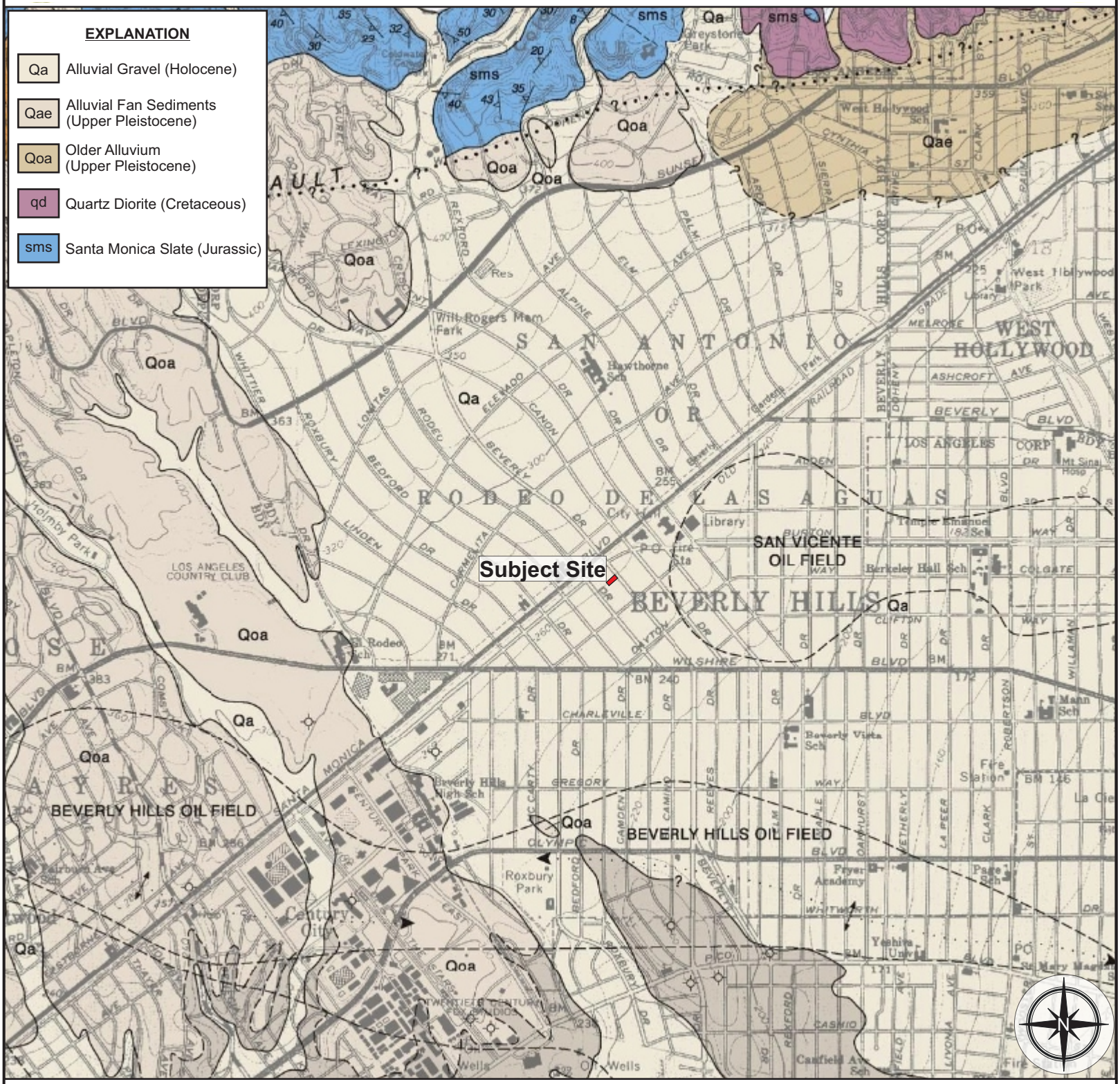
FEET

Modified from Hoots and Kew (1931) and Yerkes and Campbell (2005)
Contour Interval: 25 and 5 feet

FEFFER GEOLOGICAL CONSULTING

Figure 4
Regional Geologic Map

Modified from Earth Consultants International (2018)





FEFFER GEOLOGICAL CONSULTING

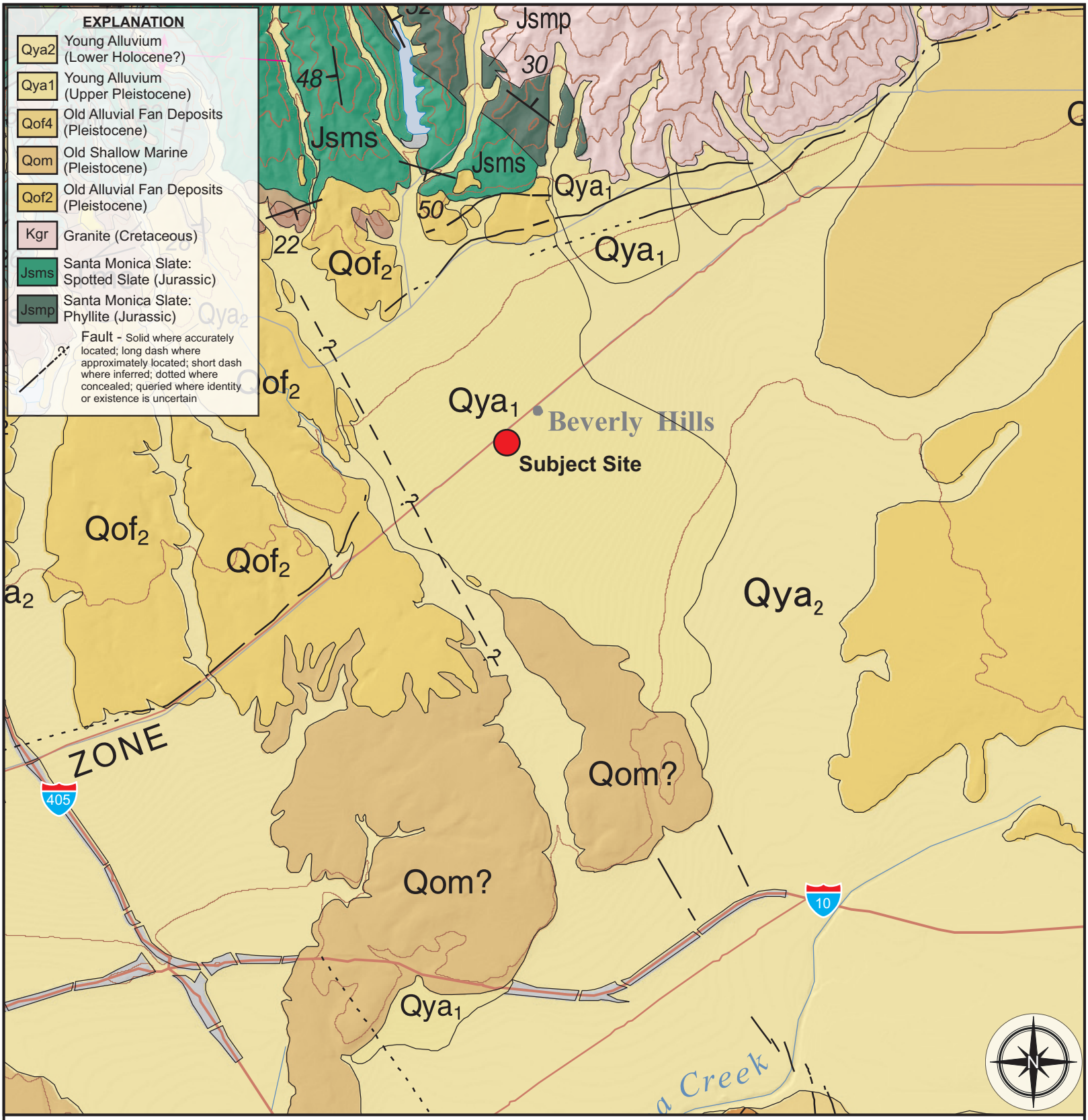
MILES
0 0.5 1

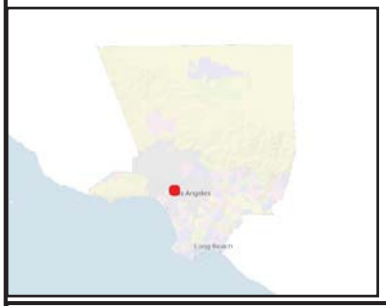
SCALE 1:24000

Figure 5

Regional Geologic Map

Modified from Dibblee & Ehrenspeck (1991)





FEFFER GEOLOGICAL CONSULTING

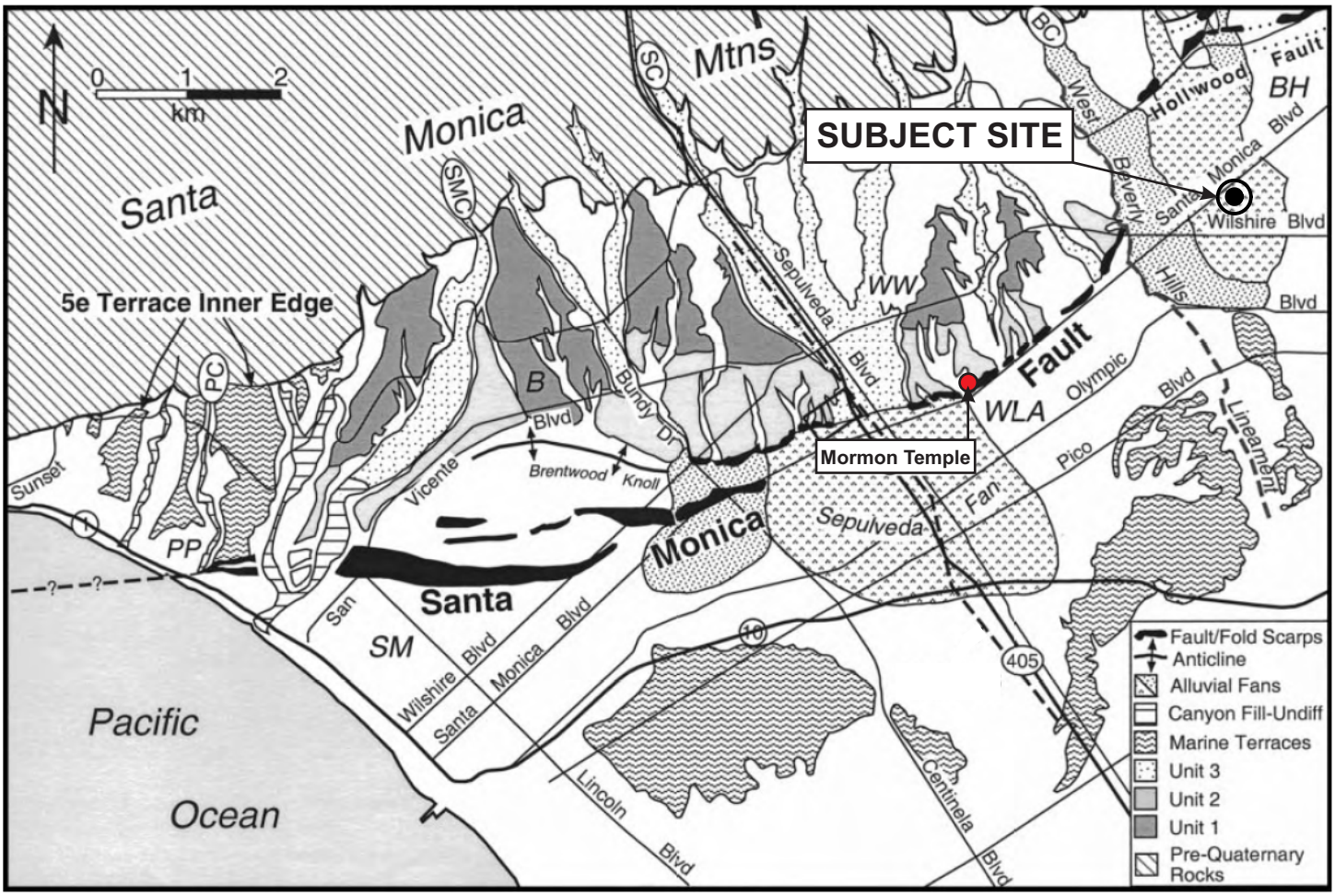
MILES
0 0.5 1

SCALE 1:100,000

Figure 6

Regional Geologic Map

Modified from Campbell et. al., (2014)

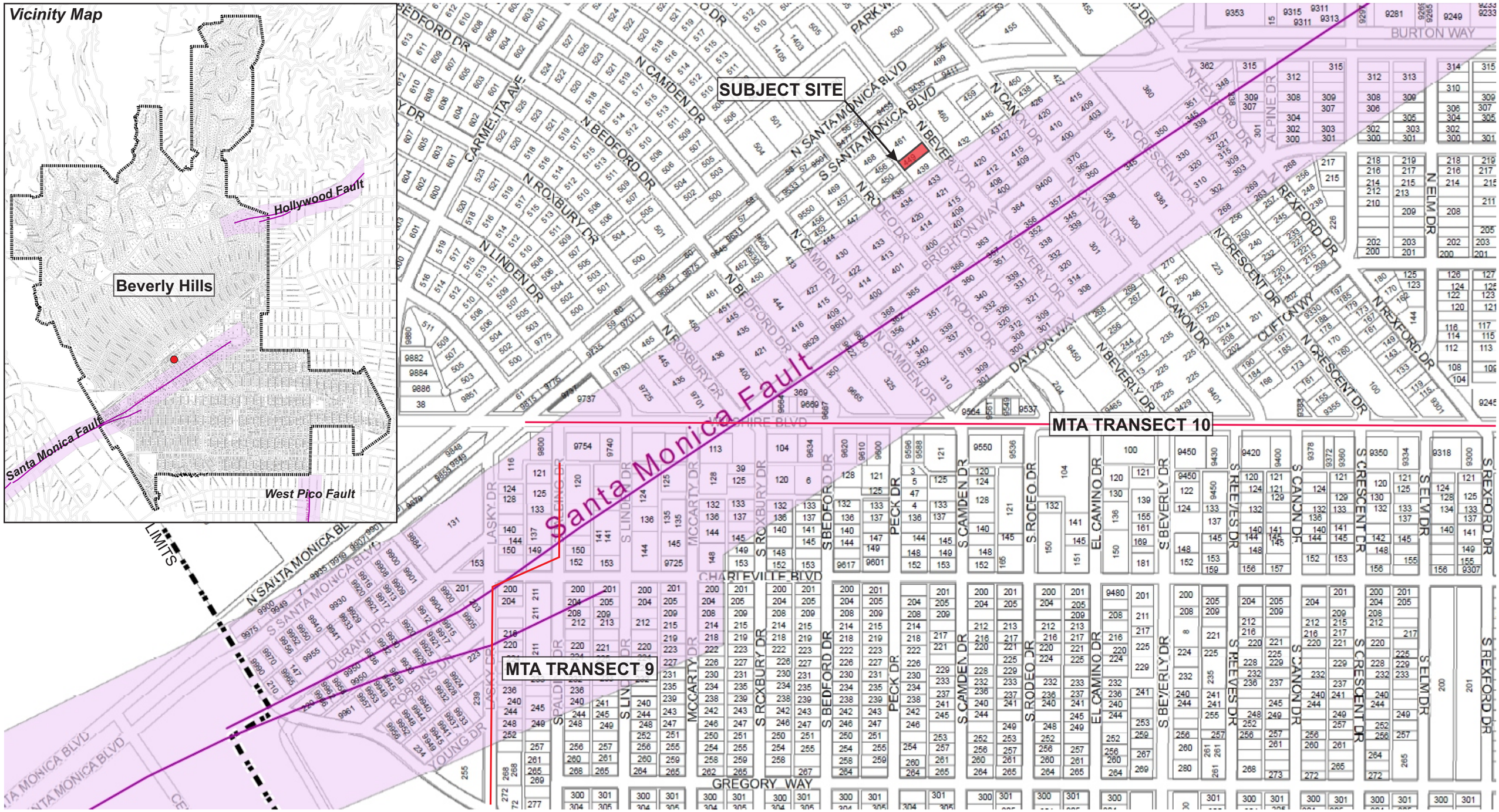


FEFFER GEOLOGICAL CONSULTING

Figure 7

Regional Fault Expression Map

Modified from Dolan et al., (2000)

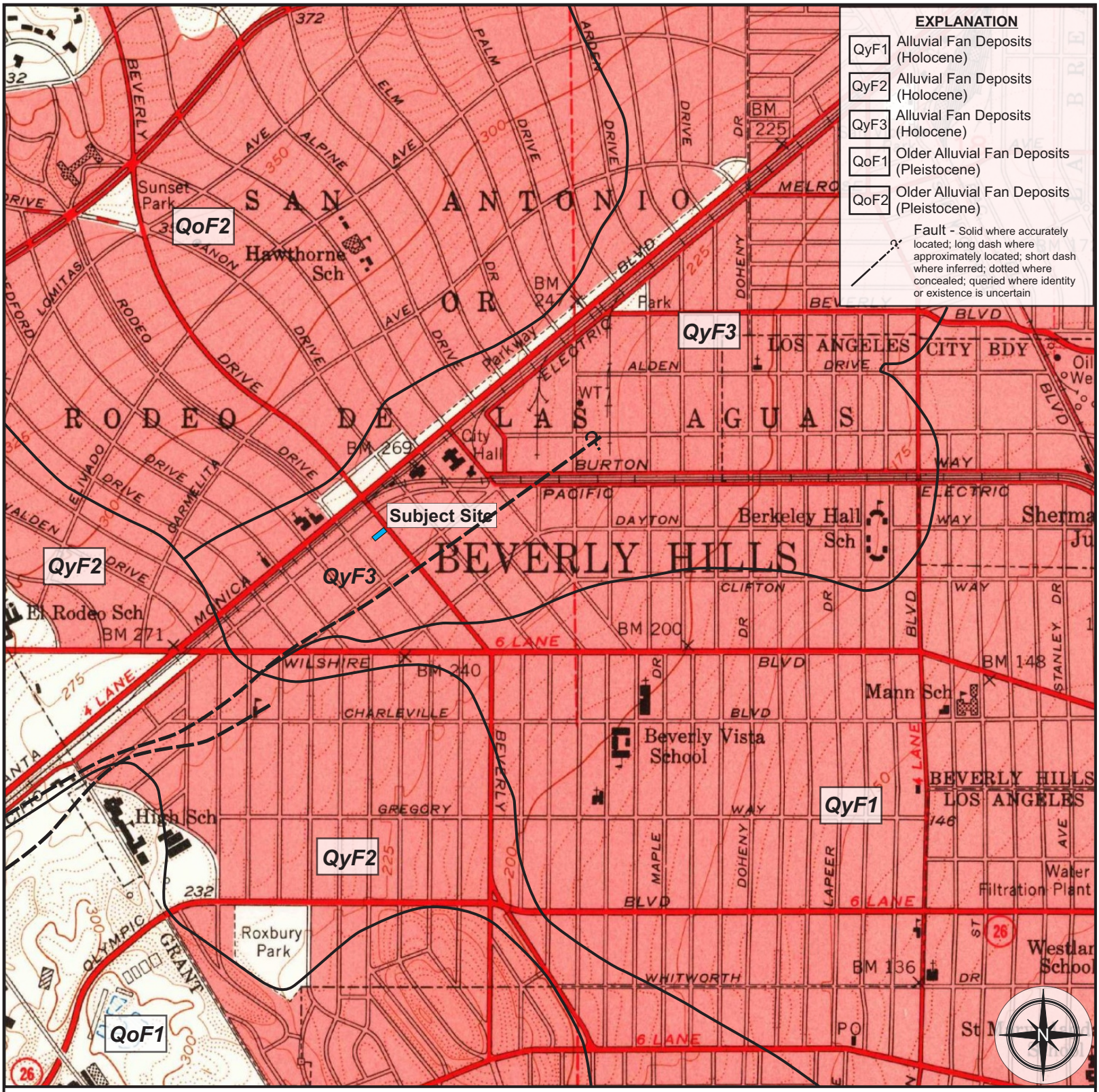


FEFFER GEOLOGICAL CONSULTING

Figure 8

Beverly Hills Fault Map

Modified from the City of Beverly Hills "Final Earthquake Fault Zone January 2018"





FEFFER GEOLOGICAL CONSULTING

MILES
0 0.5 1

SCALE 1:24000

Figure 9

Site Topographic and Quaternary Geologic Map

Modified from the LACounty.gov GIS Viewer (2018) and USGS (1950)

Figure 10

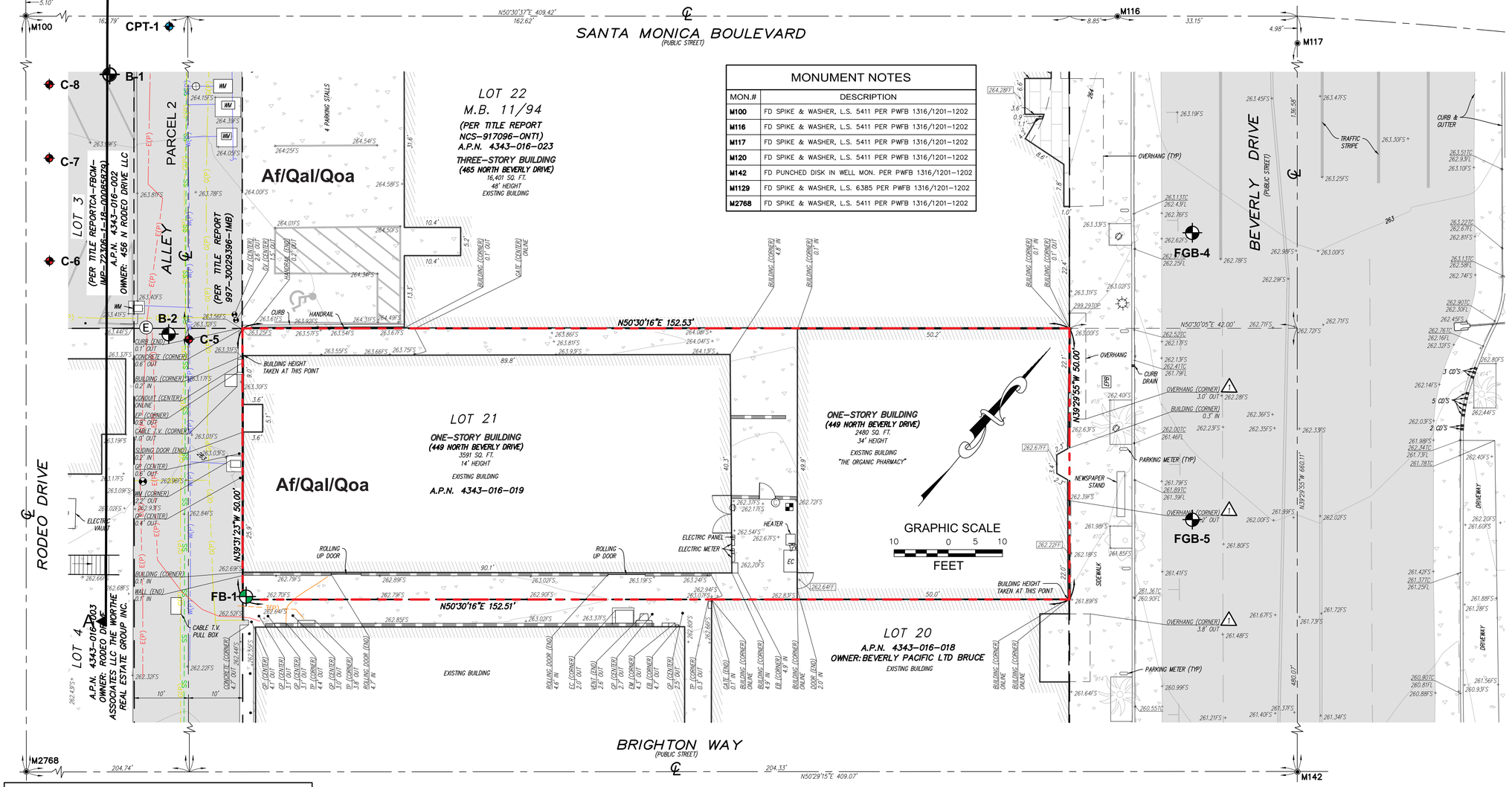
FEFFER GEOLOGICAL CONSULTING	SITE SURVEY ILLUSTRATING SUBSURFACE EXPLORATION
JB: 2387-95	NAME: 449 N. BEVERLY DRIVE LLC. BY: AG
DATE: 1/10/20	SCALE: 1"=10' SITE: 449 N. BEVERLY DRIVE
REF:	BASE MAP FROM SURVEY

EXPLANATION

- FB-1 CONTINUOUS BORING LOCATION (449 N. BEVERLY DR.)
- FGB-5 CONTINUOUS BORING LOCATION (461 N. BEVERLY DR.)
- B-2 CONTINUOUS BORING LOCATION (456 N. RODEO DR.)
- C-8 CPT SOUNDING LOCATION (456 N. RODEO DR.)
- CPT-7 CPT SOUNDING LOCATION (468 N. RODEO DR.)
- A A' CROSS SECTION LINE
- Af ARTIFICIAL FILL
- Qal HOLOCENE AGED ALLUVIUM
- Qoa PLEISTOCENE AGED OLDER ALLUVIUM

A.L.T.A./N.S.P.S. LAND TITLE SURVEY

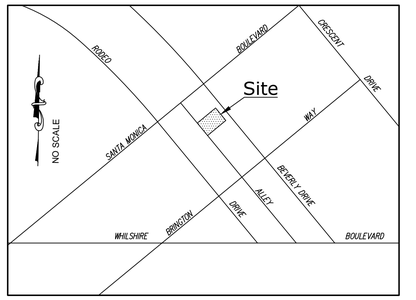
449 N. BEVERLY DRIVE, BEVERLY HILLS, CA 90210



MONUMENT NOTES

MON.#	DESCRIPTION
M100	FD SPIKE & WASHER, L.S. 5411 PER PWFB 1316/1201–1202
M116	FD SPIKE & WASHER, L.S. 5411 PER PWFB 1316/1201–1202
M117	FD SPIKE & WASHER, L.S. 5411 PER PWFB 1316/1201–1202
M120	FD SPIKE & WASHER, L.S. 5411 PER PWFB 1316/1201–1202
M142	FD PUNCHED DISK IN WELL MON. PER PWFB 1316/1201–1202
M1129	FD SPIKE & WASHER, L.S. 6385 PER PWFB 1316/1201–1202
M2768	FD SPIKE & WASHER, L.S. 5411 PER PWFB 1316/1201–1202

VICINITY MAP



LEGAL DESCRIPTION

THE LAND REFERRED TO HEREIN BELOW IS SITUATED IN THE CITY OF BEVERLY HILLS, IN THE COUNTY OF LOS ANGELES, STATE OF CALIFORNIA, AND IS DESCRIBED AS FOLLOWS:

LOT 21 IN BLOCK 2 OF BEVERLY, IN THE CITY OF BEVERLY HILLS, COUNTY OF LOS ANGELES, STATE OF CALIFORNIA, AS PER MAP RECORDED IN BOOK 11, PAGE 94 OF MAPS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY.

SCHEDULE B ITEMS

BASED UPON TITLE REPORT NO. 30038006-987-987-CS7, DATED NOVEMBER 12, 2019 AS PREPARED BY FIDELITY NATIONAL TITLE INSURANCE COMPANY.

1 WATER RIGHTS, CLAIMS OR TITLE TO WATER, WHETHER OR NOT DISCLOSED BY THE PUBLIC RECORDS. **(NOT PLOTTED, NOT SURVEY RELATED)**

2 INTENTIONALLY DELETED.

3 INTENTIONALLY DELETED.

4 INTENTIONALLY DELETED.

5 INTENTIONALLY DELETED.

6 INTENTIONALLY DELETED.

7 INTENTIONALLY DELETED.

8 A DEED OF TRUST. **(NOT PLOTTED, NOT SURVEY RELATED)**

9 A DEED OF TRUST. **(NOT PLOTTED, NOT SURVEY RELATED)**

10 INTENTIONALLY DELETED.

11 A SUBSURFACE OIL AND GAS LEASE FOR THE TERM THEREIN PROVIDED, WITH CERTAIN COVENANTS, CONDITIONS AND PROVISIONS, TOGETHER WITH EASEMENTS, IF ANY, AS SET FORTH THEREIN, DISCLOSED BY DOCUMENT, ENTITLED SUBSURFACE OIL AND GAS, DATED DECEMBER 1, 1997, LESSEE STOKER RESOURCES, L.P., RECORDING NO. 98-563201 OF OFFICIAL RECORDS. **(NOT PLOTTED, NOT SURVEY RELATED)**

12 INTENTIONALLY DELETED.

13 THE EFFECT OF A DEED. **(NOT PLOTTED, NOT SURVEY RELATED)**

THE EFFECT OF A DEED. **(NOT PLOTTED, NOT SURVEY RELATED)**

14 THE EFFECT OF A DEED. **(NOT PLOTTED, NOT SURVEY RELATED)**

15 THE EFFECT OF A DEED. **(NOT PLOTTED, NOT SURVEY RELATED)**

16 THE EFFECT OF A DEED. **(NOT PLOTTED, NOT SURVEY RELATED)**

17 INTENTIONALLY DELETED.

18 ANY INVALIDITY OR DEFECT IN THE TITLE OF THE VESTEES IN THE EVENT THAT THE TRUST REFERRED TO HEREIN IS INVALID OR FAILS TO GRANT SUFFICIENT POWERS TO THE TRUSTEE(S) OR IN THE EVENT THERE IS A LACK OF COMPLIANCE WITH THE TERMS AND PROVISIONS OF THE TRUST INSTRUMENT. IF TITLE IS TO BE INSURED IN THE TRUSTEE(S) OF A TRUST, (OR IF THEIR ACT IS TO BE INSURED), THIS COMPANY WILL REQUIRE A TRUST CERTIFICATION PURSUANT TO CALIFORNIA PROBATE CODE SECTION 18100.5.
THE COMPANY RESERVES THE RIGHT TO ADD ADDITIONAL ITEMS OR MAKE FURTHER REQUIREMENTS AFTER REVIEW OF THE REQUESTED DOCUMENTATION. **(NOT PLOTTED, NOT SURVEY RELATED)**

19 ANY EASEMENTS NOT DISCLOSED BY THE PUBLIC RECORDS AS TO MATTERS AFFECTING TITLE TO REAL PROPERTY, WHETHER OR NOT SAID EASEMENTS ARE VISIBLE AND APPARENT.

20 MATTERS WHICH MAY BE DISCLOSED BY AN INSPECTION AND/OR BY A CORRECT ALTA/NSPS LAND TITLE SURVEY OF SAID LAND THAT IS SATISFACTORY TO THE COMPANY, AND/OR BY INQUIRY OF THE PARTIES IN POSSESSION THEREOF.

21 ANY RIGHTS OF THE PARTIES IN POSSESSION OF A PORTION OF, OR ALL OF, SAID LAND, WHICH RIGHTS ARE NOT DISCLOSED BY THE PUBLIC RECORDS.
THE COMPANY WILL REQUIRE, FOR REVIEW, A FULL AND COMPLETE COPY OF ANY UNRECORDED AGREEMENT, CONTRACT, LICENSE AND/OR LEASE, TOGETHER WITH ALL SUPPLEMENTS, ASSIGNMENTS AND AMENDMENTS THERETO, BEFORE ISSUING ANY POLICY OF TITLE INSURANCE WITHOUT EXCEPTING THIS ITEM FROM COVERAGE.
THE COMPANY RESERVES THE RIGHT TO EXCEPT ADDITIONAL ITEMS AND/OR MAKE ADDITIONAL REQUIREMENTS AFTER REVIEWING SAID DOCUMENTS.

SURVEYOR'S CERTIFICATE

TO RENDA JOYE ABRAMSON AND SYDNEY J. DUNITZ, AS TRUSTEES UNDER THAT CERTAIN DECLARATION OF TRUST DATED AUGUST 1, 1952, AS TO AN UNDIVIDED 1/2 INTEREST; A.S. HERSHENSON AND BRENDA ABRAMSON, CO-TRUSTEES UNDER THE WILL OF SYLVIA HERSHENSON, DECEASED, AS TO AN UNDIVIDED 1/4 INTEREST; BRENDA ABRAMSON AND ALAN ABRAMSON, CO-TRUSTEES OF THE A.S. HERSHENSON FAMILY TRUST DATED MARCH 29, 1989 AS TO AN UNDIVIDED 1/4 INTEREST AND FIDELITY NATIONAL TITLE INSURANCE COMPANY:

THIS IS TO CERTIFY THAT THIS MAP OR PLAT AND THE SURVEY ON WHICH IT IS BASED WERE MADE IN ACCORDANCE WITH THE 2016 MINIMUM STANDARD DETAIL REQUIREMENTS FOR ALTA/NSPS LAND TITLE SURVEYS, JOINTLY ESTABLISHED AND ADOPTED BY ALTA AND NSPS, AND INCLUDES ITEMS 2, 3, 4, 5, 6(a), 7(a), 7(b)(1), 7(c), 8, 9, 10(a), 11, 13, 14, 16, 17 AND 18 OF TABLE A THEREOF. THE FIELD WORK WAS COMPLETED ON NOVEMBER 19, 2019

DATE OF PLAT OR MAP: DECEMBER 05, 2019

LEGEND

	ASPHALT PAVEMENT	EP	ELECTRIC PANEL
CONCRETE	CONCRETE PAVEMENT	EV	ELECTRIC VAULT
	DOOR	FF	FINISH FLOOR
E	ELECTRIC MANHOLE	FS	FINISH SURFACE
	ELECTRIC OUTLET	FL	FLOW LINE
	FIRE HYDRANT	GP	GUARD POST
	FOUND MONUMENT AS NOTED	GV	GROUND VENT
	GAS METER	HCR	HANDICAP RAMP
	GAS VALVE	INV	INVERT
	GATE	NG	NATURAL GROUND
	GUARD POST	TPB	TELCO PULL BOX
	LIGHT	TC	TOP OF CURB
	PALM TREE	TOP	TOP OF STRUCTURE
	SEWER CLEAN OUT	WM	WATER METER
S	SEWER MANHOLE	WV	WATER VAULT
	STAIRS SHOWING DOWNWARD DIRECTION		BLOCK WALL
D	STORM DRAIN MANHOLE		CENTER LINE
	STREET LIGHT	E(P)	ELECTRIC LINE PAINTED
T	TELECOM MANHOLE		FLOW LINE
	TRAFFIC LIGHT	G(P)	GAS LINE PAINTED
	TREE (TYPICAL)		INTERIOR LOT LINE
	TRUNCATED DOME		OVERHANG
	WATER VALVE		PROPERTY LINE
CB	CATCH BASIN		RIGHT-OF-WAY
℄	CENTER LINE	SS(P)	SANITARY SEWER LINE PAINTED
EB	ELECTRIC BREAK	SD(P)	STORM DRAIN LINE PAINTED
EC	ELECTRIC CABINET	T(P)	TELECOM LINE PAINTED
EM	ELECTRIC METER	W(P)	WATER LINE PAINTED
			WROUGHT IRON FENCE

ZONING RESTRICTIONS

NOTE: INDICATED ZONING INFORMATION IS FROM THE CITY OF BEVERLY HILLS ZONING ORDINANCES IN EFFECT AS OF THE DATE OF THIS SURVEY. ZONING AND RESTRICTIONS SHOWN HEREON WERE OBTAINED BY A GENERAL REQUEST AT THE PUBLIC COUNTER OF THE ABOVE NAMED DEPARTMENT. NO REPRESENTATION IS MADE FOR THE ACCURACY OR COMPLETENESS OF SAID THIRD PARTY INFORMATION. THIS FIRM IS NOT AN EXPERT IN THE REPRESENTATION OF COMPLEX ZONING ORDINANCES. COMPLIANCE IS BEYOND THE SCOPE OF THIS SURVEY. ANY USER OF SAID INFORMATION IS URGED TO CONTACT THE LOCAL AGENCY DIRECTLY.

ZONE: C-3 (COMMERCIAL ZONE)

MINIMUM SETBACKS: FRONT: NOT SPECIFIED
SIDE: NOT SPECIFIED
REAR: NOT SPECIFIED

HEIGHT RESTRICTIONS: NOT SPECIFIED

POSSIBLE ENCROACHMENT NOTES

THIS IS A LISTING OF OBSERVED IMPROVEMENTS THAT CROSS PROPERTY LINES. STATEMENT OF OWNERSHIP OR POSSESSION IS NOT THE INTENT OF THIS LISTING.

⚠ OVERHANG OVERLAPS ONTO BEVERLY DRIVE RIGHT-OF-WAY

FLOOD NOTE: BY GRAPHIC PLOTTING ONLY, THIS PROPERTY IS IN ZONE "X" OF THE FLOOD INSURANCE RATE MAP, PANEL NO. 06037C1585F, PANEL DATED 09/26/2008. THIS PROPERTY IS NOT LOCATED IN AN AREA WHERE FLOOD HAZARDS EXIST AS DETERMINED BY FEMA. BY TELEPHONE CALL TO THE NATIONAL FLOOD INSURANCE PROGRAM (800-638-6620) WE HAVE LEARNED THIS COMMUNITY DOES CURRENTLY PARTICIPATE IN THE PROGRAM. NO FIELD SURVEYING WAS PERFORMED TO DETERMINE THIS ZONE AND AN ELEVATION CERTIFICATE MAY BE NEEDED TO VERIFY THIS DETERMINATION OR APPLY FOR A VARIANCE FROM THE FEDERAL EMERGENCY MANAGEMENT AGENCY.

ITEMS CORRESPONDING TO TABLE A ITEMS

- ITEM 14
THE NEAREST INTERSECTION STREET TO THE PROPERTY ARE SHOWN HEREON

- ITEM 16
NO EVIDENCE OF RECENT EARTH MOVING WORK, BUILDING CONSTRUCTION OR BUILDING ADDITIONS OBSERVED IN THE PROCESS OF CONDUCTION THE FIELD WORK.

- ITEM 17
NO EVIDENCE OF RECENT STREET OR SIDEWALK CONSTRUCTION OR REPAIRS OBSERVED IN THE PROCESS OF CONDUCTING THE FIELD WORK.

- ITEM 18
NO EVIDENCE OF WETLANDS ON THE SUBJECT PROPERTY. NO DELINEATION MARKERS OF WETLANDS WERE OBSERVED IN THE PROCESS OF CONDUCTIONG THE FIELD WORK.

SURVEYOR'S NOTES

- THE UTILITIES SHOWN HEREON ARE BASED ON OBSERVED EVIDENCE ONLY. THIS SURVEY WOULD NOT SHOW UTILITIES COVERED BY CARS/TRUCKS OR RECENTLY PAVED ASPHALT/CONCRETE OR OVERGROWN BRUSH, TREES AND SHRUBS.

- UNLESS THIS PLAN HAS THE SEAL AND SIGNATURE OF THE SURVEYOR AND/OR ENGINEER RESPONSIBLE FOR ITS PREPARATION, THIS IS NOT AN AUTHENTIC COPY OF THE ORIGINAL SURVEY AND SHALL NOT BE DEEMED RELIABLE.

REVISIONS			
NO.	DATE	REVISIONS	BY
0	12/05/19	SUBMITTAL	VG

UTILITY STATEMENT

BURIED UTILITIES AND/OR PIPELINES SHOWN HEREON ARE PER VISIBLE AND APPARENT SURFACE EVIDENCE, RECORD DRAWINGS OF THE CONSTRUCTED UTILITY LINES OBTAINED FROM RELIABLE AND RESPONSIBLE SOURCES. NOT CONNECTED WITH CALVADA SURVEYING, INC. OR MARKINGS PROVIDED BY AN INDEPENDENT LOCATING CONTRACTOR. NO GUARANTEE OR WARRANTY, EITHER EXPRESSED OR IMPLIED, IS MADE AS TO THE ACCURACY OR THOROUGHNESS OF SUCH INFORMATION. IF MORE ACCURATE LOCATIONS OF UNDERGROUND UTILITIES OR PIPE LINES ARE REQUIRED, THE UTILITY OR PIPELINE WILL HAVE TO BE VERIFIED BY FIELD POTHOLING. CALVADA SURVEYING, INC. AND THE SURVEYOR OF RECORD SHALL NOT BE HELD LIABLE FOR THE LOCATION OF OR THE FAILURE TO NOTE THE LOCATION OF NON-VISIBLE UTILITIES OR PIPELINES.

Underground Service Alert
Call: TOLL FREE
1-800 227-2600
TWO WORKING DAYS BEFORE YOU DIG

PREPARED FOR

Kimley-Horn
660 S. FIGUEROA ST., SUITE 2050
LOS ANGELES, CA 90017
PHONE: (213) 261-4057

BASIS OF BEARINGS

THE BEARINGS SHOWN HEREON ARE BASED UPON THE CENTERLINE OF SANTA MONICA BOULEVARD, BEING N50°30'37"E PER CORNER RECORD, PWFB 1316-1202.

SITE INFORMATION

SITE ADDRESS: 449 N. BEVERLY DR., BEVERLY HILLS, CA 90210

PROPERTY AREA: 0.175 AC. OR 7226 SQ. FT.

TOTAL GROUND FLOOR AREA OF BUILDINGS: 6,071 SQ. FT.

ASSESSOR'S PARCEL NO.: 4343-016-019

SURVEYOR OF RECORD

FIELD COMPLETION DATE: NOVEMBER 19, 2019

LICENSED LAND SURVEYOR Armando D. DuPont L.S. 7780 Exp. 12-31-19 STATE OF CALIFORNIA

Armando D. DuPont
Registration No. 7780

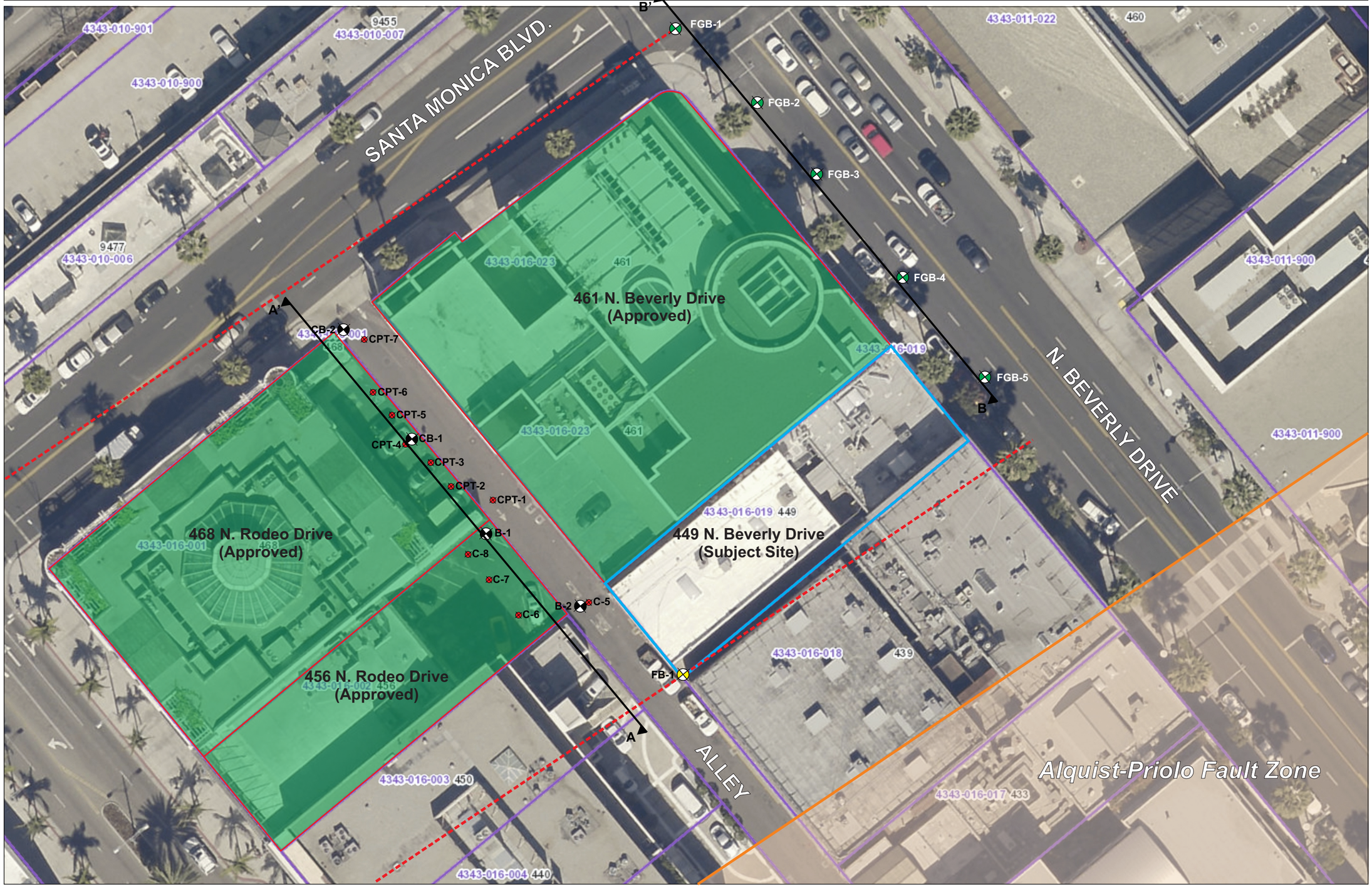
CALVADA SURVEYING, INC.
411 Jenks Cir., Suite 205, Corona, CA 92880
Phone: 951-280-9960 Fax: 951-280-9746
Toll Free: 800-CALVADA www.calvada.com

EST. 1989 JOB NO. 19656

FEFFER
GEOLOGICAL CONSULTING

Figure 11

Map of Previously Approved Fault Investigations and Site Work in Relation to 449 N. Beverly Drive





EXPLANATION

FB-1	BORING LOCATION FOR 449 N. BEVERLY DR.
CB-2/B2	BORING LOCATIONS FOR 456 & 468 N. RODEO DR.
FGB-5	BORING LOCATIONS FOR 461 N. BEVERLY DR.
CPT-7/C-8	CPT LOCATIONS FOR 456 & 468 N. RODEO DR.
A A'	CROSS SECTION A (THIS STUDY)
B B'	CROSS SECTION B (461 N. BEVERLY DR.)
	LATERAL LIMITS OF SUBSURFACE EXPLORATION PARALLEL TO THE STRIKE OF THE SMFZ
	OUTERMOST LIMIT TO OF ALQUIST-PRIOLO FAULT ZONE FOR THE SANTA MONICA FAULT

Modified from LACounty.gov GIS Viewer (2019)

Notes

FEET
100 0 50 100

This map is for reference only and should not be used for legal decisions. While the County of Los Angeles makes its best effort to ensure data is accurate, the County makes no representation or warranty of any kind.

Figure 11a

Site-Specific Seismic Investigations

Modified from the City of Beverly Hills GIS "Site-Specifc Seismic Investigations" (2020)

FEFFER GEOLOGICAL CONSULTING

Explanation

- Investigation Completed
- Investigation Pending (Active)
- Fault Zone
- City Boundary
- (19) Site Number; Refer to Table 3

SUBJECT SITE

Hollywood Fault

Santa Monica Fault

West Pico Fault

0 0.15 0.3mi

FEFFER GEOLOGICAL CONSULTING

CROSS SECTION A-A'

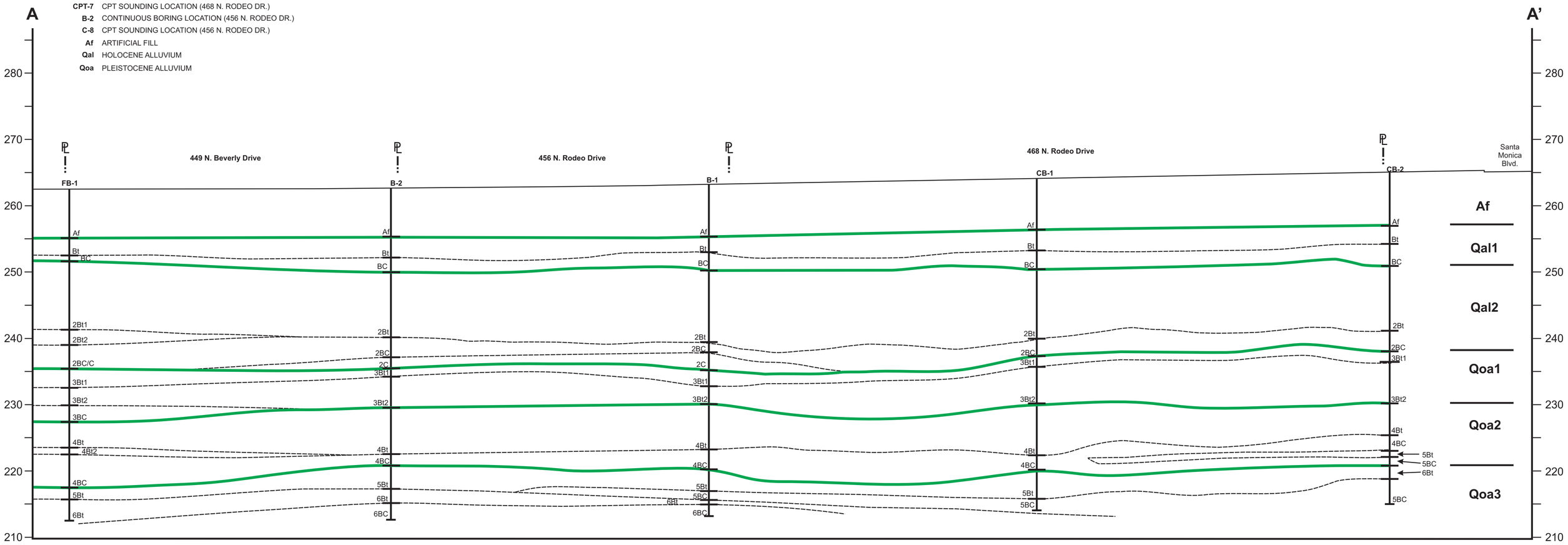
JB: 2387-95	NAME: 449 N. BEVERLY DRIVE LLC	BY: AG	
DATE: 1/10/20	SCALE: 1"=10'	SITE: 449 N. BEVERLY DRIVE	
REF: TOPOGRAPHY FROM LA COUNTY GIS VIEWER			

Figure 12

Boring Depth & Stratigraphic Correlation

EXPLANATION

- **FB-1** CONTINUOUS BORING LOCATION (449 N. BEVERLY DR.)
- **CB-2** CONTINUOUS BORING LOCATION (468 N. RODEO DR.)
- **CPT-7** CPT SOUNDING LOCATION (468 N. RODEO DR.)
- **B-2** CONTINUOUS BORING LOCATION (456 N. RODEO DR.)
- **C-8** CPT SOUNDING LOCATION (456 N. RODEO DR.)
- **Af** ARTIFICIAL FILL
- **Qal** HOLOCENE ALLUVIUM
- **Qoa** PLEISTOCENE ALLUVIUM



Graphical Illustration of Lithology

EXPLANATION

- TRUNCATED & BURIED SOIL
- BURIED SOIL

SCOUR DEPOSITS

- BC
- 2BC
- 2C
- 4BC
- 5BC
- 6BC

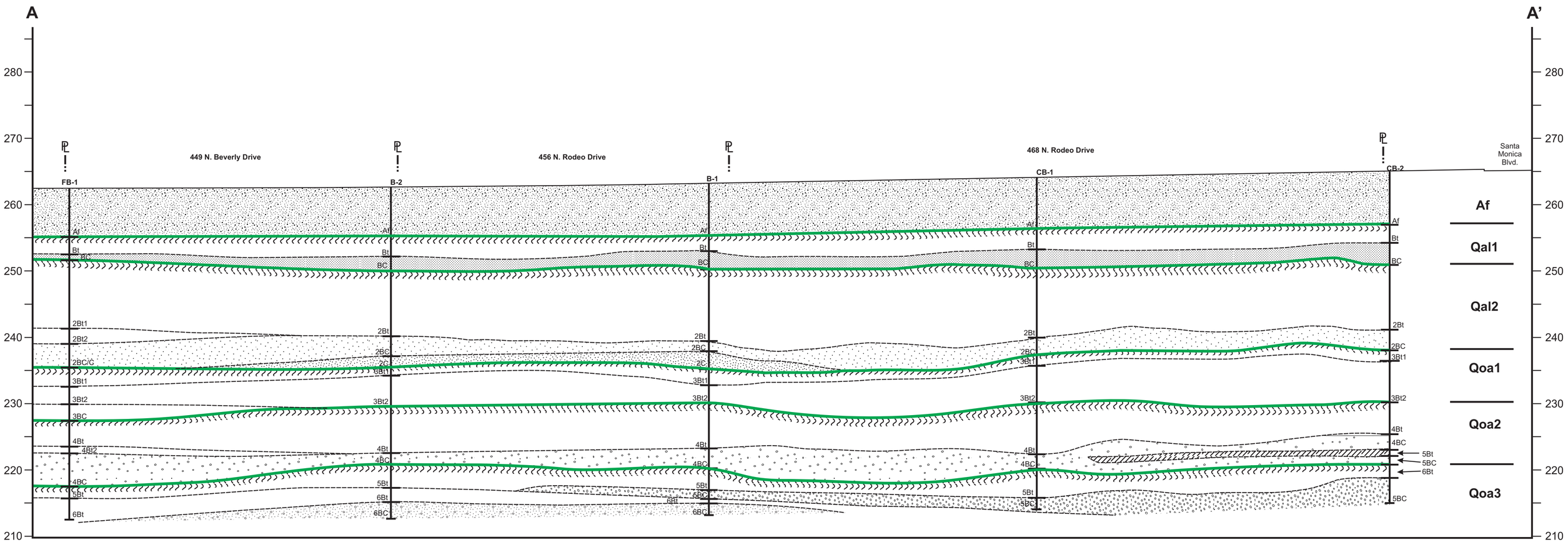
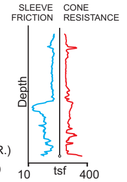


Figure 13

Stratigraphic Correlation of CPTs & Continuous Borings

FEFFER GEOLOGICAL CONSULTING	CROSS SECTION A-A'	
JB: 2387-85	NAME: 449 N. BEVERLY DRIVE LLC	BY: AG
DATE: 1/10/20	SCALE: 1"=10'	SITE: 449 N. BEVERLY DRIVE
REF: TOPOGRAPHY FROM LA COUNTY GIS VIEWER		



EXPLANATION

- **FB-1** CONTINUOUS BORING LOCATION (449 N. BEVERLY DR.)
- **CB-2** CONTINUOUS BORING LOCATION (468 N. RODEO DR.)
- **CPT-7** CPT SOUNDING LOCATION (468 N. RODEO DR.)
- **B-2** CONTINUOUS BORING LOCATION (456 N. RODEO DR.)
- **C-8** CPT SOUNDING LOCATION (456 N. RODEO DR.)
- **Af** ARTIFICIAL FILL
- **Qal** HOLOCENE ALLUVIUM
- **Qoa** PLEISTOCENE ALLUVIUM

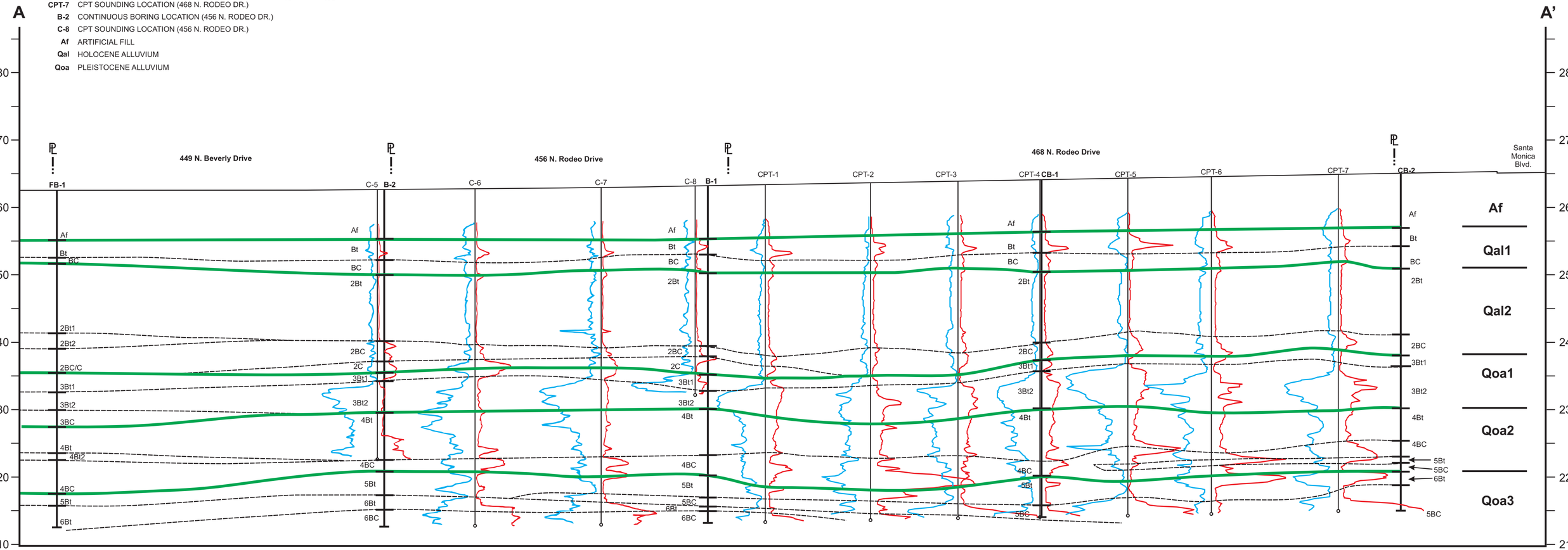


Table 1. Summary of Hollow Stem Auger Borings

						Groundwater	
Boring No.	Boring Location (See Site Map)	Date Drilled	Total Depth (ft)	Boring G.S. Elevation (ft)	Boring Depth Elevation (ft)	Depth (ft)	Elevation (ft)
FB-1	449 N. Beverly	12/2/2019	50	262.7	212.7	N.E.	--
B-1	456 N. Rodeo	7/11/2018	50	263.8	213.8	N.E.	--
B-2	456 N. Rodeo	7/11/2018	50	262.5	212.5	N.E.	--
CB-1	468 N. Rodeo	7/30/2018	50	264.5	214.5	N.E.	--
CB-2	468 N. Rodeo	7/31/2018	50	265.5	215.5	N.E.	--

Table 2. Summary of CPT Soundings

						Groundwater	
CPT No.	Boring Location (See Site Map)	Date	Total Depth (ft)	Boring G.S. Elevation (ft)	Boring Depth Elevation (ft)	Depth (ft)	Elevation (ft)
CPT-1	468 N. Rodeo	7/31/2018	49.87	264	214.13	N.E.	--
CPT-2	468 N. Rodeo	7/30/2018	49.87	264.2	214.33	N.E.	--
CPT-3	468 N. Rodeo	7/31/2018	49.87	264.3	214.43	N.E.	--
CPT-4	468 N. Rodeo	7/31/2018	49.87	264.5	214.63	N.E.	--
CPT-5	468 N. Rodeo	7/31/2018	49.87	264.7	214.83	N.E.	--
CPT-6	468 N. Rodeo	7/31/2018	49.87	265	215.13	N.E.	--
CPT-7	468 N. Rodeo	7/30/2018	49.87	265.4	215.53	N.E.	--
C-5	456 N. Rodeo	7/12/2018	39.77	262.5	222.73	N.E.	--
C-6	456 N. Rodeo	7/11/2018	50.15	263	212.85	N.E.	--
C-7	456 N. Rodeo	7/11/2018	50.07	263.5	213.43	N.E.	--
C-8	456 N. Rodeo	7/12/2018	30.91	263.8	232.89	N.E.	--

Table 3. Site Specific Seismic Investigations		
Number	**Site Address**	**Status**
1	461 N. Beverly Drive	Completed
2	468 N. Rodeo Drive	Completed
3	456 N. Rodeo Drive	Completed
4	420 N. Rodeo Drive	Pending
5	400 N. Rodeo Drive	Pending
6	370 N. Rodeo Drive	Pending
7	319 N. Rodeo Drive	Pending
8	315 N. Rodeo Drive	Pending
9	250 N. Crescent Drive	Completed
10	322 Foothill Road	Completed
11	425 N. Palm Drive	Completed
12	457 N. Oakhurst Drive	Pending
13	8635 Wilshire Boulevard	Pending
14	9000 Wilshire Boulevard	Pending
15	9200 Wilshire Boulevard	Completed
16	330 Reeves Drive	Completed
17	9255 Whitworth Drive	Completed
18	9900 Santa Monica Boulevard	Completed
19	140 S. Lasky Drive	Completed

Sites currently mapped by the City of Beverly Hills (2020) GIS website "Site-Specific Fault Investigations" As of 1/10/2020. Refer to Figure 11a

APPENDIX 'A'

Boring Logs

LOG OF EXPLORATORY BORING

Job Number: 2387-95
Project: 449 N. Beverly Drive

Boring No: FB-1
Boring Location: See Site Map

Date Performed: 12/2/19

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
0	1			**Artificial Fill** **0-7.4’:** Silty sand, scattered concrete and asphalt fragments Hand augered upper 5’ due to utilities	Brown	Medium Dense	Af
5	2	4.2 /5					Af
				Holocene Alluvium (Qal1) **7.4’:** Sandy clay with silt, moist, few fine gravels, slightly oxidized, fine grained well sorted sand, slight organics, few fine CaCO3 veinlets, few fine clay films on ped faces	Yellow Brown 10 YR 5/4	Very Hard	Bt
10				**10’:** Silty sand with very minor clay, fine to medium grained sand, slightly moist, large basalt cobble, clay stains on clasts	Pale Brown 10 YR 6/3	Soft	BC
	3	3.7 /5		**Holocene Alluvium (Qal2)** **10.9’:** Fine to medium sand with clay, few fine gravels, moderately well sorted, slightly weathered, common CaCO3 veinlets present, slightly moist, mica rich	Brown 7.5 YR 5/4	Hard	
15				**15’:** Clayey sand with silt, fine grained, few fine gravels, slightly oxidized, moderately well sorted, slightly moist			2Bt1
	4	3.6 /5		**16.3’:** Sandy clay with few fine medium gravels, slightly oxidized trace CaCO3, very few think clay films on ped faces and common clay stains, slightly moist	Brown 10 YR 5/3	Hard	
20							

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Figure

LOG OF EXPLORATORY BORING

Job Number: 2387-95
Project: 449 N. Beverly Drive

Boring No: FB-1
Boring Location: See Site Map

Date Performed: 12/2/19

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
20				**20’:** Silty sand with clay, scattered poorly sorted medium grained gravels, slightly oxidized, slightly moist	Brown 10 YR 5/3	Hard	2Bt1
	5	4.1 /5		**21.2’:** Medium to coarse sandy clay, poorly sorted, crudely stratified, slightly weathered, gravels angular to sub-angular, minor carbonates, slightly moist, gravels consisting of weathered slate and granite, very few fine clay films on ped faces, slighlty well oxidized	Brown 7.5 YR 5/3	Hard	2Bt2
				23.5’: Fine to coarse grained sand with trace clay binders, weakly bedded to crudely stratified, poorly sorted, slightly oxidized, moderate carbonates present, slightly moist, scoured contact	Pale Brown 10 YR 6/3 Yellow Brown 10 YR 5/4	Slightly Hard to Soft	2BC/C
25							
	6	3.3 /5		**Pleistocene Older Alluvium (Qoa1)** **27.1’:** Fine to medium sandy clay, abundant carbonates, few scattered, weathered, fine to medium grained rounded gravels, locally gleyed and highly weathered gravel, few thin clay films on ped faces and coating clasts, slightly moist	Brown 7.5 YR 5/4	Very Hard	3Bt1
30				**30’:** Fine to coarse sandy clay, abundant carbonates, moderately weathered fine to coarse grained poorly sorted sand and gravels, locally gleyed, slightly oxidized, few thin clay films coating clasts, slightly moist	Brown 7.5 YR 4/4	Very Hard	3Bt2
	7	5/5		**32.6’:** Sandy clay, moderately well sorted, gradational loss of carbonates, slightly oxidized, common clay stains on ped faces, fine to medium grained sand with few pea gravel, slightly moist	Brown 7.5 YR 5/3	Very Hard	3BC
35				**Pleistocene Older Alluvium (Qoa2)** **35.1’:** Sandy clay/clayey sand, few scattered weathered gravels, crudely stratified, oxidized, slight organics, coarse grained poorly sorted sand with common highly weathered gravel, thin few clay films common to moderately thick on ped faces and coating clasts, slightly moist	Brown 7.5 YR 4/3	Hard to Very Hard	4Bt
	8	5/5		**39’:** Sandy clay/clayey sand, abundant scattered weathered gravels, crudely stratified, oxidized, slightly moist	Brown 7.5 YR 4/3	Hard to Very Hard	4Bt2
40							

LOG OF EXPLORATORY BORING

Job Number: 2387-95
Project: 449 N. Beverly Drive

Boring No: FB-1
Boring Location: See Site Map

Date Performed: 12/2/19

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
40							
	9	3.4 /5		**40’:** Fine to coarse sand, scattered weathered gravels, poorly sorted, angular to sub-angular gravels, **42.9’:** Fine grained silty clay with sand, weakly to crudely stratified, gradational loss of carbonates, slightly oxidized, slightly moist	Brown 7.5 YR 4/4	Slightly Hard to Hard	4BC
45				**Pleistocene Older Alluvium (Qoa3)** **45’:** Fine to medium grained sandy clay, scattered fine to medium gravels, crudely stratified, minor carbonates, few to common thin clay films on ped faces, oxidized, moist	Brown 7.5 YR 5/4	Hard	5Bt
	10	4.5 /5		**46.8’:** Very fine grained clayey sand with silt, few scattered gravels, moderately well sorted, moderately well oxidized, few thin clay films on ped faces, moist	Brown 7.5 YR 5/4	Very Hard	6Bt
50				End at 50’, Fill to 7.4’, No Water, No Caving			
55							
60							

456 N. Rodeo Drive

&

468 N. Rodeo Drive

LOG OF EXPLORATORY BORING

Job Number: 2176-85
Project: 456 N. Rodeo Drive

Boring No: B-1
Boring Location: See Site Map

Date Performed: 7/11/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
0	1			**0-7.8’:** Fill - Silty sand, scattered concrete and asphalt fragments Hand augered upper 5’ due to utilities	Brown	Medium Dense	Af
5	2	5/5					Af
				Holocene Alluvium (Qal1) **7.8-10’:** Clayey sand, massive, slightly well oxidized, medium to coarse grained, moderately sticky and plastic, poorly sorted sand, common thin and few moderately thick clay films	Brown 7.5 YR 4/3	Hard, friable	Bt
10						Slightly Hard, friable	C
	3	3.7 /5		**10-12.7’:** Silty sand with clay, massive, slightly well oxidized, medium to coarse grained, slightly sticky, moderately plastic, few fine to medium slate gravels, few to common thin clay films	Brown 7.5 YR 5/3	Slightly Hard, friable	BC
				Holocene Alluvium (Qal2) **12.7-23.5’:** Clayey sand, massive, slightly well oxidized, fine to medium grained moderately well sorted sand, moderate to very sticky, very plastic, few localized fine $CaCO_3$ nodules, common thin and very few moderately thick clay films	Brown 7.5 YR 5/4	Hard, firm	2Bt
15	4	5/5					
20							

LOG OF EXPLORATORY BORING

Job Number: 2176-85
Project: 456 N. Rodeo Drive

Boring No: B-1
Boring Location: See Site Map

Date Performed: 7/11/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
20				**12.7-23.5’:** Clayey sand, massive, slightly well oxidized, fine to medium grained moderately well sorted sand, moderate to very sticky, very plastic, few localized fine $CaCO_3$ nodules, common thin and very few moderately thick clay films	Brown 7.5 YR 5/4	Hard, firm	2Bt
	5	4/5					
				23.5-25’: Silty sand with clay, massive, slightly well oxidized, coarse grained poorly sorted sand, common clay stains, slightly sticky, non-plastic	Brown 7.5 YR 5/4	Slightly Hard, friable	2BC
25				**25-27.7’:** Silty sand, massive, coarse grained poorly sorted sand, non-sticky, non-plastic	Brown 7.5 YR 5/3	Soft, friable	2C
	6	3.5 /5		**Pleistocene Older Alluvium (Qoa1)**			
				27.7 -30’: Clayey sand, massive, moderately well oxidized, slight organics, medium grained, moderately well sorted sand, common thin clay films, very sticky, very plastic	Reddish Brown 5 YR 4/3	Very Hard, firm	$3Bt_1$
30				**30-32.8’:** Sandy clay with gravel, massive, moderately well oxidized, coarse grained, poorly sorted sand, with common fine to medium highly weathered gravels, many thin and common moderately thick clay films	Reddish Brown 5 YR 4/4	Very Hard, friable	$3Bt_2$
	7	5/5		**Pleistocene Older Alluvium (Qoa2)**			
				32.8-39.5’: Clayey silt with sand - silty clay, moist, moderately oxidized, becoming fine to medium grained silty sand with clay, containing few scattered medium gravels	Strong Brown 7.5 YR 5/6	Very Hard, firm	4Bt
35							
	8	5/5					
40				**39.5-42.9’:** Becomes medium to coarse sand with scattered gravels, slightly moist	Brown 7.5 YR 5/4	Soft, friable	4BC

LOG OF EXPLORATORY BORING

Job Number: 2176-85
Project: 456 N. Rodeo Drive

Boring No: B-1
Boring Location: See Site Map

Date Performed: 7/11/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
40				**39.5-42.9’:** Becomes medium to coarse sand with scattered gravels, slightly moist	Brown 7.5 YR 5/4	Soft, friable	4BC
	9	3.3 /5		**42.9-46’:** Clayey sand, massive, moderately oxidized, fine to medium grained moderately well sorted sand, very sticky, very plastic, many thin and common moderately thick clay films	Brown 7.5 YR 4/4	Very hard, friable	5Bt
45				**46-47.2’:** Silty sand with gravel, massive, slightly well oxidized, slightly sticky, non-plastic, coarse grained poorly sorted sand common to many fine to medium, highly weathered slate gravel	Brown 7.5 YR 4/3	Slightly hard, friable	5BC
	10	4/5		**Pleistocene Older Alluvium (Qoa3)** **47.2-48’:** Silty sand with clay, massive, moderately well oxidized, highly truncated, medium to coarse grained poorly sorted sand, with few fine to medium gravels, few to common thin and few moderately thick clay films	Strong Brown 7.5 YR 4/6	Very hard, firm	6Bt
				48’: Silty sand with gravel, slightly oxidized, massive, coarse grained, with many fine to medium subangular and highly weathered gravel, non-sticky, non-plastic	Brown 7.5 YR 5/3	Hard, friable	6BC
50				End at 50, Fill to 7.8’, No Water, No Caving			
55							
60							

LOG OF EXPLORATORY BORING

Job Number: 2176-85
Project: 456 N. Rodeo Drive

Boring No: B-2
Boring Location: See Site Map

Date Performed: 7/11/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
0	1			**0-7.2’:** Fill - Silty sand, scattered concrete and asphalt fragments Hand augered upper 5’ due to utilities	Brown	Medium Dense	Af
5	2	5/5					Af
				Holocene Alluvium (Qal1) **7.2-10.2’:** Silty sand with clay, massive, slight organics, moderately sticky, very plastic, medium to coarse grained poorly sorted sand, common thin and few moderately thick clay films	Brown 7.5 YR 4/4	Hard, firm	Bt
10						Slightly Hard, friable	C
	3	3.9 /5		**10.2-12.5’:** Silty sand with clay, massive, medium to coarse grained poorly sorted sand, slightly well oxidized, few fine gravels, few thin clay films, slightly sticky, slightly plastic	Brown 7.5 YR 5/4	Slightly Hard, friable	BC
				Holocene Alluvium (Qal2) **12.5-22.2’:** Clayey sand, massive, medium grained moderately well sorted sand, very sticky, very plastic, slightly well oxidized	Brown 7.5 YR 4/3-4	Hard, firm	2Bt
15	4	5/5					
20							

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Figure

LOG OF EXPLORATORY BORING

Job Number: 2176-85
Project: 456 N. Rodeo Drive

Boring No: B-2
Boring Location: See Site Map

Date Performed: 7/11/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
20				**12.5-22.2’:** Clayey sand, massive, medium grained moderately well sorted sand, very sticky, very plastic, slightly well oxidized	Brown 7.5 YR 4/3-4	Hard, firm	2Bt
	5	4.5 /5		**22.2-25’:** Silty sand with clay, massive, moderately well oxidized slightly sticky, slightly plastic, coarse grained poorly sorted sand, few fine to medium slate gravels, common thin clay films	Brown 7.5 YR 4/3	Slightly Hard, friable	2BC
25				**25-26.7’:** Silty sand with gravel, massive, slightly well oxidized, coarse grained poorly sorted sand with common fine to medium gravel, non-sticky, non-plastic	Brown 7.5 YR 5/3	Soft, very friable	2C
	6	2.9 /5		**Pleistocene Older Alluvium (Qoa1)** **26.7-28’:** Clayey sand, massive, moderately oxidized, slight organics, medium grained, common thin and few moderately thick clay films	Reddish Brown 5 YR 4/3	Very Hard, firm	$3Bt_1$
				28-33’: Clayey sand with gravel, massive, moderately oxidized, coarse grained poorly sorted sand, common to many fine to medium slate rich gravels, moderately sticky, moderately plastic	Reddish Brown 5 YR 4/4	Very Hard, friable	$3Bt_2$
30	7	5/5		**Pleistocene Older Alluvium (Qoa2)** **33-39.7’:** Sandy clay, massive, faintly mottled, moderately well oxidized, fine to medium grained, moderately well sorted sand	Strong Brown 7.5 YR 4/4	Very Hard, firm	4Bt
35	8	5/5					
40				See Next Page	Brown 7.5 YR 5/4	Slightly Hard, friable	4BC

LOG OF EXPLORATORY BORING

Job Number: 2176-85
Project: 456 N. Rodeo Drive

Boring No: B-2
Boring Location: See Site Map

Date Performed: 7/11/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
40				**39.7-41.5’:** Silty sand with gravel, crudely stratified, coarse grained poorly sorted sand with common to many fine to medium gravels, non to slightly sticky, non-plastic, few clay stains on gravel	Brown 7.5 YR 5/4	Slightly Hard, friable	4BC
	9	3.4 /5		**41.5-45’:** Clayey sand, massive, moderately well oxidized, fine grained well sorted sand, moderately sticky, very plastic, common thin and few moderately thick clay films	Strong Brown 7.5 YR 4/6	Very hard, friable	5Bt
45				**Pleistocene Older Alluvium (Qoa3)** **45-47.5’:** Sandy clay, massive, moderately well oxidized, slight organics, medium to coarse grained poorly sorted sand with few fine to medium gravels, common thin clay films and common moderately thick clay films	Reddish Brown 5 YR 4/4	Very hard, firm	6Bt
	10	3.6 /5		**47.5’:** Silty sand with gravel, crudely stratified, coarse grained poorly sorted sand, slightly well oxidized, common to many fine to medium gravel, sub angular and highly weathered	Brown 7.5 YR 5/4	Hard, friable	5BC
50				End at 50, Fill to 7.2’, No Water, No Caving			
55							
60							

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Figure

LOG OF EXPLORATORY BORING

Job Number: 2188-85
Project: 468 N. Rodeo Drive

Boring No: CB-1
Boring Location: See Site Map

Date Performed: 7/30/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
0	1			**0-7.5’:** Fill - Silty sand, scattered concrete and asphalt fragments Hand augered upper 7’ due to utilities	Brown	Medium Dense	Af
5	2	3/3		**Holocene Alluvium (Qal1)** **7.5-10.5’:** Clayey sand, massive, moderate to very sticky, very plastic, medium to coarse grained, poorly sorted, common thin and fine moderately thick clay films with basal scour, of sand with silt	Brown 7.5 YR 4/3	Hard, friable	Af Bt
10						Slightly Hard, friable	C
	3	3.6 /5		**10.5-13.3’:** Silty sand with clay, slightly sticky, moderately plastic, medium to coarse grained, poorly sorted sand, slightly to well oxidized, few common thin clay films	Brown 7.5 YR 5/4	Slightly Hard, friable	BC
15	4	5/5		**Holocene Alluvium (Qal2)** **13.3’:** Sandy clay, clayey sand, very sticky, very plastic, medium to coarse grained, poorly sorted sand, common $CaCO_3$ veinlets, many thin and few moderately thick clay films	Brown 7.5 YR 5/4	Hard, firm	2Bt
20							

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Figure

LOG OF EXPLORATORY BORING

Job Number: 2188-85
Project: 468 N. Rodeo Drive

Boring No: CB-1
Boring Location: See Site Map

Date Performed: 7/30/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
20	5	4.3 /5		**13.3-24’:** Sandy clay, clayey sand, very sticky, very plastic, medium to coarse grained, poorly sorted sand, common $CaCO_3$ veinlets, many thin and few moderately thick clay films	Brown 7.5 YR 5/4	Hard to firm	2Bt
25				**24-26.5’:** Silty sand with clay and gravel, massive to crudely stratified, slightly to moderately sticky, slightly plastic, coarse grained, poorly sorted sand, common fine to medium gravel, few to common thin clay films,	Brown 7.5 YR 5/3	Soft, very friable	2BC
	6	4/5		**Pleistocene Older Alluvium (Qoa1)** **26.5-28’:** Clayey sand, massive, moderately well oxidized, med. - coarse grained sand, very sticky, very plastic, slight organics, common thin and few moderately thick clay films	Reddish Brown 5 YR 4/3	Firm to Very Hard	$3Bt_1$
30				**28-33.5’:** Clayey sand with gravel, massive, moderately well oxidized, coarse grained, poorly sorted sand with common to many thin and common moderately thick clay films	Reddish Brown 5 YR 4/4	Very Hard, friable	$3Bt_2$
	7	5/5		**Pleistocene Older Alluvium (Qoa2)** **33.5-42.5’:** Sandy clay, massive, faintly mottled, very sticky and very plastic, moderately well oxidized, medium grained, moderately well sorted sand	Brown 7.5 YR 5/4	Very Hard, firm	4Bt
35	8	5/5					
40							

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Figure

LOG OF EXPLORATORY BORING

Job Number: 2188-85
Project: 468 N. Rodeo Drive

Boring No: CB-1
Boring Location: See Site Map

Date Performed: 7/30/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
40				**33.5-42.5’:** Sandy clay, massive, faintly mottled, very sticky and very plastic, moderately well oxidized, medium grained, moderately well sorted sand	Brown 7.5 YR 5/4	Very Hard, firm	4Bt
	9	4.2 /5		**42.5-43.7’:** Silty sand with clay, massive, moderately well oxidized, coarse grained poorly sorted sand with common thin clay films, few fine to medium sub rounded slate gravels, slightly sticky, non to slightly plastic	Brown 7.5 YR 5/4	Slightly hard, friable	4BC
				Pleistocene Older Alluvium (Qoa3)	Strong Brown 7.5 YR 5/6	Very hard, firm	5Bt
45				**43.7-48.2’:** Sandy clay, massive, moderately well oxidized, fine grained well sorted sand, plugged with clay, many thin common moderately thick clay films, very sticky, very plastic			
	10	4.6 /5		**48.2’:** Silty sand with gravel, crudely stratified, slightly well oxidized, coarse grained poorly sorted sand, non to slightly sticky, non plastic, with common fine to medium slate gravels	Brown 7.5 YR 5/4	Soft, very friable	5BC
50				End at 50, Fill to 7.5’, No Water, No Caving			
55							
60							

LOG OF EXPLORATORY BORING

Job Number: 2188-85
Project: 468 N. Rodeo Drive

Boring No: CB-2
Boring Location: See Site Map

Date Performed: 7/31/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
0	1			**0-7.3’:** Fill - Silty sand, scattered concrete and asphalt fragments Hand augered upper 7’ due to utilities	Brown	Medium Dense	Af
5	2	2.8 /3		**Holocene Alluvium (Qal1)** **7.3-10.3’:** Silty sand with clay, massive, slightly to moderately sticky, slightly plastic, medium grained moderately well-sorted sand, slightly well oxidized, common fine clay films (7.5 YR 4/4), basal scour at top of run 2.	Brown 7.5 YR 4/3	Slightly Hard, friable	Af Bt C
10	3	4.9 /5		**10.3- 13.1’:** Silty sand, massive, slightly sticky, moderately to slightly plastic, medium grained moderately well-sorted sand, moderately well oxidized, few fine clay films (7.5 YR 4/4), sand scour deposit	Brown 7.5 YR 5/4	Slightly Hard, friable	BC
15	4	4.9 /5		**Holocene Alluvium (Qal2)** **13.5-23.2’:** Clayey sand grades to sandy clay with depth, massive, very sticky, very plastic, fine grained well-sorted sand, slightly well oxidized, plugged with clay	Brown 7.5 YR 4/2	Hard, firm	2Bt
20							

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Figure

LOG OF EXPLORATORY BORING

Job Number: 2188-85
Project: 468 N. Rodeo Drive

Boring No: CB-2
Boring Location: See Site Map

Date Performed: 7/31/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
20				**13.5-23.2’:** Clayey sand grades to sandy clay with depth, massive, very sticky, very plastic, fine grained well-sorted sand, slightly well oxidized, plugged with clay	Brown 7.5 YR 4/2	Hard to firm	2Bt
	5	3.6 /5					
				23.2-26.8’: Silty sand, massive, crudely stratified, slightly sticky, non-plastic, coarse grained with common fine and medium gravels	Brown 7.5 YR 5/4	Slightly hard, very friable	2BC
25							
				Pleistocene Older Alluvium (Qoa1)			
	6	2.7 /5		**26.8-28.2’:** Sandy clay with silt, massive, fine grained, very sticky, very plastic, slight organics	Reddish Brown 5 YR 4/3	Firm to Very Hard	$3Bt_1$
				28.2-33’: Clayey sand with gravel, massive, very sticky, very plastic	Reddish Brown 5 YR 4/4	Very Hard, friable	$3Bt_2$
30							
	7	4.3 /5		**33-35’:** Coarse grained to poorly sorted sand, scattered gravel, fine grained sand, plugged with clay			
35				**Pleistocene Older Alluvium (Qoa2)**			
	8	5/5		**34.8-39.4’:** Sandy clay, massive, very hard, very sticky, very plastic, fine grained well-sorted sand, moderately well oxidized, plugged with clay	Brown 7.5 YR 5/4	Very Hard, firm	4Bt
40				**39.4-41.8’: See next page**	Brown 7.5 YR 4/3	Hard, friable	4BC

LOG OF EXPLORATORY BORING

Job Number: 2188-85
Project: 468 N. Rodeo Drive

Boring No: CB-2
Boring Location: See Site Map

Date Performed: 7/31/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
40				**39.4-41.8’:** Silty sand with clay and gravel, stratified, slightly sticky, non to slightly plastic, coarse grained, poorly sorted sand, slightly well oxidized, common clay films	Brown 7.5 YR 4/3	Hard, friable	4BC
	9	4.2 /5		**41.8-42.8’:** Clayey sand, massive, moderately well oxidized, fine grained well-sorted sand, moderately sticky, moderately plastic, few moderately thick clay films	Brown 7.5 YR 5/4	Very Hard, friable	5Bt
				42.8-45’: Silty sand with gravel, massive, slightly well oxidized, coarse grained, poorly sorted sand, with common fine and medium gravel, slightly sticky, non plastic, common clay stains	Brown 7.5 YR 5/3	Slightly Hard, very friable	5BC
45				**Pleistocene Older Alluvium (Qoa3)** **45-46’:** Sandy clay, massive, very hard, moderately well oxidized, fine grained, very sticky, very plastic, plugged with clay	Brown 7.5 YR 5/4	Very Hard, firm	6Bt
	10	4.1 /5		**46-50’:** Silty sand with gravel, crudely stratified, slightly sticky, slightly plastic, slightly well oxidized, coarse grained with common fine and medium gravel	Brown 7.5 YR 5/3	Slightly Hard, very friable	6BC
50				End at 50, Fill to 7.3’, No Water, No Caving			
55							
60							

Feffer Geological Consulting

Figure

APPENDIX ‘B’

Soil Stratigraphy & Soil Age Estimates

Soil Stratigraphy Study And Relative Age Estimates For A Fault Rupture Hazard Investigation At 449 North Beverly Drive, Beverly Hills, CA

Prepared by:

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Submitted to:

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January 7, 2019

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Mr. Josh Feffer, CEG
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1990 South Bundy Drive, 4th Floor
Los Angeles, CA 91025

January 7, 2019

Subject: Soil Stratigraphy Study And Relative Age Estimates For A Fault Rupture Hazard Investigation At 449 North Beverly Drive, Beverly Hills, CA.

Dear Mr. Feffer:

I am pleased to present to you this soil stratigraphic study and relative-age determinations to be used with your fault rupture hazard assessment of the proposed development located at 449 North Beverly Drive in the City of Beverly Hills, California.

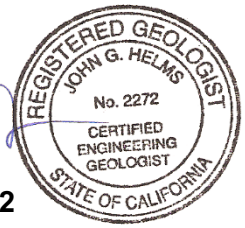
Feffer Geological retained John Helms CEG to describe and assist in correlations of the soil stratigraphy from continuously cored borehole samples and to assign relative age dates for the deposits identified across the site. This study builds off of previously collected continuously cored bore hole samples with one additional new boring placed at the southern end of a single transect of borings, transect A. One borehole (FB-1) was completely described from transect A for this study, and several additional boreholes (B-1, B-2, CB-1, and CB-2) from transect A were reviewed and summarized previously. The detailed soil description for this site was used to calculate various soil development indices (or SDIs). The SDI values were then compared to the SDI values from similar described soils with known ages to estimate age ranges for the soils understudy.

The attached report classifies the described soil profiles, identifies stratigraphic relationships, defines soil chronosequences, and estimates the relative ages for the soil profile described in detail. Calculated SDI's show strong correlations to the SDI values of other published, described, and dated soil profiles with similar parent materials.

Age estimates range from 59 to 124 ka for the stratigraphic section studied along transect A in boring FB-1. There are several distinctive buried soil units that can be correlated across the entire length of transect A. One distinctive buried soil (buried soil 2, Qoa1) which can be correlated across the entire length of transect A, is a well preserved and moderately well oxidized argillic soil profile that ranges in relative age from 25 – 51 ka. Please see Table 5 in the attached report for a summary listing of all of the determined relative ages at the study site.

Thank you for this opportunity to be of service. Should you have any questions or require additional information, please do not hesitate to contact me.

Sincerely,



John Helms, CEG 2272

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SOIL STRATIGRAPHY STUDY AND RELATIVE AGE ESTIMATES FOR A FAULT RUPTURE HAZARD STUDY FOR A PROPOSED DEVELOPMENT AT 449 N. BEVERLY DRIVE, BEVERLY HILLS, CALIFORNIA.

INTRODUCTION

Due to a laterally continuous sequence of stratigraphy across the entire transect of borings from the subject site area (Transect A) and an adjacent site to the north (Transect B), one soil profile has been studied for geomorphic characteristics and relative degrees of weathering to estimate deposit relative-age. Boring FB-1 was the only one drilled for this study as its' location extended the existing transect of borings (Transect A) farther south. The relative age estimate is based on index value comparisons with other published and dated soil profile descriptions. The comparative soils are from areas with a similar climate and similar parent material to this study area. The estimated relative ages in this report will be used by Feffer Geological, Inc. to assess the recency and recurrence of faulting across the study area. Alluvial units are assessed chronostratigraphically across a single transect of borings that shadow the area proposed for development. In this study, the soil stratigraphy is defined with soil field description data, and no laboratory data. This study identifies the soil stratigraphy across the area under study and estimates the relative age of one soil profile. Continuously cored and sampled borehole FB-1 has been described in detail. Transect A is located along a graded and stripped alluvial surface.

For the Quaternary geologist, a soil can be defined as a natural body that consists of horizons of organic and/or mineral constituents which differ from its parent material in some way (Birkland, 1984). A chronosequence is a group of soils for which all soil forming factors (such as topography, parent material, vegetation, and climate) except time is relatively equal (Jenny, 1941). Past geologic studies in the coastal region of southern California provide age constraints for several deposits and geomorphic surfaces ranging in age from middle Pleistocene to recent (McFadden, 1982; Rockwell, 1988; and WLA, 1998). Often it has proven difficult to date older deposits due to changes in past climatic regimes. Studies on the impacts of glacial to interglacial climatic changes on soil development in specific regions (McFadden, 1982; Birkland, 1984; McFadden, 1988) indicate that soil development has occurred throughout the Quaternary.

This study is concerned with a section of alluvium derived from the southern range front of the Santa Monica Mountains, which is within the Transverse Ranges Geomorphic Province. A series of stacked and truncated argillic soil subsurface horizons within all of the stratigraphic sections studied indicates that the alluvial stratigraphic section across the entire study area correlates well and is significantly old. Age estimates range from 59 to 124 ka (Qoa3) for the stratigraphic section studied across the southern portion of transect A in boring FB-1. To the north, age estimates range from 46 to 94 ka (Qoa3) for the stratigraphic section studied near the center portion of transect A in boring CB-1. The minor difference in ages across transect A are attributed to a scour deposit at the base of buried soil 4 that pinches out to the south where an additional buried soil 5 is preserved.

Soil relative age estimates have broad ranges, dependent upon the pool of comparative data used. Most of the buried soils across the study area fall into the Entisol and Alfisol soil orders (Soil Conservation Service, 1999). The soil profile that is described in detail is from boring FB-1 in Transect A. Boring locations are shown on the geologic map that is provided with the main fault rupture hazard report.

MATERIALS AND METHODS

Continuous core samples collected from boring FB-1 by Feffer Geological, Inc. were described in detail as part of this study. The soils were described using guidelines set by the Soil Survey Staff (1991 and 1999). Specific soil properties such as soil structure and soil horizon boundaries could not be accurately described from the core sample exposures. These soil qualifiers have not been described and do not factor into the estimated soil relative age comparisons.

Soil profile field description values quantify soil properties that are used to develop a soil development index (SDI) value as outlined by Harden (1982). Points are assigned to descriptive data for each of several observed soil properties, such as dry color, moist color, texture, dry and wet consistence, and clay film content, for each soil horizon in a soil profile relative to the soil horizon's thickness, and normalized to a common depth. The maturity of a soil profile is gauged through data collected from active wash deposits (or raw alluvium).

Table 1.1 lists the detailed soil description for the studied boring in longhand format. Table 1.2 lists the soil description using soil conservation service notation and shows the SDI calculations. Table 1.2 shows the calculated SDI values, the soil profile description, and the normalization values for raw alluvium. SDI values are calculated by assigning point values to each described soil properties. The points are summed for each soil horizon and divided by the total number of descriptive properties used. This equals the mean horizon index value (HI). HI values are multiplied by the corresponding soil horizon thickness. The SDI value equals the sum of the thickness normalized horizon indices. The maximum horizon index (MHI) is the value of the horizon with the largest summed descriptive value. MHI is independent of horizon thickness, and is usually the diagnostic subsurface soil horizon for most soil profiles. Tables 1.2 lists all of the determined HI, SDI, and MHI values for the soil profile under study.

SDI and MHI values have shown significant correlations to soil age in many past studies (Harden, 1982; Rockwell *et al.*, 1983; Reheis *et al.*, 1989; Rockwell *et al.*, 1994). The soils described in this study are compared to soils described and dated by McFadden (1982 and 1988) in San Bernardino County near Mission Creek, by Rockwell (1983) in the Ventura River basin, and by William Lettis and Associates, Inc. (1998) in West Hollywood. SDI values have all calibrated to a common depth of 3 feet.

The changes in the subsurface pedogenic properties of the Entisol and Alfisol soil orders allows for relative age determinations by emphasizing specific soil properties (such as color and clay film content) that are most diagnostic. Soil properties that express themselves well through time are most often used in the assessment of soil relative ages through a specific soil property index such as the color or clay film index. The color index (Rockwell *et al.,* 1985, 1988) is used to quantify observed colors (in Munsell notation) of each profile in order to compare relative degrees of reddening. The color index is simply the summation of an entire profile's horizon index values for dry colors. The clay film index (Rockwell *et al.,* 1985, 1988) is used to quantify field descriptions of this soil property in order to compare relative profile maturity. The clay film index is simply the summation of an entire soil profile's horizon index values for clay films. MHI is a comparison of a soil pedons master (or diagnostic) subsurface horizon (typically an argillic or cambic horizon). Independent of horizon thickness, the MHI directly compares the properties of the soil profiles strongest soil horizon.

SOIL RELATIVE AGE METHODS

Soil relative ages are calculated and compared independently for each soil profile described. The soil profile described for this study is located across several buried alluvial surfaces that differ in relative age, facies of deposition, and degrees of preservation. A series of stacked, buried, and truncated hard, clayey soils with illuvial clays characterize a majority of the soil profiles described on this project site.

The soil profile described in detail has a surface age that is implied by estimating the time of inception for the exposed surficial soil. The soil profile described in detail for this study also contains a series of stacked and / or buried soil profiles. In this case, deposit age assessments are obtained by identifying and isolating the different parent materials (or deposits). Then comparing a set of abridged calculated indices to an additional suite of similar soils that have been radiometrically dated yields the equivalent to a buried surface age estimate. Such burial relationships are common along the southern Santa Monica Mountains range front; especially where soils that have developed into alluvial fan deposits which commonly bury or locally truncate older soils that have developed previously in older alluvial deposits. A cumulic soil profile estimated age can assess landform age, and has potential to assess rates of erosion, rates of landform evolution, and rates of tectonic activity across the study area.

The described soil profiles have an SDI value which is used to estimate the soil relative age. Cumuli relative age estimates for a stacked or buried soil profiles are specifically referred to as “deposit ages”. The relative age estimate for the surface profile or modern soil is referred to as the “surface age”. All of the relative age estimates given are considered minimum ages given that an unknown amount of erosion has occurred after the formation of and before the burial of each truncated surface and buried soil studied.

DISCUSSION AND RESULTS

This section contains a brief write up for the continuously cored boring described in detail with designated tables for the soil profile. The attached Table 1.1 presents the soil profile description in longhand format. Table 1.2 presents the results of the calculated SDI values. Table 2 is a summary of the soil relative age estimates for the soil profile under study. Table 3 is a compilation of the comparative data in a format that compares to the data generated for this study. Table 4 is a soil abbreviation key to be used in conjunction with the SDI calculation sheets. Table 5 lists the relative ages for each designated stratigraphic unit that is shown on the geologic cross section in the fault rupture hazard report.

Soil descriptions, SDI calculations, and relative age determinations follow for the soil profile studied.

TRANSECT A BORING

One soil profile was described in detail out of core samples from boring FB-1. Age estimates range from 59 to 124 ka for the alluvial section studied.

Boring FB-1

The core samples from Transect A, Boring FB-1 were reviewed at the project site on 12/16/2019 and on 12/23/2019. This boring is located at the southern end of Transect A, and this alluvial section is characterized by a sequence of weakly developed surficial soils over a series of truncated argillic soils interbedded with massive and crudely stratified scour deposits. See Table 1.1 for a complete soil description of the continuously sampled boring, Table 1.2 for the SDI index value calculations and relative age estimates, and Feffer Geological Inc.'s cross section and geologic map for both the borehole and transect location.

The surface deposit (Qal1) in boring FB-1 consists of a weakly-developed soil that is characterized by a severely truncated cambic to juvenile argillic horizon and an estimated relative age of 4 – 8 ka. The first buried soil (Buried Soil 1 / Qal2) can be correlated across the entire length of Transect A is a truncated, thick (cumulic), and diffuse weakly to moderately well-developed Alfisol soil with an estimated relative age value of 16 – 29 ka. This correlates well with the Qal2 cumulic soil identified in Transect B to the east. The second buried soil in this alluvial sequence is a conservative top of the Pleistocene in this stratigraphic section. This marker bed (Qoa1) can be correlated across the entire area investigated (Transects A and B) and is a highly truncated, moderately well oxidized, and moderately well-developed Alfisol soil that has an estimated relative age value of 25 – 51 ka. The third buried soil (Buried Soil 3 / Qoa2) also can be correlated across the entire length of Transect B is a truncated, massive, weakly to moderately well-developed Alfisol soil with an estimated relative age value of 33 – 64 ka. The fourth and fifth buried soils (Qoa3) in Transect A, has an estimated age that ranges from 59 – 124 ka. This forth buried soil in this alluvial sequence can be correlated across a majority of the area investigated and the fifth buried soil is scoured out across the center and north end of Transect A.

Differences in the number of soils, depths of burial and unit thicknesses due to differential erosion / truncation laterally along Transect A may cause minor variances in relative age estimates between the individual borings. In order to control for this additional soil summary descriptions were generated across this transect which assesses the same buried surfaces at differing depths of burial and in differing states of preservation.

CONCLUSIONS

A majority of the buried soils observed across the study area are Alfisols that have developed in alluvial environments. All of the soil profiles across Transect A consist of a series of stacked, truncated, and buried argillic soil horizons. The truncated and buried soils with argillic sub surface soil horizons are weakly and moderately well developed. The Alfisol soils typically have 10YR to 7.5YR color hues with a modest amounts of secondary (pedogenic) clay in a series of argillic (Bt) diagnostic subsurface horizons.

Several buried soil profiles across the area investigated are laterally continuous across both Transects A and B. Localized lateral variability observed in the buried soils across the site is due to localized erosion, scouring, infilling, and stacking of these materials in an alluvial environment. In this sedimentological environment surfaces that have been stable long enough to form a robust soil, can suddenly be buried by a new deposit, or scoured out (truncated) and possibly in-filled with younger material. The amount of erosion that has occurred with each truncated soil under study is unknown. Thus the relative age estimates given in this study are minimum ages.

These soil relative age determinations are consistent with the general geologic and pedogenic observations of soils in southern California. Strongly developed, well horizonated, thick, and oxidized Alfisols can be as much as 200 ka in age. Erosion tends to act as a rejuvenating aspect in soil development, by decreasing the strength of the soil development properties and the consequent age estimates are younger. In that past magnitudes and rates of erosion are difficult to assess, the soil relative age estimates are utilized as minimum ages.

The soils observed along Transect A are Holocene and Pleistocene in age. The buried and stacked soils display soil horizons that have weak to moderately strong argillic horizon development at depth. Age estimates range from 59 to 124 ka for the entire alluvial stratigraphic section studied along transect A. Age estimates range from 37 to 72 ka for the truncated alluvial stratigraphic section studied along transect B. The third buried soil (buried soil 3) (Qoa1) in Transect B and the second buried soil (buried soil 2) (Qoa1) in Transect A can be correlated across the entire area investigated is a truncated, moderately well oxidized, and moderately well-developed argillic soil profile that ranges in relative age from 25 – 51 ka along the southern portion of Transect A. The lowermost buried soil (buried soil 4) (Qoa2) that can be correlated across the entire area investigated is a truncated, stacked, and moderately well-developed argillic soil profile that ranges in relative age from 46 – 94 ka along the southern portion of Transect A.

LIMITATIONS

The conclusions and recommendations presented herein are the results of an inherently limited scope. Specifically, the scope of services consisted of an assessment of relative age from core samples and did not participate in any drilling activities at the site. The conclusions and recommendations contained in this report are professional opinions derived in accordance with current standards of professional practice. No warranty is expressed or implied.

This report has been prepared for the exclusive use of Feffer Geological, Inc. and applies only to the Fault Rupture Hazard Study located at 449 N Beverly Drive. In the event that significant changes in the interpretations of this study are made, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed by John Helms, CEG, and the conclusions and recommendations of this report are verified in writing.

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Table 1.1

449 N. Beverly Drive

Table 1.1 Soil Description - Transect A; Boring FB 1

Depth (Ft)	Horizon	Transect A; FB-1 Description
0 - 7.4	NR	No Recovery
7.4 - 10.0	Bt	Yellowish brown (10YR 5/4d, 10YR 4/3m), sandy clay loam, slight-organics, slightly well oxidized, very hard, friable, moderately to very sticky, very plastic, fine-grained well sorted sand with few fine sub rounded gravel, calcium carbonate stage 1--, very few fine veinlets and slightly disseminated in soil matrix, clay films few thin on ped faces, undetermined lower boundary to;
10.0 -10.9	BC	Pale brown (10YR 6/3 d, 10YR 5/2 m), loam, soft, friable, slightly well oxidized, slightly sticky, moderately plastic, fine- to medium-grained moderately well sorted sand with common fine and medium sub rounded gravel, few clay stains coating clasts and ped faces, clear lower boundary to;
10.9 - 21.2	2Btb1	Brown (7.4YR 5/4d, 7.5YR 4/3m), sandy clay loam, slightly well oxidized, hard, firm, very sticky, very plastic, fine-grained well sorted sand, few fine and medium pores, clay films few to common thin on ped faces, calcium carbonate stage 1, common veinlets and fine nodules and slightly well disseminated in soil matrix, gradational lower boundary to;
21.2 - 23.5	2Btb2	Brown (10YR 5/3d, 10YR 4/2m), loam, slightly oxidized, hard, friable, slightly sticky, moderately plastic, medium- to coarse-grained poorly sorted sand with few fine and medium sub rounded gravel, clay films very few thin on ped faces, calcium carbonate stage 1-, few fine veinlets and slightly disseminated in soil matrix, gradational lower boundary to;
23.5 - 27.1	2BCb	Yellowish brown (10YR 5/4d, 10YR 4/3m), loam, slightly oxidized, crudely stratified, soft to slightly hard, friable, slightly to moderately sticky, slightly plastic, coarse-grained poorly sorted sand with common fine and medium sub rounded gravel, very few clay stains on gravel, abrupt lower boundary to;
27.1 - 30.0	3Btb1	Brown (7.5YR 5/4d, 7.5YR 4/3m), clay loam, moderately well oxidized, slight organics, very hard, firm, very sticky, very plastic, fine- to medium-grained moderately well sorted sand, few fine highly weathered sub rounded gravel, clay films few thin on ped faces and common thin coating clasts, localized gleyed pockets, undetermined lower boundary to;
30.0 - 32.6	3Btb2	Brown (7.5YR 3/4d, 7.5YR 2.5/3m), sandy clay loam, slightly well oxidized, hard to very hard, friable, moderately to very sticky, very plastic, medium- to coarse-grained poorly sorted sand with few fine and medium high weathered gravel, clay films very few thin on ped faces and few thin coating clasts, gradational lower boundary to;

Table 1.1

Depth (Ft)	Horizon	Transect A; FB-1 Description
32.6 - 35.1	3BCb	Brown (7.5YR 5/4d, 7.5YR 4/3m), loam, moderately well oxidized, hard, friable, slightly sticky, moderately plastic, medium- to coarse-grained poorly sorted sand with few medium high weathered gravel, few clay stains on ped faces and coating clasts, clear lower boundary to;
35.1 - 39.0	4Btb1	Brown (7.5YR 4/3d, 7.5YR 3/2m), sandy clay, slightly well oxidized, very hard, firm, very sticky, very plastic, coarse-grained poorly sorted sand with common fine high weathered gravel, clay films few thin on ped faces and few to common thin coating clasts, gradational lower boundary to;
39.0 - 40.0	4Btb2	Brown (7.5YR 4/3d, 7.5YR 3/2m), sandy clay loam, slightly well oxidized, hard to very hard, firm, moderately to very sticky, very plastic, coarse-grained poorly sorted sand with common to many fine ad medium high weathered gravel, clay films very few thin on ped faces and few thin coating clasts, gradational lower boundary to;
40.0 - 45.0	4BCb	Brown (7.5YR 4/4d, 7.5YR 3/3m), loam, moderately well oxidized, crudely stratified, slightly hard to hard, friable, slightly sticky, non- to slightly plastic, coarse-grained poorly sorted sand with common to many fine and medium, sub rounded slate rich gravel, very few clay stains on gravel, undetermined lower boundary to;
45.0 - 46.8	5Btb	Brown (7.5YR 5/4d, 7.5YR 4/3m), sandy clay to clay, moderately well oxidized, hard, firm, very sticky, very plastic, fine-grained well sorted sand, clay films few to common thin and few moderately thick on ped faces, clear lower boundary to;
46.8 - 50.0+	5BCb	Brown (7.5YR 5/4d, 7.5YR 4/3m), sandy clay, moderately well oxidized, very hard, friable, very sticky, very plastic, coarse-grained poorly sorted sand with common highly weathered fine and medium, sub rounded gravel, clay films few thin on ped faces and common thin coating clasts, undetermined lower boundary.

Table 1.2

Soil Development Index Calculation Sheet
449 Beverly Drive Transect A; Boring FB 1

Unit	Thickness (Feet)	Color				Texture		Consistence				Clay Films		Horizon Values	Mean Hor. Values
		Dry		Moist				Dry		Wet					
Raw Alluvium	*3*	*2.5Y 7/3*	*X/10*	*10YR 6/2*	*X/10*	*s*	*X/6*	*lo*	*X/5*	*so, po*	*X/6*	*0*	*X/15*		
Transect A; Boring FB 1															
Bt	2.6	10YR 5/4	0.2	10YR 4/3	0.1	scl	0.67	vh	0.80	s-vs, vp	0.92	v1-1npf	0.17	0.48	1.24
BC	0.9	10YR 6/3	0.1	10YR 5/2	0.2	l	0.5	so	0.20	ss, p	0.50	v1vnpf	0.13	0.27	0.25
2Btb1	11.2	7.5YR 5/4	0.3	7.5YR 4/3	0.2	scl	0.67	h	0.60	vs, vp	1.00	1-2npf	0.23	0.50	5.61
2Btb2	2.3	10YR 5/3	0.1	10YR 4/2	0.2	l	0.5	h	0.60	ss, p	0.50	v1npf	0.17	0.34	0.79
2BCb	3.6	10YR 5/4	0.2	10YR 4/3	0.1	l	0.5	so - sh	0.35	ss-s, ps	0.42	v1vncl	0.1	0.28	1.00
3Btb1	2.9	7.5YR 5/3	0.2	7.5YR 4/2	0.1	cl	0.67	vh	0.80	vs, vp	1.00	1npf, 2ncl	0.33	0.52	1.50
3Btb2	2.6	7.5YR 3/4	0.3	7.5YR 2.5/3	0.2	scl	0.67	h-vh	0.70	s-vs, vp	0.92	v1npf, 1ncl	0.25	0.51	1.32
3BCb	2.5	7.5YR 5/4	0.3	7.5YR 4/3	0.2	l	0.5	h	0.60	ss, p	0.50	2vnpf	0.23	0.39	0.97
4Btb1	3.9	7.5YR 4/3	0.2	7.5YR 3/2	0.1	sc	0.67	vh	0.80	vs, vp	1.00	1npf, 2ncl	0.33	0.52	2.02
4Btb2	1	7.5YR 4/3	0.2	7.5YR 3/2	0.1	scl	0.67	h-vh	0.70	s-vs, vp	0.92	v1npf, 1ncl	0.25	0.47	0.47
4BCb	5	7.5YR 4/4	0.3	7.5YR 3/3	0.2	l	0.5	sh-h	0.50	ss, po-ps	0.25	1vncl	0.17	0.32	1.60
5Btb	1.8	7.5YR 5/4	0.3	7.5YR 4/3	0.2	sc-c	0.92	h	0.60	vs, vp	1.00	1-2npf, 1mkpf	0.38	0.57	1.02
6Btb	3.2	7.5YR 5/4	0.3	7.5YR 4/3	0.2	sc	0.83	vh	0.80	vs, vp	1.00	1npf, 2ncl	0.33	0.58	1.85

INDEX VALUES AND DETERMINED AGES (ka)

Soil Member	MHI	Mean Soil Index	SDI @ 7 feet	Color Index	Clay Film Index	Soil Age Estimate ka	Section Age Estimate ka	Stratigraphic Unit
Surface Soil	**0.48**	**1.48**	**2.96**	**0.60**	**0.30**	**4 - 8**	**4 - 8**	**Qal1**
Buried Soil 1	**0.50**	**7.40**	**3.03**	**1.10**	**0.50**	**8 - 13**	**12 - 21**	**Qal2**
Buried Soil 2	**0.52**	**3.79**	**3.31**	**1.30**	**0.81**	**13 - 30**	**25 - 51**	**Qoa1**
Buried Soil 3	**0.52**	**4.09**	**2.89**	**1.10**	**0.75**	**8 - 13**	**33 - 64**	**Qoa2**
Buried Soil 4	**0.57**	**1.02**	**3.97**	**0.50**	**0.38**	**13 - 30**	**46 - 94**	**Qoa3**
Buried Soil 5	**0.58**	**1.85**	**4.04**	**0.50**	**0.33**	**13 - 30**	**59 - 124**	

Table 2. Soil Surface Relative-Age Estimates
449 N. Beverly Drive - Summary Age Table

Profile Number	Soil Member	Stratigraphic Unit	MHI Value	SDI Value	Clay Film	Relative Age (ka)
Transect A Boring FB-1	Surface Soil	Qal1	0.48	2.96	0.30	4 - 8
	Buried Soil 1	Qal2	0.50	3.03	0.50	12 - 21
	Buried Soil 2	Qoa1	0.52	3.31	0.81	25 - 51
	Buried Soil 3	Qoa2	0.52	2.89	0.75	33 - 64
	Buried Soil 4	Qoa3	0.57	3.97	0.38	46 - 94
	Buried Soil 5		0.58	4.04	0.33	59 - 124

Table 3. Comparison Soil Data Indices Value Summary

(McFadden) Mission Creek Soils	SDI At 7'	MHI	Reddening Index	Clay Film Index
S7 0-1000 yrbp	0.59	0.12	0	0
S5 4-13 ka	1.02	0.3	0.1	0
S4 13-70 ka	3.14	0.37	3.94	7.37
S2 70-250 ka	5.61	0.61	4.80	6.24
S2 250-700 ka	2.57	0.39	6.20	10.31

(Rockwell) Ventura River Basin Soils	SDI At 7'	MHI	Reddening Index	Clay Film Index
Qt3 4 - 8 ka	1.7	0.17	0.5	0
Qt4 10 -15 ka	2.7	0.43	2	4
Qt5a 15 – 20 ka	2.8	0.37	3.5	4.2
Qt5b 30 ka	3.2	0.46	5	7

(WLA) West Hollywood Buried Soils	SDI At 7'	MHI	Reddening Index	Clay Film Index
Qol1 100 ka	2.1	0.42	1.05	1.99
Qol2 100-300 ka	7.3	0.8	8.2	13.2

TABLE 4. Soil Field Description Abbreviation Key

Texture		Structure		Consistence						Clay Films		Calcium Carbonate	
				Dry		Moist		Wet				(Pedogenic CaCO3)	
S	- sand	m	- massive	l	- loose	vfr	-very friable	so	non stickey	v1	veryfew	sl dis	slightly dissemenated
LS	- loamy sand	sg	- single grained	so	-soft	fr	-friable	ss	slightly stickey	1	few	I	slight coatings common on clast bottoms
SL	- sandy loam	**OR**		sh	-slightly hard	fi	-firm	s	moderately siteckey	2	common	II	moderately thick coatings on clast bottoms; few medium common fine nooduses
L	- loam	1	- weak	h	-hard	vfi	-very firm	vs	very stickey	3	continuous	III	thick coatings common on clast bottoms, common medium nodules, common fine pendants, many fine nodules
CL	- clay loam	2	- moderate	vh	-very hard			**AND**		**AND**		VI	many thick coatings on clasts bottoms common coarse pendants few clasts completely enveloped
SCL	- sandy clay loam	3	- strong	eh	-extremely hard			po	non plastci	vn	stains	V	many thick coatings on clasts bottoms, many coarse pendants common clasts completely enveloped- petrocalcic
C	- clay	**AND**						ps	slightly plastic	n	thin	V+	many thick coatings on clasts bottoms, many coarse pendants many clasts completely enveloped, completely disseminated in matrix - petrocalcic
Si	- silt	vf	- very fine					p	moderately plastic	mk	moderately thick		
SiL	- silt loam	f	- fine					vp	very plastic	k	thick		
SiCL	- silt clay loam	m	- medium							**AND**			
SiC	- silty clay	c	- coarse							cl	coating clasts		
		vc	- very coarse							pf	ped faces		
		AND								br	brodgeing sand grains		
		gr	- granular							po	lining pores		
		pl	- platty										
		pr	-prismatic										
		abk	-angular blockey										
		sbk	- sub angular blockey										

Table 5. Geological Cross Section Unit Age

Cross Sec. Unit	Description	Age (ka)
Qal1	Truncated weakly developed thin soil (Surface Soil)	4 - 8
Qal2	Truncated thick diffuse moderately well to weakly developed Alfisol soil (Buried Soil 1)	12 - 21
Qoa1	Truncated moderately thick moderately well developed Alfisol soil (Buried Soil 2)	25 - 51
Qoa2	Truncated weakly to moderately well developed Alfisol soil (Buried soil 3)	33 - 64
Qoa3	Truncated and stacked sequence of moderately well developed Alfisol soils (Buried soils 5 and 6)	59 - 124

APPENDIX 'C'

CPT Reporting

8/3/18

Feffer Geological Consulting
Attn: Alexander Greene

Subject: CPT Site Investigation
468 Rodeo Drive
Beverly Hills, California
GREGG Project Number: 180590SH

Dear Mr. Greene:

The following report presents the results of GREGG Drilling & Testing's Cone Penetration Test investigation for the above referenced site. The following testing services were performed:

1	Cone Penetration Tests	(CPTU)	☒
2	Pore Pressure Dissipation Tests	(PPD)	☐
3	Seismic Cone Penetration Tests	(SCPTU)	☐
4	UVOST Laser Induced Fluorescence	(UVOST)	☐
5	Groundwater Sampling	(GWS)	☐
6	Soil Sampling	(SS)	☐
7	Vapor Sampling	(VS)	☐
8	Pressuremeter Testing	(PMT)	☐
9	Vane Shear Testing	(VST)	☐
10	Dilatometer Testing	(DMT)	☐

A list of reference papers providing additional background on the specific tests conducted is provided in the bibliography following the text of the report. If you would like a copy of any of these publications or should you have any questions or comments regarding the contents of this report, please do not hesitate to contact our office at (562) 427-6899.

Sincerely,
GREGG Drilling & Testing, Inc.



Frank Stolfi
HRSC Division Manager, Gregg Drilling & Testing, Inc.

Cone Penetration Test Sounding Summary

-Table 1-

CPT Sounding Identification	Date	Termination Depth (feet)	Depth of Groundwater Samples (feet)	Depth of Soil Samples (feet)	Depth of Pore Pressure Dissipation Tests (feet)
CPT-1	7/31/2018	49.87	-	-	-
CPT-2	7/30/2018	49.87	-	-	-
CPT-3	7/31/2018	49.87	-	-	-
CPT-4	7/31/2018	49.87	-	-	-
CPT-5	7/31/2018	49.87	-	-	-
CPT-6	7/31/2018	49.87	-	-	-
CPT-7	7/30/2018	49.87	-	-	-

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Copies of ASTM Standards are available through www.astm.org

Cone Penetration Testing Procedure (CPT)

Gregg Drilling carries out all Cone Penetration Tests (CPT) using an integrated electronic cone system, *Figure CPT*.

The cone takes measurements of tip resistance (q_c), sleeve resistance (f_s), and penetration pore water pressure (u_2). Measurements are taken at either 2.5 or 5 cm intervals during penetration to provide a nearly continuous profile. CPT data reduction and basic interpretation is performed in real time facilitating on-site decision making. The above mentioned parameters are stored electronically for further analysis and reference. All CPT soundings are performed in accordance with revised ASTM standards (D 5778-12).

The 5mm thick porous plastic filter element is located directly behind the cone tip in the u_2 location. A new saturated filter element is used on each sounding to measure both penetration pore pressures as well as measurements during a dissipation test (*PPDT*). Prior to each test, the filter element is fully saturated with oil under vacuum pressure to improve accuracy.

When the sounding is completed, the test hole is backfilled according to client specifications. If grouting is used, the procedure generally consists of pushing a hollow tremie pipe with a "knock out" plug to the termination depth of the CPT hole. Grout is then pumped under pressure as the tremie pipe is pulled from the hole. Disruption or further contamination to the site is therefore minimized.

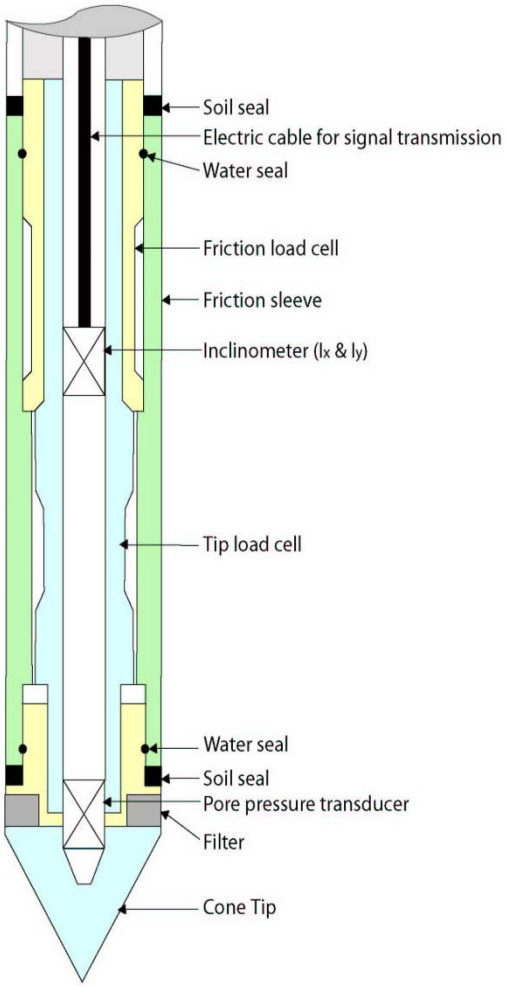


Figure CPT

Gregg 15cm^2 Standard Cone Specifications

Dimensions	
Cone base area	15 cm^2
Sleeve surface area	225 cm^2
Cone net area ratio	0.80
Specifications	
Cone load cell	
Full scale range	180 kN (20 tons)
Overload capacity	150%
Full scale tip stress	120 MPa (1,200 tsf)
Repeatability	120 kPa (1.2 tsf)
Sleeve load cell	
Full scale range	31 kN (3.5 tons)
Overload capacity	150%
Full scale sleeve stress	1,400 kPa (15 tsf)
Repeatability	1.4 kPa (0.015 tsf)
Pore pressure transducer	
Full scale range	7,000 kPa (1,000 psi)
Overload capacity	150%
Repeatability	7 kPa (1 psi)

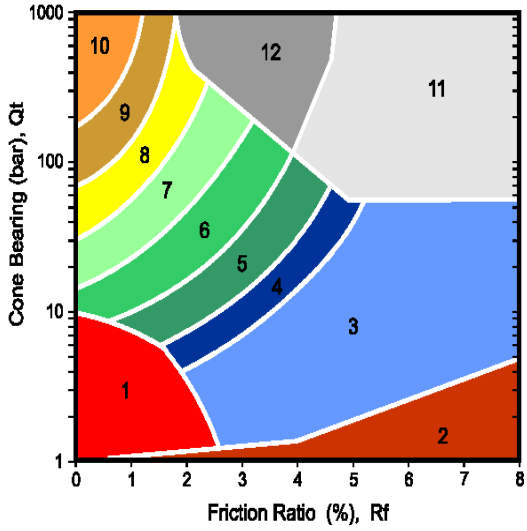
Note: The repeatability during field use will depend somewhat on ground conditions, abrasion, maintenance and zero load stability.

Cone Penetration Test Data & Interpretation

The Cone Penetration Test (CPT) data collected are presented in graphical and electronic form in the report. The plots include interpreted Soil Behavior Type (SBT) based on the charts described by Robertson (1990). Typical plots display SBT based on the non-normalized charts of Robertson et al (1986). For CPT soundings deeper than 30m, we recommend the use of the normalized charts of Robertson (1990) which can be displayed as SBTn, upon request. The report also includes spreadsheet output of computer calculations of basic interpretation in terms of SBT and SBTn and various geotechnical parameters using current published correlations based on the comprehensive review by Lunne, Robertson and Powell (1997), as well as recent updates by Professor Robertson (Guide to Cone Penetration Testing, 2015). The interpretations are presented only as a guide for geotechnical use and should be carefully reviewed. Gregg Drilling & Testing Inc. does not warranty the correctness or the applicability of any of the geotechnical parameters interpreted by the software and does not assume any liability for use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used in the software. Some interpretation methods require input of the groundwater level to calculate vertical effective stress. An estimate of the in-situ groundwater level has been made based on field observations and/or CPT results, but should be verified by the user.

A summary of locations and depths is available in Table 1. Note that all penetration depths referenced in the data are with respect to the existing ground surface.

Note that it is not always possible to clearly identify a soil type based solely on q_t, f_s, and u_2. In these situations, experience, judgment, and an assessment of the pore pressure dissipation data should be used to infer the correct soil behavior type.



ZONE		SBT
1		Sensitive, fine grained
2		Organic materials
3		Clay
4		Silty clay to clay
5		Clayey silt to silty clay
6		Sandy silt to clayey silt
7		Silty sand to sandy silt
8		Sand to silty sand
9		Sand
10		Gravely sand to sand
11		Very stiff fine grained*
12		Sand to clayey sand*

*over consolidated or cemented

Figure SBT (After Robertson et al., 1986) – Note: Colors may vary slightly compared to plots

Cone Penetration Test (CPT) Interpretation

Gregg uses a proprietary CPT interpretation and plotting software. The software takes the CPT data and performs basic interpretation in terms of soil behavior type (SBT) and various geotechnical parameters using current published empirical correlations based on the comprehensive review by Lunne, Robertson and Powell (1997). The interpretation is presented in tabular format using MS Excel. The interpretations are presented only as a guide for geotechnical use and should be carefully reviewed. Gregg does not warranty the correctness or the applicability of any of the geotechnical parameters interpreted by the software and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used in the software.

The following provides a summary of the methods used for the interpretation. Many of the empirical correlations to estimate geotechnical parameters have constants that have a range of values depending on soil type, geologic origin and other factors. The software uses 'default' values that have been selected to provide, in general, conservatively low estimates of the various geotechnical parameters.

Input:

1 Units for display (Imperial or metric) (atm. pressure, p_a = 0.96 tsf or 0.1 MPa)
2 Depth interval to average results (ft or m). Data are collected at either 0.02 or 0.05m and can be averaged every 1, 3 or 5 intervals.
3 Elevation of ground surface (ft or m)
4 Depth to water table, z_w (ft or m) – input required
5 Net area ratio for cone, a (default to 0.80)
6 Relative Density constant, C_{Dr} (default to 350)
7 Young's modulus number for sands, α (default to 5)
8 Small strain shear modulus number
  a. for sands, S_G (default to 180 for SBT_n 5, 6, 7)
  b. for clays, C_G (default to 50 for SBT_n 1, 2, 3 & 4)
9 Undrained shear strength cone factor for clays, N_{kt} (default to 15)
10 Over Consolidation ratio number, k_{ocr} (default to 0.3)
11 Unit weight of water, (default to γ_w = 62.4 lb/ft^3 or 9.81 kN/m^3)

Column

1 Depth, z, (m) – CPT data is collected in meters
2 Depth (ft)
3 Cone resistance, q_c (tsf or MPa)
4 Sleeve resistance, f_s (tsf or MPa)
5 Penetration pore pressure, u (psi or MPa), measured behind the cone (i.e. u_2)
6 Other – any additional data
7 Total cone resistance, q_t (tsf or MPa) $q_t = q_c + u\,(1-a)$

8	Friction Ratio, R_f (%)	$R_f = (f_s/q_t) \times 100\%$
9	Soil Behavior Type (non-normalized), SBT	see note
10	Unit weight, γ (pcf or kN/m^3)	based on SBT, see note
11	Total overburden stress, σ_v (tsf)	$\sigma_{vo} = \sigma\, z$
12	In-situ pore pressure, u_o (tsf)	$u_o = \gamma_w (z - z_w)$
13	Effective overburden stress, σ'_{vo} (tsf)	$\sigma'_{vo} = \sigma_{vo} - u_o$
14	Normalized cone resistance, Q_{t1}	$Q_{t1} = (q_t - \sigma_{vo}) / \sigma'_{vo}$
15	Normalized friction ratio, F_r (%)	$F_r = f_s / (q_t - \sigma_{vo}) \times 100\%$
16	Normalized Pore Pressure ratio, B_q	$B_q = u - u_o / (q_t - \sigma_{vo})$
17	Soil Behavior Type (normalized), SBT_n	see note
18	SBT_n Index, I_c	see note
19	Normalized Cone resistance, Q_{tn} (n varies with I_c)	see note
20	Estimated permeability, k_{SBT} (cm/sec or ft/sec)	see note
21	Equivalent SPT N_{60}, blows/ft	see note
22	Equivalent SPT $(N_1)_{60}$ blows/ft	see note
23	Estimated Relative Density, D_r, (%)	see note
24	Estimated Friction Angle, ϕ', (degrees)	see note
25	Estimated Young's modulus, E_s (tsf)	see note
26	Estimated small strain Shear modulus, Go (tsf)	see note
27	Estimated Undrained shear strength, s_u (tsf)	see note
28	Estimated Undrained strength ratio	s_u/σ_v'
29	Estimated Over Consolidation ratio, OCR	see note

Notes:

1 Soil Behavior Type (non-normalized), SBT (Lunne et al., 1997 and table below)

2 Unit weight, γ either constant at 119 pcf or based on Non-normalized SBT (Lunne et al., 1997 and table below)

3 Soil Behavior Type (Normalized), SBT_n Lunne et al. (1997)

4 SBT_n Index, I_c $I_c = ((3.47 - \log Q_{t1})^2 + (\log F_r + 1.22)^2)^{0.5}$

5 Normalized Cone resistance, Q_{tn} (n varies with Ic)

$Q_{tn} = ((q_t - \sigma_{vo})/pa)\ (pa/(\sigma'_{vo})^n$ and recalculate I_c, then iterate:

When $I_c < 1.64$, n = 0.5 (clean sand)
When $I_c > 3.30$, n = 1.0 (clays)
When $1.64 < I_c < 3.30$, $n = (I_c - 1.64)0.3 + 0.5$
Iterate until the change in n, $\Delta n < 0.01$

6 Estimated permeability, k_{SBT} based on Normalized SBT_n (Lunne et al., 1997 and table below)

7 Equivalent SPT N_{60}, blows/ft Lunne et al. (1997)

$$\frac{(q_t/p_a)}{N_{60}} = 8.5\left(1 - \frac{I_c}{4.6}\right)$$

8 Equivalent SPT $(N_1)_{60}$ blows/ft $(N_1)_{60} = N_{60}\, C_N$,
where $C_N = (pa/\sigma'_{vo})^{0.5}$

9 Relative Density, D_r, (%) $D_r^2 = Q_{tn} / C_{Dr}$
Only SBT_n 5, 6, 7 & 8 *Show 'N/A' in zones 1, 2, 3, 4 & 9*

10 Friction Angle, ϕ', (degrees) $\tan\phi' = \frac{1}{2.68}\left[\log\left(\frac{q_c}{\sigma'_{vo}}\right) + 0.29\right]$
Only SBT_n 5, 6, 7 & 8 *Show'N/A' in zones 1, 2, 3, 4 & 9*

11 Young's modulus, E_s $E_s = \alpha\, q_t$
Only SBT_n 5, 6, 7 & 8 *Show 'N/A' in zones 1, 2, 3, 4 & 9*

12 Small strain shear modulus, Go

a. $G_o = S_G\,(q_t\ \sigma'_{vo}\ pa)^{1/3}$ *For SBT_n 5, 6, 7*

b. $G_o = C_G\, q_t$ *For SBT_n 1, 2, 3& 4*

Show 'N/A' in zones 8 & 9

13 Undrained shear strength, s_u $s_u = (q_t - \sigma_{vo}) / N_{kt}$
Only SBT_n 1, 2, 3, 4 & 9 *Show 'N/A' in zones 5, 6, 7 & 8*

14 Over Consolidation ratio, OCR $OCR = k_{ocr}\, Q_{t1}$
Only SBT_n 1, 2, 3, 4 & 9 *Show 'N/A' in zones 5, 6, 7 & 8*

The following updated and simplified SBT descriptions have been used in the software:

SBT Zones		**SBT_n Zones**	
1	sensitive fine grained	1	sensitive fine grained
2	organic soil	2	organic soil
3	clay	3	clay
4	clay & silty clay	4	clay & silty clay
5	clay & silty clay		
6	sandy silt & clayey silt		

7	silty sand & sandy silt	5	silty sand & sandy silt
8	sand & silty sand	6	sand & silty sand
9	sand		
10	sand	7	sand
11	very dense/stiff soil*	8	very dense/stiff soil*
12	very dense/stiff soil*	9	very dense/stiff soil*

*heavily overconsolidated and/or cemented

Track when soils fall with zones of same description and print that description (i.e. if soils fall only within SBT zones 4 & 5, print 'clays & silty clays')

Estimated Permeability (see Lunne et al., 1997)

SBT_n	Permeability (ft/sec)	(m/sec)
1	$3x\ 10^{-8}$	$1x\ 10^{-8}$
2	$3x\ 10^{-7}$	$1x\ 10^{-7}$
3	$1x\ 10^{-9}$	$3x\ 10^{-10}$
4	$3x\ 10^{-8}$	$1x\ 10^{-8}$
5	$3x\ 10^{-6}$	$1x\ 10^{-6}$
6	$3x\ 10^{-4}$	$1x\ 10^{-4}$
7	$3x\ 10^{-2}$	$1x\ 10^{-2}$
8	$3x\ 10^{-6}$	$1x\ 10^{-6}$
9	$1x\ 10^{-8}$	$3x\ 10^{-9}$

Estimated Unit Weight (see Lunne et al., 1997)

SBT	Approximate Unit Weight (lb/ft^3)	(kN/m^3)
1	111.4	17.5
2	79.6	12.5
3	111.4	17.5
4	114.6	18.0
5	114.6	18.0
6	114.6	18.0
7	117.8	18.5
8	120.9	19.0
9	124.1	19.5
10	127.3	20.0
11	130.5	20.5
12	120.9	19.0

Pore Pressure Dissipation Tests (PPDT)

Pore Pressure Dissipation Tests (PPDT's) conducted at various intervals can be used to measure equilibrium water pressure (at the time of the CPT). If conditions are hydrostatic, the equilibrium water pressure can be used to determine the approximate depth of the ground water table. A PPDT is conducted when penetration is halted at specific intervals determined by the field representative. The variation of the penetration pore pressure (*u)* with time is measured behind the tip of the cone and recorded.

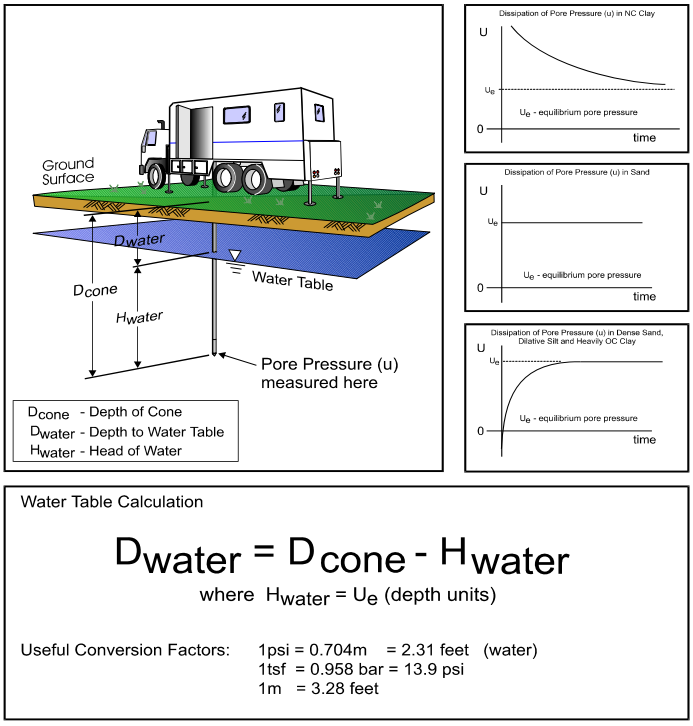
Pore pressure dissipation data can be interpreted to provide estimates of:

- Equilibrium piezometric pressure
- Phreatic Surface
- In situ horizontal coefficient of consolidation (c_h)
- In situ horizontal coefficient of permeability (k_h)

In order to correctly interpret the equilibrium piezometric pressure and/or the phreatic surface, the pore pressure must be monitored until it reaches equilibrium, *Figure PPDT*. This time is commonly referred to as t_{100}, the point at which 100% of the excess pore pressure has dissipated.

A complete reference on pore pressure dissipation tests is presented by Robertson et al. 1992 and Lunne et al. 1997.

A summary of the pore pressure dissipation tests are summarized in Table 1.



Water Table Calculation

$$D_{water} = D_{cone} - H_{water}$$

where $H_{water} = U_e$ (depth units)

Useful Conversion Factors: 1psi = 0.704m = 2.31 feet (water)
1tsf = 0.958 bar = 13.9 psi
1m = 3.28 feet

Figure PPDT

Seismic Cone Penetration Testing (SCPT)

Seismic Cone Penetration Testing (SCPT) can be conducted at various intervals during the Cone Penetration Test. Shear wave velocity (Vs) can then be calculated over a specified interval with depth. A small interval for seismic testing, such as 1-1.5m (3-5ft) allows for a detailed look at the shear wave profile with depth. Conversely, a larger interval such as 3-6m (10-20ft) allows for a more average shear wave velocity to be calculated. Gregg's cones have a horizontally active geophone located 0.2m (0.66ft) behind the tip.

To conduct the seismic shear wave test, the penetration of the cone is stopped and the rods are decoupled from the rig. An automatic hammer is triggered to send a shear wave into the soil. The distance from the source to the cone is calculated knowing the total depth of the cone and the horizontal offset distance between the source and the cone. To calculate an interval velocity, a minimum of two tests must be performed at two different depths. The arrival times between the two wave traces are compared to obtain the difference in time (Δt). The difference in depth is calculated (Δd) and velocity can be determined using the simple equation: $v = \Delta d/\Delta t$

Multiple wave traces can be recorded at the same depth to improve quality of the data.

A complete reference on seismic cone penetration tests is presented by Robertson et al. 1986 and Lunne et al. 1997.

A summary the shear wave velocities, arrival times and wave traces are provided with the report.

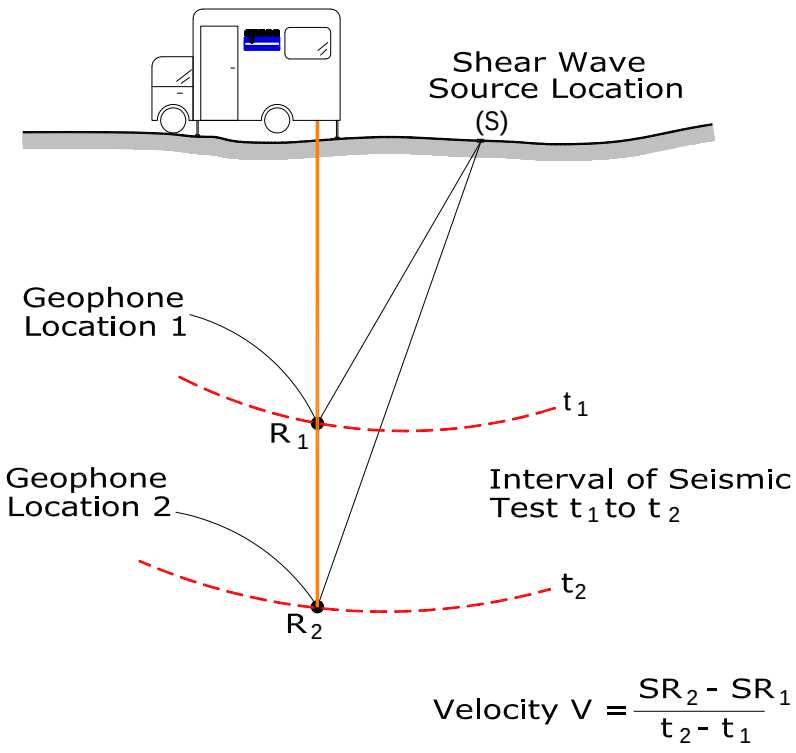


Figure SCPT

Groundwater Sampling

Gregg Drilling & Testing, Inc. conducts groundwater sampling using a sampler as shown in *Figure GWS*. The groundwater sampler has a retrievable stainless steel or disposable PVC screen with steel drop off tip. This allows for samples to be taken at multiple depth intervals within the same sounding location. In areas of slower water recharge, provisions may be made to set temporary PVC well screens during sampling to allow the pushing equipment to advance to the next sample location while the groundwater is allowed to infiltrate.

The groundwater sampler operates by advancing 44.5mm (1¾ inch) hollow push rods with the filter tip in a closed configuration to the base of the desired sampling interval. Once at the desired sample depth, the push rods are retracted; exposing the encased filter screen and allowing groundwater to infiltrate hydrostatically from the formation into the inlet screen. A small diameter bailer (approximately ½ or ¾ inch) is lowered through the push rods into the screen section for sample collection. The number of downhole trips with the bailer and time necessary to complete the sample collection at each depth interval is a function of sampling protocols, volume requirements, and the yield characteristics and storage capacity of the formation. Upon completion of sample collection, the push rods and sampler, with the exception of the PVC screen and steel drop off tip are retrieved to the ground surface, decontaminated and prepared for the next sampling event.

For a detailed reference on direct push groundwater sampling, refer to Zemo et. al., 1992.

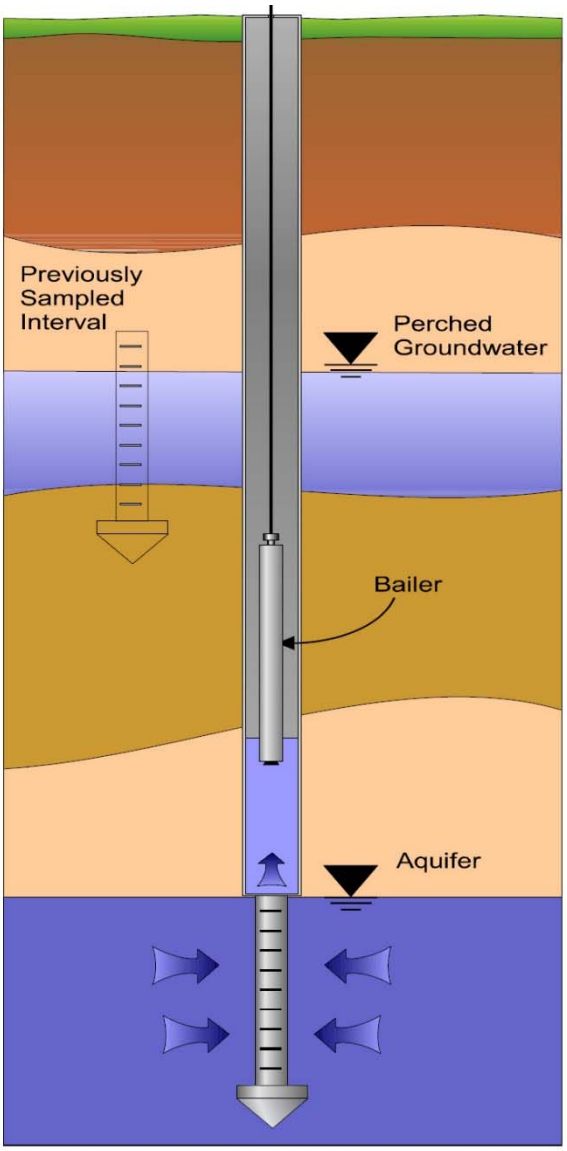


Figure GWS

Soil Sampling

Gregg Drilling & Testing, Inc. uses a piston-type push-in sampler to obtain small soil samples without generating any soil cuttings, *Figure SS*. Two different types of samplers (12 and 18 inch) are used depending on the soil type and density. The soil sampler is initially pushed in a "closed" position to the desired sampling interval using the CPT pushing equipment. Keeping the sampler closed minimizes the potential of cross contamination. The inner tip of the sampler is then retracted leaving a hollow soil sampler with inner 1¼" diameter sample tubes. The hollow sampler is then pushed in a locked "open" position to collect a soil sample. The filled sampler and push rods are then retrieved to the ground surface. Because the soil enters the sampler at a constant rate, the opportunity for 100% recovery is increased. For environmental analysis, the soil sample tube ends are sealed with Teflon and plastic caps. Often, a longer "split tube" can be used for geotechnical sampling.

For a detailed reference on direct push soil sampling, refer to Robertson et al, 1998.

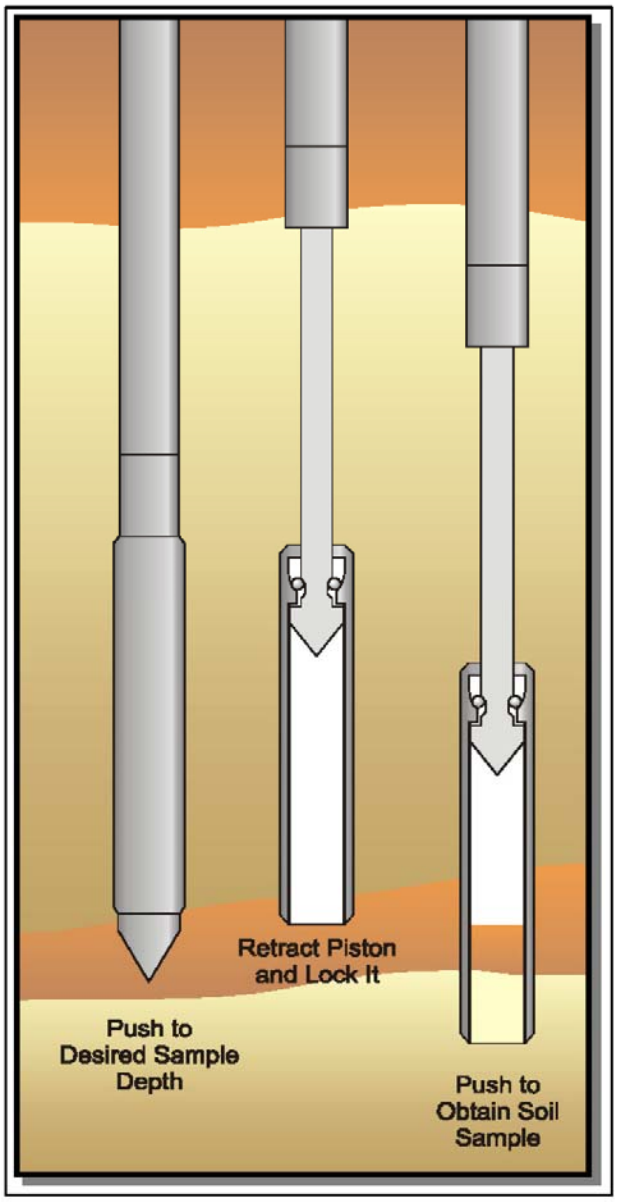


Figure SS

GREGG DRILLING, INC.
www.greggdrilling.com

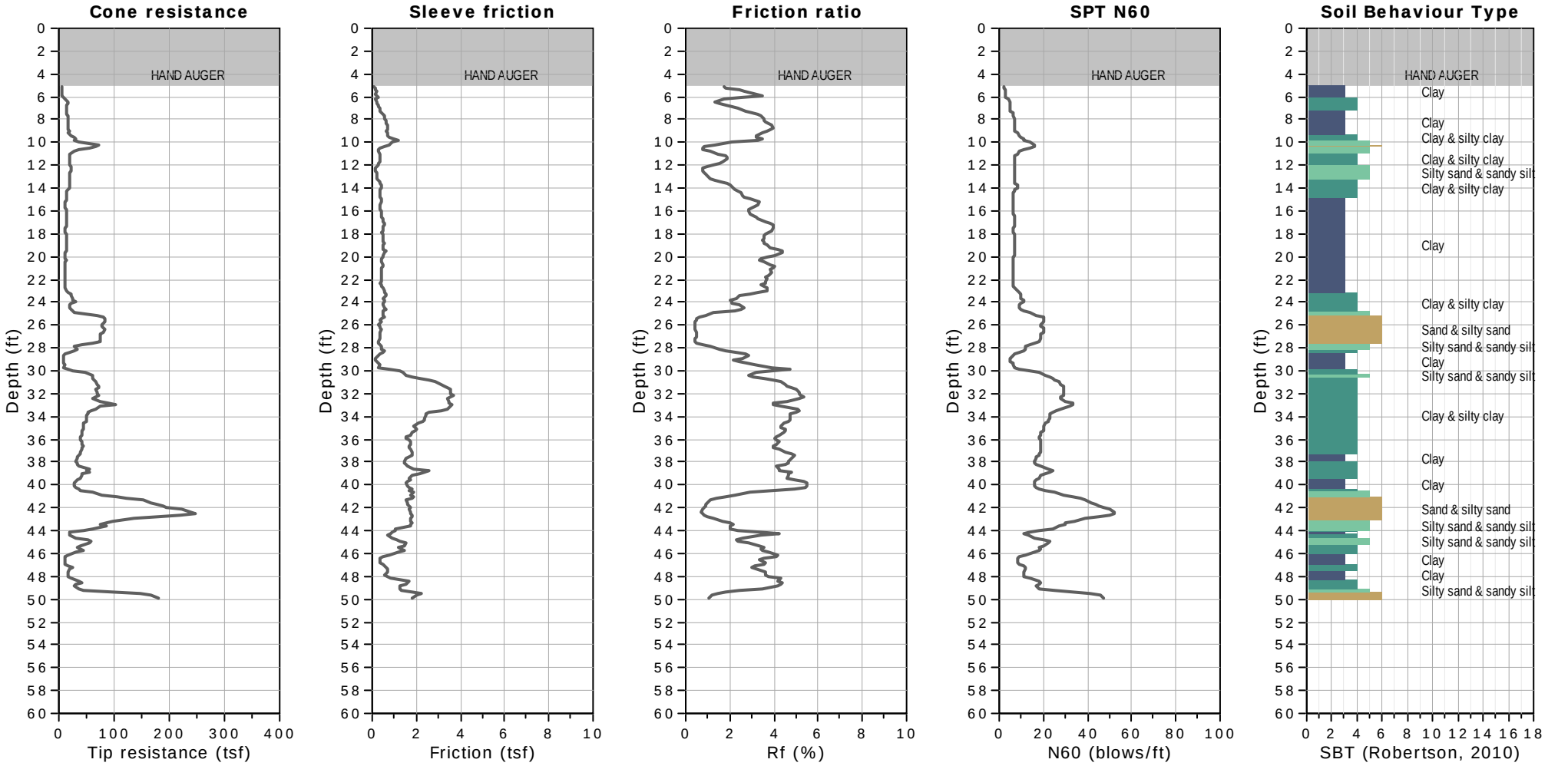
CPT: CPT-1

CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/31/2018

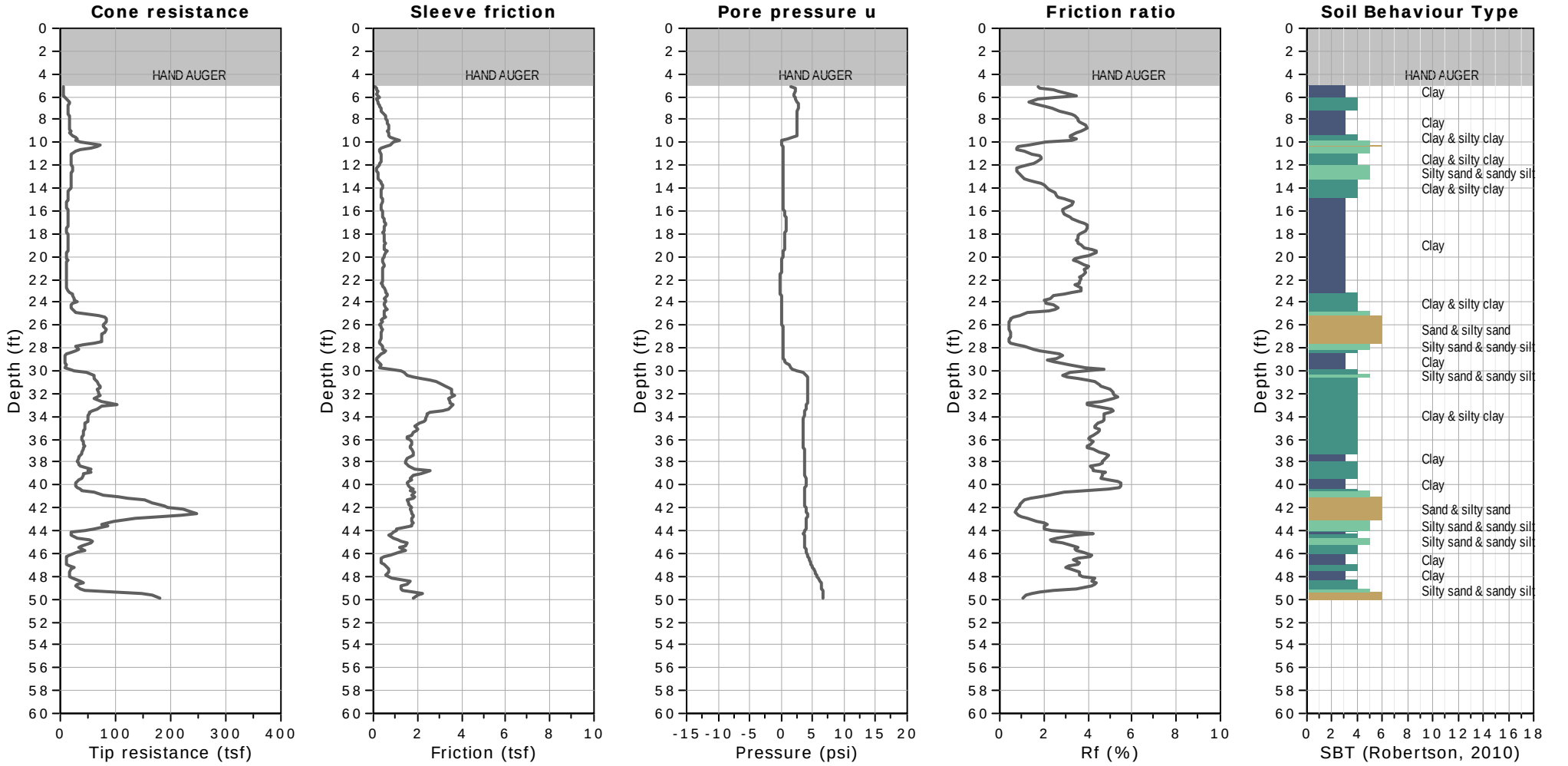


CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/31/2018



WATER TABLE FOR ESTIMATING PURPOSES ONLY

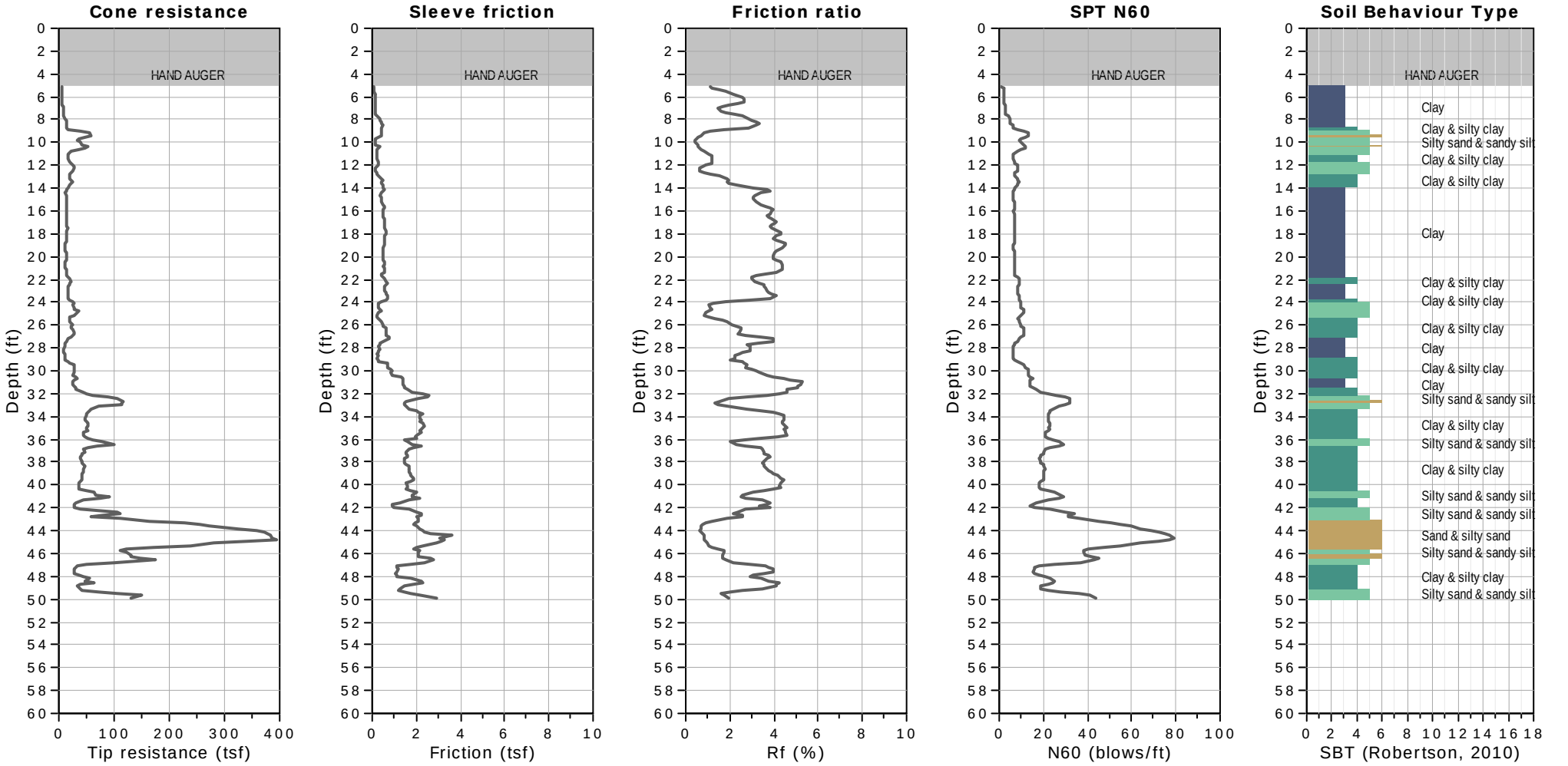
CPT: CPT-2

CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/30/2018

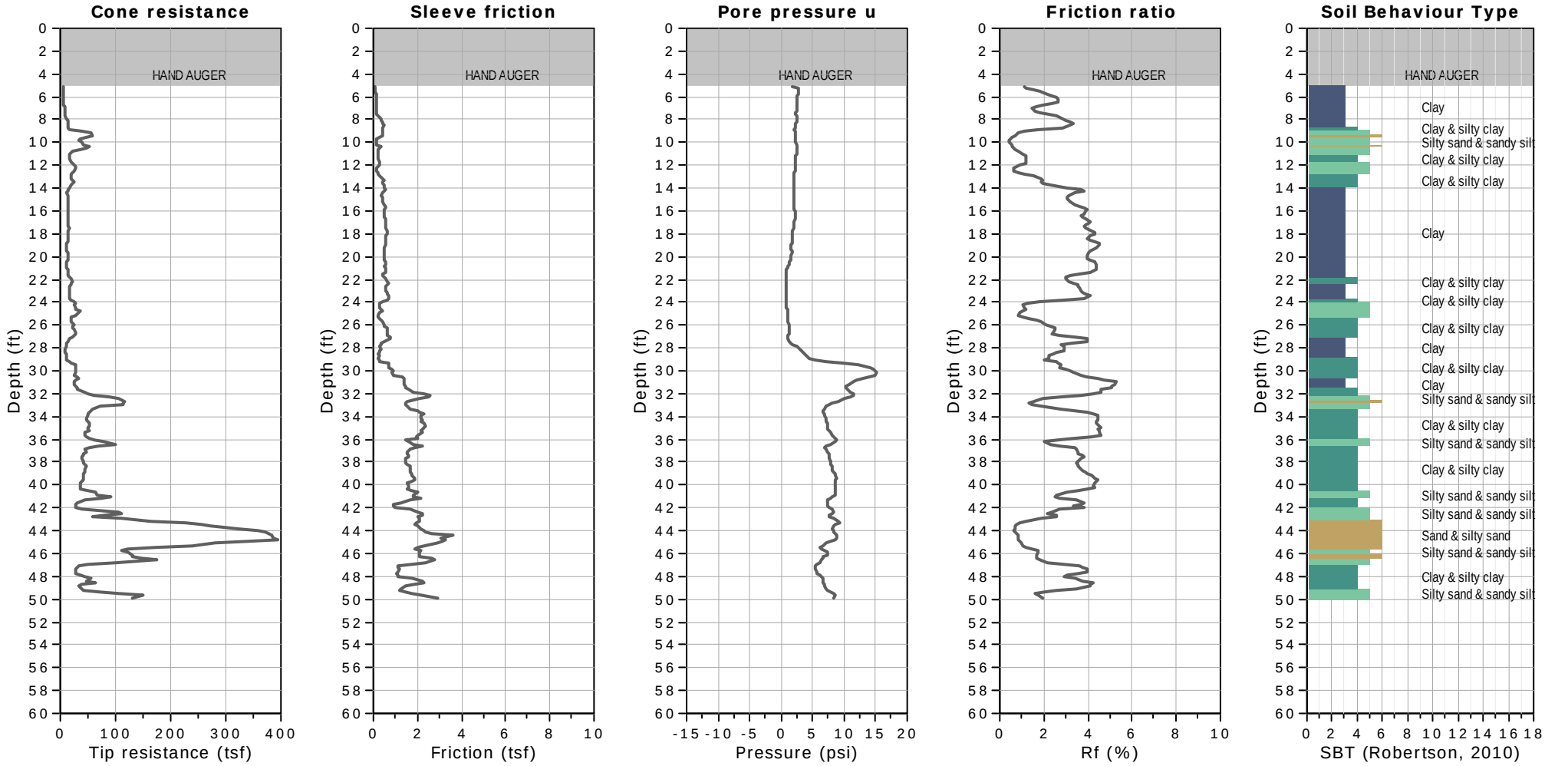


CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/30/2018



WATER TABLE FOR ESTIMATING PURPOSES ONLY

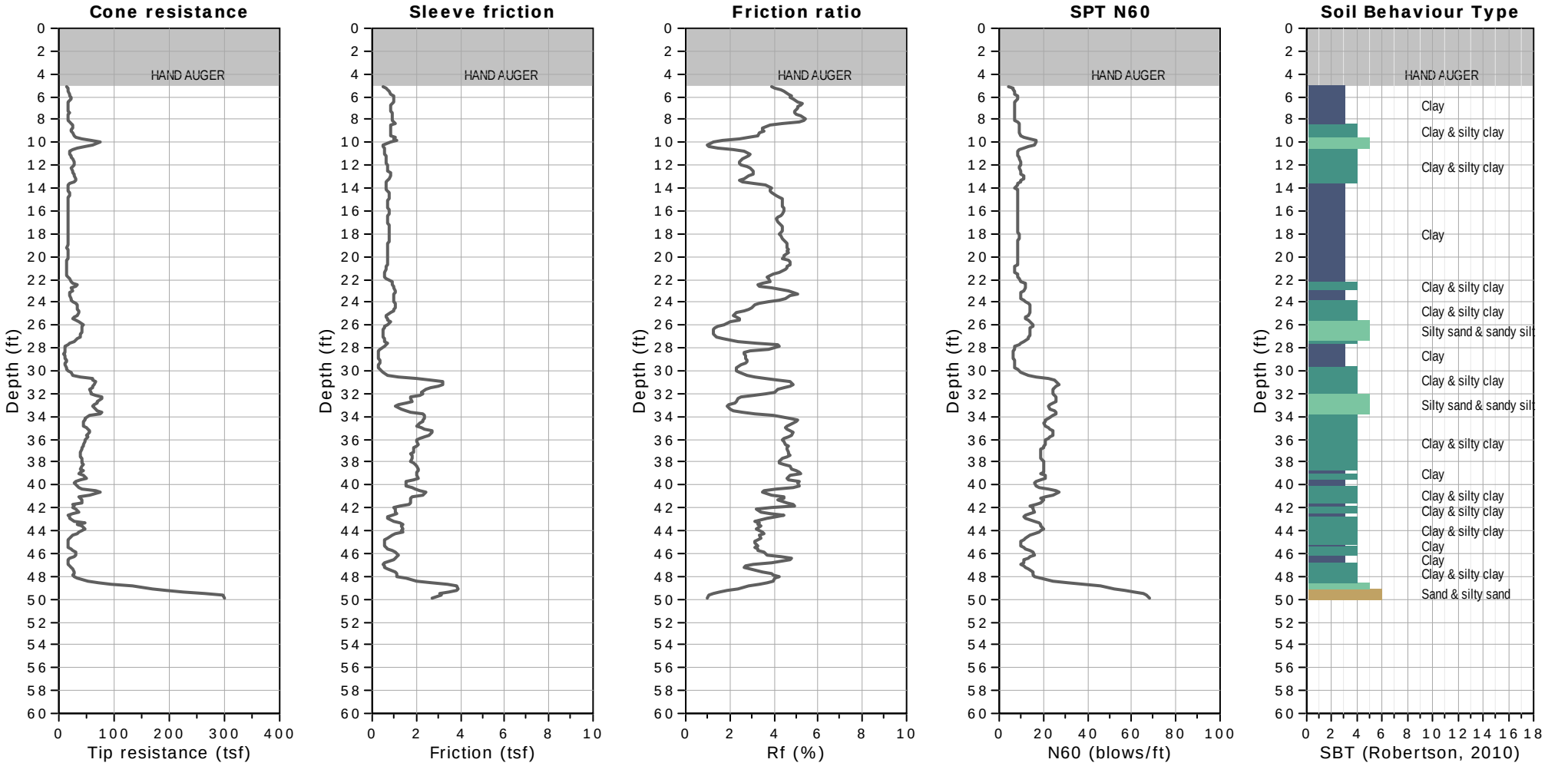
CPT: CPT-3

CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/31/2018

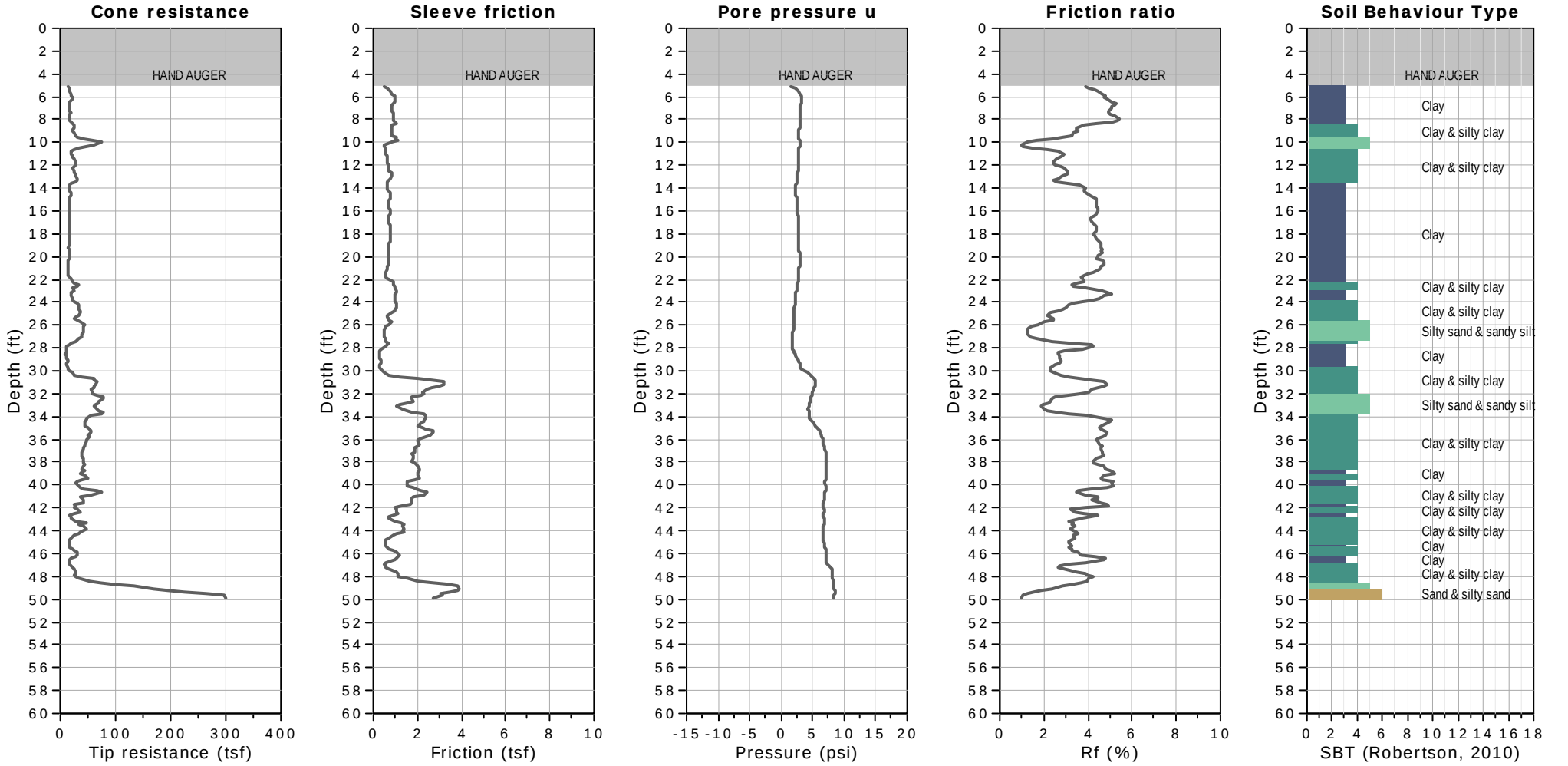


CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/31/2018



WATER TABLE FOR ESTIMATING PURPOSES ONLY

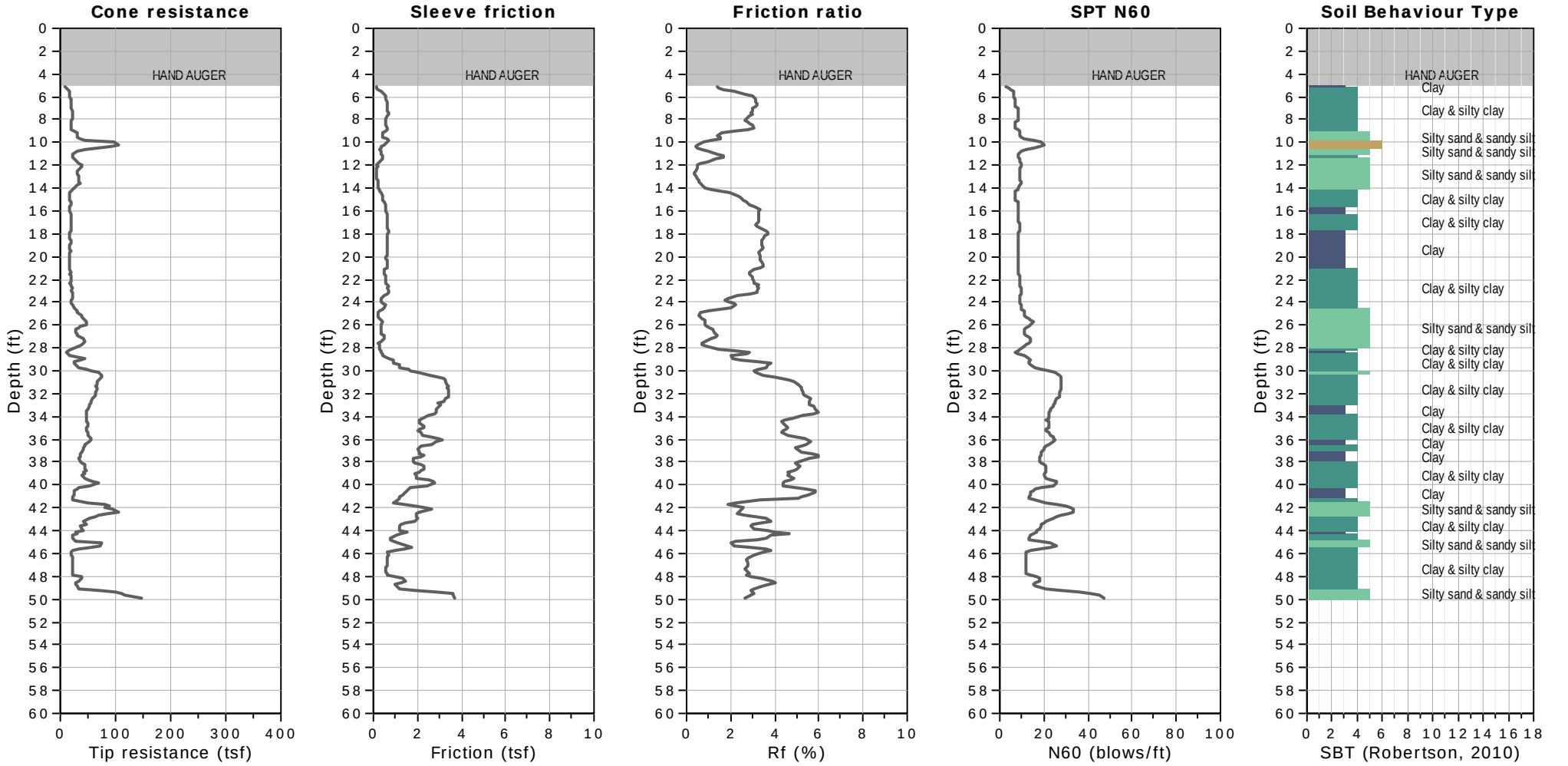
CPT: CPT-4

CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/31/2018

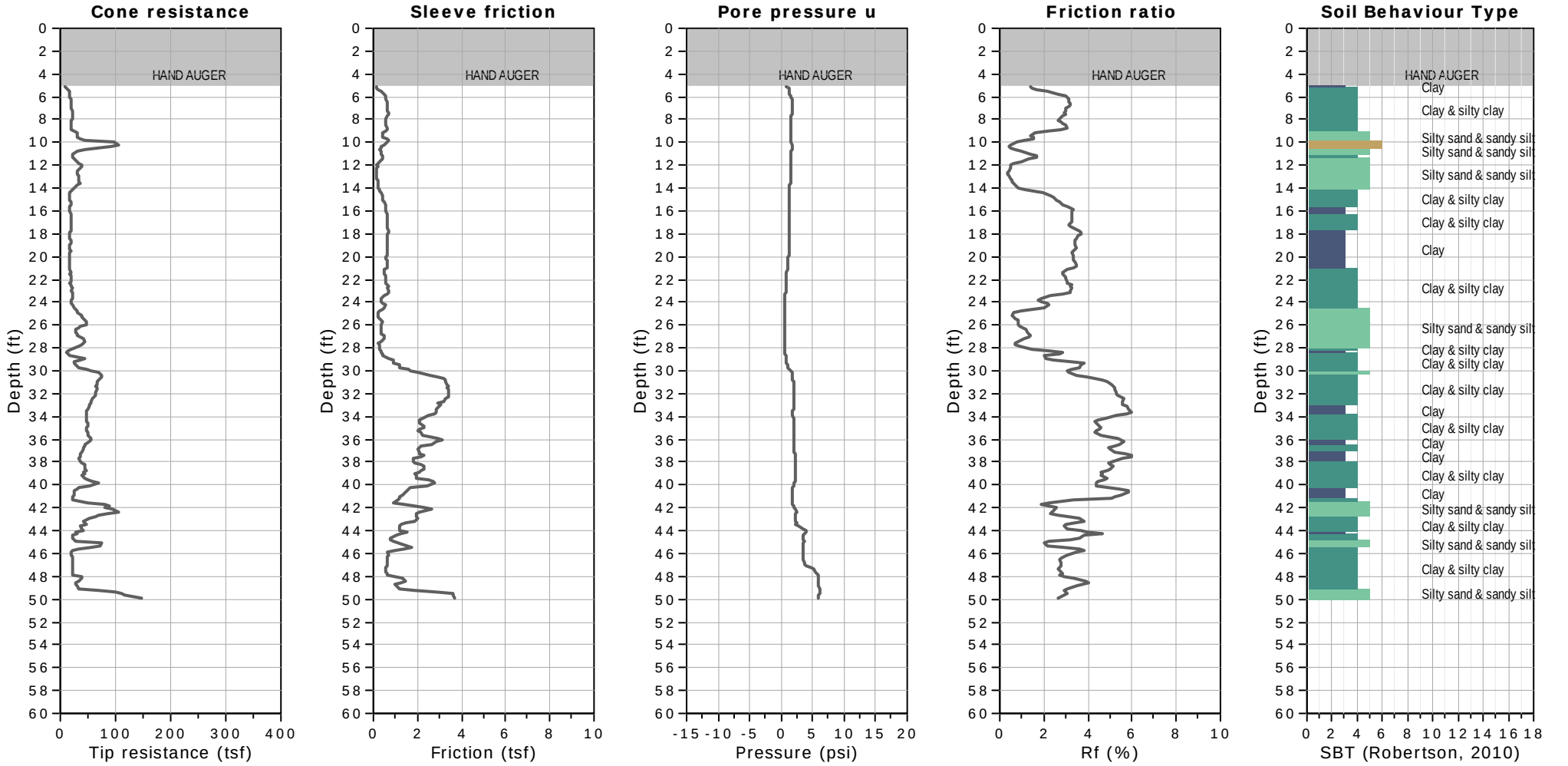


CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/31/2018



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

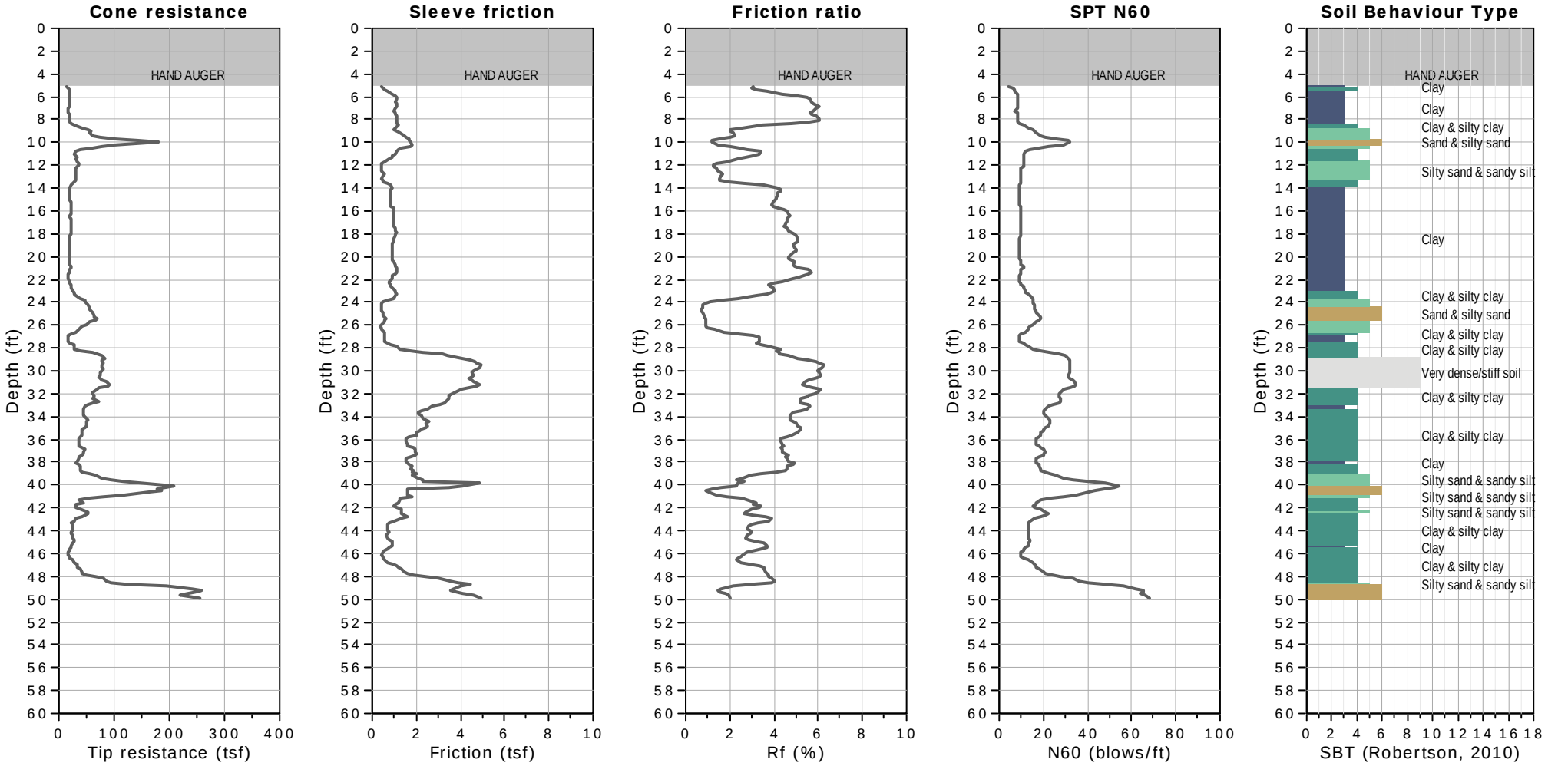
WATER TABLE FOR ESTIMATING PURPOSES ONLY

CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/31/2018



SBTn legend

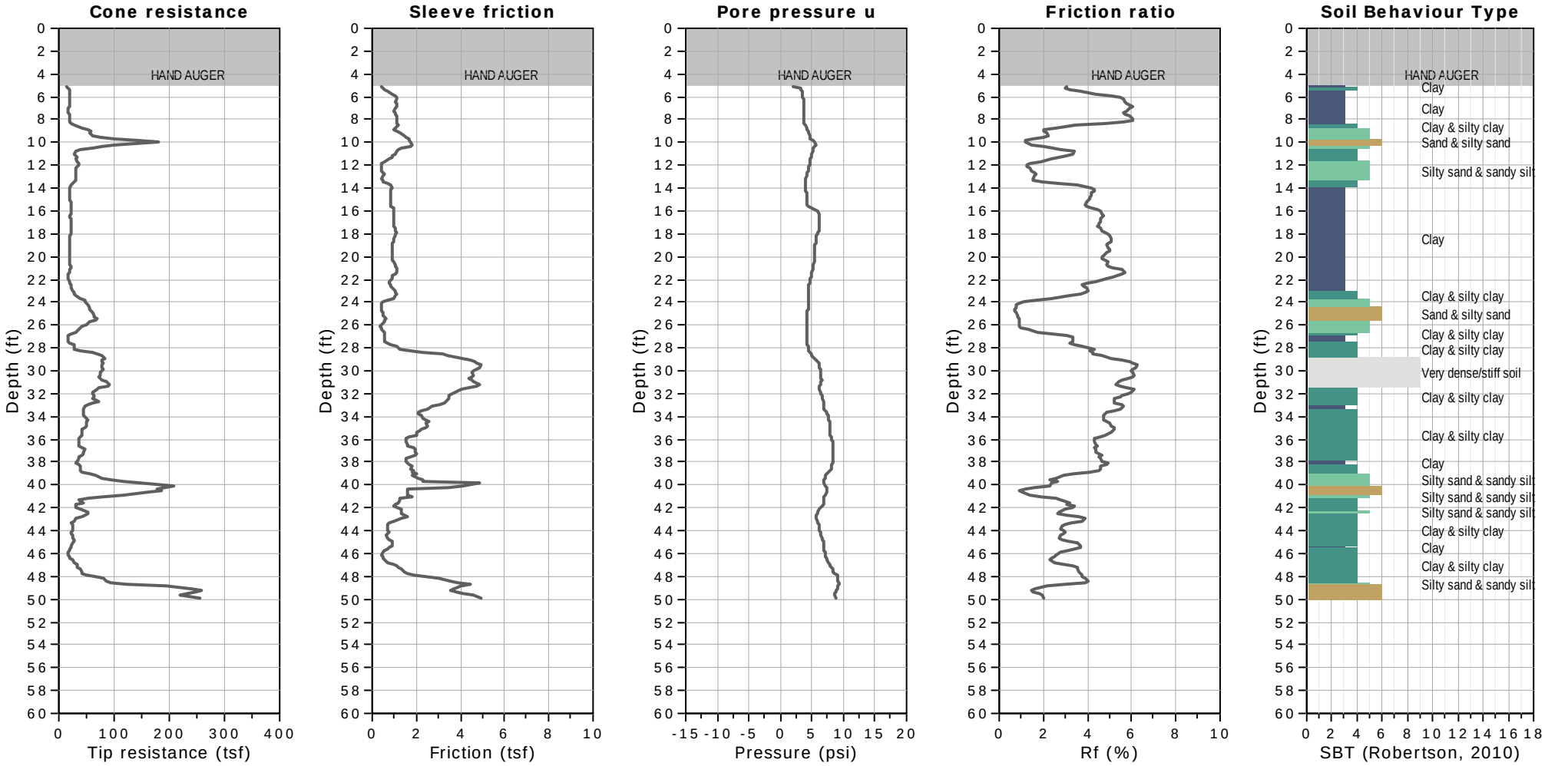
1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/31/2018



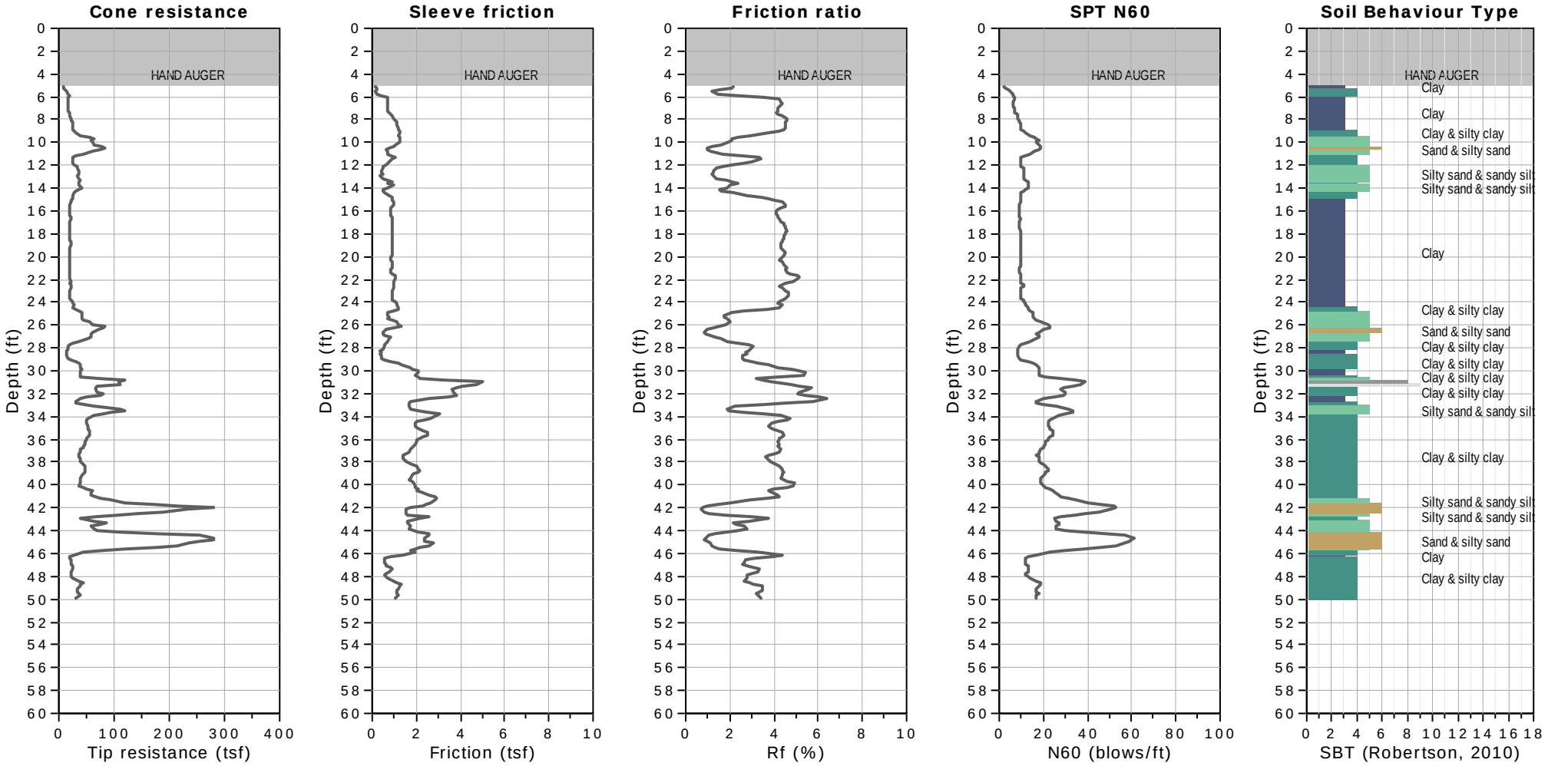
WATER TABLE FOR ESTIMATING PURPOSES ONLY

CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/31/2018

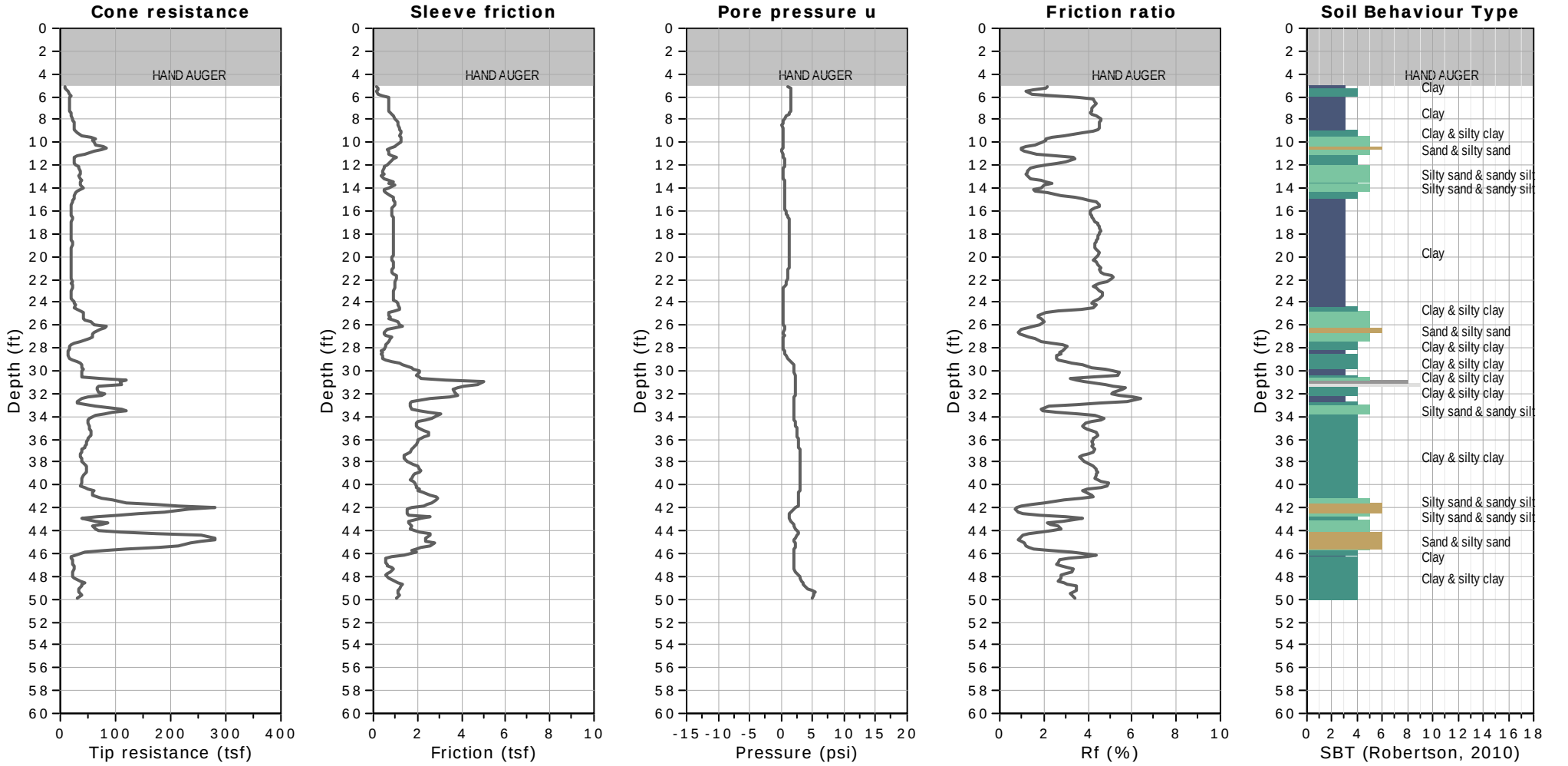


CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/31/2018



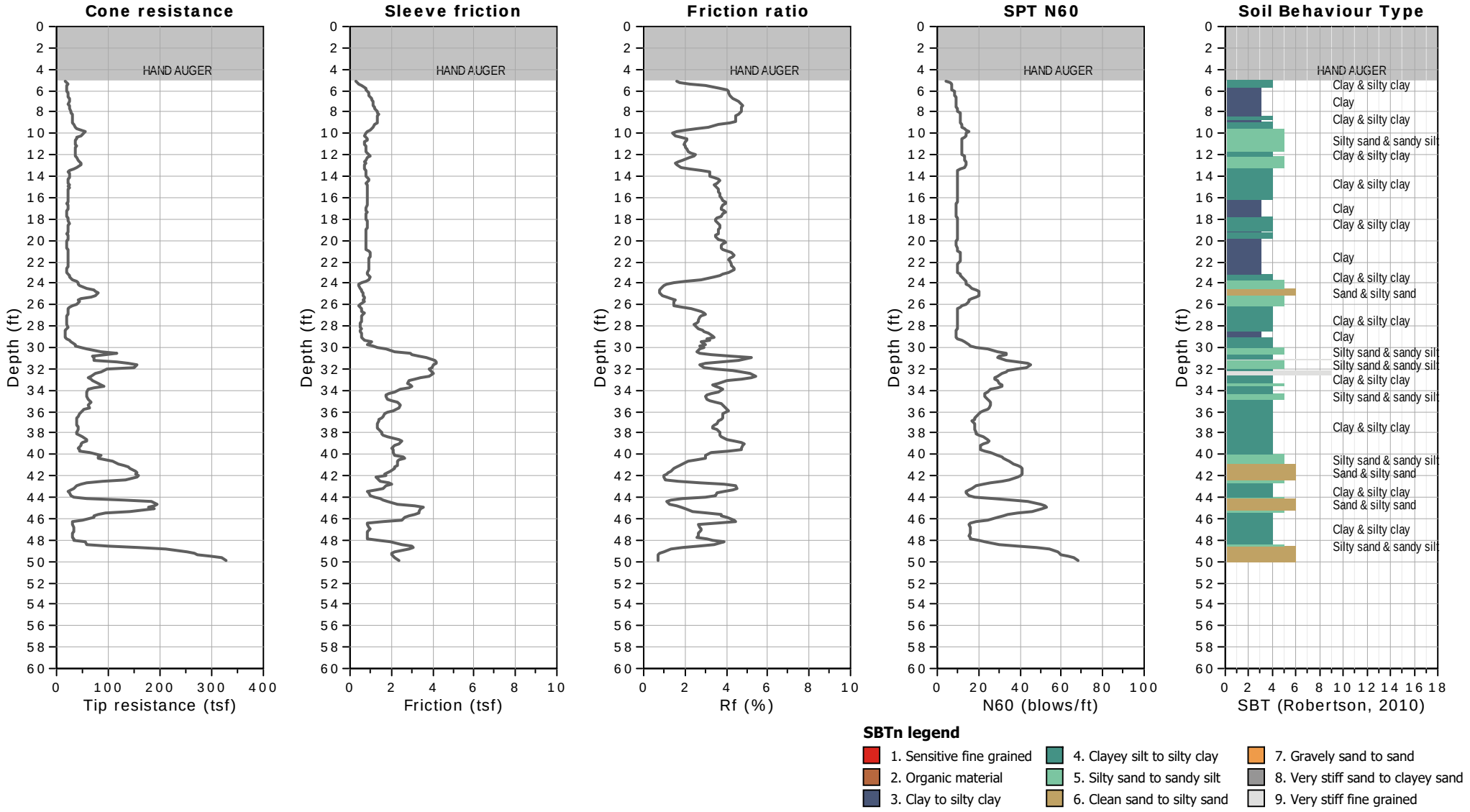
WATER TABLE FOR ESTIMATING PURPOSES ONLY

CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/30/2018



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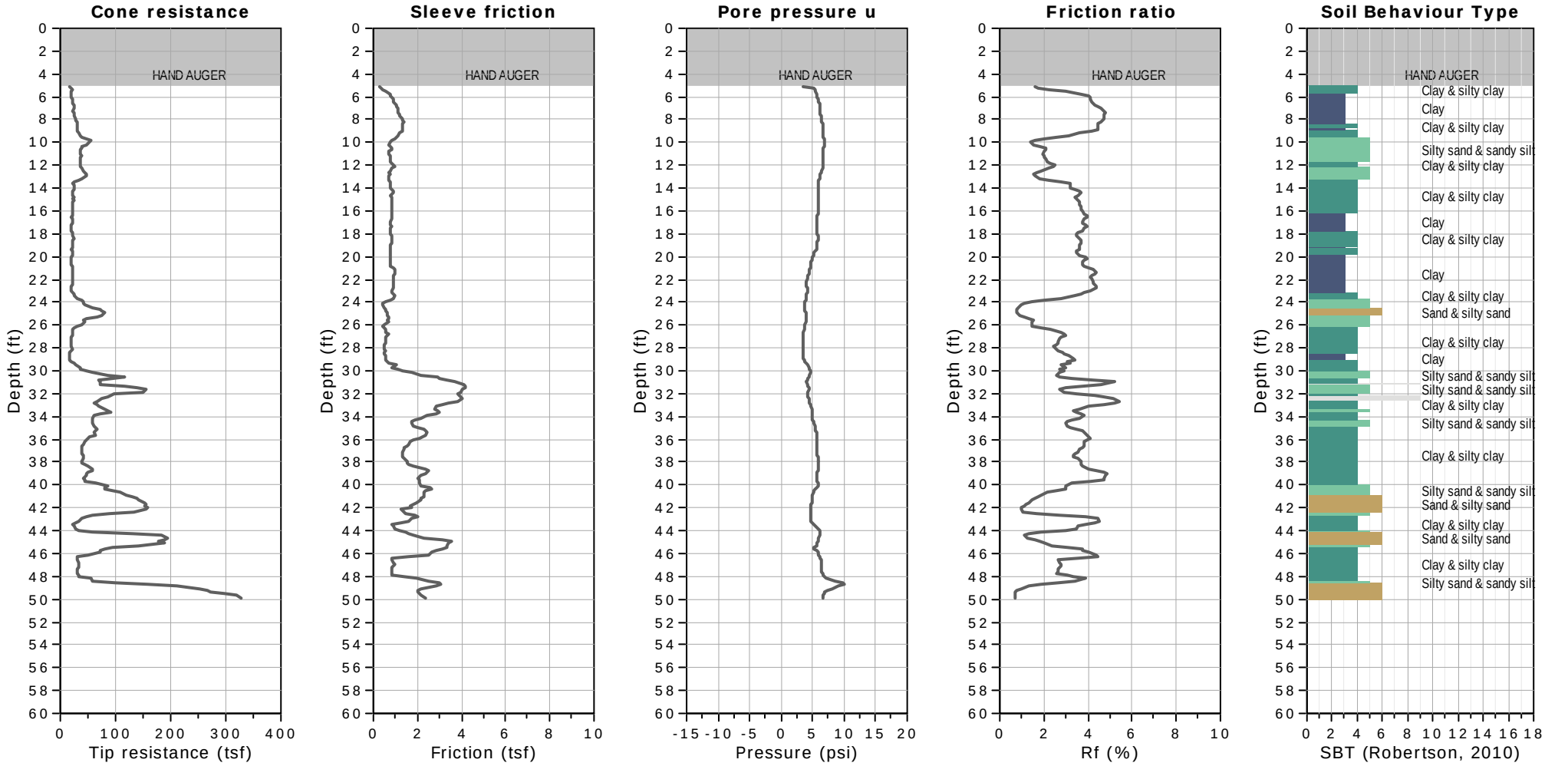
SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/30/2018



WATER TABLE FOR ESTIMATING PURPOSES ONLY

SUMMARY

OF

CONE PENETRATION TEST DATA

Project:

456 N. Rodeo Drive
Beverly Hills, CA
July 11-13, 2018

Prepared for:

Mr. Alexander Greene
Feffer Geological Consulting
1990 S. Bundy Drive, Ste 400
Los Angeles, CA 90025
Office (310) 207-5048 / Fax (310) 826-0182

Prepared by:



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

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

APPENDIX

- CPT Plots
- CPT Classification/Soil Behavior Chart
- Interpretation Output (CPeT-IT)
- CPeT-IT Calculation Formulas

SUMMARY
OF
CONE PENETRATION TEST DATA

1. INTRODUCTION

This report presents the results of a Cone Penetration Test (CPT) program carried out for the project located at 456 N. Rodeo Drive in Beverly Hills, California. The work was performed by Kehoe Testing & Engineering (KTE) on July 11-13, 2018. The scope of work was performed as directed by Feffer Geological Consulting personnel.

2. SUMMARY OF FIELD WORK

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

LOCATION	DEPTH OF CPT (ft)	COMMENTS/NOTES:
CPT-5	39	Refusal, hole open to 36 ft (dry)
CPT-6	50	Hole open to 48 ft (dry)
CPT-7	50	Hole open to 46 ft (dry)
CPT-8	30	Refusal, hole open to 30 ft (dry)

TABLE 2.1 - Summary of CPT Soundings

3. FIELD EQUIPMENT & PROCEDURES

The CPT soundings were carried out by **KTE** using an integrated electronic cone system manufactured by Vertek. The CPT soundings were performed in accordance with ASTM standards (D5778). The cone penetrometers were pushed using a 30-ton CPT rig and a direct push rig anchored with an eight-inch diameter ground anchor. The direct push rig has a pushing capacity of approximately 15 tons. The cone used during the program was a 15 cm^2 cone and a 10 cm^2 was used with the direct push rig. Both recorded the following parameters at approximately 2.5 cm depth intervals:

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

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

4. CONE PENETRATION TEST DATA & INTERPRETATION

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

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

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

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

Sincerely,

KEHOE TESTING & ENGINEERING



Richard W. Koester, Jr.
General Manager

07/19/18-hh-9580

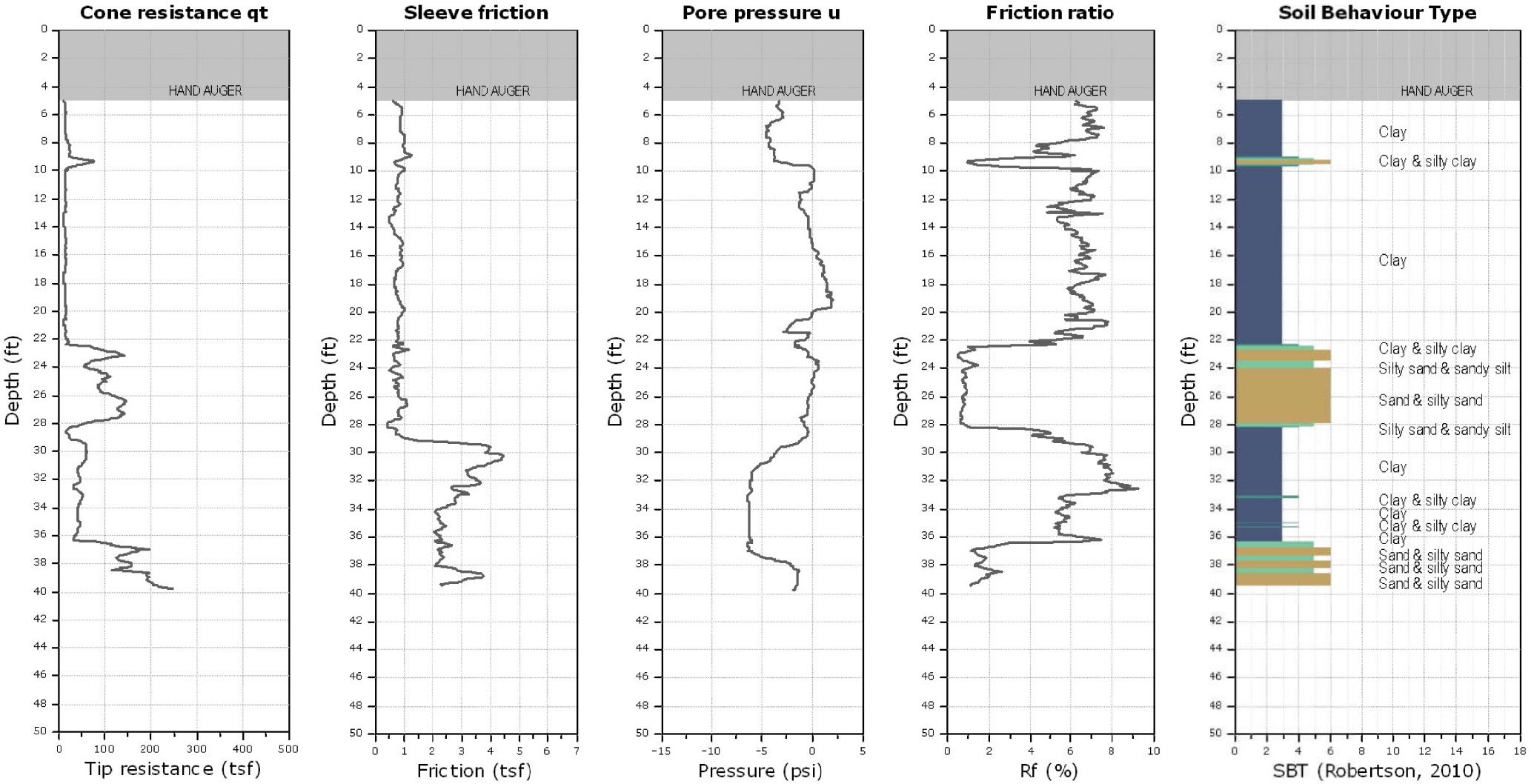
APPENDIX

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

CPT-5

Project: **Feffer Geological Consulting**
Location: **456 N. Rodeo Drive Beverly Hills, Ca**

Total depth: 39.77 ft, Date: 7/12/2018
Cone Type: Vertek



Kehoe Testing and Engineering
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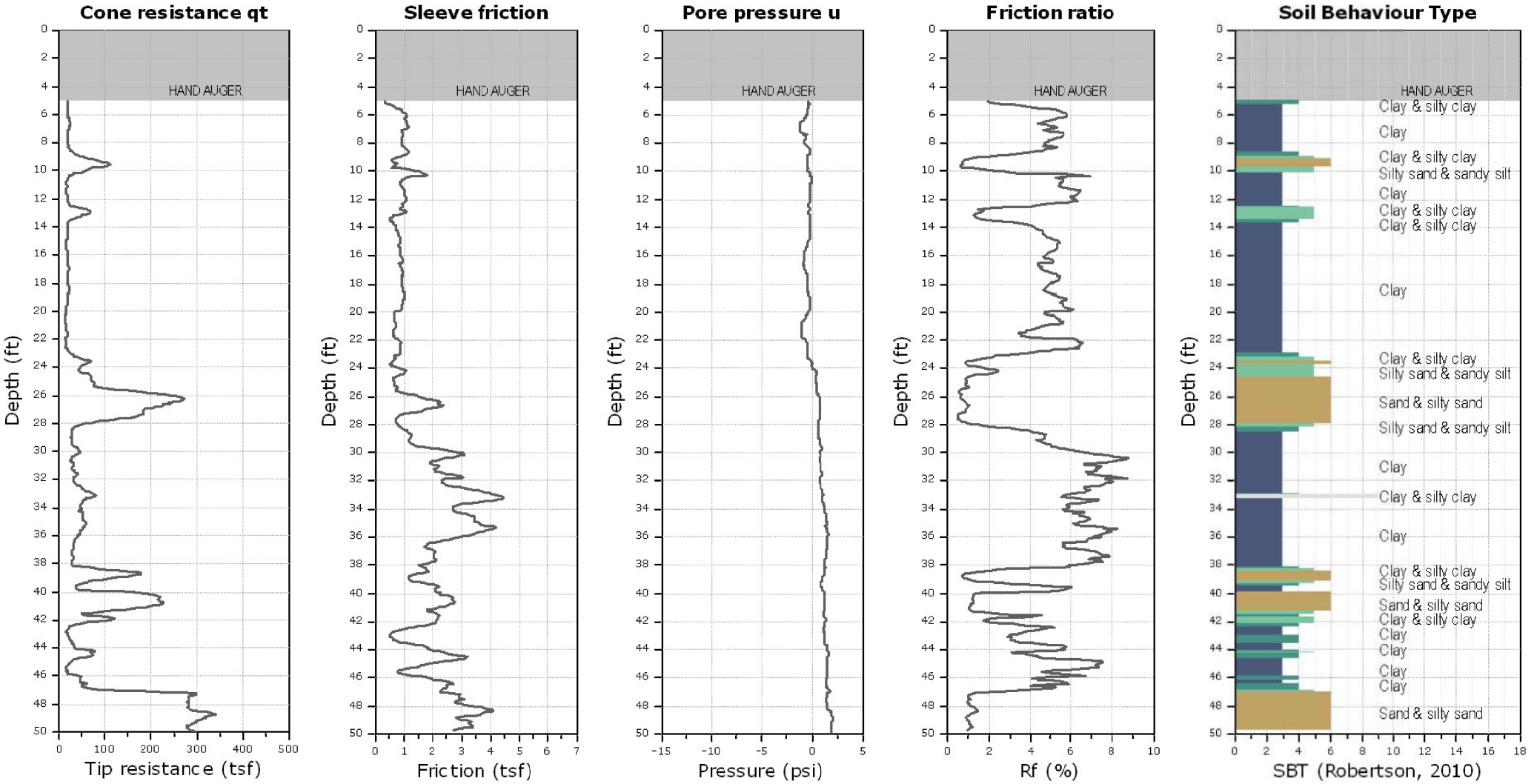
www.kehoetesting.com

CPT-6

Project: **Feffer Geological Consulting**
Location: **456 N. Rodeo Drive Beverly Hills, Ca**

Total depth: 50.15 ft, Date: 7/11/2018
Cone Type: Vertek



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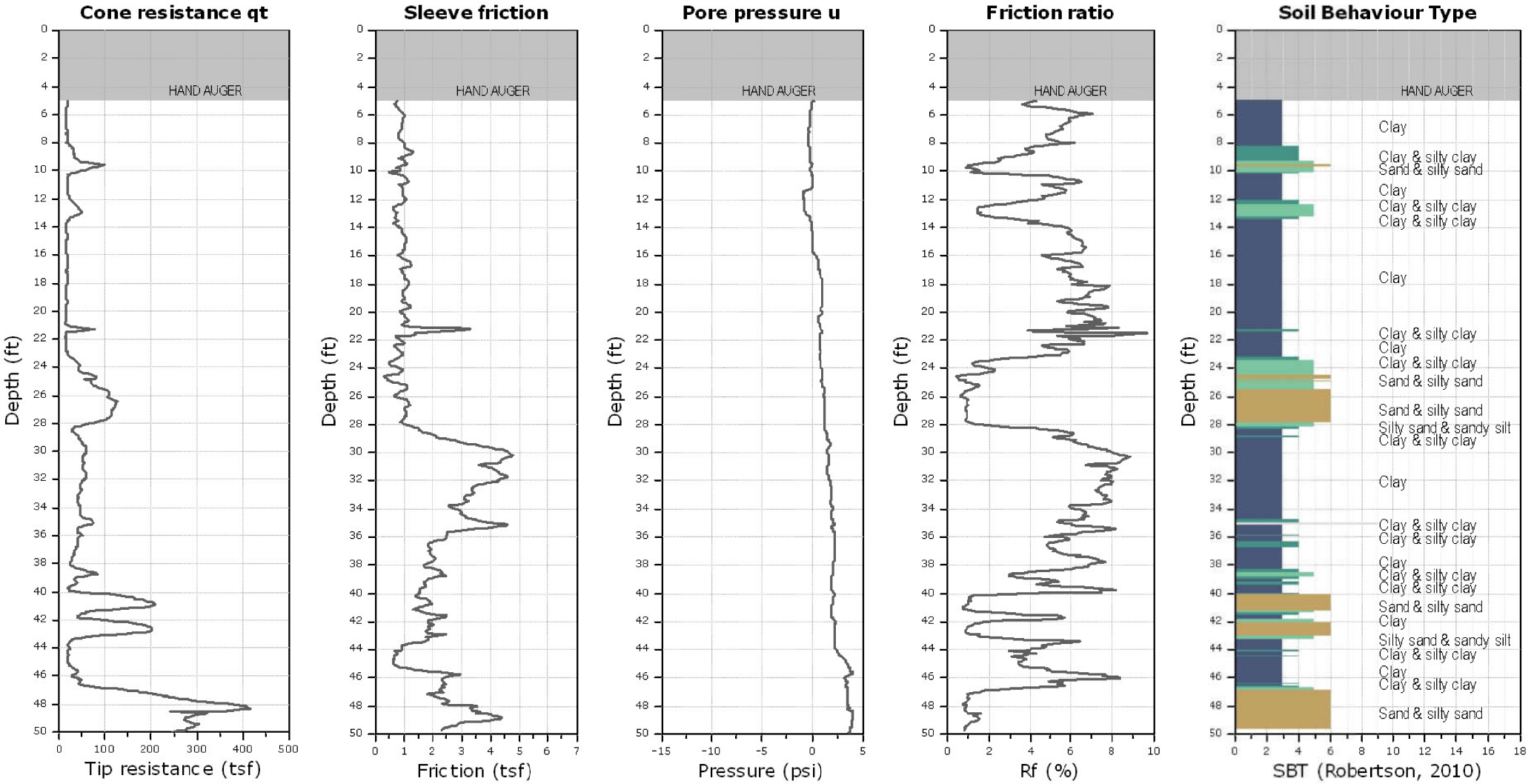
www.kehoetesting.com

CPT-7

Project: **Feffer Geological Consulting**
Location: **456 N. Rodeo Drive Beverly Hills, Ca**

Total depth: 50.07 ft, Date: 7/11/2018
Cone Type: Vertek

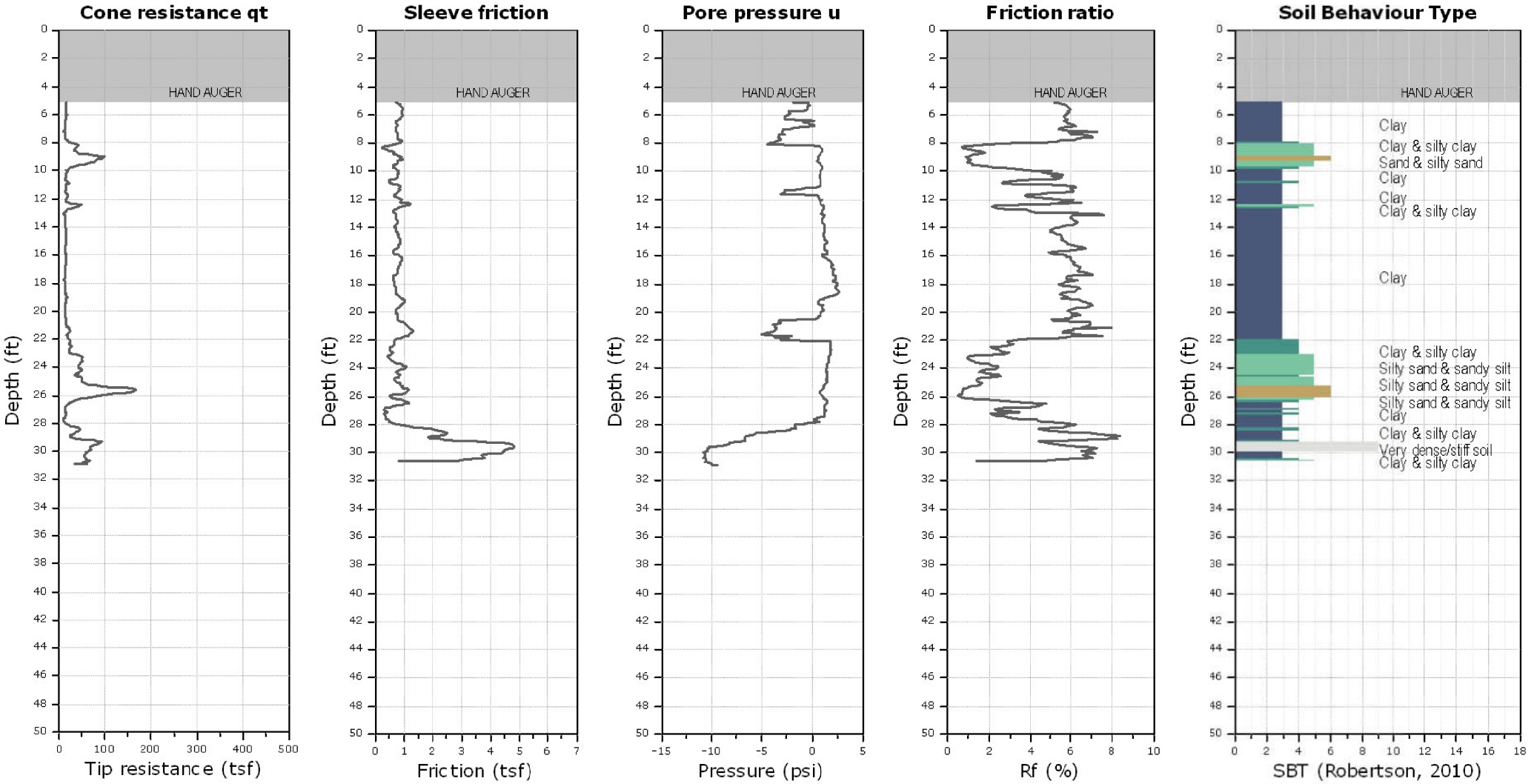


Kehoe Testing and Engineering
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

CPT-8

Project: **Feffer Geological Consulting**
Location: **456 N. Rodeo Drive Beverly Hills, Ca**

Total depth: 30.91 ft, Date: 7/12/2018
Cone Type: Vertek



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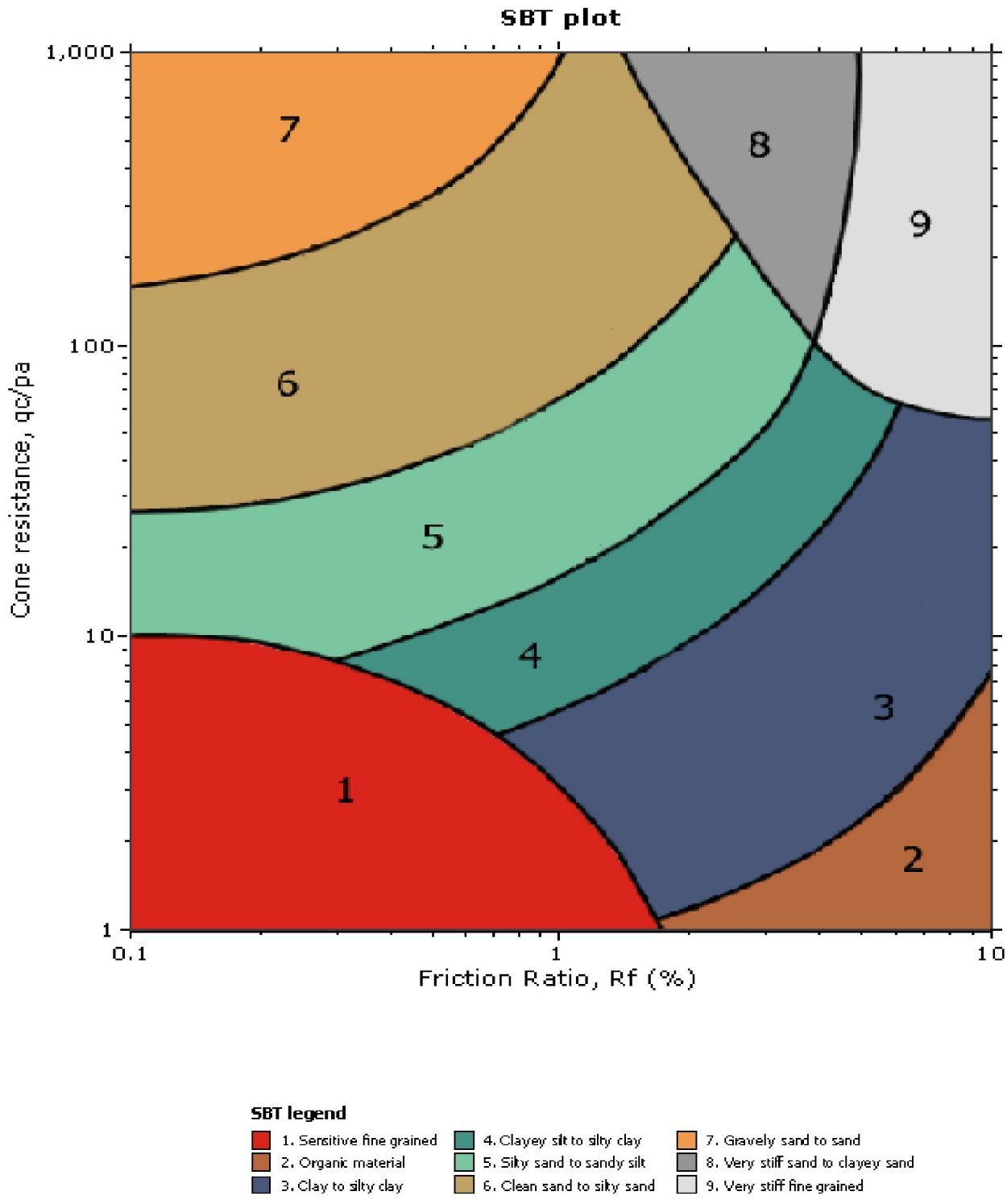

	CPT-5	In situ data							Basic output data													
Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ã (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn	U2	I(B)	Mod. SBTn
1	34.79	0.89	1.39	2.32	34.84	2.55	4	2.54	18.56	0.01	0	0.01	3750.4	2.55	0	8	0.54	13.2	1.83	434.32	10.78	37.75	7
2	6.88	0.55	-0.75	2.87	6.85	7.98	3	3.4	17.38	0.02	0	0.02	380.15	8	-0.01	9	0.79	25.06	2.47	161.88	-2.99	12.58	3
3	7.15	0.37	-0.53	2.47	7.14	5.14	3	3.27	16.93	0.03	0	0.03	268.99	5.16	-0.01	9	0.76	16.7	2.4	112.21	-1.44	18.84	3
4	8.08	0.44	-0.9	2.22	8.05	5.43	3	3.24	17.19	0.04	0	0.04	228.96	5.46	-0.01	9	0.78	14.1	2.43	106.87	-1.85	17.89	3
5	10.37	0.63	-3.21	2.47	10.27	6.09	3	3.19	17.69	0.04	0	0.04	233.17	6.11	-0.02	9	0.79	12.2	2.45	117.98	-5.27	16.17	3
6	13.39	0.9	-3	2.12	13.3	6.75	3	3.13	18.2	0.05	0	0.05	249.98	6.78	-0.02	9	0.79	10.61	2.45	132.82	-4.07	14.71	3
7	12.54	0.9	-4.5	1.7	12.4	7.27	3	3.18	18.18	0.06	0	0.06	198.79	7.31	-0.03	9	0.81	9.98	2.51	116.43	-5.22	13.72	3
8	20.02	1.03	-4.39	1.25	19.88	5.16	3	2.93	18.51	0.07	0	0.07	277.81	5.18	-0.02	9	0.75	7.51	2.34	140.52	-4.43	18.86	3
9	24.05	1.04	-3.75	1.37	23.93	4.33	3	2.81	18.6	0.08	0	0.08	295.87	4.35	-0.01	9	0.72	6.4	2.27	144.38	-3.35	22.13	5
10	13.29	0.89	0.11	1.68	13.29	6.68	3	3.13	18.19	0.09	0	0.09	147.11	6.73	0	9	0.82	7.58	2.54	94.54	0.09	14.81	3
11	11.29	0.79	-0.11	1.7	11.28	7.02	3	3.2	18	0.1	0	0.1	113.29	7.08	0	9	0.85	7.44	2.6	78.64	-0.08	14.15	3
12	11.33	0.79	-1.13	1.48	11.3	6.96	3	3.2	17.99	0.11	0	0.11	103.9	7.03	-0.01	9	0.85	6.96	2.62	73.64	-0.76	14.24	3
13	9.06	0.59	-0.62	2	9.05	6.55	3	3.25	17.58	0.12	0	0.12	76.65	6.63	0	3	0.87	6.8	2.66	57.35	-0.38	14.96	3
14	10.6	0.61	-0.32	2.61	10.59	5.75	3	3.17	17.67	0.13	0	0.13	83.49	5.82	0	4	0.85	6.09	2.61	60.24	-0.18	16.7	3
15	14.39	0.87	-0.11	2.53	14.38	6.05	3	3.08	18.2	0.13	0	0.13	105.99	6.11	0	9	0.83	5.56	2.56	74.82	-0.06	16.09	3
16	13.57	0.91	0.43	2.4	13.58	6.73	3	3.13	18.23	0.14	0	0.14	93.59	6.8	0	9	0.85	5.5	2.62	69.78	0.21	14.65	3
17	12.54	0.87	1.18	2.14	12.58	6.91	3	3.16	18.14	0.15	0	0.15	81.39	6.99	0.01	9	0.87	5.37	2.66	63.01	0.55	14.3	3
18	10.46	0.71	1.5	2.42	10.5	6.75	3	3.21	17.84	0.16	0	0.16	64.02	6.86	0.01	3	0.89	5.29	2.7	51.75	0.67	14.54	3
19	11.78	0.81	1.79	2.6	11.84	6.86	3	3.18	18.04	0.17	0	0.17	68.39	6.96	0.01	3	0.88	5.01	2.69	55.18	0.75	14.35	3
20	13.75	0.92	0	2.84	13.75	6.66	3	3.12	18.24	0.18	0	0.18	75.5	6.75	0	3	0.87	4.68	2.66	59.96	0	14.74	3
21	11.06	0.78	-2.21	2.68	10.99	7.09	3	3.21	17.97	0.19	0	0.19	57.26	7.21	-0.01	3	0.9	4.74	2.74	48.36	-0.84	13.94	3
22	16.79	0.9	-1.11	2.88	16.76	5.36	3	2.99	18.29	0.2	0	0.2	83.72	5.42	0	4	0.84	4.07	2.57	63.66	-0.4	17.74	3
23	125.41	1.09	-0.32	2.21	125.41	0.87	6	1.81	19.28	0.21	0	0.21	603.52	0.87	0	6	0.46	2.12	1.58	250.91	-0.11	90.7	7
24	54.66	0.9	0.54	2.47	54.67	1.65	5	2.27	18.75	0.22	0	0.22	251.15	1.66	0	6	0.61	2.63	1.97	135.29	0.18	49.35	7
25	101.32	0.82	-0.11	2.18	101.32	0.81	6	1.87	18.88	0.23	0	0.23	446.76	0.82	0	6	0.48	2.1	1.63	200.56	-0.03	90.19	7
26	114.6	0.87	-0.32	2.35	114.59	0.76	6	1.81	18.99	0.24	0	0.24	485.01	0.76	0	6	0.46	2.01	1.58	216.8	-0.1	96.71	7
27	125.53	0.92	-0.54	2.49	125.51	0.73	6	1.77	19.09	0.25	0	0.25	510.6	0.73	0	6	0.45	1.94	1.55	229.54	-0.16	100.72	7
28	57.9	0.66	-0.86	2.41	57.88	1.14	5	2.15	18.42	0.25	0	0.25	226.4	1.15	0	6	0.58	2.28	1.88	124.18	-0.24	63.09	7
29	20.01	1.7	-1.07	2.43	19.97	8.5	3	3.07	19.09	0.26	0	0.26	74.64	8.61	0	9	0.9	3.48	2.72	64.8	-0.29	11.91	3
30	58.85	3.95	-3.53	2.2	58.75	6.73	3	2.68	20.48	0.27	0	0.27	213.15	6.76	0	9	0.78	2.87	2.41	158.65	-0.93	14.77	3
31	46.93	3.79	-5.46	2.37	46.77	8.11	3	2.8	20.34	0.28	0	0.28	163.4	8.16	-0.01	9	0.83	2.96	2.53	129.97	-1.38	12.38	3
32	46.62	3.18	-6.21	2.91	46.43	6.84	3	2.75	20.14	0.29	0	0.29	156.61	6.88	-0.01	9	0.81	2.81	2.48	122.51	-1.52	14.51	3
33	47.87	2.74	-6.36	2.57	47.67	5.75	3	2.69	19.98	0.3	0	0.3	155.55	5.79	-0.01	9	0.79	2.67	2.42	119.34	-1.5	17	3
34	40.15	2.41	-6.31	2.31	39.96	6.04	3	2.75	19.76	0.31	0	0.31	126.09	6.09	-0.01	9	0.81	2.68	2.49	100.29	-1.45	16.2	3
35	44.24	2.14	-6.31	2.24	44.04	4.87	4	2.66	19.66	0.32	0	0.32	134.83	4.9	-0.01	9	0.78	2.51	2.4	103.88	-1.4	19.66	3
36	35.19	2.18	-6.28	0.91	35	6.24	3	2.8	19.6	0.33	0	0.33	103.76	6.3	-0.01	9	0.83	2.61	2.54	85.54	-1.35	15.7	3
37	180.86	2.37	-6.25	0.65	180.67	1.31	6	1.82	20.32	0.34	0	0.34	523.86	1.31	0	6	0.5	1.75	1.67	299.06	-1.31	66.78	7
38	156.79	2.66	-2.06	2.29	156.73	1.7	6	1.95	20.4	0.35	0	0.35	441.23	1.7	0	6	0.55	1.82	1.79	268.73	-0.42	52.79	7
39	194.2	0	-1.51	2.75	194.15	0	0	0	13.73	0.36	0	0.36	536.42	0	0	0	1	2.93	0	536.42	-0.3	780.59	0

	CPT-6	In situ data						Basic output data														
Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ã (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn	U2	I(B)	Mod. SBTn
1	13.89	0.06	0.19	0.79	13.89	0.41	5	2.5	15.06	0.01	0	0.01	1842.6	0.41	0	6	0.46	9.55	1.61	125.3	1.82	111.05	7
2	20.91	0.15	0.1	0.91	20.91	0.73	5	2.43	16.34	0.02	0	0.02	1330	0.73	0	6	0.49	7.94	1.67	156.69	0.44	90.42	7
3	14.3	0.18	0	0.93	14.3	1.25	4	2.68	16.37	0.02	0	0.02	597.9	1.25	0	6	0.58	8.95	1.91	120.76	0	59.15	7
4	14.12	0.28	-0.19	1.04	14.12	1.97	4	2.79	16.88	0.03	0	0.03	435.79	1.97	0	5	0.63	9.16	2.05	121.93	-0.42	42.49	7
5	18.6	0.54	-0.38	1.08	18.59	2.93	4	2.79	17.76	0.04	0	0.04	450.23	2.93	0	5	0.66	8.54	2.13	149.72	-0.67	31.37	5
6	18.5	0.98	-0.59	1.1	18.49	5.28	3	2.96	18.43	0.05	0	0.05	365.71	5.29	0	9	0.74	9.39	2.31	163.62	-0.85	18.56	3
7	21.07	1.05	-1.24	1.16	21.06	4.98	3	2.9	18.56	0.06	0	0.06	351.68	4.99	0	9	0.73	8.14	2.3	161.44	-1.49	19.57	3
8	19.23	1.02	-0.76	1.2	19.22	5.29	3	2.94	18.49	0.07	0	0.07	277.83	5.31	0	9	0.75	7.77	2.35	140.54	-0.8	18.46	3
9	52.05	0.97	-0.57	1.27	52.04	1.87	5	2.32	18.82	0.08	0	0.08	663.3	1.87	0	6	0.57	4.41	1.87	216.62	-0.53	47.64	7
10	57.86	0.73	-0.48	1.27	57.86	1.27	5	2.18	18.54	0.09	0	0.09	659.32	1.27	0	6	0.53	3.7	1.76	202.02	-0.39	64.89	7
11	16.74	0.96	-0.19	1.35	16.74	5.77	3	3.01	18.38	0.1	0	0.1	171.87	5.8	0	9	0.79	6.64	2.46	104.42	-0.14	16.94	3
12	17	0.96	-0.29	1.43	17	5.66	3	3	18.38	0.11	0	0.11	159.38	5.69	0	9	0.79	6.22	2.46	99.32	-0.19	17.21	3
13	65.84	0.77	-0.38	1.58	65.84	1.17	5	2.11	18.64	0.12	0	0.12	570.02	1.17	0	6	0.52	3.18	1.74	197.51	-0.24	68.8	7
14	17.02	0.69	-0.19	1.62	17.02	4.07	3	2.91	18	0.12	0	0.12	135.92	4.1	0	4	0.77	5.21	2.4	83.26	-0.11	22.65	5
15	16.21	0.85	-0.42	1.66	16.21	5.24	3	3	18.22	0.13	0	0.13	120.47	5.29	0	9	0.81	5.32	2.49	80.77	-0.23	18.26	3
16	18.93	0.86	-0.81	1.66	18.92	4.54	3	2.91	18.29	0.14	0	0.14	131.68	4.57	0	9	0.78	4.8	2.43	85.24	-0.41	20.72	3
17	20.1	0.88	-0.7	1.66	20.09	4.38	3	2.88	18.34	0.15	0	0.15	131.4	4.41	0	9	0.78	4.54	2.42	85.47	-0.33	21.36	3
18	18.59	0.95	-0.48	1.68	18.59	5.13	3	2.95	18.4	0.16	0	0.16	114.5	5.18	0	9	0.81	4.56	2.49	79.34	-0.21	18.58	3
19	18.01	0.97	-0.29	1.72	18.01	5.4	3	2.97	18.41	0.17	0	0.17	104.84	5.46	0	9	0.82	4.46	2.52	75.2	-0.12	17.74	3
20	14.16	0.82	-0.38	1.74	14.15	5.78	3	3.07	18.12	0.18	0	0.18	77.99	5.86	0	4	0.85	4.54	2.61	59.95	-0.15	16.61	3
21	15.47	0.65	-1.05	1.64	15.45	4.21	3	2.95	17.89	0.19	0	0.19	81.13	4.26	0	4	0.81	4.08	2.51	58.89	-0.4	21.46	3
22	13.3	0.72	-0.67	1.58	13.29	5.4	3	3.07	17.95	0.2	0	0.2	66.42	5.48	0	4	0.86	4.24	2.63	52.42	-0.24	17.48	3
23	25.72	0.76	-0.57	1.62	25.71	2.95	4	2.68	18.26	0.21	0	0.21	123.66	2.97	0	5	0.74	3.34	2.3	80.6	-0.2	29.26	5
24	44.92	0.61	0.05	1.56	44.92	1.36	5	2.29	18.23	0.22	0	0.22	207.59	1.37	0	6	0.61	2.64	1.97	111.49	0.02	54.64	7
25	71.81	0.68	0.29	1.58	71.81	0.95	6	2.03	18.53	0.22	0	0.22	318.7	0.95	0	6	0.53	2.27	1.76	153.85	0.09	75.74	7
26	246.04	1.31	0.67	1.31	246.05	0.53	6	1.45	19.75	0.23	0	0.23	1048.2	0.53	0	7	0.35	1.7	1.29	394.86	0.2	144.67	7
27	185.98	1.78	0.76	1.22	185.98	0.96	6	1.72	20.01	0.24	0	0.24	759.59	0.96	0	6	0.44	1.92	1.53	336.46	0.22	88.09	7
28	58.3	0.88	0.57	1.2	58.31	1.51	5	2.22	18.75	0.25	0	0.25	228.67	1.52	0	6	0.61	2.37	1.95	130.17	0.16	52.33	7
29	25.58	1.4	0.64	1.3	25.59	5.49	3	2.86	18.97	0.26	0	0.26	96.15	5.55	0	9	0.83	3.15	2.53	75.4	0.17	17.49	3
30	44.3	1.84	0.86	1.45	44.31	4.15	4	2.61	19.49	0.27	0	0.27	161.23	4.17	0	9	0.75	2.75	2.32	114.3	0.23	22.72	5
31	29.57	2.26	0.86	1.41	29.58	7.64	3	2.92	19.57	0.28	0	0.28	103.54	7.72	0	9	0.86	3.1	2.61	85.72	0.22	13.08	3
32	29.33	3.11	0.76	1.63	29.34	10.61	3	3.03	19.94	0.29	0	0.29	99.18	10.72	0	9	0.9	3.18	2.72	87.24	0.19	9.68	2
33	74.6	3.32	1.14	1.89	74.61	4.45	4	2.47	20.37	0.3	0	0.3	245.2	4.47	0	9	0.72	2.45	2.24	172.24	0.27	21.7	3
34	46.27	3.2	1.24	2.01	46.28	6.9	3	2.75	20.14	0.31	0	0.31	146.81	6.95	0	9	0.81	2.7	2.49	117.11	0.28	14.38	3
35	57.63	3.51	1.52	1.99	57.65	6.1	3	2.65	20.34	0.32	0	0.32	177.31	6.13	0	9	0.78	2.53	2.41	137.1	0.34	16.16	3
36	40.46	2.94	1.62	2.07	40.48	7.27	3	2.81	20	0.33	0	0.33	120.46	7.33	0	9	0.84	2.63	2.55	99.86	0.35	13.7	3
37	29.17	1.85	1.43	2.12	29.19	6.33	3	2.86	19.34	0.34	0	0.34	84.11	6.4	0	9	0.85	2.62	2.59	71.32	0.3	15.44	3
38	25.7	1.86	1.33	2.08	25.71	7.24	3	2.94	19.3	0.35	0	0.35	71.93	7.35	0	9	0.88	2.64	2.67	63.33	0.27	13.7	3
39	126.24	1.63	0.95	2.18	126.25	1.29	6	1.93	19.75	0.36	0	0.36	347.3	1.29	0	6	0.54	1.77	1.76	211.14	0.19	64.53	7
40	145.08	2.3	1.33	2.22	145.09	1.59	6	1.95	20.2	0.37	0	0.37	388.41	1.59	0	6	0.55	1.77	1.79	242.49	0.26	55.35	7
41	203.6	2.55	1.24	2.31	203.62	1.25	6	1.77	20.45	0.38	0	0.38	530.88	1.25	0	6	0.49	1.65	1.64	316.41	0.23	69.99	7
42	111.39	1.67	1.33	2.28	111.41	1.5	6	2.01	19.73	0.39	0	0.39	282.7	1.5	0	6	0.57	1.76	1.84	184.69	0.24	56.01	7
43	17.72	0.96	1.24	2.33	17.73	5.44	3	2.98	18.4	0.4	0	0.4	43.13	5.56	0.01	3	0.9	2.4	2.72	39.29	0.22	17.08	3
44	34.91	1.99	1.62	2.58	34.93	5.69	3	2.78	19.49	0.41	0	0.41	83.86	5.75	0	9	0.84	2.21	2.55	72.23	0.28	16.93	3
45	24.61	2.23	1.52	2.98	24.62	9.04	3	3.03	19.48	0.42	0	0.42	57.44	9.19	0	3	0.93	2.36	2.79	54.04	0.26	11.3	3
46	46.55	1.42	1.44	2.93	46.57	3.05	4	2.5	19.21	0.43	0	0.43	107.05	3.08	0	5	0.75	1.95	2.3	85.25	0.24	28.62	5
47	139.96	2.63	1.71	2.95	139.98	1.88	5	2.01	20.34	0.44	0	0.44	316.31	1.89	0	6	0.58	1.67	1.87	219.88	0.28	47.4	7
48	278.87	3.05	1.62	2.99	278.89	1.09	6	1.64	20.78	0.45	0	0.45	616.66	1.1	0	6	0.46	1.48	1.54	388.25	0.26	80.38	7
49	314.76	3.28	2.1	3.06	314.78	1.04	6	1.59	20.91	0.46	0	0.46	680.37	1.04	0	6	0.44	1.44	1.5	428.19	0.33	84.88	7
50	298.66	0	1.9	2.95	298.68	0	0	0	13.73	0.47	0	0.47	636.05	0	0	0	1	2.26	0	636.05	0.29	922.93	0

	CPT-7	In situ data						Basic output data														
Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ã (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn	U2	I(B)	Mod. SBTn
1	8.08	0.06	0.09	0.21	8.08	0.78	4	2.82	14.95	0.01	0	0.01	1079	0.78	0	6	0.54	14.24	1.81	108.6	0.91	76.86	7
2	13.47	0.21	0.03	0.44	13.47	1.54	4	2.75	16.53	0.02	0	0.02	854.55	1.54	0	6	0.58	11.47	1.92	145.94	0.15	52.8	7
3	10.22	0.29	0.09	0.42	10.22	2.88	3	3	16.82	0.02	0	0.02	422.52	2.89	0	5	0.68	12.84	2.17	123.74	0.28	31.3	5
4	10.75	0.38	0.18	0.5	10.75	3.55	3	3.03	17.14	0.03	0	0.03	327.66	3.56	0	8	0.71	11.74	2.25	118.9	0.4	26.15	5
5	17.87	0.6	0.18	0.54	17.87	3.36	3	2.84	17.85	0.04	0	0.04	428.08	3.37	0	8	0.68	8.98	2.17	151.23	0.31	27.83	5
6	15.38	0.85	-0.23	0.59	15.38	5.56	3	3.03	18.2	0.05	0	0.05	301.97	5.57	0	9	0.76	9.91	2.36	143.48	-0.33	17.65	3
7	16.38	0.88	-0.38	0.67	16.38	5.39	3	3	18.26	0.06	0	0.06	272.5	5.41	0	9	0.76	8.78	2.37	135.38	-0.46	18.13	3
8	16.78	0.98	-0.35	0.75	16.77	5.87	3	3.02	18.4	0.07	0	0.07	241.83	5.9	0	9	0.77	8.23	2.41	129.85	-0.36	16.74	3
9	32.52	1.16	-0.29	0.81	32.52	3.58	4	2.66	18.85	0.08	0	0.08	413.29	3.59	0	8	0.68	5.8	2.15	177.76	-0.26	26.52	5
10	48.74	0.98	-0.17	0.94	48.74	2.02	5	2.36	18.81	0.09	0	0.09	553.47	2.02	0	6	0.59	4.33	1.92	199.02	-0.14	44.21	7
11	18.19	1.08	0	0.91	18.19	5.93	3	2.99	18.53	0.1	0	0.1	186.14	5.96	0	9	0.79	6.57	2.45	112.26	0	16.55	3
12	22.86	0.86	-0.86	0.89	22.85	3.75	4	2.79	18.36	0.11	0	0.11	213.82	3.77	0	8	0.73	5.31	2.29	114.12	-0.58	24.81	5
13	47.63	0.62	-0.67	0.88	47.62	1.29	5	2.25	18.26	0.12	0	0.12	411.42	1.29	0	6	0.56	3.46	1.85	155.55	-0.42	61	7
14	14.68	0.75	-0.08	0.89	14.68	5.09	3	3.02	18.03	0.12	0	0.12	116.9	5.13	0	9	0.81	5.63	2.5	77.37	-0.05	18.71	3
15	16.14	1.01	0.09	0.89	16.14	6.26	3	3.05	18.41	0.13	0	0.13	119.69	6.32	0	9	0.82	5.51	2.55	83.27	0.05	15.65	3
16	17.42	1.07	0.29	0.91	17.42	6.16	3	3.02	18.51	0.14	0	0.14	120.84	6.21	0	9	0.82	5.18	2.54	84.52	0.14	15.89	3
17	16.62	1.17	0.66	0.95	16.63	7.01	3	3.07	18.59	0.15	0	0.15	108.19	7.07	0	9	0.84	5.14	2.6	80.09	0.31	14.15	3
18	17.99	1.01	0.95	0.98	18	5.59	3	2.98	18.45	0.16	0	0.16	110.47	5.64	0	9	0.82	4.65	2.52	78.41	0.42	17.25	3
19	15.15	1.05	0.95	1.04	15.17	6.92	3	3.1	18.43	0.17	0	0.17	87.85	7	0	9	0.86	4.81	2.63	68.16	0.4	14.29	3
20	14.85	1.18	0.95	1.06	14.86	7.95	3	3.14	18.56	0.18	0	0.18	81.58	8.04	0	9	0.88	4.78	2.69	66.26	0.38	12.65	3
21	17.69	1.19	0.76	1.14	17.7	6.73	3	3.04	18.64	0.19	0	0.19	92.5	6.8	0	9	0.85	4.34	2.61	71.8	0.29	14.66	3
22	14.56	1.12	0.67	3.02	14.57	7.66	3	3.14	18.49	0.2	0	0.2	72.37	7.76	0	9	0.89	4.43	2.7	60.1	0.24	13.07	3
23	17.47	0.68	0.76	3.14	17.48	3.87	3	2.89	17.98	0.21	0	0.21	83.24	3.91	0	4	0.8	3.7	2.48	60.33	0.26	22.99	5
24	42.59	0.44	0.92	3.26	42.6	1.03	5	2.24	17.83	0.22	0	0.22	195.84	1.04	0	6	0.59	2.55	1.91	102.17	0.3	63.74	7
25	70.47	0.56	0.95	3.31	70.48	0.79	6	1.99	18.29	0.23	0	0.23	311.42	0.79	0	6	0.52	2.22	1.72	147.24	0.3	84.34	7
26	108.08	0.98	1.15	3.43	108.09	0.91	6	1.88	19.11	0.24	0	0.24	458.67	0.91	0	6	0.49	2.08	1.64	212.12	0.35	84.51	7
27	116.18	1.09	1.25	3.35	116.2	0.94	6	1.86	19.26	0.24	0	0.24	473.68	0.94	0	6	0.49	2.04	1.64	223.2	0.37	83.27	7
28	67.24	1.26	1.33	3.41	67.26	1.87	5	2.24	19.21	0.25	0	0.25	263.4	1.87	0	6	0.61	2.4	1.97	151.84	0.38	45.66	7
29	42.96	2.6	1.53	3.47	42.98	6.06	3	2.73	19.88	0.26	0	0.26	161.6	6.1	0	9	0.79	3	2.44	120.93	0.42	16.22	3
30	57.8	4.12	1.62	3.43	57.82	7.13	3	2.7	20.52	0.27	0	0.27	209.57	7.17	0	9	0.79	2.9	2.43	157.87	0.42	13.97	3
31	49.92	4.41	1.59	3.22	49.94	8.84	3	2.81	20.54	0.28	0	0.28	174.32	8.89	0	9	0.83	2.98	2.54	139.73	0.4	11.41	3
32	54.16	4.14	1.81	3.12	54.18	7.64	3	2.74	20.5	0.3	0	0.3	182.6	7.68	0	9	0.81	2.81	2.48	143.13	0.44	13.1	3
33	43.57	3.21	1.91	2.98	43.59	7.37	3	2.79	20.13	0.31	0	0.31	141.84	7.42	0	9	0.83	2.79	2.52	114.16	0.45	13.53	3
34	44.65	3.08	2.1	2.85	44.67	6.89	3	2.76	20.09	0.32	0	0.32	140.72	6.94	0	9	0.82	2.69	2.5	112.85	0.48	14.4	3
35	73.3	3.02	2.1	2.81	73.33	4.11	4	2.45	20.25	0.33	0	0.33	224.4	4.13	0	8	0.71	2.32	2.23	160.25	0.47	23.26	5
36	48.33	2.28	2.19	2.62	48.36	4.72	4	2.62	19.77	0.34	0	0.34	143.26	4.75	0	9	0.77	2.42	2.37	110	0.47	20.25	3
37	35.46	1.9	2.29	2.58	35.49	5.36	3	2.75	19.44	0.34	0	0.34	101.88	5.41	0	9	0.82	2.5	2.49	82.93	0.48	17.91	3
38	24.56	2.14	2.1	2.54	24.59	8.72	3	3.02	19.44	0.35	0	0.35	68.33	8.85	0.01	9	0.91	2.71	2.74	61.98	0.43	11.64	3
39	39.54	2.08	1.91	2.31	39.56	5.26	3	2.71	19.59	0.36	0	0.36	107.56	5.31	0	9	0.81	2.37	2.47	87.75	0.38	18.23	3
40	35.43	1.67	2.12	2.2	35.45	4.72	4	2.71	19.3	0.37	0	0.37	93.77	4.77	0	9	0.81	2.32	2.47	76.91	0.41	19.9	3
41	200.44	2.07	2	2.12	200.47	1.04	6	1.72	20.21	0.38	0	0.38	520.74	1.04	0	6	0.47	1.61	1.58	304.41	0.38	81.52	7
42	95.74	2.16	2.36	2.1	95.77	2.26	5	2.18	19.97	0.39	0	0.39	241.93	2.27	0	5	0.63	1.87	2.01	168.39	0.43	39.48	7
43	139.15	1.47	2.28	2.1	139.18	1.06	6	1.84	19.68	0.4	0	0.4	343.48	1.06	0	6	0.51	1.64	1.69	214.62	0.41	75.37	7
44	22.67	0.86	2.42	1.98	22.7	3.8	3	2.79	18.36	0.41	0	0.41	53.92	3.87	0.01	4	0.84	2.21	2.55	46.47	0.42	22.62	5
45	18.75	1.25	3.48	1.92	18.79	6.67	3	3.02	18.72	0.42	0	0.42	43.47	6.82	0.01	3	0.93	2.34	2.77	40.65	0.59	14.58	3
46	27.94	2.37	3.24	1.85	27.98	8.48	3	2.97	19.61	0.43	0	0.43	63.7	8.61	0.01	9	0.92	2.27	2.74	59.12	0.54	11.93	3
47	151.88	2.47	3.43	1.72	151.92	1.63	6	1.94	20.3	0.44	0	0.44	342.29	1.63	0	6	0.56	1.63	1.81	233.12	0.56	53.98	7
48	370.03	3.1	3.62	1.72	370.07	0.84	6	1.47	20.91	0.45	0	0.45	815.98	0.84	0	6	0.4	1.4	1.38	489.87	0.58	103.91	7
49	273.45	3.45	3.94	1.75	273.5	1.26	6	1.69	20.91	0.46	0	0.46	589.16	1.26	0	6	0.48	1.48	1.59	382.88	0.61	70.99	7
50	247.87	0	3.64	1.85	247.92	0	0	0	13.73	0.47	0	0.47	526.14	0	0	0	1	2.25	0	526.14	0.56	765.91	0

	CPT-8	In situ data						Basic output data														
Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ã (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn	U2	I(B)	Mod. SBTn
1	22.94	0.5	1.61	0.31	22.99	2.19	4	2.64	17.75	0.01	0	0.01	2587.5	2.19	0.01	6	0.55	14.19	1.84	308.18	13.02	42.7	7
2	10.25	0.35	0.54	0.35	10.27	3.39	3	3.04	17.01	0.02	0	0.02	589.48	3.39	0	8	0.67	15.91	2.17	154.15	2.22	27.69	5
3	11.43	0.4	0	0.13	11.43	3.52	3	3.01	17.22	0.03	0	0.03	438.96	3.53	0	8	0.69	12.93	2.21	139.35	0	26.61	5
4	12.69	0.5	-0.28	0.29	12.68	3.95	3	3	17.52	0.03	0	0.03	363.94	3.96	0	8	0.71	11.32	2.26	135.32	-0.57	23.96	5
5	14.36	0.61	-0.69	0.03	14.34	4.25	3	2.98	17.79	0.04	0	0.04	327.49	4.27	0	9	0.72	10.08	2.28	136.1	-1.14	22.45	5
6	16.55	0.88	-2.29	-0.03	16.48	5.36	3	3	18.27	0.05	0	0.05	311.22	5.38	-0.01	9	0.75	9.43	2.35	146.34	-3.13	18.24	3
7	13.51	0.78	-2.51	0.33	13.43	5.82	3	3.09	18.05	0.06	0	0.06	216.31	5.85	-0.01	9	0.78	9.2	2.43	116.28	-2.92	16.83	3
8	24.43	0.74	-4.13	0.45	24.3	3.03	4	2.71	18.21	0.07	0	0.07	341.77	3.04	-0.01	5	0.68	6.21	2.15	142.22	-4.19	30.31	5
9	99.09	0.59	0.64	0.38	99.11	0.6	6	1.8	18.5	0.08	0	0.08	1235.6	0.6	0	6	0.4	2.83	1.45	264.87	0.58	120.07	7
10	16.74	0.62	0.86	0.41	16.76	3.71	3	2.89	17.87	0.09	0	0.09	187.16	3.73	0	5	0.74	6.24	2.32	98.41	0.69	24.82	5
11	14.76	0.54	0.86	0.26	14.78	3.64	3	2.93	17.66	0.1	0	0.1	149.97	3.67	0	4	0.76	6.04	2.36	83.84	0.63	24.85	5
12	16.2	0.69	0.81	0.58	16.23	4.25	3	2.94	17.98	0.11	0	0.11	150.78	4.28	0	9	0.77	5.83	2.4	88.81	0.55	21.95	5
13	10.96	0.71	0.89	0.37	10.98	6.48	3	3.19	17.86	0.12	0	0.12	93.83	6.55	0.01	9	0.85	6.55	2.62	67.33	0.55	15.13	3
14	12.97	0.78	1.29	0.67	13.01	6.01	3	3.11	18.04	0.12	0	0.12	103.19	6.07	0.01	9	0.83	5.93	2.57	72.25	0.74	16.17	3
15	14.77	0.77	1.5	0.86	14.82	5.22	3	3.03	18.07	0.13	0	0.13	109.67	5.27	0.01	9	0.81	5.39	2.51	74.75	0.81	18.27	3
16	15.11	0.68	1.03	0.74	15.14	4.49	3	2.98	17.93	0.14	0	0.14	104.95	4.53	0	4	0.8	4.98	2.48	70.61	0.52	20.66	3
17	12.13	0.79	2.17	0.82	12.19	6.46	3	3.15	18.02	0.15	0	0.15	79.28	6.54	0.01	3	0.86	5.34	2.64	60.76	1.03	15.14	3
18	12.13	0.67	2.46	0.67	12.2	5.49	3	3.1	17.84	0.16	0	0.16	74.89	5.57	0.01	4	0.85	4.97	2.61	56.52	1.1	17.29	3
19	16.68	0.74	1.17	0.49	16.72	4.45	3	2.94	18.08	0.17	0	0.17	97.45	4.5	0.01	4	0.8	4.35	2.49	68.09	0.49	20.75	3
20	11.82	0.83	0.98	0.5	11.85	7	3	3.18	18.07	0.18	0	0.18	65.25	7.1	0.01	3	0.89	4.85	2.71	53.53	0.4	14.11	3
21	16.44	0.98	-3.74	0.73	16.33	5.98	3	3.03	18.38	0.19	0	0.19	85.81	6.05	-0.02	9	0.85	4.32	2.6	65.83	-1.43	16.19	3
22	21.02	0.95	-3.07	1.35	20.93	4.55	3	2.87	18.45	0.2	0	0.2	105.08	4.59	-0.01	4	0.8	3.82	2.47	74.86	-1.12	20.5	3
23	22.93	0.63	1.82	1.31	22.99	2.74	4	2.7	18.01	0.21	0	0.21	110.44	2.77	0.01	5	0.74	3.36	2.31	72.42	0.64	30.47	5
24	43	0.82	1.51	1.28	43.05	1.91	5	2.39	18.56	0.22	0	0.22	198.71	1.92	0	5	0.65	2.8	2.07	113.41	0.5	42.83	7
25	48.74	0.86	1.44	1.41	48.78	1.77	5	2.33	18.66	0.22	0	0.22	215.9	1.78	0	5	0.63	2.65	2.02	121.8	0.46	45.98	7
26	84.14	1.02	1.07	1.51	84.17	1.21	6	2.04	19.06	0.23	0	0.23	358.05	1.22	0	6	0.54	2.26	1.78	179.34	0.33	65.69	7
27	13.18	0.58	1.36	1.37	13.22	4.42	3	3.02	17.71	0.24	0	0.24	53.33	4.5	0.01	4	0.86	3.54	2.62	43.36	0.4	20.13	3
28	13.3	1.02	-1.29	1.58	13.26	7.71	3	3.17	18.35	0.25	0	0.25	51.53	7.86	-0.01	3	0.92	3.75	2.78	46.05	-0.37	12.98	3
29	25.5	3.08	-6.74	1.73	25.3	12.17	3	3.11	19.87	0.26	0	0.26	95.43	12.3	-0.02	9	0.92	3.61	2.78	85.32	-1.85	8.52	2
30	63.27	0	-10.79	1.81	62.95	0	0	0	13.73	0.27	0	0.27	232.79	0	-0.01	0	1	3.93	0	232.79	-2.88	346.84	0

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

:: Unit Weight, g (kN/m³) ::

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

where g_w = water unit weight

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

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

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

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

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

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

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

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

(applicable only to $I_c < I_{c_cutoff}$)

:: Relative Density, Dr (%) ::

$100 \cdot \sqrt{\frac{Q_{tn}}{k_{DR}}}$ (applicable only to SBT_n: 5, 6, 7 and 8 or $I_c < I_{c_cutoff}$)

:: State Parameter, ψ ::

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

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

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

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

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

If $I_c > 2.20$

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

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

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

If $I_c \leq 2.20$

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

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

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

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

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

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

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

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

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

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

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

:: Overconsolidation Ratio, OCR ::

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

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

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

:: In situ Stress Ratio, Ko ::

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

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

:: Soil Sensitivity, S_t ::

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

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

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

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

(applicable for $0.10 < B_q < 1.00$)

References

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21 January 2020

RECOMMENDATION FOR ACCEPTANCE OF INVESTIGATION AND REPORT

POTENTIAL SURFACE FAULT RUPTURE
449 N. Beverly Drive, LLC, City of Beverly Hills CA 90210

APN: 4343-016-019

As authorized by the City of Beverly Hills, this document summarizes technical (peer) reviews for a "Fault Hazard [Ground Rupture] Investigation" for proposed redevelopment of the 449 N. Beverly Drive property in the City of Beverly Hills, California. The investigations were carried by Feffer Geological Consulting, Inc. (FGC), the Consultants-of-Record, on behalf of the applicant, the 449 N. Beverly Drive, LLC. The main purpose of the FGC investigation was to determine if potential splays of the Santa Monica fault zone impact the site, and if such faults were "active" (defined by the California Geological Survey [CGS] as surface or near-surface displacement within the last 11,700 years).

The site is about 75 ft from the Santa Monica fault system, the nearest, CGS-designated Earthquake Fault Zone (EFZ), and relatively near the Hollywood EFZ that extends into the City on the northeast, and the West Pico EFZ that currently "stops" at the City limits on the southeast (see FGC Figs. 2 and 8 and related enlargements given in report pocket). The City requires independent fault-activity reviews in conformance with building codes, with current requirements of the CGS (2018, Special Publication 42) and with contemporary standards-of-practice to ensure public health, safety and welfare.

The technical reviews included initial and on-going telephone and email discussions with applicant representatives, the consultants and City personnel about investigation requirements and scope of work. These were followed by on-site field observation of continuous cores, interpretations of FGC preliminary cross-sections, cone penetrometer tests and site-specific soil-stratigraphic correlations. Also reviewed were draft reports followed by discussions with FGC personnel, sub-consultants and the permit applicant. After review of the "Final Report," this document was prepared to summarize the

fundamental technical conclusions and to submit to the City of Beverly Hills for appropriate processing.

The FGC final report, dated 16 January 2020, was received on 21 January 2020. The report provides pertinent literature and maps, recapitulates field investigation procedures, summarizes the regional geologic framework and tectonic setting, and expounds on specific investigation procedures and technical data supporting the professional conclusions and recommendations.

In sum, the fundamental conclusions of the Consultants-of-Record (FGC) are:

1. That the FGC regional assessments and site-specific investigations meet current standards-of-practice for fault-activity assessments in southern California in general and for those specifically required by the City of Beverly Hills in particular;

2. That the FGC site-specific investigations and interpretations are sufficient to identify, date and correlate subsurface stratigraphic markers, which are unbroken and generally more than 11,700 years old (Figs. 12 and 13).

3. That, despite diligent observation, no charcoal or other materials amenable to unequivocal radiocarbon or other numeric dating methods were recovered;

4. That subsurface sediment and paleosol interpretations were facilitated by interpretation of a single, on-site continuous core correlated with data from adjacent and nearby properties previously investigated by FGC (Appendix A).

5. That the on-site sediments were dated primarily by soil-stratigraphic techniques (Appendix B). Identified were multiple moderately to strongly developed buried paleosols locally replete with common to many, moderately thick illuvial clay films all indicating a pre-11,700-yr age; and that these soils and sediments, traced across the site and in association with CPT “signatures,” are unbroken.

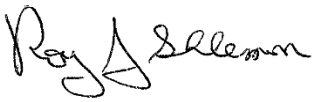
6. That, the 449 N. Beverly Drive property is not subject to potential surface or near-surface displacement associated with the Santa Monica, the Hollywood, the West Pico or any other fault reasonably projected toward it (Fig. 11a).

Accordingly, based substantially on, and in reliance of their professional interpretations and conclusions, the FGC regional summaries and site-specific investigations are judged to meet current standards-of-practice for fault-activity assessments in southern California in general and for those specifically required by the City of Beverly Hills in particular.

Please note that the ECI report focuses solely on potential surface or near-surface fault rupture and does not specifically address possible high seismic accelerations, ground

deformation or other structural design and geotechnical investigations required by applicable building codes or by present professional engineering and geological standards of practice. It is therefore incumbent upon the applicant, FGC, or other consultants, to provide this information to the City of Beverly Hills for technical review and potential acceptance prior to issuance of building permits.

Recommended for Acceptance of Investigation and Report



Roy J. Shlemon, Ph.D.
Technical (peer) Reviewer

21 January 2020

David Yelton, Deputy Building Official
Development Services Division
Community Development Department

January 27, 2020

449 N. Beverly Drive LLC,
A California Limited Liability Company
Attention: C/O Franklin E. Dickinson, AIA
SVP Architecture & Construction for
LVMH Moët Hennessy Louis Vuitton
19 E. 57th Street
New York, NY 10022

Subject: Acceptance of City's Peer-Reviewer Recommendation For Acceptance:
Investigation Of Potential Faulting 449 N. Beverly Drive, Beverly Hills, California, 90210
APN: 4343-016-019

Dear 449 N. Beverly Drive LLC:

The "Fault Hazard [Ground Rupture] Investigation" (Investigation) for the 449 N. Beverly Drive property, in the City of Beverly Hills, California 90210. The investigations were carried out by Feffer Geological Consulting, Inc. ("FGC"), the Consultants-of-Record, on behalf of the applicant, 449 N. Beverly Drive LLC. The main purpose of the FGC investigation was to determine if possible splays of the Santa Monica fault zone potentially impact the site, and if such faults were "active" (defined by the California Geological Survey [CGS] as surface or near-surface displacement within the last 11,700 years). The FGC investigation has been peer reviewed by the City's consultant, Roy J. Shlemon, Ph.D., PG 2867; CPG 1766; CPESC 2167, of Roy J. Shlemon & Associates, Inc. ("RSA").

The peer review included critique of the Site-Specific Fault Rupture Investigation report provided by FGC, titled "Investigation Of Potential Faulting 449 N. Beverly Drive, Beverly Hills, California, 90210 APN: 4343-016-019" (FGC Project File No. 2387-95 dated January 16, 2020 attached).

As the lead agency, the City of Beverly Hills requires appropriate fault-activity investigations and independent technical reviews for conformance with governing local and state building codes, including Department of Conservation California Geological Survey Special Publication 42 titled, "Earthquake Fault Zones A Guide For Government Agenies, Property Owners / Developers, And Geoscience Practitioners For Assessing Fault Rupture Hazards In California," and with current geologic standards of practice that ensure public health, safety and welfare.

Accordingly, in reliance on the technical documentation and assurances provided by the Consultants-of-Record, including their opinions and conclusions, the City of Beverly Hills now formally accepts the technical "Recommendation For Acceptance" of the Reviewer (attached).

Sincerely,

D. Yelton

Attachments: 1) FGC Project File No. 2387-95 dated January 16, 2020
2) Roy J. Shlemon, Ph.D., PG 2867; CPG 1766; CPESC 2167, of Roy J. Shlemon & Associates, Inc., "Recommendation For Acceptance," January 21, 2020

Appendix IS-3.4



Investigation of Potential Faulting:
461 North Rodeo

PD EXHIBIT 12

FEFFER
GEOLOGICAL CONSULTING

September 20, 2018 File No. 2196-85

461 N. Beverly Drive LLC,
a California limited liability company
19 E. 57th St., New York, NY 10022
Attn: Mr. Franklin Dickinson

SUBJECT: **INVESTIGATION OF POTENTIAL FAULTING**
461 North Beverly Drive, Beverly Hills, CA 90210

Dear Mr. Dickinson:

We are pleased to submit this report summarizing our fault rupture hazard investigation for 461 N. Beverly Drive in the City of Beverly Hills, California. This investigation assesses the potential for surface fault rupture and determines if the area of 461 N. Beverly Drive is suitable for the construction of human-occupied structures. 461 N. Beverly Drive is currently not mapped as being potentially affected by surface faulting and is approximately 130 feet to the northwest of the currently mapped Santa Monica Fault Zone (SMFZ).

The investigation consisted of review of pertinent published and unpublished reports, assessed the site geomorphology, and drilled five continuously cored borings to determine underlying stratigraphy. The combination of continuous, unbroken late Pleistocene soil horizons and stratigraphy demonstrates the absence of active faulting beneath the site.

We therefore conclude that the project site is not impacted by state-defined active faults. Accordingly, no fault setback distances or "no-build" zones impact or limit future development.

We appreciate this opportunity to be of service. Should you have any questions regarding the information contained in this report, please do not hesitate to contact us.

Sincerely,

FEFFER GEOLOGICAL CONSULTING, INC.



Joshua R. Feffer
Principal Engineering Geologist
C.E.G. 2138

INTRODUCTION AND BACKGROUND

The project site is located on the southwest side of north Beverly Drive at the corner of south Santa Monica Boulevard and north Beverly Drive, and consists of a commercial lot that is currently occupied by a multi-story building within a developed portion of the City of Beverly Hills, CA (Figure 1). For the purpose of description it is assumed that Beverly Drive is oriented in a north-south direction. The site is bounded to the north by south Santa Monica Boulevard, to the west by an alley, and to the east by north Beverly Drive. Commercial structures and office buildings are located adjacent to the site.

The existing 461 N. Beverly Drive structure was constructed prior to the establishment of the State-mandated Santa Monica Earthquake Fault Zone (SMFZ) (Figure 2). The subject site is entirely outside of this zone and is about 130 feet to the northwest from the northernmost edge of the zone. To ensure public health and safety, a fault investigation is required by the City of Beverly Hills. The surface expression of fault-related geomorphic features has been destroyed by urbanization and development within the greater Los Angeles area which has obscured the lateral extent, location, and rupture history of faulting. Dolan et al. (2000) identified the fault based on topographic scarps north of Santa Monica Boulevard in the Westwood area. Additional work (Olson, 2015) refined the map representation of the fault scarps, and largely confirms the work by Dolan et al. (2000). The mapped location of the SMFZ in relation to the subject site was also obtained from the State of California's recent Earthquake Fault Zone Map (Olson, 2018) (Figure 2).

The site is outside of the current Earthquake Zones of Required Investigation (CGS, 2018a). However, it is subject to the Alquist-Priolo Special Studies Zone Act of 1972 (California Public Resources Code, Chapter 7.5, Division 2), and an investigation is required by the City of Beverly Hills. The AP Special Studies Zone Act specifically defines a fault as active if it demonstrates surface displacement that has occurred within the Holocene (past 11,700 years). This investigation specifically assesses the potential for surface fault rupture at 461 N. Beverly Drive.

SCOPE OF WORK

Trenching is the preferred method for evaluating the presence or absence of faults because it offers a continuous, direct exposure of the fault zone or near surface stratigraphy. However, in this portion of the SMFZ, trenching is difficult due to existing structures. Therefore, this fault rupture hazard study consists mainly of five continuously cored borings drilled to 50 feet in depth and incorporated CPT and continuous core data collected from the adjacent site at 468 N. Rodeo Drive. The scope of work consisted of:

- Review of published and unpublished geotechnical data in the site vicinity;
- Analysis of topographic maps of the site vicinity;
- Obtaining drilling permits and marking of underground utilities;
- Excavating and logging five, fifty foot deep borings;
- Preparation of this report.

FAULT ACTIVITY CRITERIA

In general, fault activity is based on the age of displaced and undisturbed sediment. According to the CGS (2018b), a fault can be either age-undetermined, Holocene-active, or a pre-Holocene fault (see

details below). If charcoal or other numerically datable specimens are present, a numeric age can be established. If no datable material exists, then a relative age can be assigned to movement along the fault usually based on the relative development of buried paleosols.

According to CGS Special Publication 42 (2018b), a fault is defined as the following:

> *"A shear or zone of closely associated shears across which earth materials on one side have been displaced with respect to those on the other side because of tectonic forces. A fault is distinguished from those fractures or shears caused by landsliding or other gravity-driven surficial failures.*
>
> ***age-undetermined fault:*** *A fault whose age of most recent movement is not known or is unconstrained by dating methods or by limitations in stratigraphic resolution.*
>
> ***Holocene-active fault:*** *A fault that has had surface displacement within Holocene time (the last 11,700 years).*
>
> ***pre-Holocene fault:*** *A fault whose recency of past movement is older than 11,700 years, and thus does not meet the criteria of Holocene-active fault as defined in the State Mining and Geology Board regulations (California Code of Regulations, Title 14, Division 2, Section 3601.(a)).*" (CGS, 2018b, p. 1-2)

REGIONAL AND LOCAL GEOLOGY

The site is located in the Los Angeles Basin, a part of the Transverse Ranges Geomorphic province (Figure 3). The Los Angeles Basin lies within a transitional zone between the Transverse Ranges to the north and the Peninsular Ranges (Yerkes et. al., 1965). The basin is bounded on the north by the Santa Monica Mountains, on the east by the Elysian Hills, the west by the Newport-Inglewood Uplift and the south by the La Brea high, an area of shallow bedrock.

The predominate structure in the project site area is the east-west trending Malibu Coast-Santa Monica-Raymond-Cucamonga fault system (Crook et al., 1983), which extends for approximately 125 miles to form the southern boundary of the Transverse Ranges. This fault system is also referred to as the Transverse Ranges Southern Boundary fault system (TRSB) by Dolan et al. (2000). This complex system of east-west trending faults accommodates north-south shortening and uplift, and concurrent westward motion of the Western Transverse Ranges. Individual faults within the TRSB fault system exhibit varying degrees of both left-lateral strike-slip and contractional dip-slip faulting and related folding (Hill, 1979; Crook et al., 1983; Jones et al., 1990; Dolan et al., 2000). All faults within the system show evidence for Quaternary activity and several, including the Santa Monica and Hollywood faults, have been demonstrated by site-specific paleoseismic studies to be active during the Holocene (Jones et al., 1990; Weaver and Dolan, 2000; Dolan et al., 2000).

From a local perspective, the site is located within the uplifted and dissected Beverly Hills area. Geologic mapping of the area is fairly consistent and provides more accurate age constraints in later mapping. Yerkes and Campbell (2005) and Hoots and Kew (1931) mapped Holocene aged alluvium over older Pleistocene aged alluvial and fan deposits (Figure 4) while Dibblee (1991) mapped younger Holocene aged alluvial gravels at the surface overlying older Pleistocene age alluvial fan sediments (Figure 5). More recent mapping (Figure 6) from Campbell (2014) indicates that the sediments exposed

in the area consist of primarily lower Holocene to upper Pleistocene age alluvium near the ground surface underlain by upper to lower Pleistocene aged alluvial fan deposits, and interbedded terrestrial fan and shallow marine sediments. None of these regional geologic maps delineate the SMFZ in the vicinity of the project site area.

Santa Monica Fault Zone

The SMFZ portion of the TRSB trends east-west from the Santa Monica coastline on the west to the Hollywood area on the east (see Figure 2). It is an oblique-reverse, left-lateral fault that is thought to be a surface expression of tectonic deformation related to Pliocene-Quaternary structural development of the Santa Monica Mountains. Integration of subsurface oil and gas exploration seismic data and well logs with surficial mapping indicate the mountains are underlain by a large southward-vergent asymmetric anticline formed over a regional north-dipping thrust ramp at a depth of 6 to 9 miles. Geophysical studies conducted at the Veteran's Administration (VA) property in West Los Angeles indicate the SMFZ is a gently dipping thrust fault with secondary near-vertical faults extending from the primary basal fault toward the ground surface (Pratt et al., 1998; Dolan et al., 2000).

The surface expression of the SMFZ is limited to fault-related geomorphic features, many of which have been destroyed by urbanization and development within the greater Los Angeles area (Figure 7). This has resulted in a poor understanding of the lateral extent, location, and rupture history of the SMFZ. Dolan et al. (2000) identified the fault location based on topographic scarps north of Santa Monica Boulevard. The most prominent of these scarps is located at the base of a late to middle Pleistocene fan surface in west Los Angeles that extends from approximately University High School to the Mormon Temple, juxtaposing older surficial deposits and relatively shallow bedrock to the north against younger surficial deposits and a thick expanse of old alluvium to the south. Both trenching studies and seismic reflections profiles reveal that, at the VA property, the SMFZ topographic scarp contains a series of steeply dipping to sub-vertical faults that offset late Quaternary sediments (Crook et al., 1983; Pratt et al., 1998; Dolan et al., 2000; Catchings et al., 2001). Radiometric dating of key stratigraphic horizons at the VA site indicate that five to six surface-rupturing events have occurred between approximately 50,000 and 1,000-3,000 years before present (Dolan et al., 2000).

West of the project site, the SMFZ has typically been mapped just north of and parallel to Santa Monica Boulevard, following a series of scarps at the base of late to middle Pleistocene fan surfaces (Dolan et al., 2000; Bedrossian et al., 2012; Olson, 2015). However, recent subsurface explorations and geophysical studies in Century City (e.g., Parsons, 2011) have inferred the presence of a zone of faulting that extends south of Santa Monica Boulevard as well. Parsons (2011) interpreted these faults as active, however, subsequent studies have refuted this interpretation. Kenney (2012; 2013) reviewed the data by Parsons (2011) and subsequent studies and supplemented them with his own geologic and geomorphic analysis. Kenney (2012) interpreted the data to indicate that the primary basal SMFZ actually projects far to the south of the project site, and that faulting along and south of Santa Monica Boulevard should be attributed to the newly designated "Santa Monica Boulevard Fault Zone" (SMBFZ).

Faults associated with the SMBFZ dip steeply to the north and are thought to exhibit right-lateral displacement (Kenney, 2012), although a definitive sense of slip has not been established (Kenney, 2013). These faults are interpreted to be secondary structures related to the primary basal reverse SMFZ that is thought to underlie the Century City area at depth (Kenney, 2012; Lettis, 2013). Based on our review of the recent Century City studies (discussed in detail below), the faults subject to this investigation are part of the SMBFZ.

Both Kenney (2012) and Parsons (2011) indicate there is no direct evidence that SMBFZ faults along and south of Santa Monica Boulevard are active. To date, the only evidence of Holocene activity within the SMFZ and SMBFZ is for faults that are coincident with the topographic scarp north of Santa Monica Boulevard (e.g., Dolan et al., 2000; Geocon, 2014). Updated mapping of the SMBFZ (Figure 8) provided by the City of Beverly Hills, based on mapping by the CGS, locates the fault zone as extending from the beyond the western city boundary trending northeastward and terminating near north Maple Drive and Alden Drive (City of Beverly Hills, 2018). Furthermore, the SMBFZ postulated by Kenney (2012) or just the SMFZ as it is commonly referred to, is approximately 130 feet south of the subject site (see Figure 2 and Figure 8).

Newport-Inglewood Fault Zone

The Newport-Inglewood fault (NIFZ) zone is mapped across the western portion of the Los Angeles Basin and generally trends north to northwest. The faulting is topographically expressed onshore by elevated surfaces which extend from the Newport Mesa in the south to the Beverly Hills area in the north (Earth Consultants International, 2018). As currently mapped, the northern portion of the Newport-Inglewood Fault ends near Pico Boulevard south of the Beverly Hills area (see Figure 2 and Figure 8); however, the location of the northern fault strands has been debated widely in the geological literature.

TOPOGRAPHIC / GEOMORPHIC REVIEW

Existing topography was examined for recognizable scarps or breaks in slope that may suggest the location of faulting through a combined review of previous geomorphic analyses (Earth Consultants International, 2018 and Lettis, 2013 and Dolan et. al., 2000) and historical U.S. Geologic Survey topographic maps (Figures 7 and 9).

Geomorphically, the site is on a degraded Holocene-aged alluvial fan surface that has been incised by north-south to northwest-southeast trending drainages (Figures 4, 5, 6, 7, and 9). Locally, the area gently slopes to the east and southeast which is consistent with natural sedimentary and fluvial processes. To the southwest of the site a prominent southeast-facing escarpment, which has historically been used to locate the Santa Monica fault, is crosscut by multiple northwest trending drainages (e.g., Dolan et al., 2000). This scarp shown in Figure 7 is prominently expressed approximately 3 mi southwest of the site at the Mormon Temple. However, from the Mormon Temple to the site, this scarp becomes less pronounced in the landscape and unrecognizable in the vicinity of the subject site (see Figure 9) where urbanization masks geomorphic features related to faulting.

PREVIOUS INVESTIGATIONS

This firm prepared a Fault Investigation Report for 468 N. Rodeo Drive, located approximately 20 feet directly west of the subject site, dated August 20, 2018 (FGC, 2018). The subsurface investigation consisted of drilling of 4 continuously cored borings and 11 CPT soundings within the alley to the west of the subject site (see Figure 10). The investigation concluded that no faults traverse the subject property and that the underlying sediment exhibited multiple continuous stratigraphic horizons across the entire boring and CPT transect. The Fault Investigation report was reviewed by Roy J. Shlemon and Associates and recommended for approval on August 29th, 2018. The City of Beverly Hills issued a formal approval for the referenced site on August 29th, 2018. Data from the approved report for 468 north Rodeo Drive has been utilized to support the findings and conclusion of this report.

In 2011, Parsons-Brinkerhoff (Parsons) completed a fault study for the METRO Westside Subway Extension for the purpose of locating potential subway station and tunnel alignments. Based on their interpretation of continuous-core borings, cone penetrometer tests (CPTs), and geophysical surveys, Parsons (2011) depicted two zones of faulting in the area: 1) a zone of northeast-southwest trending faults, generally parallel to and south of Santa Monica Boulevard, which they attributed to the SMFZ and 2) a zone of northwest-southeast trending faults coincident with the West Beverly Hills Lineament (WBHL). These faults were considered active based on geomorphic evidence and interpreted association with known active faults. To the west of the project site, Parsons (2011) interpreted the SMFZ to span a width from the topographic scarp north of Santa Monica Boulevard to approximately 150 feet southeast of the boulevard. Parsons (2011) interpreted additional faults immediately to the southeast of this zone, but they were unable to determine whether these faults were active.

Leighton Consultants Inc. (Leighton, 2012) performed a fault investigation at Beverly Hills High School focused on the WBHL faults interpreted by Parsons (2011). Leighton (2012) advanced borings, CPTs, and excavated trenches along Parsons' (2011) borehole and CPT transects. Based on the observation of unbroken Pleistocene age soils across the grounds of the high school, Leighton concluded that the faults identified by Parsons (2011) were not active. Furthermore, Leighton (2012) provided geologic evidence that the WHBL scarp is an erosional feature, rather than a tectonic feature. The California Geological Survey (CGS) approved the Leighton report and agreed that none of the investigated faults were active (CGS, 2013).

Feffer Geological Consulting and Geocon, (2012) prepared a fault report for the 10000 Santa Monica project located immediately north of the BHHS campus and lies immediately adjacent to the MTA Santa Monica station site and between MTA Transects 2 and 4. The 10000 investigation included a trench across the entire site that paralleled the Leighton/MTA Transect 4 and the MTA Transect 2. The trench crossed the location of several fault strands proposed by MTA (Parsons, 2011) associated with their WBHL fault zone as well as the new WBHL fault location. No faults, active or otherwise, were found in the 10000 Santa Monica trench to depths of 30+ feet and ages of >300,000 years.

Kenney GeoScience (Kenney, 2012, 2013) performed geomorphic, structural, and stratigraphic analysis using the available subsurface data from the Metro investigation (Parsons, 2011), the Beverly Hills High School fault investigation (Leighton, 2012), and other data generated from recent fault studies in the Beverly Hills/Century City area (e.g., Feffer-Geocon, 2012; Legg, 2012). Based on these data, Kenney (2012) developed a tectonic and geologic history of the area, which included an evaluation of the location and activity of suspected faults. As discussed above, Kenney (2012, 2013) interpreted the faults along Santa Monica Boulevard as secondary upper plate structures, and referred to them as the SMBFZ. This interpretation is based on the observation that the SMBFZ faults are dominantly strike-slip (possibly right-lateral). Although individual faults within the SMBFZ may exhibit normal or reverse apparent displacement, there is little net vertical displacement across the zone (Kenney, 2013). This contrasts with the observations north of Santa Monica Boulevard, where oblique left-lateral reverse motion has produced net north-side-up displacement across the fault (e.g., Dolan et al., 2000; Geocon, 2014).

Kenney (2012) noted that multiple investigations and reevaluations of the faults first interpreted by Parsons (2011) along Santa Monica Boulevard had not produced any evidence of Holocene-age activity for the SMBFZ. In fact, the most recent data indicates that activity along these faults likely ceased approximately 40,000 to 50,000 years ago (Kenney, 2012). However, Kenney (2013) noted that additional study of these faults is needed in order to confidently assess their activity.

Subsequent to Kenney's (2012, 2013) reinterpretation of the SMFZ and the SMBFZ, Geocon West, Inc. (Geocon, 2013) conducted a fault study for Westfield at the Century City mall. This study was specifically designed to identify the evidence for Holocene activity (or lack thereof) along the SMBFZ south of Santa Monica Boulevard. Geocon's (2013) study consisted of one boring transect along Avenue of the Stars, and another boring transect along Century Park West. Geocon (2013) documented a thick section of unfaulted Pleistocene-age alluvium overlying faulted sections of Lakewood Formation sediments. Based on the apparent continuation of the Pleistocene-age geologic units overlying several faults, Geocon (2013) concluded that no active faults were present at the Westfield site, and no restrictions on future development of the Westfield Site are necessary with respect to potential faulting.

The Los Angeles County Metropolitan Transit Authority prepared a report in 2017 for Transect 9 (Figure 8) of Tunnel Reach 5 located approximately 1500 feet to the southwest of the subject site (MTA, 2017). The following is a summary from FER-259 (Olson, 2018):

"In 2017, AMEC Foster Wheeler performed a supplemental fault investigation for the planned LA Metro Westside Purple Line subway extension (Metro, 2017) to assess a strand of the Santa Monica Fault Zone encountered during the preliminary fault investigation report (Parsons Brinckerhoff, 2011), which trended northeasterly towards a section of the proposed subway alignment. To investigate for potential faulting, a series of continuous core borings and CPTs were drilled along Laskey Drive, turning east at Charleville Boulevard, and continuing north along Spaulding Drive (see Figure 14, locality 15). This was referred to as Transect 9, which continues the numbering sequence from Parsons Brinckerhoff (2011). The new subsurface profile was constructed using data collected from twenty new continuous core borings drilled from 110 to 245 feet deep and 34 CPTs advanced to depths ranging from 61 to 117 feet. Based on the subsurface data the consultants identify Holocene and Pleistocene alluvial units overlying bedrock of the Pleistocene Lakewood and San Pedro Formations." (Olson, 2018, p. 31-32)

"From their observations and interpretations of the subsurface data, AMEC Foster Wheeler identified a significant fault zone at depth between their stations 6+50 and 9+00 (Figure 19) consisting of up to three strands, which dip steeply to the north. The faults exhibited greater than 90 feet of apparent down-to-the-north vertical displacement of the contact between the older alluvium and the Lakewood Formation. From the southern end of the cross section, the depth to the Pleistocene bedrock units consistently increases to the north until they are abruptly truncated and no longer encountered north of the inferred fault zone. AMEC states these faults appear to extend up near the present-day ground surface and offset Holocene sediments dated between approximately 9,100 and 16,500 years old based on radiometric dating of charcoal samples. The locations of the fault traces in the near surface sediments is based on identifying the location where laterally persistent laminated fine-grained "sag deposits" to the north are abruptly missing in adjacent down-gradient borings. It is postulated these fine-grained silts and clays were deposited in depressions or impounded drainages formed by topographic scarps created by surface-rupturing events along faults in this zone. Additional faults were also interpreted between borings north and south of this main zone." (Olson, 2018, p. 32)

As illustrated on Figure 8, MTA Transect 9 is located approximately 0.4 miles southwest of 461 N. Beverly Drive. The interpretation of faulting by MTA (2017) is similar to the previously identified activity of the Santa Monica Fault Zone by MTA, and has been questioned by many consultants. None of the purported active faults conclusively offset Holocene age soil.

Earth Consultants International (ECI), (2018) prepared a Fault Investigation Report for 322 N. Foothill Road in the City of Beverly Hills. The site is located partially within the AP Fault Hazard zone. To

resolve the issue of Holocene time faulting, ECI drilled two continuously cored borings, pushed 6 CPT soundings, and excavated one trench. The consultant estimated the age of subsurface paleosols and observed and documented un-broken pre-Holocene stratigraphy and concluded that the site is not impacted by faulting.

METHODOLOGY

Approach

The subsurface investigation was designed to investigate across the subject site in a northwest-southeast oriented transect within north Beverly Drive, adjacent to the subject site (see Figure 10). Typically, trenching is the preferred method for evaluating the presence or absence of faults because it offers a continuous, direct exposure of the fault zone or near surface stratigraphy. However, this portion of the SMBFZ is difficult to expose in trenches due to the dense urban cover in the vicinity. Because of existing structures, underground utilities, and the extent of data collected from the neighboring site, this fault study consists of a single transect of five 50 foot deep continuously cored borings. Located to the west within the adjacent alleyway (Figure 10), an additional transect of borings and CPT's (Cone Penetrometer Soundings) was utilized to verify the findings of this report. The evaluated transects are located on a 1 inch = 10 foot scale base map, and the subsurface data is plotted on 1 inch = 10 foot scale cross sections for interpretation (see Figures 11 and 12).

Field Exploration

Prior to beginning the subsurface field exploration, work permits were obtained from the City of Beverly Hills. Underground Service Alert (USA) was notified to identify buried utilities in the vicinity of the proposed excavations, and an independent utility locating company was also contracted to verify "no-conflict" areas for the drilling.

Subsurface exploration of the five continuously cored borings within the street adjacent to 461 N. Beverly Drive were completed on August 29, 2018. The borings were excavated to a maximum depth of 50 feet beneath the existing ground surface (Table 1). The boring logs, soil descriptions, and a photographic detail of the cores are included in Appendices A, B respectively.

GEOLOGIC MATERIALS

The continuity of soil (pedogenic) horizons and primary stratigraphic contacts provides data to evaluate the presence or absence of faulting. Five conformable stratigraphic units within the alluvium were encountered in each of the 5 borings (Appendix B). These units consist of basal coarse-grained sediments, fining-upward to fine sand and silt and local clays, typically capped by a buried paleosol.

Holocene Alluvial Fan Deposit 1 and 2 (Qal 1)

The uppermost unit in section B-B' (Figure 11) consists of two weakly developed soil profiles composed of silty sand to silty sand with clay with interbedded gravels that consist of sub angular to sub rounded fragments of slate. We interpret this unit as late Holocene age alluvial deposits (sheet flows), and designate it as Qal1. An approximately 7 to 8 foot layer of artificial fill overlies this unit across the entire study area. Unit Qal1 includes both a surficial soil with a basal scour deposit and a weakly-developed and truncated buried soil for each sheet flow within this alluvial deposit.

Holocene Alluvial Fan Deposit 2 (Qal2)

The lowest Holocene unit in section B-B' (Figure 11) is composed of sandy clay to clayey sand with basal gravels. The unit is generally massive with fine to medium grained sand and sub rounded fragments of slate. Soil color hues are in the 7.5YR range (brown). We interpret this unit as a latest Pleistocene alluvial deposit (axial valley deposit), but conservatively designate it as Qal2. A scour deposit overlies and truncates this unit across the entire study area. Qal2 includes alluvial deposits with a diffuse (cumulic), and weakly- to moderately well-developed argillic soil.

Pleistocene Alluvial Fan Deposit 3 (Qoa 1)

The interpreted uppermost Pleistocene unit in section B-B' (Figure 11) is an organic-rich top soil remnant over a gravelly clayey sand to sandy clay. Gravels are sub angular and highly weathered fragments of slate. Illuvial clay film hues are in the 5YR range (reddish brown). We interpret this unit as a Pleistocene alluvial fan deposit (debris flow), and designate it as Qoa1. A scour deposit overlies this unit across the entire study area. Unit Qoa1 includes alluvial deposits that contain a well-developed, well oxidized, and truncated argillic soil. The contact between Qal2 and Qoa1 occurs at a depth of approximately 25 feet across the entire study area (See Appendix B; Continuous Core Photographic Detail).

Pleistocene Alluvial Fan Deposit 4 (Qoa 2)

Beneath unit Qoa1, we encountered a unit composed of silty sand with gravel to sandy clay. The interbedded gravels within this unit are composed of rounded slate and sandstone. Illuvial clay film hues are in the 7.5YR range (brown). This unit is interpreted as a highly weathered late Pleistocene braided stream channel deposit that contains two highly truncated, moderately well-developed soil remnants designated as unit Qoa2. The contact between Qoa1 and Qoa2 is at approximately 32 feet across the entire study area (See Appendix B; Continuous Core Photographic Detail). The Qoa2 basal scour is incised across the center portion of Transect B where the underlying unit Qoa3 has been eroded.

Pleistocene Alluvial Fan Deposit 5 (Qoa 3)

Beneath unit Qoa2, we encountered a unit composed of sandy clay to silty sand with interbedded gravel that is composed of highly weathered and sub rounded to sub angular slate and sandstone. Soil color clay film hues are in the 7.5YR range (brown). This unit is interpreted as a strongly weathered late Pleistocene braided stream channel deposit that contains a truncated, stacked, and well developed soil remnant designated as Qoa3. Unit Qoa3 is the oldest unit encountered during the subsurface exploration. The contact between Qoa2 and Qoa3 occurs at a depth of approximately 42 feet across the entire study area (See Appendix B; Continuous Core Photographic Detail).

Soil Development/Soil Profiles

The borings (see Figures 11, 12, and Appendix A) are located on a graded (or stripped) and artificially filled surface that is geomorphically inactive. The soil profile in each boring at depth consists of a truncated sequence of multiple stacked and truncated soils (Qoa1, Qoa2, and Qoa3). The entire section in this locality is capped by 6 to 7 feet of artificial fill. Parent materials for these soils originate north of the site in the Santa Monica mountains and primarily consist of slate-rich debris flow and or stream terrace deposits that have emanated from drainages to the north of the site (primarily Benedict and

Coldwater Canyons) With the exception of boring 3 (Figure 11), the soil profiles contain a surface deposit that overlies 4 buried soils to depths of approximately 50 feet below the ground surface. This stratigraphic section occurs across the entire area investigated. The individual soil profiles and relative age estimates are summarized below.

The uppermost soils on site (Qal1) consists of a pair of highly truncated soil remnants that consists of two weakly developed cambic diagnostic subsurface horizon (Bw – BC – 2Bw). The deposit consists of two nested crudely stratified fining upwards sequences. This soil unit is characterized by a coarse-grained deposit with few to common clay stains on ped faces and has an estimated relative age of 4 - 8 ka (Appendix B).

The uppermost Pleistocene soil on site (Qal2) is a diffuse and cumulic soil remnant that consists of a thick and weakly developed argillic diagnostic subsurface horizon (3Bt – 3BC). The deposit consists of a crudely stratified fining upwards to massive deposit. This soil unit is characterized by basal gravel and fine-grained deposit with 7.5YR hues and common thin clay films on ped faces and coating gravel. Qal2 has an estimated relative age of 8 – 16 ka (Appendix B).

A conservative pick for the top of Pleistocene soil Qoa1 is the remnant of a strongly developed Alfisol soil. This is a truncated soil that consists of a relic top soil horizon over two moderately well-developed argillic diagnostic subsurface horizons (4ABb - 4Bt1 – 4Bt2). The deposit is a fining upwards sequence and most likely represents the distal portion of a debris flow deposit. This soil unit is characterized by a highly weathered, well oxidized, and gravel-rich and fine-grained deposit with 5 YR hues on common thin and common moderately thick clay films on ped faces and coating gravel. This soil unit has a relative age estimate of 21 - 46 ka (Appendix B).

The third buried soil profile on site (Qoa2) is a truncated and older cumulic soil remnant that consists of a thick and moderately well-developed argillic soil profile (5Btb – 5BC). The deposit consists of a crudely stratified fining upwards sequence. This soil profile is characterized by a fine-grained deposit with 7.5YR hues on common thin and few to common moderately thick clay films on ped faces. This deposit locally scours out the underlying unit Qoa3 across the center portion of Transect B and has an estimated relative age of 29 – 59 ka (Appendix B).

The oldest and lowest buried soil profile on site (Qoa3) is a truncated and stacked soil remnant that consists of two moderately well-developed punctuated argillic soil profiles (5Btb – 5BC - 6Bt – 6BC). The deposit consists of two crudely stratified fining upwards sequences. This soil unit is characterized by a stratified deposit with 7.5 to 10YR hues on common thin and few to common moderately thick clay films. Qoa3 and the entire stratigraphic section under study has an estimated relative age of 46 – 94 ka (Appendix B).

In sum, the entire stratigraphic sequence examined at the project site is estimated to be greater than 46 ka in age. The stratigraphic units encountered provide visually and texturally distinct, mappable contacts that are overlapping across the project site area and across the transect of borings. No features or structural characteristic of faulting, such as shear zones or high angle contacts between units were observed. The contacts between Qoa2 and Qoa3 undulate and slope gently south as expected by normal sedimentary processes.

EVIDENCE FOR THE ABSENCE OF FAULTING

Several subsurface geologic relationships at the 461 N. Beverly Drive provide direct evidence that preclude Holocene faulting. When these relationships are considered together, there is compelling evidence for the absence of faulting beneath the subject site. The primary lines of evidence that support the interpretation that no faults traverse the site are:

• **Continuous, unfaulted soil horizons and primary stratigraphy across the site:** The transects of borings and CPTs conducted to the east and west of the subject site exhibits multiple continuous and unbroken stratigraphic horizons. All deposits encountered correlate across the project site. If faults with a vertical slip component of slip were active in this area, they would have produced recognizable, vertical separations or displacements of the Pleistocene units. Similarly, active strike-slip faulting would have produced an apparent dip-slip component or truncation of units due to the juxtaposition of different Pleistocene strata or pedogenic horizons.

• **No faults were encountered in the subsurface exploration:** No features characteristic of faulting, such as shear zones or high angle contacts between units were observed within the collected continuously cored samples. Though not compelling enough to preclude the presence of faulting, it is consistent with and corroborates other lines of evidence.

• **No irregularities or topographic features indicative of faulting were observed:** Geomorphically, the project site exists on an incised and degraded Holocene-aged alluvial fan deposit. Mapping by Campbell at al., (2014), Yerkes and Campbell (2005), Dibblee and Ehrenspeck (1991) and Hoots and Kew (1931) confirm this and is further supported by the findings of this report. Moreover, the site lies north of the eastward projection of the existing Santa Monica Fault Zone, and no escarpments are apparent on historic topographic maps.
• **Supporting evidence from the neighboring investigation:** The data collected and conclusions reached within the approved accompanying report reinforce the conclusions and overall findings of this report (FGC, 2018).

CONCLUSIONS AND RECOMMENDATIONS

The fault investigation for 461 N. Beverly Drive documents continuous unbroken, pre-Holocene sediments across the entire site. The observed continuous and un-broken stratigraphy implies that no active faults traverse the site. The project site is not exposed to the hazard of surface fault rupture which would impact or limit future development of the site.

While the area explored in our study is not likely subject to surface faulting, a future earthquake on the Santa Monica Boulevard, Santa Monica, Hollywood, or Newport - Inglewood fault zones will likely produce very strong, near-field ground motions at the project site that must be assessed by an appropriate geotechnical evaluation of the site.

LIMITATIONS

The conclusions and recommendations presented herein are the results of an inherently limited scope. Specifically, the scope of services consisted of an assessment of whether or not active faults are present within the area explored at the site. The conclusions and recommendations contained in this report are professional opinions derived in accordance with current standards of professional practice. No warranty is expressed or implied.

This report has been prepared for the exclusive use of 461 N. Beverly Drive LLC and applies only to potential future development at the site located at 461 N. Beverly Drive in the City of Beverly Hills, California. In the event that significant changes in the development planning should occur, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed by Feffer Geological, and the conclusions and recommendations of this report are verified in writing.

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Figures

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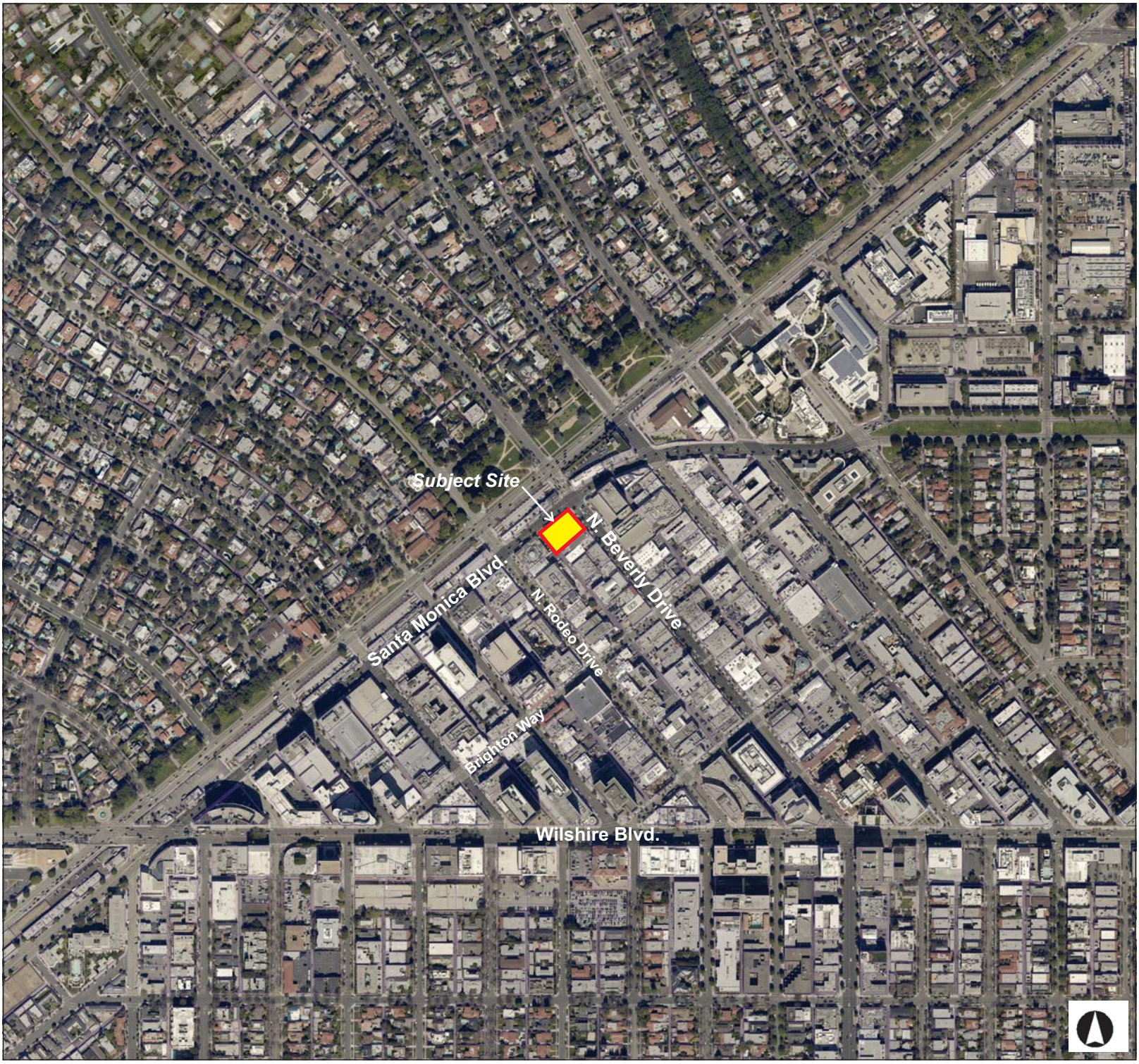
Tables

461 N. Beverly Drive



This map is for reference only and should not be used for legal decisions. While the County of Los Angeles makes its best effort to ensure data is accurate, the County makes no representation or warranty of any kind.



FEFFER GEOLOGICAL CONSULTING

0.3 0 0.14 0.3 Miles

Figure 1

Site Location Map

Modified From The LACounty.gov GIS Viewer

Figure 2

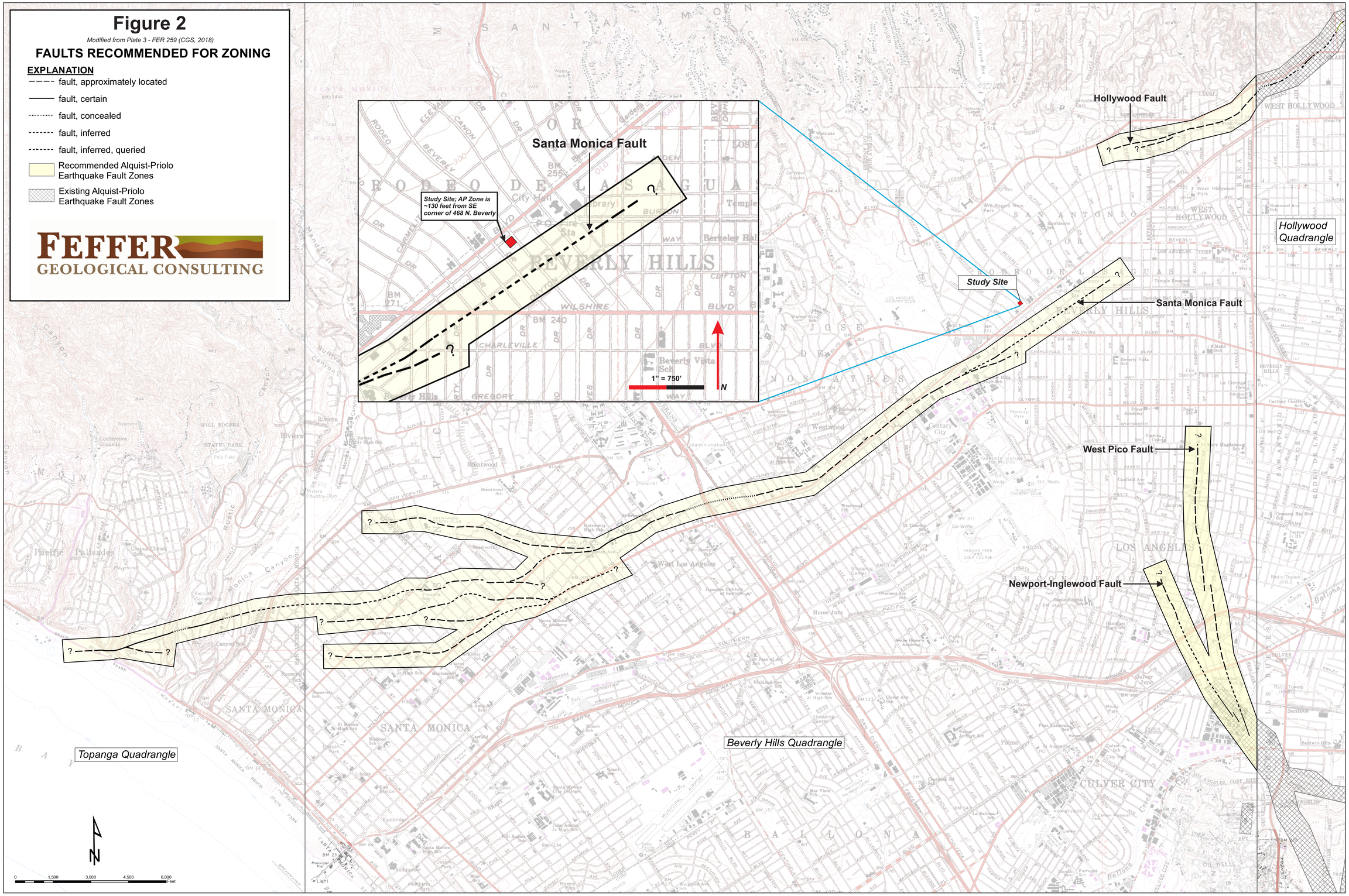
Modified from Plate 3 - FER 259 (CGS, 2018)

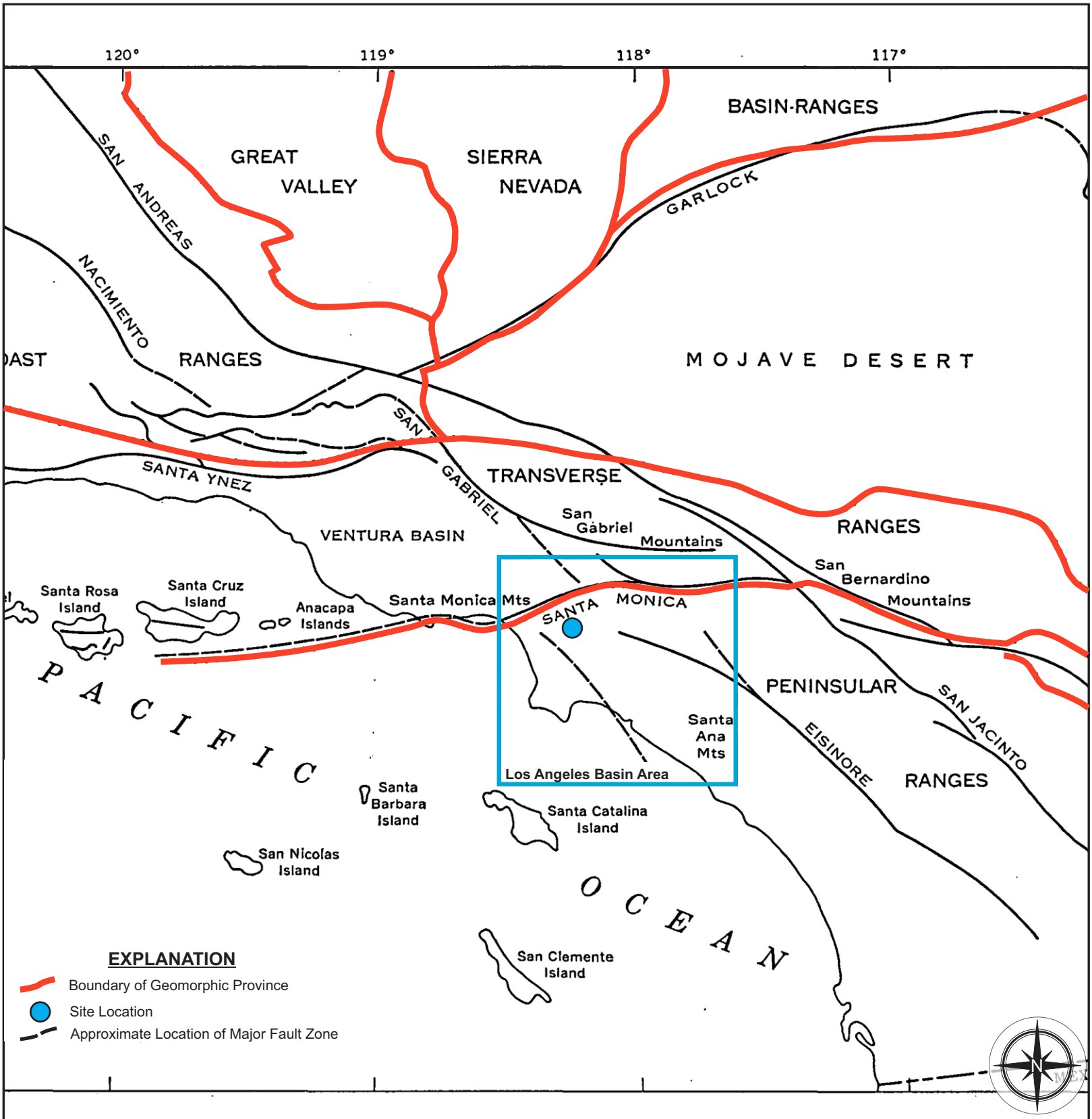
FAULTS RECOMMENDED FOR ZONING

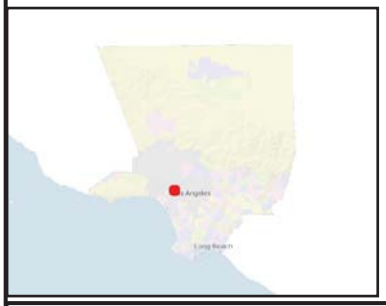
EXPLANATION

- fault, approximately located
- fault, certain
- fault, concealed
- fault, inferred
- fault, inferred, queried
- Recommended Alquist-Priolo Earthquake Fault Zones
- Existing Alquist-Priolo Earthquake Fault Zones

FEFFER GEOLOGICAL CONSULTING







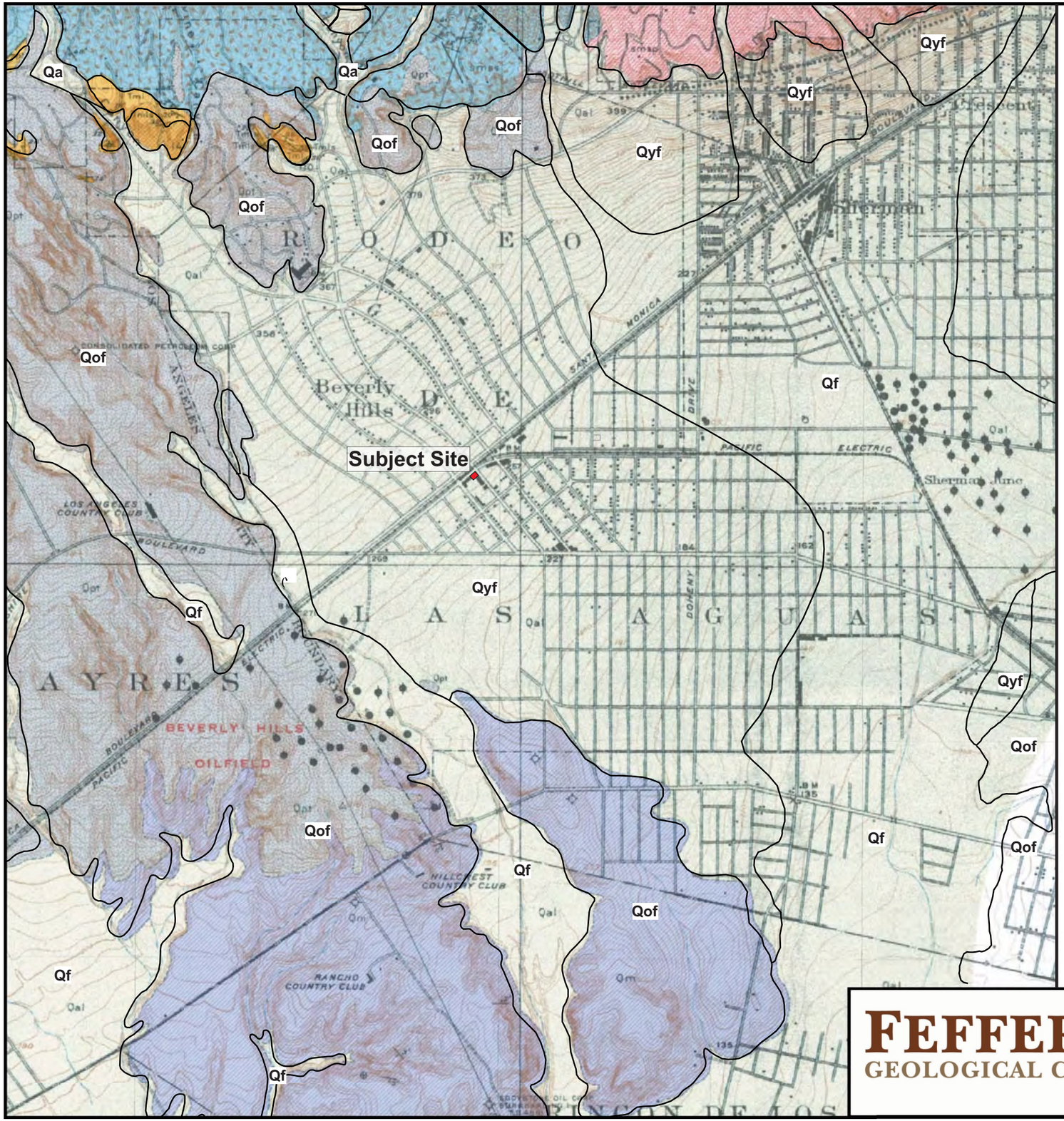
FEFFER GEOLOGICAL CONSULTING

MILES
0 40 80

Figure 3

Regional Geomorphic Province Map

Modified from Yerkes et al., (1965)



EXPLANATION

Geomorphic surfaces which include active channels (Qa), active alluvial fan deposits (Qf), young alluvial fan deposits (Qyf), and old alluvial fan deposits (Qof). (Yerkes and Campbell, 2005)

Sedimentary Deposits

Qal — Alluvium: Coarse unconsolidated deposits in valleys and stream channels (Holocene)

Qpt — Alluvial plain, stream, and marine terrace deposits (Upper Pleistocene)

Sedimentary Rocks

Qm — Marine deposits: Marine sandstone, conglomerate, and clay shale (Upper Pleistocene).

Tml — Modelo Formation: Marine; lower member; consisting of interbedded, hard, platy siliceous shale and softer brown shale (Miocene).

Tmls — Modelo Formation: Marine; lower member; consisting of lenticular beds of coarse grained sandstone (Miocene).

Metamorphic Rocks

smss — Santa Monica Slate: Dark gray to blue-black slate (Triassic).

smsp — Santa Monica Slate: Dark gray mica schist and phyllite cut by white quartz veins (Triassic).

Igneous Rocks

g — Granite and granodorite (Jurrasic).

N

2000 1000 0 2000 4000

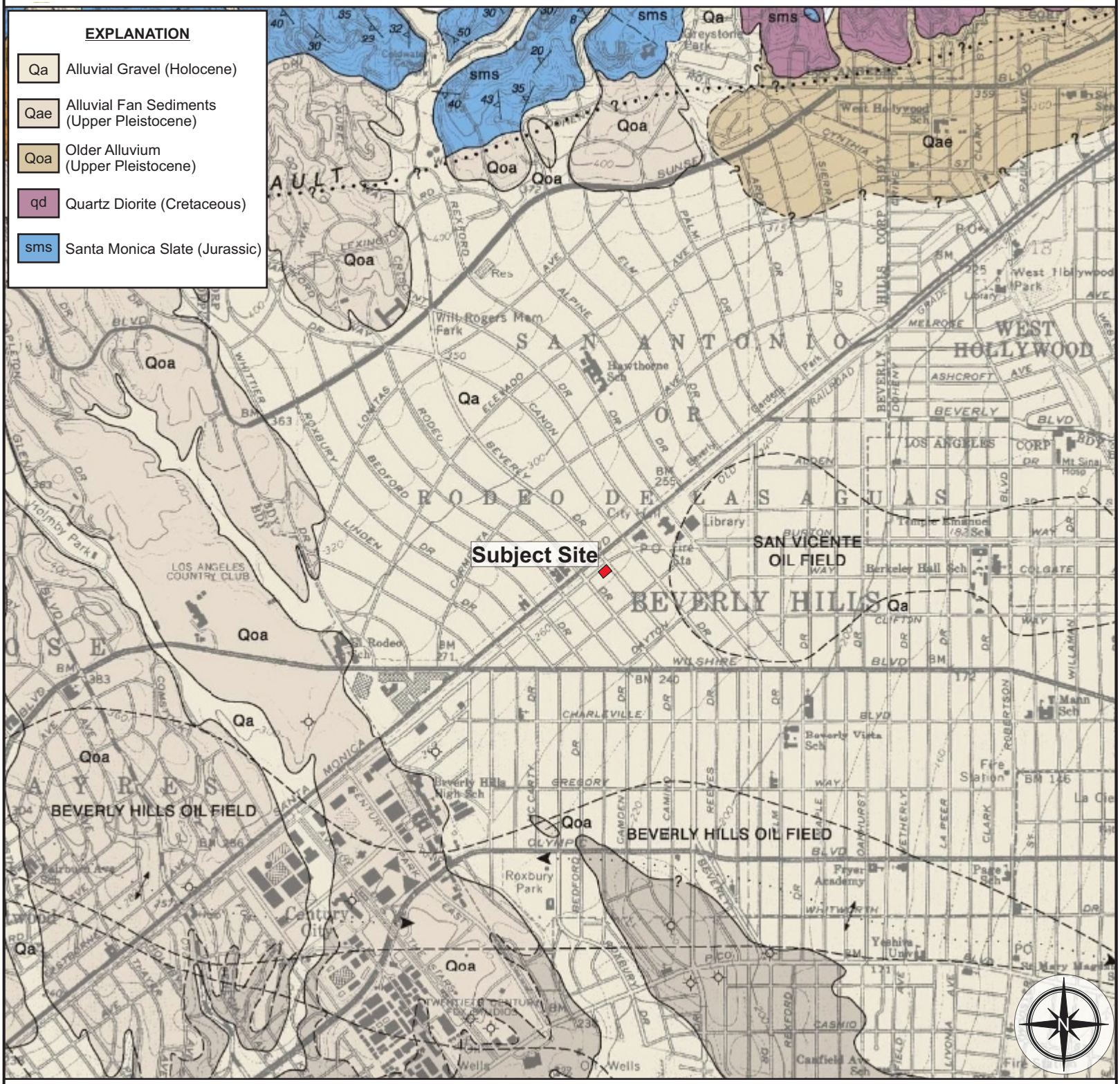
FEET

Modified from Hoots and Kew (1931) and Yerkes and Campbell (2005)
Contour Interval: 25 and 5 feet

FEFFER GEOLOGICAL CONSULTING

Figure 4
Regional Geologic Map

Modified from Earth Consultants International (2018)





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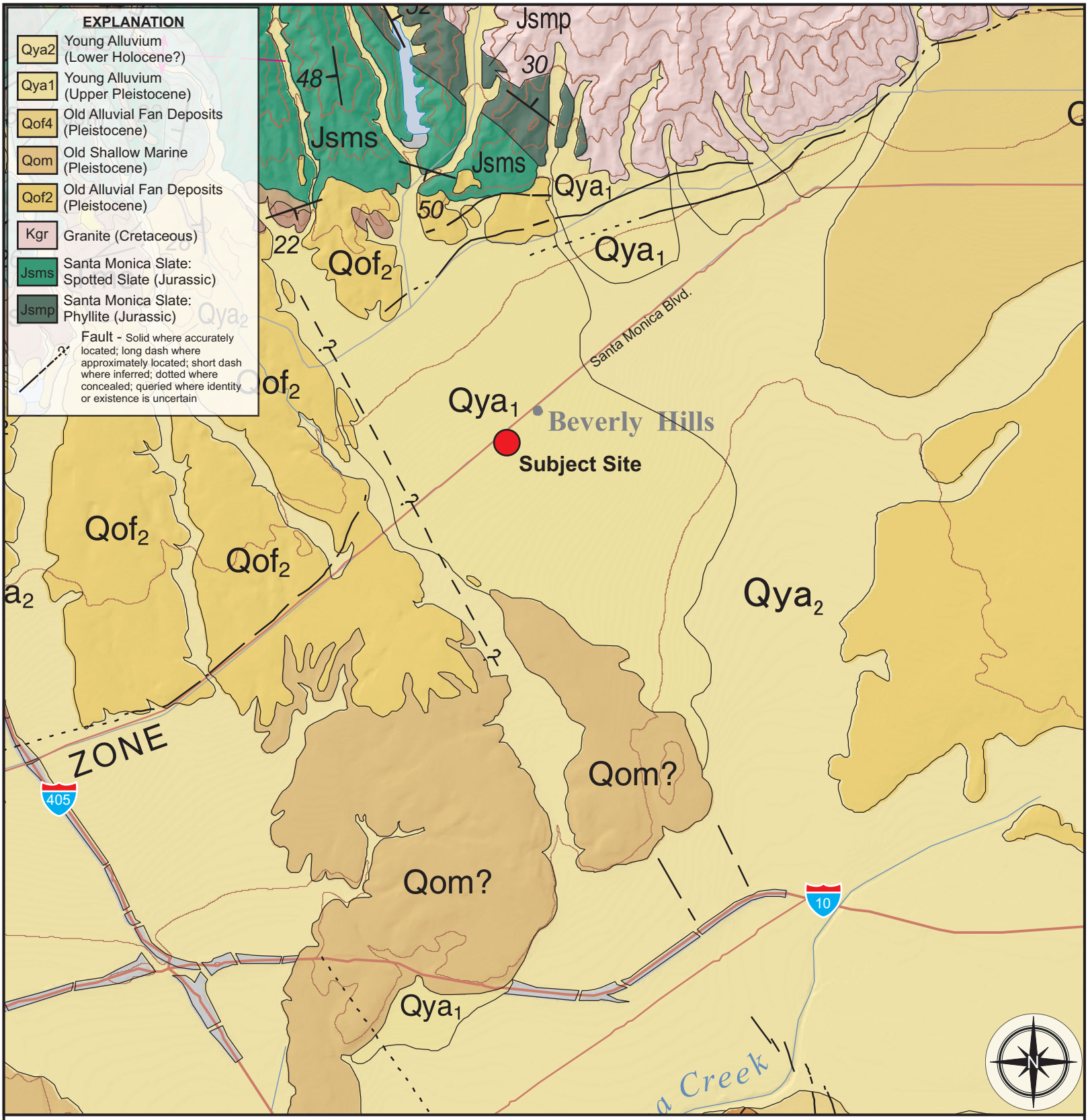
MILES
0 0.5 1

SCALE 1:24000

Figure 5

Regional Geologic Map

Modified from Dibblee & Ehrenspeck (1991)





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MILES
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SCALE 1:100,000

Figure 6

Regional Geologic Map

Modified from Campbell et. al., (2014)

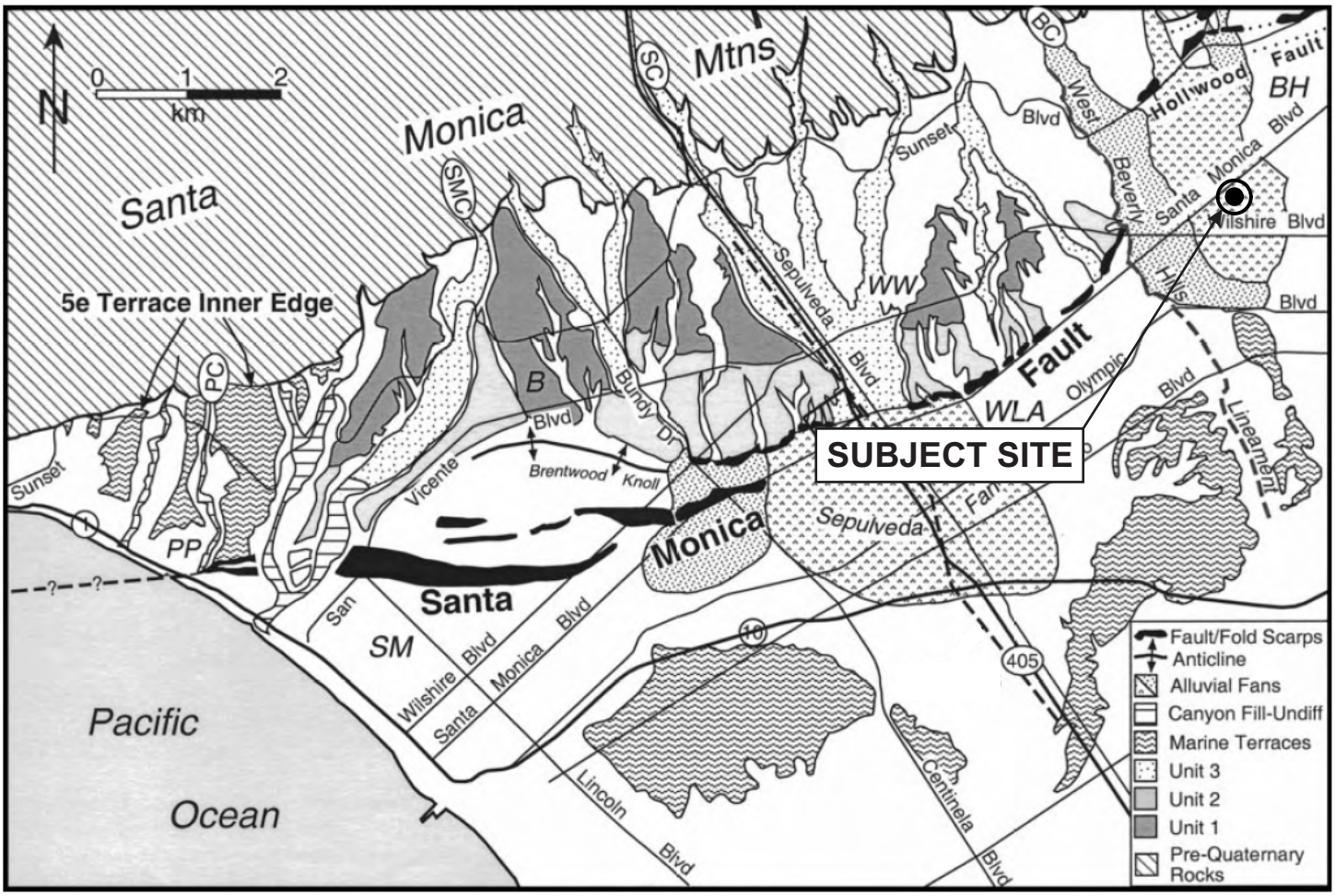

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Figure 7

Regional Fault Scarp Map

Modified from Prat et al., (1998)

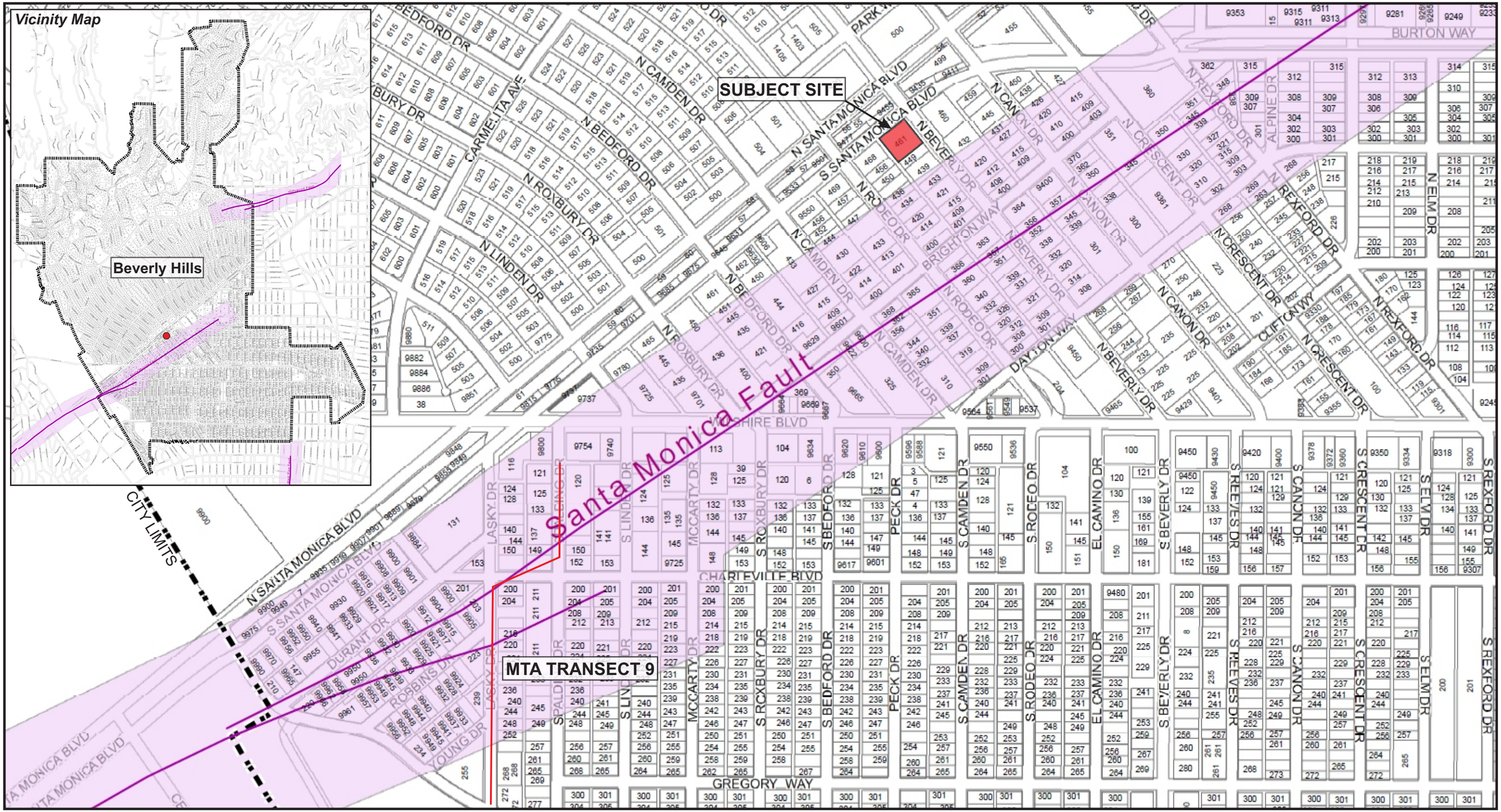

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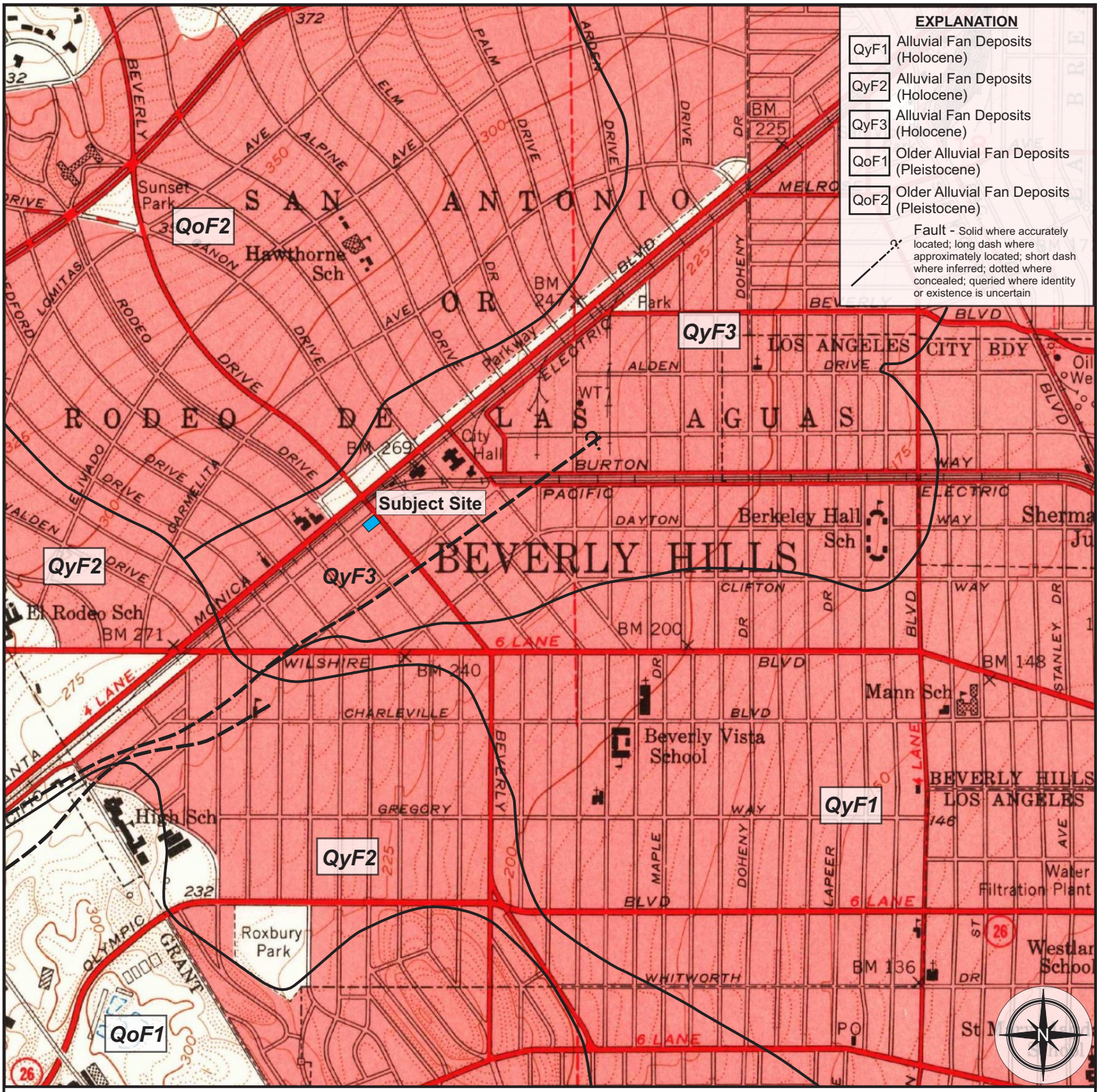
Figure 8

Beverly Hills Fault Map

Modified from the City of Beverly Hills "Final Earthquake Fault Zone January 2018" (2018)

250 125 0 250 750
FEET





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MILES
0 0.5 1

SCALE 1:24000

Figure 9

Site Topographic and Quaternary Geologic Map

Modified from the LACounty.gov GIS Viewer (2018) and USGS (1950)

ALTA/NSPS LAND TITLE SURVEY

461 N. BEVERLY DRIVE,
BEVERLY HILLS, CA

Figure 10

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SITE MAP

JB: 2196-85 NAME:461 N. BEVERLY DRIVE LLC BY: AG

DATE: 9/20/18 SCALE: 1"=20' SITE: 461 N. BEVERLY DRIVE

REF: BASE MAP FROM SURVEY

EXPLANATION

- B-5 — CONTINUOUS BORING LOCATION
- FGB-2 & FGCB-2 — CONTINUOUS BORING AT 468 N. RODEO (FEFFER GEOLOGICAL, 2018)
- CPT-7 & C-7 — CPT SOUNDING AT 468 N. RODEO (FEFFER GEOLOGICAL, 2018)
- A — A' — CROSS SECTION LINE FROM 468 N. RODEO (FEFFER GEOLOGICAL, 2018)
- B — B' — CROSS SECTION LINE
- LIMITS OF EXPLORATION PARALLEL TO STRIKE OF FAULT
- Af ARTIFICIAL FILL
- Qal HOLOCENE AGED ALLUVIUM
- Qoa PLEISTOCENE AGED ALLUVIUM

BASIS OF BEARINGS:

THE BEARING OF NORTH 39°31'30" WEST ALONG THE CENTERLINE OF RODEO DRIVE PER PWFB 1316/1201-1202, IN THE CITY OF BEVERLY HILLS, COUNTY OF LOS ANGELES, STATE OF CALIFORNIA, WAS USED AS THE BASIS OF BEARINGS FOR THIS SURVEY.

SITE RESTRICTIONS:

PENDING ZONING REPORT OR LETTER)

LEGEND:

E – EAST
FD – FOUND
FSC – FIRE SERVICE CONNECTION
LS – LICENSED SURVEYOR
N – NORTH
OH – OVERHANG
PL – PROPERTY LINE
S – SOUTH
S&W – SPIKE AND WASHER
ST – STAIRS
W – WEST
(R1) – RECORD DATA PER BEVERLY, M.B. 11/94
(R2) – RECORD DATA PER PWFB 1316/1201-1202
(R3) – RECORD DATA PER LEGAL DESCRIPTION

LINE AND CURVE DATA:

1. N50°30'50"E 40.11'
2. N39°29'10"E 5.00' (N39°30'27"E R3)
3. Δ = 50°37'28" R = 10.00' L = 8.84'

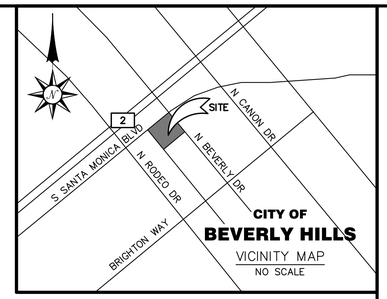
20' 0' 20' 40'

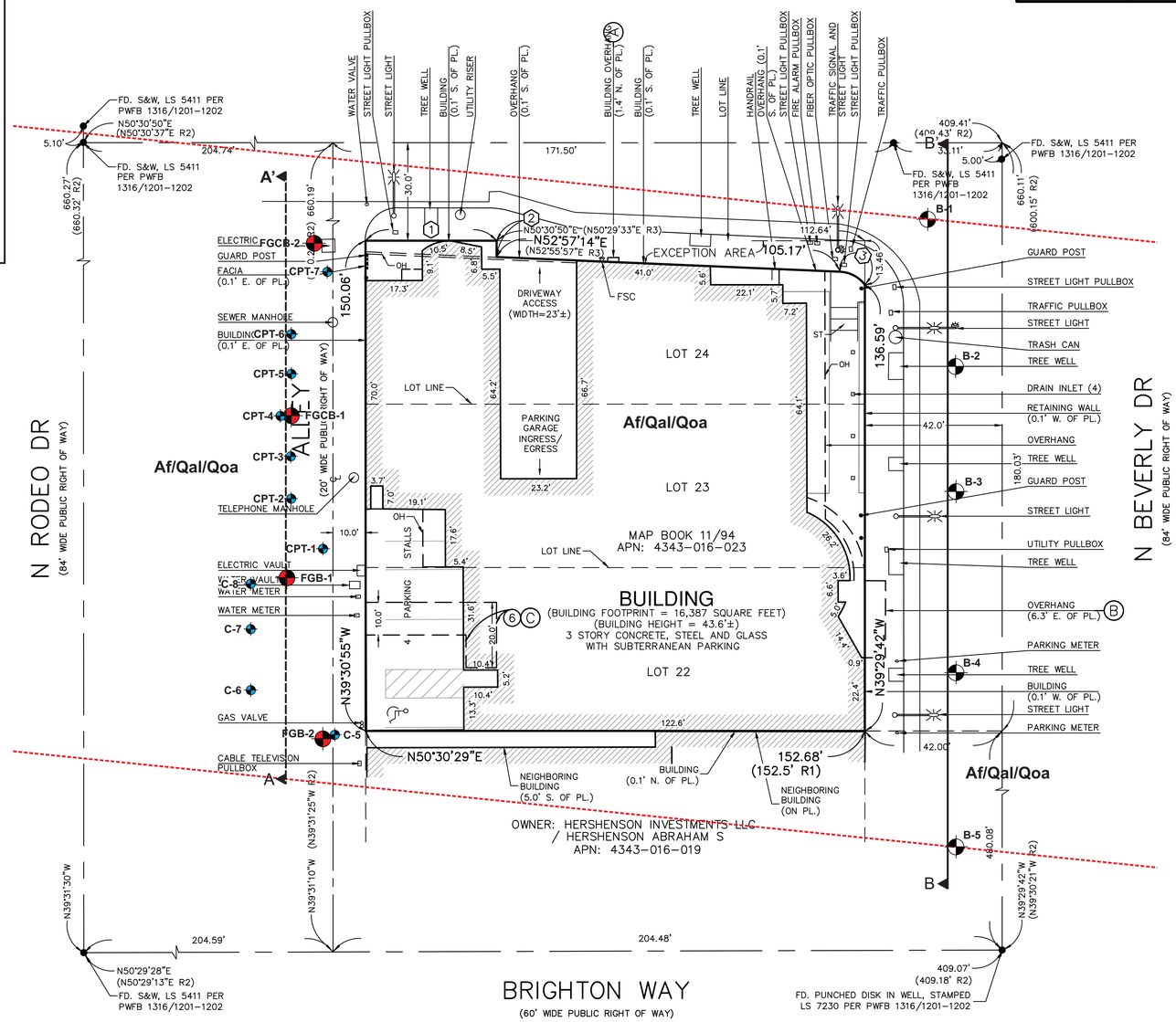
SCALE: 1" = 20'

LAND AREA:

22,074 SQUARE FEET
0.51 ACRES

PARKING SPACE TABLE	
TYPE OF SPACE	TOTAL EXISTING
STANDARD	4
STANDARD GARAGE	43
HANDICAP	1
HANDICAP GARAGE	2
TOTAL	50





UTILITY NOTE:

NOTE TO THE CLIENT, INSURER, AND LENDER – WITH REGARD TO TABLE A, ITEM 11, SOURCE INFORMATION FROM PLANS AND MARKINGS HAVE BEEN COMBINED WITH OBSERVED EVIDENCE OF UTILITIES PURSUANT TO SECTION 5.E.IV. TO DEVELOP A VIEW OF THE UNDERGROUND UTILITIES. HOWEVER, LACKING EXCAVATION, THE EXACT LOCATION OF UNDERGROUND FEATURES CANNOT BE ACCURATELY, COMPLETELY, AND RELIABLY DEPICTED. IN ADDITION, IN SOME JURISDICTIONS, 811 OR OTHER SIMILAR UTILITY LOCATE REQUESTS FROM SURVEYORS MAY BE IGNORED OR RESULT IN AN INCOMPLETE RESPONSE. WHERE ADDITIONAL OR MORE DETAILED INFORMATION IS REQUIRED, THE CLIENT IS ADVISED THAT EXCAVATION AND/OR A PRIVATE UTILITY LOCATE REQUEST MAY BE NECESSARY. CONTRACTORS MUST VERIFY LOCATIONS PRIOR TO DIGGING.

STATEMENT OF POSSIBLE ENCROACHMENTS:

NOTE: THE FOLLOWING IS A LISTING OF OBSERVED IMPROVEMENTS THAT CROSS PROPERTY LINES, STATEMENT OF OWNERSHIP OR POSSESSION IS NEITHER IMPLIED NOR THE INTENT OF THIS LISTING.

(A) BUILDING OVERHANG LIES 1.4' NORTHERLY OF PROPERTY LINE.

(B) BUILDING OVERHANG LIES 6.3' EASTERLY OF PROPERTY LINE.

(C) BUILDING LIES 10.1' WESTERLY OVER ITEM 6. IT APPEARS FROM DOCUMENT THAT IMPROVING OVER SAID ITEM 6 IS ACCEPTABLE.

LEGAL DESCRIPTION:

THE LAND REFERRED TO IN THIS COMMITMENT IS SITUATED IN THE CITY OF BEVERLY HILLS, COUNTY OF LOS ANGELES, STATE OF CALIFORNIA, AND IS DESCRIBED AS FOLLOWS:

LOTS 22, 23 AND 24 IN BLOCK 2 OF BEVERLY, IN THE CITY OF BEVERLY HILLS, COUNTY OF LOS ANGELES, STATE OF CALIFORNIA, AS PER MAP RECORDED IN BOOK 11 PAGE 94 OF MAPS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY.

EXCEPT THAT PORTION OF LOT 24 IN BLOCK 2 OF BEVERLY, IN THE CITY OF BEVERLY HILLS, COUNTY OF LOS ANGELES, STATE OF CALIFORNIA, AS SHOWN ON MAP RECORDED IN BOOK 11 PAGE 94 OF MAPS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY, DESCRIBED AS FOLLOWS:

BEGINNING AT THE MOST NORTHERLY CORNER OF SAID LOT 24; THENCE SOUTH 50° 29' 33" WEST, ALONG THE NORTHWESTERLY LINE OF SAID LOT 24, A DISTANCE OF 112.64 FEET; THENCE SOUTH 39° 30' 27" EAST 5.00 FEET; THENCE NORTH 52° 55' 57" EAST 105.17 FEET TO THE BEGINNING OF A TANGENT CURVE CONCAVE SOUTHERLY AND HAVING A RADIUS OF 10.00 FEET; THENCE NORTHEASTERLY, ALONG SAID CURVE, AN ARC DISTANCE OF 8.84 FEET TO THE NORTHEASTERLY LINE OF SAID LOT 24; THENCE NORTH 39° 31' 30" WEST, ALONG SAID NORTHEASTERLY LINE, 13.47 FEET TO THE POINT OF BEGINNING AS PER DEED RECORDED OCTOBER 30, 1987 AS INSTRUMENT NO. 87-1734961 AND AS PER FINAL ORDER OF CONDEMNATION RECORDED JULY 21, 1989 AS INSTRUMENT NO. 89-1168212 OF OFFICIAL RECORDS.

APN: 4343-016-023

ITEMS CORRESPONDING TO SCHEDULE "B":

BY: FIRST AMERICAN TITLE INSURANCE COMPANY
3281 E GUASTI ROAD, SUITE 440
ONTARIO, CA 91761
(909)510-6225

COMMITMENT NO.: NCS-917096-ONT1
TITLE OFFICER: WENDY HAGEN BOWEN
DATED: JULY 09, 2018

THE FOLLOWING ITEMS WERE FOUND IN SAID COMMITMENT AND ARE REFERENCED ON THIS MAP. COVENANTS AND AGREEMENTS LISTED HEREON CONTAIN NUMEROUS ITEMS THAT AFFECT THE SUBJECT PROPERTY, CONTENTS SHOULD BE REVIEWED TO DISCERN SPECIFICS

(6) AN EASEMENT FOR PUBLIC UTILITIES AND INCIDENTAL PURPOSES, RECORDED JANUARY 26, 1979, AS INSTRUMENT NO. 79-116365 OF OFFICIAL RECORDS. **THIS ITEM AFFECTS THE SUBJECT PROPERTY AND IS PLOTTED HEREON.**

ITEMS #'S SHOWN HEREON ARE STATED AS EXCEPTIONS ON ABOVE REFERENCED COMMITMENT. NO RESPONSIBILITY FOR THE COMPLETENESS, ACCURACY, OR CONTENT OF SAID REPORT IS ASSUMED BY THIS MAP.

FLOOD NOTE:

ZONE – "X" PER FEDERAL EMERGENCY MANAGEMENT AGENCY MAP NO. 06037C1585F EFFECTIVE SEPTEMBER 26, 2008.

ZONE "X" DENOTES AREAS SUBJECT TO MINIMAL FLOODING

THE ABOVE STATEMENT IS FOR INFORMATION ONLY AND THIS SURVEYOR ASSUMES NO LIABILITY FOR THE CORRECTNESS OF THE CITED MAP(S). IN ADDITION, THE ABOVE STATEMENT DOES NOT REPRESENT THIS SURVEYOR'S OPINION OF THE PROBABILITY OF FLOODING.

SURVEYOR'S CERTIFICATE:

TO: 461 N BEVERLY DRIVE, LLC, AND FIRST AMERICAN TITLE INSURANCE COMPANY

THIS IS TO CERTIFY THAT THIS MAP OR PLAT AND THE SURVEY ON WHICH IT IS BASED WERE MADE IN ACCORDANCE WITH THE 2016 MINIMUM STANDARD DETAIL REQUIREMENTS FOR ALTA/NSPS LAND TITLE SURVEYS, JOINTLY ESTABLISHED AND ADOPTED BY ALTA AND NSPS, AND INCLUDES ITEMS 2, 3, 4, 7(A), 7(B1), 7(C), 8, 9, 11, 13, 14, 16, 17 AND 20 OF TABLE A THEREOF. THE FIELD WORK WAS COMPLETED ON 8/9/18.

DATE OF PLAT OR MAP: 8/13/18

JEFFERY L. MAYS L.S. NO. 6379

PROFESSIONAL LAND SURVEYOR ★ JEFFERY L. MAYS ★ No. 6379 ★ STATE OF CALIFORNIA

REVISIONS

JRN CIVIL ENGINEERS
SAN CLEMENTE, CALIFORNIA 92672
232 AVENIDA FABRICANTE, STE. 107
PHONE (949) 248-4685
FAX (949) 248-4687
PROJECT COORDINATOR: TRAVIS EDWARDS (TEDWARDS@JRNCIVIL.COM)

ALTA/NSPS LAND TITLE SURVEY
ADDRESS: 461 N. BEVERLY DRIVE, BEVERLY HILLS, CA
CLIENT: MORGAN, LEWIS & BOCKIUS LLP-LA

SCALE: 1" = 20'
DATE: 8/13/18
DRAWN BY: TVE
CHKD. BY: JRN

SHEET 1 OF 1
FILE NO. 17680

FEFFER GEOLOGICAL CONSULTING

CROSS SECTION B-B'

JB: 2196-85 NAME: BY: AG

DATE: 9/20/18 SCALE: 1"=10' SITE: 461 N. BEVERLY DRIVE

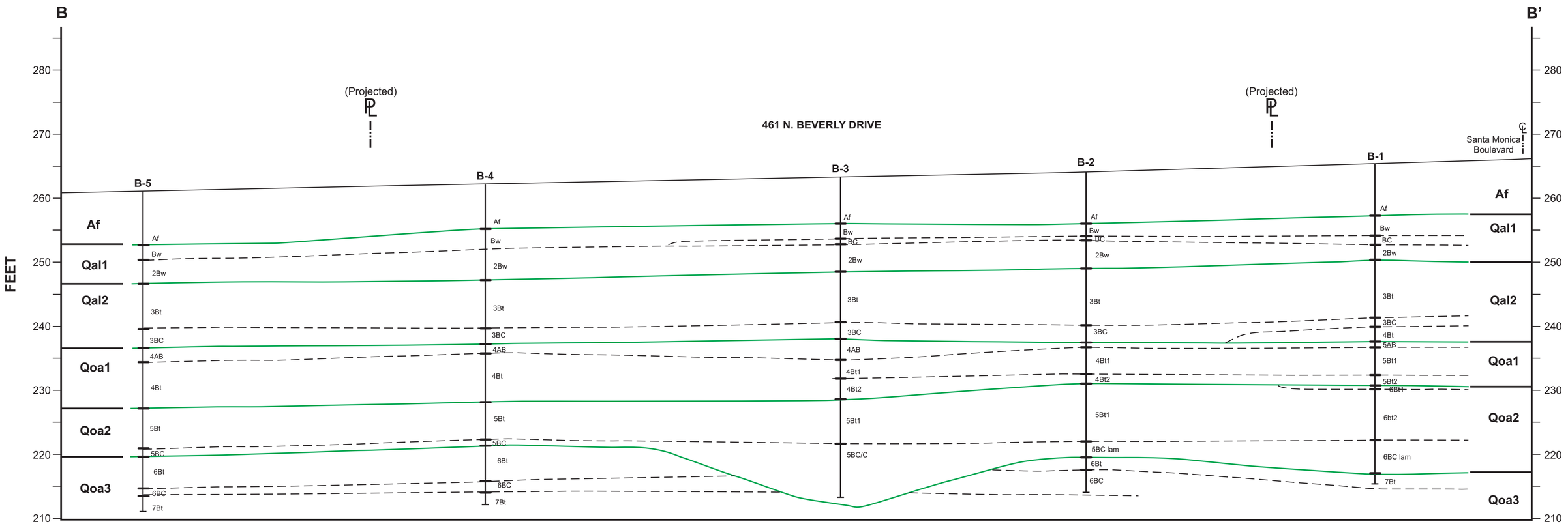
REF: TOPOGRAPHY FROM LA COUNTY GIS VIEWER

Figure 11

Soil Depth and Stratigraphic Correlation

EXPLANATION

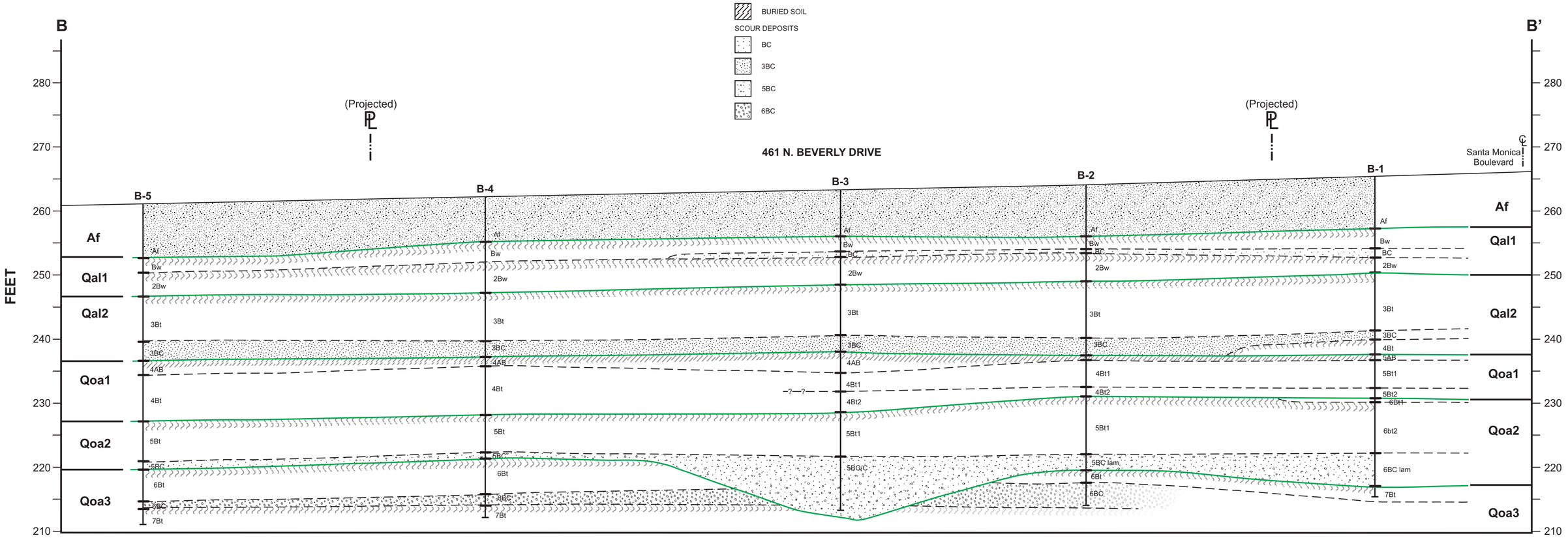
B-5 CONTINUOUS BORING LOCATION
Af ARTIFICIAL FILL
Qal HOLOCENE ALLUVIUM
Qoa PLEISTOCENE ALLUVIUM



Lithologic Section

EXPLANATION

TRUNCATED & BURIED SOIL
BURIED SOIL
SCOUR DEPOSITS
BC
3BC
5BC
6BC



FEFFER GEOLOGICAL CONSULTING

CROSS SECTION A-A'

JB: 2188-85 NAME: 468 N. RODEO DRIVE LLC. BY: AG

DATE: 8/20/18 SCALE: 1"=10' SITE: 468 N. RODEO DRIVE

REF: TOPOGRAPHY FROM LA COUNTY GIS VIEWER

EXPLANATION

- **CB-2** CONTINUOUS BORING LOCATION (468 N. RODEO DR.)
- **CPT-7** CPT SOUNDING LOCATION (468 N. Rodeo DR.)
- **B-2** CONTINUOUS BORING LOCATION (456 N. RODEO DR.)
- **C-8** CPT SOUNDING LOCATION (456 N. Rodeo DR.)
- **Af** ARTIFICIAL FILL
- **Qal** HOLOCENE ALLUVIUM
- **Qoa** PLEISTOCENE ALLUVIUM

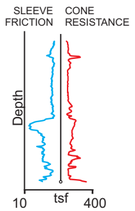


Figure 12

Soil Depth and Stratigraphic Correlation

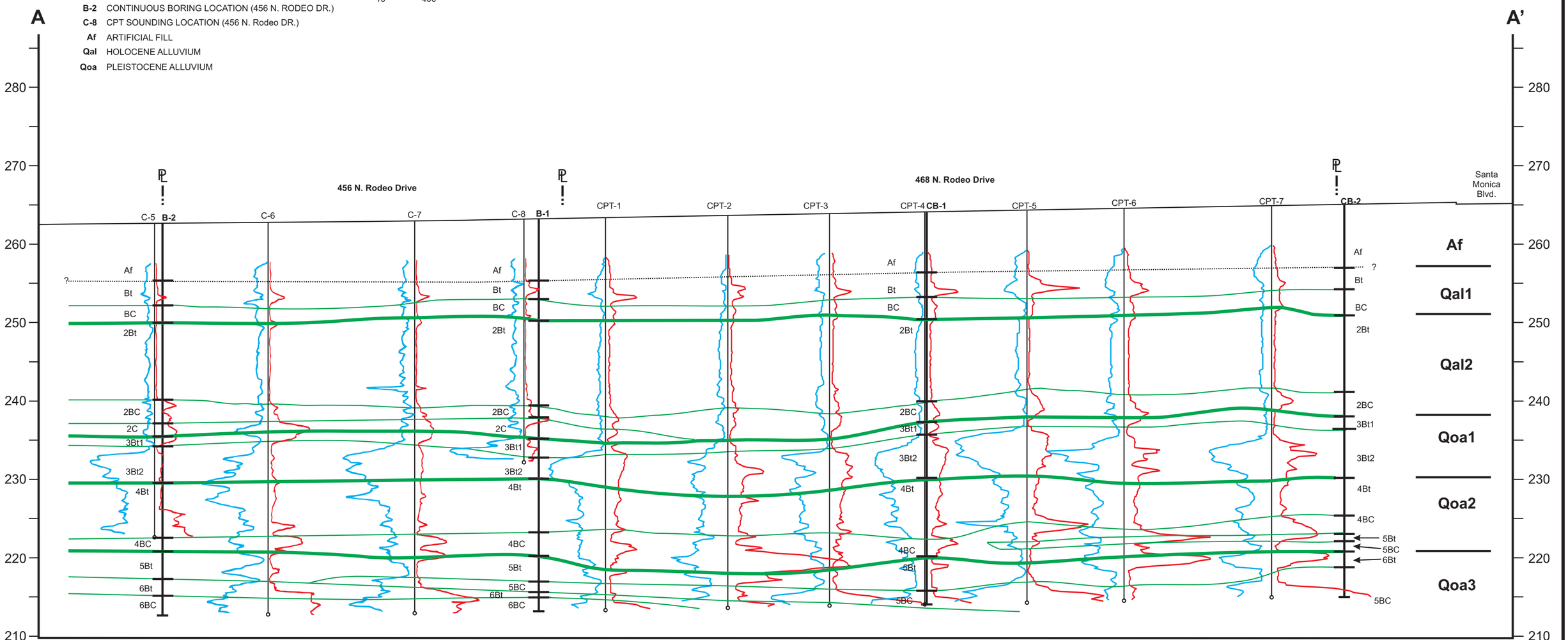


Table 1. Summary of Hollow Stem Auger Borings							
						Groundwater	
Boring No.	Boring Location (See Site Map)	Date Drilled	Total Depth (ft)	Boring G.S. Elevation (ft)	Boring Depth Elevation (ft)	Depth (ft)	Elevation (ft)
B-1	461 N. Beverly	8/27/2018	50	265.4	215.4	N.E.	--
B-2	461 N. Beverly	8/28/2018	50	264.1	214.1	N.E.	--
B-3	461 N. Beverly	8/28/2018	50	263.3	213.3	N.E.	--
B-4	461 N. Beverly	8/29/2018	50	262.3	212.3	N.E.	--
B-5	461 N. Beverly	8/29/2018	50	261.5	211.5	N.E.	--

Table 2. Summary of Hollow Stem Auger Borings (456 & 468 N. Rodeo Dr.)

						Groundwater	
Boring No.	Boring Location (See Site Map)	Date Drilled	Total Depth (ft)	Boring G.S. Elevation (ft)	Boring Depth Elevation (ft)	Depth (ft)	Elevation (ft)
CB-1	468 N. Rodeo	7/30/2018	50	264.5	214.5	N.E.	--
CB-2	468 N. Rodeo	7/31/2018	50	265.5	215.5	N.E.	--
B-1	456 N. Rodeo	7/11/2018	50	263.8	213.8	N.E.	--
B-2	456 N. Rodeo	7/11/2018	50	262.5	212.5	N.E.	--

Table 3. Summary of CPT Soundings (456 & 468 N. Rodeo Dr.)

						Groundwater	
CPT No.	Boring Location (See Site Map)	Date	Total Depth (ft)	Boring G.S. Elevation (ft)	Boring Depth Elevation (ft)	Depth (ft)	Elevation (ft)
CPT-1	468 N. Rodeo	7/31/2018	49.87	264	214.13	N.E.	--
CPT-2	468 N. Rodeo	7/30/2018	49.87	264.2	214.33	N.E.	--
CPT-3	468 N. Rodeo	7/31/2018	49.87	264.3	214.43	N.E.	--
CPT-4	468 N. Rodeo	7/31/2018	49.87	264.5	214.63	N.E.	--
CPT-5	468 N. Rodeo	7/31/2018	49.87	264.7	214.83	N.E.	--
CPT-6	468 N. Rodeo	7/31/2018	49.87	265	215.13	N.E.	--
CPT-7	468 N. Rodeo	7/30/2018	49.87	265.4	215.53	N.E.	--
C-5	456 N. Rodeo	7/12/2018	39.77	262.5	222.73	N.E.	--
C-6	456 N. Rodeo	7/11/2018	50.15	263	212.85	N.E.	--
C-7	456 N. Rodeo	7/11/2018	50.07	263.5	213.43	N.E.	--
C-8	456 N. Rodeo	7/12/2018	30.91	263.8	232.89	N.E.	--

APPENDIX 'A'

Boring Logs

LOG OF EXPLORATORY BORING

Job Number: 2196-85
Project: 461 N. Beverly Drive

Boring No: B-1
Boring Location: See Site Map

Date Performed: 8/27/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
0	1			**0-8’ Fill:** Silty sand with gravel (Upper 7’ hand augered due to utilities)	Red Brown	Friable, Hard	Af
5	2	3/3		**Holocene Alluvium (Qal 1)** **8-11’:** Silty sand, massive, slight organics, slightly sticky, non to slightly plastic, coarse grained, few fine gravels, common clay stains, slightly moist	10 YR 5/3 (Brown)	Sl. Hard, Friable	Bw
10	3	2.9 /5		**11-12.5’:** Silty sand with gravel, massive, slightly oxidized, non to slightly sticky, non plastic, medium to coarse grained sand with common fine and medium sandstone gravel	10 YR 6/3 (Pale Brown)	Soft, Friable	BC
				12.5-15’: Silty sand with clay, massive, slightly oxidized, slightly to moderately sticky, slightly plastic, medium grained, moderately well sorted, few thin clay films	10 YR 6/4 (Light Yellow Brown)	Hard, Friable	2Bw
15	4	4.8 /5		**Holocene Alluvium (Qal 2)** **15-18.6’:** Sandy clay/ clayey silt with sand, moist, moderately to very sticky, very plastic, fine to medium grained, common thin clay films, **18.6-19.8’:** Cumulic soil, fine gravels, slightly oxidized, few fine CaCO3 nodules	7.5 YR 5/3 (Lt. Brown to Brown)	Hard to Very Hard, Firm	3Bt Cumulic
20							

LOG OF EXPLORATORY BORING

Job Number: 2196-85
Project: 461 N. Beverly Drive

Boring No: B-1
Boring Location: See Site Map

Date Performed: 8/27/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
20				**15-24’:** Sandy clay/ clayey silt with sand, moist, moderately to very sticky, very plastic, fine to medium grained, common thin clay films	7.5 YR 5/3 (Lt. Brown to Brown)	Hard to Very Hard, Firm	3Bt
	5	4.6 /5					
				24-25.5’: Silty sand with gravel, slightly well oxidized, massive, slightly sticky, slightly plastic, coarse sand with scattered angular to sub rounded gravels	7.5 YR 5/4 (Brown)	Hard, Friable	3BC
25				**25.5-27.7’:** Clayey sand, fine to medium grained, slightly oxidized, scattered gravels	7.5 YR 4/4 (Brown)	Hard, Firm	4Bt
	6	4.2 /5		**Pleistocene Older Alluvium (Qoa 1)** **27.7-28.4’:** Clayey sand, fine to medium grained, moderately well oxidized, scattered angular gravels, slightly moist, common thin clay films	5 YR 4/3 (Reddish Brown)	Slightly Hard	5AB
				28.4-33’: Sandy clay, massive, very sticky, very plastic, coarse sand with abundant angular weathered slate fragments, oxidized, CaCO3 nodules, slightly moist, common thin and moderately thick clay films	5 YR 5/4 (Reddish Brown)	Very Hard, Friable	5Bt1
30	7	5/5		**33-34.3’:** Silty sand with clay and gravel, massive, slightly well oxidized, slightly sticky, slightly plastic, common fine and medium sub angular gravel, locally faint gleying, thin clay films	7.5 YR 5/4 (Brown)	Hard, Friable	5Bt2
				Pleistocene Older Alluvium (Qoa 2) **34.3-35’:** Clayey silt/sand, fewer gravels, fine to medium grained, oxidized, slightly moist, very sticky, very plastic, common thin and thick clay films	7.5 YR 4/4 (Brown)	Very Hard, Firm	6Bt1
35				**35-36.5’:** Clayey sand with abundant angular gravels, oxidized, slightly moist, medium to coarse grains, very sticky to very plastic, scattered angular to sub rounded gravels, mottling localized yellow to gray and brown, slightly moist	7.5 YR 4/4 (Brown)	Very Hard, Friable	6Bt2
	8	5/5					
40							

LOG OF EXPLORATORY BORING

Job Number: 2196-85
Project: 461 N. Beverly Drive

Boring No: B-1
Boring Location: See Site Map

Date Performed: 8/27/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
40				**35-43.1’:** Clayey sand with abundant angular gravels, oxidized, slightly moist, medium to coarse grains, very sticky to very plastic, scattered angular to sub rounded gravels, mottling localized yellow to gray and brown, slightly moist	7.5 YR 4/4 (Brown)	Very Hard, Friable	6Bt2
	9	5/5					
				43.1-48.4’: Silty sand with clay and gravel, coarse sand with gravles, angular to sub angular, oxidized, weakly stratified, slightly dry, granitic and slate gravels, slightly sticky, slightly plastic, crude laminations ~1’ thick spaced 1.5-2” apart	7.5 YR 5/4 (Brown)	Hard, Friable	6BC lam
45							
	10	4/5					
				Pleistocene Older Alluvium (Qoa 3) **48.4-49’:** Sandy clay with gravel, well oxidized, moist, very sticky, very plastic, medium grained, common moderately thick and thin clay films	5 YR 4/3 (Reddish Brown)	Very Hard, Dense	7Bt
50				End at 50, Fill to 7’, No Water, No Caving			
55							
60							

LOG OF EXPLORATORY BORING

Job Number: 2196-85
Project: 461 N. Beverly Drive

Boring No: B-2
Boring Location: See Site Map

Date Performed: 8/28/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
0	1			**0-7.8’:** Sandy silt with clay, few scattered pebbles, roots, slightly moist	Brown	Dense	Af
5	2	3.9 /5		**Holocene Alluvium (Qal 1)** **7.8-10’:** Silty sand with gravel, medium to coarse grained, slightly sticky, non plastic, massive, few clay stains, slightly oxidized	10YR 5/3 (Brown)	Slightly Hard	Bw
10				**10-10.5’:** Silty sand with gravel, coarse sand, common scattered gravels, sub angular to sub rounded, non sticky, non plastic	10 YR 6/3 (Pale Light Brown)	Soft, Very Friable	BC
	3	4.3 /5		**10.5-15’:** Silty sand, massive, slight organics, slightly sticky, slightly massive, few medium to coarse grained gravels, slightly moist, CaCO3, root casts, common clay stains	10 YR 5/3 (Brown)	Slightly Hard, Friable	2Bw
15	4	5/5		**Holocene Alluvium (Qal 2)** **15’:** Silty sand with clay, massive, scattered weathered sandstone and slate gravel, medium to coarse grained, slightly moist, slightly well oxidized, clay lenses, moderately sticky, moderately plastic, few to common thin clay films	10 YR 5/4 (Yellow Brown)	Hard, Very Hard, Friable	3Bt
20							

LOG OF EXPLORATORY BORING

Job Number: 2196-85
Project: 461 N. Beverly Drive

Boring No: B-2
Boring Location: See Site Map

Date Performed: 8/28/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
20				**Holocene Alluvium (Qal 2)** **15-24’:** Silty sand with clay, massive, scattered weathered sandstone and slate gravel, medium to coarse grained, slightly moist, slightly well oxidized, clay lenses, moderately sticky, moderately plastic, few to common thin clay films **22.4’:** Becomes coarse sand with clay, scattered angular slate gravels, slightly moist	10 YR 5/4 (Yellow Brown)	Hard, Very Hard, Friable	3Bt
	5	4.3 /5		**24-26.6’:** Silty sand, massive, non to slightly sticky, non plastic, medium to coarse sand with rounded, to sub angular gravels and pebbles, oxidized, fining upward, poorly sorted	10 YR 5/6 (Yellow Brown)	Slightly Hard to Soft, Friable	3BC/C Scour
25				**Pleistocene Older Alluvium (Qoa 1)** **26.6-27’:** Sandy clay with silt, medium sand, very plastic, massive, very sticky, moderately well oxidized	5 YR 4/3 (Reddish Brown)	Hard to Very Hard, Firm	4AB
	6	3.4 /5		**27-31.2’:** Sandy clay, massive, very sticky, very plastic, common fine to moderately thick clay films, coarse sand with few gravels, CaCO3	5 YR 5/4 (Reddish Brown)	Friable, Very Hard	4Bt
30				**31.2-32.7’:** Silty sand with clay, coarse sand with clay, few slate gravels, slightly sticky, slightly plastic, common fine clay films	5 Yr 4/4 (Mottled Gray, Brown)	Friable, Slightly Hard	4Bt2
	7	4.9 /5		**Pleistocene Older Alluvium (Qoa 2)** **32.7’:** Clayey sand to sandy clay, massive, moderately well oxidized, very sticky, very plastic, medium to coarse grained, common thin and few to common moderately thick clay films **39.6’:** Gravelly, slightly oxidized, slightly moist	7.5 YR 5/4-5/6 (Strong Brown)	Hard to Very Hard	5Bt1 Cumulic
35							
	8	5/5					
40							

LOG OF EXPLORATORY BORING

Job Number: 2196-85
Project: 461 N. Beverly Drive

Boring No: B-2
Boring Location: See Site Map

Date Performed: 8/28/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
40				**32.7-42’:** Clayey sand to sandy clay, massive, moderately well oxidized, very sticky, very plastic, medium to coarse grained, common thin and few to common moderately thick clay films	7.5 YR 5/4-5/6 (Strong Brown)	Hard to Very Hard	5Bt1
	9	4.2 /5		**42-44.2’:** Silty sand with clay, coarse sand, weakly stratified, slightly oxidized, poorly sorted, immature, slightly to moderately sticky, slightly plastic, few thin clay films	7.5 YR 5/4 (Brown)	Hard, Friable	5BC lam
45				**Pleistocene Older Alluvium (Qoa 3)** **44.2-46’:** Sandy clay, medium grained, slightly moist, massive, moderately sticky, moderately plastic	7.5 YR 4/6 (Brown)	Very Hard, Firm	6Bt
	10	2.7 /5		**46’:** Silty sand with many gravels, weakly stratified, oxidation stains, non sticky, non plastic	10 YR 6/3 (Pale Brown)	Soft, Very Friable	6BC
50				End at 50, Fill to 7.8’, No Water, No Caving			
55							
60							

LOG OF EXPLORATORY BORING

Job Number: 2196-85
Project: 461 N. Beverly Drive

Boring No: B-3
Boring Location: See Site Map

Date Performed: 8/28/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
0	1	3/5		**0-7.2’:** Fine to medium sand with scattered slate fragments, slightly moist, oxidized	Red Brown	Hard	Af
5	2	2.6 /5		**Holocene Alluvium (Qal 1)** **7.2-10’:** Silty sand with clay, massive, medium grained with few fine to medium gravels, slightly to moderately sticky, slightly plastic, few clay stains	10 YR 5/4 (Brown)	Slightly Hard, Friable	Bw
10				**10-10.5’:** Silty sand, slightly sticky, non plastic, fine sand with few scattered rounded pebbles, slightly moist, oxidized	10 YR 6/4 (Pale Brown)	Soft, Friable	BC
	3	4.7 /5		**10.5-15’:** Silty sand with clay, massive, medium grained, minor CaCO3, few scattered angular slate fragments, moderately sticky, moderately plastic, slightly well oxidized, few thin clay films	10 YR 4/6 (Dark Yellow Brown)	Hard, Friable	2Bw
15	4	4.7 /5		**Holocene Alluvium (Qal 2)** **15’:** Clayey sand, minor CaCO3, slightly moist, minor scattered gravels, medium to coarse sand and few fine angular gravels, moderately well oxidized, common thin and few moderately thick clay films	7.5 YR 5/4-6 (Strong Brown)	Hard, Firm to Friable	3Bt Cumulic
20							

LOG OF EXPLORATORY BORING

Job Number: 2196-85
Project: 461 N. Beverly Drive

Boring No: B-3
Boring Location: See Site Map

Date Performed: 8/28/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
20				**15-23’:** Clayey sand, minor CaCO3, slightly moist, minor scattered gravels, medium to coarse sand and few fine angular gravel, moderately well oxidized, common thin and few moderately thick clay films	7.5 YR 5/4-6 (Strong Brown)	Hard, Firm to Friable	3Bt
	5	5/5		**23-25.6’:** Fine to coarse sand with gravels, oxidation stains, CaCO3 present, weathered gravels, moderately sticky, moderately plastic, few clay stains	7.5 YR 5/4 (Brown)	Slightly Hard, Friable	3BC
25				**Pleistocene Older Alluvium (Qoa 1)** **25.6-28.5’:** Clayey sand with silt, fine to medium sand, with few scattered pebbles, massive, well oxidized, moist, very sticky, very plastic	5 YR 4/4 (Red Brown)	Slightly Hard, Firm	4AB
	6	4.8 /5		**28.5-31.5’:** Sandy clay, medium to coarse sand, slightly moist, well oxidized, poorly sorted angular to sub angular gravels, very sticky, very plastic, common thin and moderately thick clay films	5 YR 5/4 (Red Brown)	Very Hard, Friable	4Bt1
30							
	7	5/5		**31.5-35’:** Sandy clay, well oxidized, massive, very sticky, slightly moist, medium to coarse grained, poorly sorted, very plastic, common thin and moderately thick clay films	5 YR 4/4 (Red Brown)	Hard, Very Hard, Friable	4Bt2
35				**Pleistocene Older Alluvium (Qoa 2)** **35’:** Sandy clay to clayey sand, slightly well oxidized, massive, slight organics, very sticky, very plastic, medium grained, common thin and few moderately thick clay films	7.5 YR 4/3 (Brown)	Hard, Frim	5bt1 Cumulic
	8	5/5		**37.7-40’:** Fine to medium sand, with angular to sub rounded gravels			
40							

LOG OF EXPLORATORY BORING

Job Number: 2196-85
Project: 461 N. Beverly Drive

Boring No: B-3
Boring Location: See Site Map

Date Performed: 8/28/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
40				**Pleistocene Older Alluvium (Qoa 2)** **35-41.8’:** Sandy clay to clayey sand, slightly well oxidized, massive, slight organics, very sticky, very plastic, medium grained, common thin and few moderately thick clay films	7.5 YR 4/3 (Brown)	Hard, Firm	5bt1
	9	2.7 /5		**35-41.8’:** Silty sand with gravel, crudely stratified, coarse grained with common to many fine to medium slate gravels, non to slightly sticky, non plastic, slightly moist	10 YR 6/3 (Pale Brown)	Soft, Very Friable	
45							5 BC/C Scour
	10	2/5					
50				End at 50, Fill to 7.2’, No Water, No Caving			
55							
60							

LOG OF EXPLORATORY BORING

Job Number: 2196-85
Project: 461 N. Beverly Drive

Boring No: B-4
Boring Location: See Site Map

Date Performed: 8/29/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
0	1	3.7 /5		**0-6.9’:** Fine to medium sand with gravel, asphalt and concrete fragments, poorly sorted	Light Brown	Medium Dense	Af
5	2	2.7 /5		**Holocene Alluvium (Qal 1)** **6.9-10’:** Silty sand with angular slate fragments, fine to medium grained, slightly moist, rootlets, coarse grained sand, slightly well oxidized, massive, slightly sticky, slightly plastic, common clay stains	10 YR 5/6 (Yellow Brown)	Slightly Hard, Friable	Bw
10	3	4.7 /5		**10-15’:** Fine to medium silty sand with clay, few angular gravels, moderately well sorted to poorly sorted, angular to sub rounded gravel, slightly moist, slightly oxidized, slightly to moderately sticky, slightly plastic, few fine clay films	10 YR 5/4 (Yellow Brown)	Slightly Hard, Friable	2Bw
15	4	4.5 /5		**Holocene Alluvium (Qal 2)** **15-22.5’:** Clayey sand/ sandy clay, fine to medium, slightly well oxidized, scattered angular to rounded and massive pebbles, clay lense, CaCO3 throughout, poorly sorted, moderate to very sticky, very plastic, few to common thin clay films	7.5 YR 4/3 (Brown)	Hard, Friable	3Bt
20							

LOG OF EXPLORATORY BORING

Job Number: 2196-85
Project: 461 N. Beverly Drive

Boring No: B-4
Boring Location: See Site Map

Date Performed: 8/29/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
20				**15-22.5’:** Clayey sand/ sandy clay, fine to medium, slightly well oxidized, scattered angular to rounded and massive pebbles, clay lense, CaCO3 throughout, poorly sorted, moderate to very sticky, very plastic, few to common thin clay films	7.5 YR 4/3 (Brown)	Hard, Friable	3Bt
	5	3.7 /5		**22.5-25’:** Silty sand with clay, massive, slightly well oxidized, common clay stains, slightly sticky, slightly plastic, medium to coarse grains, moderately immature angular gravels, minor CaCO3	7.5 YR 5/4 (Brown)	Slightly Hard, Friable	3BC
25				**Pleistocene Older Alluvium (Qoa 1)** **25-26.5’:** Clayey sand with silt, fine to medium grained, massive, slight organics, moderately well sorted, very sticky and plastic	5 YR 4/4 (Reddish Brown)	Slightly Hard, Firm	4AB
	6	4.1 /5		**26.5-34’:** Clayey sand, coarse grained, scattered angular gravels moderately well oxidized, poorly sorted, slightly moist, massive, very sticky and plastic, common fine and moderately thick clay films	5 YR 5/4 (Reddish Brown)	Very Hard, Friable	4Bt
30	7	4.8 /5					
35				**Pleistocene Older Alluvium (Qoa 2)** **34’:** Sandy clay, very sticky, very plastic, with medium sands well sorted, mature, slightly moist, many thin to thick clay bands, scattered angular slate fragments, minor oxidation, few to moderately thick and common thin clay films	7.5 YR 5/4 (Brown)	Hard	5Bt Cumulic
	8	3.3 /5					
40							

LOG OF EXPLORATORY BORING

Job Number: 2196-85
Project: 461 N. Beverly Drive

Boring No: B-4
Boring Location: See Site Map

Date Performed: 8/29/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
40				**40-41’:** Silty sand, crudely stratified, non to slightly sticky, non plastic, coarse grained, common fine to medium slate rich gravel few clay stains	7.5 YR 5/3 (Brown)	Soft, Friable	5BC
	9	2.4 /5		**Pleistocene Older Alluvium (Qoa 3)** **41-46.1’:** Sandy clay to clayey sand, massive, slightly well oxidized, coarse grained, very sticky, very plastic, common thin and moderately thick clay films, truncated or inset soil	7.5 YR 4/6 (Strong Brown)	Hard, Firm to Friable	6Bt
45				**46.1-48’:** Silty sand, massive, slightly oxidized, coarse grained, slightly sticky, non to slightly plastic, few fine to medium slate gravels, scour deposit	10 YR 6/3 (Pale Brown)	Soft, Friable	6BC
	10	3.3 /5		**48’:** Sandy clay, massive, moderately well oxidized, medium grained, very sticky, very plastic, faintly gleyed, common to many thin and moderately thick clay films	7.5 YR 4/4 (Brown)	Very Hard, Friable	7Bt
50				End at 50, Fill to 6.9’, No Water, No Caving			
55							
60							

LOG OF EXPLORATORY BORING

Job Number: 2196-85
Project: 461 N. Beverly Drive

Boring No: B-5
Boring Location: See Site Map

Date Performed: 8/29/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
0	1	2.3 /3		**0-8.2’:** Medium sand with clay, scattered asphalt and concrete fragments	Dark Brown	Dense	Af
5	2	4.8 /5		**Holocene Alluvium (Qal 1)** **8.2-10.8’:**Silty sand, with few to common gravels, poorly sorted, slightly oxidized, slightly sticky, slightly plastic, common clay stains	10 YR 6/4 (Light Yellow Brown)	Slightly Hard, Friable	Bw
10	3	4.7 /5		**10.8-14.5’:** Silty sand with clay, scattered pebbles, sightly oxidized, moderately well sorted, minor CaCO3, massive, slightly to moderately sticky, slightly plastic, few thin clay films	10 YR 5/4 (Yellow Brown)	Hard to Slightly Hard, Friable	2Bw
15	4	4.8 /5		**Holocene Alluvium (Qal 2)** **14.5-21.5’:** Clayey sand, massive, medium to coarse grained, slightly well oxidized, few poorly sorted angular gravels, moderately to very sticky, very plastic, common thin and few moderately thick clay films	7.5 YR 5/4 (Brown)	Hard, Friable	3Bt Cumulic
20							

LOG OF EXPLORATORY BORING

Job Number: 2196-85
Project: 461 N. Beverly Drive

Boring No: B-5
Boring Location: See Site Map

Date Performed: 8/29/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
20				**14.5-21.5’:** Clayey sand, massive, medium to coarse grained, slightly well oxidized, few poorly sorted angular gravels, moderately to very sticky, very plastic, common thin and few moderately thick clay films	7.5 YR 5/4 (Brown)	Hard, Friable	3Bt
	5	4.7 /5		**21.5-24.5’:** Silty sand with clay, massive, poorly sorted, immature angular to sub angular gravels, slightly to moderately sticky, slightly plastic, common clay stains, slightly moist	7.5 YR 5/4 (Brown)	Slightly Hard to Hard, Friable	3BC
25				**Pleistocene Older Alluvium (Qoa 1)** **24.5-26.7’:** Clayey sand with silt, fine to medium sand with clay, massive, few rounded to sub angular gravels, poorly sorted, slight organics, moderately to very sticky, very plastic	5 YR 4/4 (Red Brown)	Hard, Firm	4AB
	6	4.1 /5		**26.7-33.2’:** Clayey sand, abundant angular to sub rounded gravels, poorly sorted, highly weathered granite and slate fragments, very sticky, very plastic, common thin and moderately thick clay films, slightly moist	5 YR 5/4 (Red Brown)	Very Hard, Friable	4Bt
30	**7**	5/5					
				Pleistocene Older Alluvium (Qoa 2) **33.2-40.2’:** Clayey sand/sandy clay, medium grained, few rounded to sub rounded gravels, minor oxidation, slightly moist, moderately well oxidized, very sticky and plastic, common thin and few moderately thick clay films	7.5 YR 4/4 (Brown)	Hard to Very Hard, Friable to Firm	5Bt
35	**8**	4.7 /5					
40							

LOG OF EXPLORATORY BORING

Job Number: 2196-85
Project: 461 N. Beverly Drive

Boring No: B-5
Boring Location: See Site Map

Date Performed: 8/29/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
40							5Bt
				40.2-41.4’: Silty sand with gravel, coarse grained, crudely stratified, slightly well oxidized, non to slightly sticky, non plastic, common fine slate gravels	7.5 YR 5/4 (Brown)	Soft, Friable	5Bc
				Pleistocene Older Alluvium (Qoa 3)			
	9	4/5		**41.4-46.7’:** Sandy clay, few scattered weathered gravels, slightly oxidized, very sticky, very plastic, common fine and few moderately thick clay films, slightly moist	7.5 YR 5/6 (Strong Brown)	Very Hard, Friable to Firm	6Bt
45							
				46.7-47.8’: Silty sand with gravel, crudely stratified, coarse gravels, poorly sorted, immature, oxidized, slightly moist	7.5 Yr 5/3 (Brown)	Soft, Very Friable	6BC
	10	4/5		**47.8’:** Clay with fine to medium sands, few scattered pebbles, massive, moderately well oxidized, very sticky, very plastic, common to many thin and common moderately thick clay films	7.5 YR 5/6 (Brown)	Very Hard, Friable to Firm	7Bt
50				End at 50, Fill to 8.2’, No Water, No Caving			
55							
60							

468 and 456 N. Rodeo Drive

Boring Logs

LOG OF EXPLORATORY BORING

Job Number: 2188-85
Project: 468 N. Rodeo Drive

Boring No: CB-1
Boring Location: See Site Map

Date Performed: 7/30/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
0	1			**0-7.5’:** Fill - Silty sand, scattered concrete and asphalt fragments Hand augered upper 7’ due to utilities	Brown	Medium Dense	Af
5	2	3/3		**Holocene Alluvium (Qal1)** **7.5-10.5’:** Clayey sand, massive, moderate to very sticky, very plastic, medium to coarse grained, poorly sorted, common thin and fine moderately thick clay films with basal scour, of sand with silt	Brown 7.5 YR 4/3	Hard, friable	Af Bt
10						Slightly Hard, friable	C
	3	3.6 /5		**10.5-13.3’:** Silty sand with clay, slightly sticky, moderately plastic, medium to coarse grained, poorly sorted sand, slightly to well oxidized, few common thin clay films	Brown 7.5 YR 5/4	Slightly Hard, friable	BC
15	4	5/5		**Holocene Alluvium (Qal2)** **13.3’:** Sandy clay, clayey sand, very sticky, very plastic, medium to coarse grained, poorly sorted sand, common $CaCO_3$ veinlets, many thin and few moderately thick clay films	Brown 7.5 YR 5/4	Hard, firm	2Bt
20							

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Figure

LOG OF EXPLORATORY BORING

Job Number: 2188-85
Project: 468 N. Rodeo Drive

Boring No: CB-1
Boring Location: See Site Map

Date Performed: 7/30/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
20	5	4.3 /5		**13.3-24’:** Sandy clay, clayey sand, very sticky, very plastic, medium to coarse grained, poorly sorted sand, common $CaCO_3$ veinlets, many thin and few moderately thick clay films	Brown 7.5 YR 5/4	Hard to firm	2Bt
25				**24-26.5’:** Silty sand with clay and gravel, massive to crudely stratified, slightly to moderately sticky, slightly plastic, coarse grained, poorly sorted sand, common fine to medium gravel, few to common thin clay films,	Brown 7.5 YR 5/3	Soft, very friable	2BC
	6	4/5		**Pleistocene Older Alluvium (Qoa1)** **26.5-28’:** Clayey sand, massive, moderately well oxidized, med. - coarse grained sand, very sticky, very plastic, slight organics, common thin and few moderately thick clay films	Reddish Brown 5 YR 4/3	Firm to Very Hard	$3Bt_1$
30				**28-33.5’:** Clayey sand with gravel, massive, moderately well oxidized, coarse grained, poorly sorted sand with common to many thin and common moderately thick clay films	Reddish Brown 5 YR 4/4	Very Hard, friable	$3Bt_2$
	7	5/5		**Pleistocene Older Alluvium (Qoa2)** **33.5-42.5’:** Sandy clay, massive, faintly mottled, very sticky and very plastic, moderately well oxidized, medium grained, moderately well sorted sand	Brown 7.5 YR 5/4	Very Hard, firm	4Bt
35	8	5/5					
40							

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Figure

LOG OF EXPLORATORY BORING

Job Number: 2188-85
Project: 468 N. Rodeo Drive

Boring No: CB-1
Boring Location: See Site Map

Date Performed: 7/30/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
40				**33.5-42.5’:** Sandy clay, massive, faintly mottled, very sticky and very plastic, moderately well oxidized, medium grained, moderately well sorted sand	Brown 7.5 YR 5/4	Very Hard, firm	4Bt
	9	4.2 /5		**42.5-43.7’:** Silty sand with clay, massive, moderately well oxidized, coarse grained poorly sorted sand with common thin clay films, few fine to medium sub rounded slate gravels, slightly sticky, non to slightly plastic	Brown 7.5 YR 5/4	Slightly hard, friable	4BC
				Pleistocene Older Alluvium (Qoa3)	Strong Brown 7.5 YR 5/6	Very hard, firm	5Bt
45				**43.7-48.2’:** Sandy clay, massive, moderately well oxidized, fine grained well sorted sand, plugged with clay, many thin common moderately thick clay films, very sticky, very plastic			
	10	4.6 /5		**48.2’:** Silty sand with gravel, crudely stratified, slightly well oxidized, coarse grained poorly sorted sand, non to slightly sticky, non plastic, with common fine to medium slate gravels	Brown 7.5 YR 5/4	Soft, very friable	5BC
50				End at 50, Fill to 7.5’, No Water, No Caving			
55							
60							

LOG OF EXPLORATORY BORING

Job Number: 2188-85
Project: 468 N. Rodeo Drive

Boring No: CB-2
Boring Location: See Site Map

Date Performed: 7/31/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
0	1			**0-7.3’:** Fill - Silty sand, scattered concrete and asphalt fragments Hand augered upper 7’ due to utilities	Brown	Medium Dense	Af
5	2	2.8 /3		**Holocene Alluvium (Qal1)** **7.3-10.3’:** Silty sand with clay, massive, slightly to moderately sticky, slightly plastic, medium grained moderately well-sorted sand, slightly well oxidized, common fine clay films (7.5 YR 4/4), basal scour at top of run 2.	Brown 7.5 YR 4/3	Slightly Hard, friable	Af Bt C
10	3	4.9 /5		**10.3- 13.1’:** Silty sand, massive, slightly sticky, moderately to slightly plastic, medium grained moderately well-sorted sand, moderately well oxidized, few fine clay films (7.5 YR 4/4), sand scour deposit	Brown 7.5 YR 5/4	Slightly Hard, friable	BC
15	4	4.9 /5		**Holocene Alluvium (Qal2)** **13.5-23.2’:** Clayey sand grades to sandy clay with depth, massive, very sticky, very plastic, fine grained well-sorted sand, slightly well oxidized, plugged with clay	Brown 7.5 YR 4/2	Hard, firm	2Bt
20							

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Figure

LOG OF EXPLORATORY BORING

Job Number: 2188-85
Project: 468 N. Rodeo Drive

Boring No: CB-2
Boring Location: See Site Map

Date Performed: 7/31/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
20				**13.5-23.2’:** Clayey sand grades to sandy clay with depth, massive, very sticky, very plastic, fine grained well-sorted sand, slightly well oxidized, plugged with clay	Brown 7.5 YR 4/2	Hard to firm	2Bt
	5	3.6 /5					
				23.2-26.8’: Silty sand, massive, crudely stratified, slightly sticky, non-plastic, coarse grained with common fine and medium gravels	Brown 7.5 YR 5/4	Slightly hard, very friable	2BC
25							
				Pleistocene Older Alluvium (Qoa1)			
	6	2.7 /5		**26.8-28.2’:** Sandy clay with silt, massive, fine grained, very sticky, very plastic, slight organics	Reddish Brown 5 YR 4/3	Firm to Very Hard	$3Bt_1$
				28.2-33’: Clayey sand with gravel, massive, very sticky, very plastic	Reddish Brown 5 YR 4/4	Very Hard, friable	$3Bt_2$
30							
	7	4.3 /5		**33-35’:** Coarse grained to poorly sorted sand, scattered gravel, fine grained sand, plugged with clay			
35				**Pleistocene Older Alluvium (Qoa2)**			
	8	5/5		**34.8-39.4’:** Sandy clay, massive, very hard, very sticky, very plastic, fine grained well-sorted sand, moderately well oxidized, plugged with clay	Brown 7.5 YR 5/4	Very Hard, firm	4Bt
40				**39.4-41.8’: See next page**	Brown 7.5 YR 4/3	Hard, friable	4BC

LOG OF EXPLORATORY BORING

Job Number: 2188-85
Project: 468 N. Rodeo Drive

Boring No: CB-2
Boring Location: See Site Map

Date Performed: 7/31/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
40				**39.4-41.8’:** Silty sand with clay and gravel, stratified, slightly sticky, non to slightly plastic, coarse grained, poorly sorted sand, slightly well oxidized, common clay films	Brown 7.5 YR 4/3	Hard, friable	4BC
	9	4.2 /5		**41.8-42.8’:** Clayey sand, massive, moderately well oxidized, fine grained well-sorted sand, moderately sticky, moderately plastic, few moderately thick clay films	Brown 7.5 YR 5/4	Very Hard, friable	5Bt
				42.8-45’: Silty sand with gravel, massive, slightly well oxidized, coarse grained, poorly sorted sand, with common fine and medium gravel, slightly sticky, non plastic, common clay stains	Brown 7.5 YR 5/3	Slightly Hard, very friable	5BC
45				**Pleistocene Older Alluvium (Qoa3)** **45-46’:** Sandy clay, massive, very hard, moderately well oxidized, fine grained, very sticky, very plastic, plugged with clay	Brown 7.5 YR 5/4	Very Hard, firm	6Bt
	10	4.1 /5		**46-50’:** Silty sand with gravel, crudely stratified, slightly sticky, slightly plastic, slightly well oxidized, coarse grained with common fine and medium gravel	Brown 7.5 YR 5/3	Slightly Hard, very friable	6BC
50				End at 50, Fill to 7.3’, No Water, No Caving			
55							
60							

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Figure

LOG OF EXPLORATORY BORING

Job Number: 2176-85
Project: 456 N. Rodeo Drive

Boring No: B-1
Boring Location: See Site Map

Date Performed: 7/11/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
0	1			**0-7.8’:** Fill - Silty sand, scattered concrete and asphalt fragments Hand augered upper 5’ due to utilities	Brown	Medium Dense	Af
5	2	5/5					Af
				Holocene Alluvium (Qal1) **7.8-10’:** Clayey sand, massive, slightly well oxidized, medium to coarse grained, moderately sticky and plastic, poorly sorted sand, common thin and few moderately thick clay films	Brown 7.5 YR 4/3	Hard, friable	Bt
10						Slightly Hard, friable	C
	3	3.7 /5		**10-12.7’:** Silty sand with clay, massive, slightly well oxidized, medium to coarse grained, slightly sticky, moderately plastic, few fine to medium slate gravels, few to common thin clay films	Brown 7.5 YR 5/3	Slightly Hard, friable	BC
				Holocene Alluvium (Qal2) **12.7-23.5’:** Clayey sand, massive, slightly well oxidized, fine to medium grained moderately well sorted sand, moderate to very sticky, very plastic, few localized fine $CaCO_3$ nodules, common thin and very few moderately thick clay films	Brown 7.5 YR 5/4	Hard, firm	2Bt
15	4	5/5					
20							

LOG OF EXPLORATORY BORING

Job Number: 2176-85
Project: 456 N. Rodeo Drive

Boring No: B-1
Boring Location: See Site Map

Date Performed: 7/11/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
20				**12.7-23.5’:** Clayey sand, massive, slightly well oxidized, fine to medium grained moderately well sorted sand, moderate to very sticky, very plastic, few localized fine $CaCO_3$ nodules, common thin and very few moderately thick clay films	Brown 7.5 YR 5/4	Hard, firm	2Bt
	5	4/5					
				23.5-25’: Silty sand with clay, massive, slightly well oxidized, coarse grained poorly sorted sand, common clay stains, slightly sticky, non-plastic	Brown 7.5 YR 5/4	Slightly Hard, friable	2BC
25				**25-27.7’:** Silty sand, massive, coarse grained poorly sorted sand, non-sticky, non-plastic	Brown 7.5 YR 5/3	Soft, friable	2C
	6	3.5 /5		**Pleistocene Older Alluvium (Qoa1)**			
				27.7 -30’: Clayey sand, massive, moderately well oxidized, slight organics, medium grained, moderately well sorted sand, common thin clay films, very sticky, very plastic	Reddish Brown 5 YR 4/3	Very Hard, firm	$3Bt_1$
30				**30-32.8’:** Sandy clay with gravel, massive, moderately well oxidized, coarse grained, poorly sorted sand, with common fine to medium highly weathered gravels, many thin and common moderately thick clay films	Reddish Brown 5 YR 4/4	Very Hard, friable	$3Bt_2$
	7	5/5		**Pleistocene Older Alluvium (Qoa2)**			
				32.8-39.5’: Clayey silt with sand - silty clay, moist, moderately oxidized, becoming fine to medium grained silty sand with clay, containing few scattered medium gravels	Strong Brown 7.5 YR 5/6	Very Hard, firm	4Bt
35							
	8	5/5					
40				**39.5-42.9’:** Becomes medium to coarse sand with scattered gravels, slightly moist	Brown 7.5 YR 5/4	Soft, friable	4BC

LOG OF EXPLORATORY BORING

Job Number: 2176-85
Project: 456 N. Rodeo Drive

Boring No: B-1
Boring Location: See Site Map

Date Performed: 7/11/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
40				**39.5-42.9’:** Becomes medium to coarse sand with scattered gravels, slightly moist	Brown 7.5 YR 5/4	Soft, friable	4BC
	9	3.3 /5		**42.9-46’:** Clayey sand, massive, moderately oxidized, fine to medium grained moderately well sorted sand, very sticky, very plastic, many thin and common moderately thick clay films	Brown 7.5 YR 4/4	Very hard, friable	5Bt
45				**46-47.2’:** Silty sand with gravel, massive, slightly well oxidized, slightly sticky, non-plastic, coarse grained poorly sorted sand common to many fine to medium, highly weathered slate gravel	Brown 7.5 YR 4/3	Slightly hard, friable	5BC
	10	4/5		**Pleistocene Older Alluvium (Qoa3)** **47.2-48’:** Silty sand with clay, massive, moderately well oxidized, highly truncated, medium to coarse grained poorly sorted sand, with few fine to medium gravels, few to common thin and few moderately thick clay films	Strong Brown 7.5 YR 4/6	Very hard, firm	6Bt
				48’: Silty sand with gravel, slightly oxidized, massive, coarse grained, with many fine to medium subangular and highly weathered gravel, non-sticky, non-plastic	Brown 7.5 YR 5/3	Hard, friable	6BC
50				End at 50, Fill to 7.8’, No Water, No Caving			
55							
60							

LOG OF EXPLORATORY BORING

Job Number: 2176-85
Project: 456 N. Rodeo Drive

Boring No: B-2
Boring Location: See Site Map

Date Performed: 7/11/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
0	1			**0-7.2’:** Fill - Silty sand, scattered concrete and asphalt fragments Hand augered upper 5’ due to utilities	Brown	Medium Dense	Af
5	2	5/5					Af
				Holocene Alluvium (Qal1) **7.2-10.2’:** Silty sand with clay, massive, slight organics, moderately sticky, very plastic, medium to coarse grained poorly sorted sand, common thin and few moderately thick clay films	Brown 7.5 YR 4/4	Hard, firm	Bt
10						Slightly Hard, friable	C
	3	3.9 /5		**10.2-12.5’:** Silty sand with clay, massive, medium to coarse grained poorly sorted sand, slightly well oxidized, few fine gravels, few thin clay films, slightly sticky, slightly plastic	Brown 7.5 YR 5/4	Slightly Hard, friable	BC
				Holocene Alluvium (Qal2) **12.5-22.2’:** Clayey sand, massive, medium grained moderately well sorted sand, very sticky, very plastic, slightly well oxidized	Brown 7.5 YR 4/3-4	Hard, firm	2Bt
15	4	5/5					
20							

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Figure

LOG OF EXPLORATORY BORING

Job Number: 2176-85
Project: 456 N. Rodeo Drive

Boring No: B-2
Boring Location: See Site Map

Date Performed: 7/11/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
20				**12.5-22.2’:** Clayey sand, massive, medium grained moderately well sorted sand, very sticky, very plastic, slightly well oxidized	Brown 7.5 YR 4/3-4	Hard, firm	2Bt
	5	4.5 /5		**22.2-25’:** Silty sand with clay, massive, moderately well oxidized slightly sticky, slightly plastic, coarse grained poorly sorted sand, few fine to medium slate gravels, common thin clay films	Brown 7.5 YR 4/3	Slightly Hard, friable	2BC
25				**25-26.7’:** Silty sand with gravel, massive, slightly well oxidized, coarse grained poorly sorted sand with common fine to medium gravel, non-sticky, non-plastic	Brown 7.5 YR 5/3	Soft, very friable	2C
	6	2.9 /5		**Pleistocene Older Alluvium (Qoa1)** **26.7-28’:** Clayey sand, massive, moderately oxidized, slight organics, medium grained, common thin and few moderately thick clay films	Reddish Brown 5 YR 4/3	Very Hard, firm	$3Bt_1$
				28-33’: Clayey sand with gravel, massive, moderately oxidized, coarse grained poorly sorted sand, common to many fine to medium slate rich gravels, moderately sticky, moderately plastic	Reddish Brown 5 YR 4/4	Very Hard, friable	$3Bt_2$
30	7	5/5		**Pleistocene Older Alluvium (Qoa2)** **33-39.7’:** Sandy clay, massive, faintly mottled, moderately well oxidized, fine to medium grained, moderately well sorted sand	Strong Brown 7.5 YR 4/4	Very Hard, firm	4Bt
35	8	5/5					
40				See Next Page	Brown 7.5 YR 5/4	Slightly Hard, friable	4BC

LOG OF EXPLORATORY BORING

Job Number: 2176-85
Project: 456 N. Rodeo Drive

Boring No: B-2
Boring Location: See Site Map

Date Performed: 7/11/18

Drill Type: 8” Hollow Stem / Continuous Core

Depth in Feet	Run #	Recovery Ratio	Recovery Graphic	Bedrock/ Soil Description	Color	Density	Strat/ Soil Unit
40				**39.7-41.5’:** Silty sand with gravel, crudely stratified, coarse grained poorly sorted sand with common to many fine to medium gravels, non to slightly sticky, non-plastic, few clay stains on gravel	Brown 7.5 YR 5/4	Slightly Hard, friable	4BC
	9	3.4 /5		**41.5-45’:** Clayey sand, massive, moderately well oxidized, fine grained well sorted sand, moderately sticky, very plastic, common thin and few moderately thick clay films	Strong Brown 7.5 YR 4/6	Very hard, friable	5Bt
45				**Pleistocene Older Alluvium (Qoa3)** **45-47.5’:** Sandy clay, massive, moderately well oxidized, slight organics, medium to coarse grained poorly sorted sand with few fine to medium gravels, common thin clay films and common moderately thick clay films	Reddish Brown 5 YR 4/4	Very hard, firm	6Bt
	10	3.6 /5		**47.5’:** Silty sand with gravel, crudely stratified, coarse grained poorly sorted sand, slightly well oxidized, common to many fine to medium gravel, sub angular and highly weathered	Brown 7.5 YR 5/4	Hard, friable	5BC
50				End at 50, Fill to 7.2’, No Water, No Caving			
55							
60							

Feffer Geological Consulting

Figure

APPENDIX ‘B’

Soil Stratigraphy & Soil Age Estimates

Soil Stratigraphy Study And Relative Age Estimates For A Fault Rupture Hazard Investigation At 461 North Beverly Drive, Beverly Hills, CA

Prepared by:

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Submitted to:

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September 20, 2018

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1990 South Bundy Drive, 4th Floor
Los Angeles, CA 91025

September 20, 2018

Subject: Soil Stratigraphy Study And Relative Age Estimates For A Fault Rupture Hazard Investigation At 461 North Beverly Drive, Beverly Hills, CA.

Dear Mr. Feffer:

I am pleased to present to you this soil stratigraphic study and relative-age determinations to be used with your fault rupture hazard assessment of the proposed development located at 461 North Beverly Drive in the City of Beverly Hills, California.

Feffer Geological retained John Helms CEG to describe and assist in correlations of the soil stratigraphy from continuously cored borehole samples and to assign relative age dates for the deposits identified across the site. The continuously cored bore hole samples were obtained from a single transect of borings, transect B. One borehole (B-3) was completely described from transect B, and four additional boreholes (B-1, B-2, B-4, and B-5) from transect B have been reviewed and summarized. The detailed soil descriptions are used to calculate various soil development indices (or SDIs). The SDI values were then compared to the SDI values from similar described soils with known ages to estimate age ranges for the soils understudy.

The attached report classifies the described soil profiles, identifies stratigraphic relationships, defines soil chronosequences, and estimates the relative ages for the one soil profile described in detail. Calculated SDI's show strong correlations to the SDI values of other published, described, and dated soil profiles with similar parent materials.

Age estimates range from 29 to 59 ka for the stratigraphic section studied along transect B in boring B-3. There are several distinctive buried soil units that can be correlated across the entire length of Transect B and correlated to adjacent Transect A. One distinctive buried soil (buried soil 3, Qoa1) which can be correlated across the entire length of Transect B, is a well preserved and well oxidized argillic soil profile that ranges in relative age from 21 – 46 ka. Please see Table 6 in the attached report for a summary listing of all of the determined relative ages at the study site.

Thank you for this opportunity to be of service. Should you have any questions or require additional information, please do not hesitate to contact me.

Sincerely,

REGISTERED GEOLOGIST
JOHN G. HELMS
No. 2272
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

John Helms, CEG 2272

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SOIL STRATIGRAPHY STUDY AND RELATIVE AGE ESTIMATES FOR A FAULT RUPTURE HAZARD STUDY FOR A PROPOSED DEVELOPMENT AT 461 N. BEVERLY DRIVE, BEVERLY HILLS, CALIFORNIA.

INTRODUCTION

Due to a repeating sequence of stratigraphy across the entire transect of borings from the subject site (Transect B) and an adjacent site to the west (Transect A), one soil profile has been studied for geomorphic characteristics and relative degrees of weathering to estimate deposit relative-age. Boring B-3 was selected for this process due to its position being located near the center of the transect of borings, and also because this boring contains a deep channel scour and would provide a minimum age for the alluvial section under study. The relative age estimate is based on index value comparisons with other published and dated soil profile descriptions. The comparative soils are from areas with a similar climate and similar parent material to this study area. The estimated relative ages in this report will be used by Feffer Geological, Inc. to assess the recency and recurrence of faulting across the study area. Alluvial units are assessed chronostratigraphically across five borehole locations from a single transect of borings that shadow the area proposed for development. In this study, the soil stratigraphy is defined with soil field description data, and no laboratory data. This study identifies the soil stratigraphy across the area under study and estimates the relative age of one soil profile. Continuously cored and sampled borehole B-3 has been described in detail, and four additional continuously cored and sampled boreholes (B-1, B-2, B-4, and B-5) have been summarized or briefly described along Transect B. Transect B is located along a graded and stripped alluvial surface.

A pedogenic soil can be defined as a natural body that consists of horizons of organic and/or mineral constituents which differ from its parent material in some way (Birkland, 1984). A chronosequence is a group of soils for which all soil forming factors (such as topography, parent material, vegetation, and climate) except time is relatively equal (Jenny, 1941). Past geologic studies in the coastal region of southern California provide age constraints for several deposits and geomorphic surfaces ranging in age from middle Pleistocene to recent (McFadden, 1982; Rockwell, 1988; and William Lettis and Associates, Inc., 1998). Often it has proven difficult to date older deposits due to changes in past climatic regimes. Studies on the impacts of glacial to interglacial climatic changes on soil development in specific regions (McFadden, 1982; Birkland, 1984; McFadden, 1988) indicate that soil development has occurred throughout the Quaternary.

This study is focusses on a section of alluvium derived from the southern range front of the Santa Monica Mountains, which is within the Transverse Ranges Geomorphic Province. A series of stacked and truncated argillic soil subsurface horizons within all of the stratigraphic sections studied indicates that the alluvial stratigraphic section across the entire study area correlates well and is significantly old. Age estimates range from 29 to 59 ka (Qoa2) for the stratigraphic section studied near the center portion of transect B in boring B-2. To the west, age estimates range from 46 to 94 ka (Qoa3) for the stratigraphic section studied near the center portion of transect A in boring CB-1 illustrated on the site map provided with the main fault hazard report.

Soil relative age estimates have broad ranges, dependent upon the pool of comparative data used. Most of the buried soils across the study area fall into the Alfisol soil order (Soil Conservation Service, 1999). The soil profile that is described in detail is from boring B-3 in

Transect B and summary descriptions are given for borings B-1, B-2, B-4, and B-5 from Transect B. Boring locations are shown on the site map that is provided with the main fault rupture hazard report.

MATERIALS AND METHODS

Continuous core samples collected from boring B-3 by Feffer Geological, Inc. were described in detail as part of this study. The soils were described using guidelines set by the Soil Survey Staff (1991 and 1999). Specific soil properties such as soil structure and soil horizon boundaries could not be accurately described from the core sample exposures. These soil qualifiers have not been described and do not factor into the estimated soil relative age comparisons.

Soil profile field description values quantify soil properties that are used to develop a soil development index (SDI) value as outlined by Harden (1982). Points are assigned to descriptive data for each of several observed soil properties, such as dry color, moist color, texture, dry and wet consistence, and clay film content, for each soil horizon in a soil profile relative to the soil horizon's thickness, and normalized to a common depth. The maturity of a soil profile is gauged through data collected from active wash deposits (or raw alluvium).

Table 1.1 lists the detailed soil description for the studied boring in longhand format. Table 1.2 lists the soil description using soil conservation service notation and shows the SDI calculations. Table 1.2 shows the calculated SDI values, the soil profile description, and the normalization values for raw alluvium. SDI values are calculated by assigning point values to each described soil properties. The points are summed for each soil horizon and divided by the total number of descriptive properties used. This equals the mean horizon index value (HI). HI values are multiplied by the corresponding soil horizon thickness. The SDI value equals the sum of the thickness normalized horizon indices. The maximum horizon index (MHI) is the value of the horizon with the largest summed descriptive value. MHI is independent of horizon thickness, and is usually the diagnostic subsurface soil horizon for most soil profiles. Tables 1.2 lists all of the determined HI, SDI, and MHI values for the soil profile under study.

SDI and MHI values have shown significant correlations to soil age in many past studies (Harden, 1982; Rockwell *et al.*, 1983; Reheis *et al*., 1989; Rockwell *et al.*, 1994). The soils described in this study are compared to soils described and dated by McFadden (1982 and 1988) in San Bernardino County near Mission Creek, by Rockwell (1983) in the Ventura River basin, and by William Lettis and Associates, Inc. (1998) in West Hollywood. SDI values have all calibrated to a common depth of 3 feet.

The changes in the subsurface pedogenic properties of the Alfisol soil order allows for relative age determinations by emphasizing specific soil properties (such as color and clay film content) that are most diagnostic. Soil properties that express themselves well through time are most often used in the assessment of soil relative ages through a specific soil property index such as the color or clay film index. The color index (Rockwell *et al.,* 1985, 1988) is used to quantify observed colors (in Munsell notation) of each profile in order to compare relative degrees of reddening. The color index is simply the summation of an entire profile's horizon index values for dry colors. The clay film index (Rockwell *et al.,* 1985, 1988) is used to quantify field descriptions of this soil property in order to compare relative profile maturity. The clay film index is simply the summation of an entire soil profile's horizon index

values for clay films. MHI is a comparison of a soil pedons master (or diagnostic) subsurface horizon (typically an argillic or cambic horizon). Independent of horizon thickness, the MHI directly compares the properties of the soil profiles strongest soil horizon.

SOIL RELATIVE AGE METHODS

Soil relative ages are calculated and compared independently for each soil profile described. The soil profile described for this study is located across several buried alluvial surfaces that differ in relative age, facies of deposition, and degrees of preservation. A series of stacked, buried, and truncated hard, clayey soils with illuvial clays characterize a majority of the soil profiles described on this project site.

The soil profile described in detail has a surface age that is implied by estimating the time of inception for the exposed surficial soil. The soil profile described in detail for this study also contains a series of stacked and / or buried soil profiles. In this case, deposit age assessments are obtained by identifying and isolating the different parent materials (or deposits). Then comparing a set of abridged calculated indices to an additional suite of similar soils that have been radiometrically dated yields the equivalent to a buried surface age estimate. Such burial relationships are common along the southern Santa Monica Mountains range front; especially where soils that have developed into alluvial fan deposits which commonly bury or locally truncate older soils that have developed previously in older alluvial deposits. A cumulic soil profile estimated age can assess landform age, and has potential to assess rates of erosion, rates of landform evolution, and rates of tectonic activity across the study area.

The described soil profiles have an SDI value, which is used to estimate the soil relative age. Cumulic relative age estimates for a stacked or buried soil profiles are specifically referred to as “deposit ages”. The relative age estimate for the surface profile or modern soil is referred to as the “surface age”. All of the relative age estimates given are considered minimum ages given that an unknown amount of erosion has occurred after the formation of and before the burial of each truncated surface and buried soil studied.

SOIL SUMMARY DESCRIPTIONS

Soil summary descriptions were generated for borings B-1, B-2, B-4, and B-5 in this study. The summary descriptions record diagnostic pedogenic features for each soil horizon identified. This was done in order to assist with establishing stratigraphic correlations across the site. Relative age estimates were not generated for any of the listed soil summary descriptions. The soil summary descriptions are listed in Tables 2.1, 2.2, 2.3, and 2.4.

DISCUSSION AND RESULTS

This section contains a brief write up for the continuously cored boring described in detail with designated tables for the soil profile. The attached Table 1.1 presents the soil profile description in longhand format. Table 1.2 presents the results of the calculated SDI values. Table 3 is a summary of the soil relative age estimates for the soil profile under study. Table 4 is a compilation of the comparative data in a format that compares to the data generated for this study. Table 5 is a soil abbreviation key to be used in conjunction with the SDI calculation sheets. Table 6 lists the relative ages for each designated stratigraphic unit that is shown on the geologic cross section in the fault rupture hazard report.

Soil descriptions, SDI calculations, and relative age determinations follow for the soil profile studied.

TRANSECT B BORINGS

One soil profile was described in detail out of core samples from Transect B in boring B-3. Age estimates range from 29 to 59 ka for the alluvial section studied.

Boring B-3

The core samples from Transect B, Boring B-3 were reviewed at the project site on 9/11/2018 and on 9/12/2018. This boring is located near the center of Transect B, and this alluvial section is characterized by a sequence of weakly developed surficial soils over a series of truncated argillic soils interbedded with massive and crudely stratified scour deposits. See Table 1.1 for a complete soil description of the continuously sampled boring, Table 1.2 for the SDI index value calculations and relative age estimates, and Feffer Geological Inc.'s cross section and geologic map for both the borehole and transect location.

The surface deposit (Qal1) in boring B-3 consists of a series of two weakly-developed soils that are characterized by severely truncated cambic horizons and each an estimated relative age of 2 – 4 ka. The second buried soil (Buried Soil 2 / Qal2) can be correlated across the entire length of Transect B is a truncated, thick (cumulic), and diffuse weakly to moderately well-developed Alfisol soil with an estimated relative age value of 8 – 16 ka. This correlates well with the Qal2 cumulic soil identified in Transect A to the west. The third buried soil in this alluvial sequence is a conservative top of the Pleistocene in this stratigraphic section. This marker bed (Qoa1) can be correlated across the entire area investigated (Transects A and B) and is a truncated, well oxidized, and moderately well-developed Alfisol soil that has an estimated relative age value of 21 – 46 ka. The forth buried soil (Buried Soil 4 / Qoa2) also can be correlated across the entire length of Transect B is a truncated, massive, weakly to moderately well-developed Alfisol soil with an estimated relative age value of 29 – 59 ka. The fifth buried soil (Qoa3) in Transect A), has an estimated age that ranges from 46 – 94 ka. This lowest buried soil in this alluvial sequence can be correlated across a majority of the area investigated and is scoured out across the center of Transect B in Boring B-3.

Differences in the number of soils, depths of burial and unit thicknesses due to differential erosion / truncation laterally along Transect B may cause minor variances in relative age estimates between the individual borings. In order to control for this additional soil summary descriptions were generated across this transect which assesses the same buried surfaces at differing depths of burial and in differing states of preservation.

BORING SUMMARY DESCRIPTIONS

Soil summary descriptions generated for borings B-1, B-2, B-4, and B-5 are listed in Tables 2.1, 2.2, 2.3, and 2.4. Relative age estimates were not generated for the soil summary descriptions. The summary descriptions were generated to assist with establishing stratigraphic correlations across the site. The observations for the soil summary descriptions along Transect B were made on 9/11/2018. All of the borings along Transect B appear to contain a thin veneer of artificial fill that is in contact with a sequence of Holocene-aged soils that overly a sequence of Pleistocene-aged truncated argillic soils and nested sour deposits. Several of the Pleistocene-aged truncated and /stacked buried soils are maker units which

can be correlated across the area investigated and across to the adjacent Transect A to the west.

CONCLUSIONS

A majority of the buried soils observed across the study area are Alfisols that have developed in alluvial environments. All of the soil profiles across Transect A consist of a series of stacked, truncated, and buried argillic soil horizons. The truncated and buried soils with argillic sub surface soil horizons are weakly and moderately well developed. The Alfisol soils typically have 7.5YR to 5YR color hues with a modest amounts of secondary (pedogenic) clay in a series of argillic (Bt) diagnostic subsurface horizons.

The surface soil profile across the area investigated is laterally continuous across both Transects A and B. Lateral variability observed in the buried soils across the site is due to localized erosion, scouring, infilling, and stacking of these materials in an alluvial environment. In this sedimentological environment surfaces that have been stable long enough to form a robust soil, can suddenly be buried by a new deposit, or scoured out (truncated) and possibly in-filled with younger material. The amount of erosion that has occurred with each truncated soil under study is unknown. Thus the relative age estimates given in this study are minimum ages.

These soil relative age determinations are consistent with the general geologic and pedogenic observations of soils in southern California. Strongly developed, well horizonated, thick, and oxidized Alfisols can be as much as 200 ka in age. Erosion tends to act as a rejuvenating aspect in soil development, by decreasing the strength of the soil development properties and the consequent age estimates are younger. In that past magnitudes and rates of erosion are difficult to assess, the soil relative age estimates are utilized as minimum ages.

The soils observed along Transect B are Holocene and Pleistocene in age. The buried and stacked soils display soil horizons that have weak to moderately strong argillic horizon development at depth. Age estimates range from 46 to 94 ka for the entire alluvial stratigraphic section studied along transect A. Age estimates range from 29 to 59 ka for the truncated alluvial stratigraphic section studied along transect B. The third buried soil (buried soil 3) (Qoa1) in Transect B and the second buried soil (buried soil 2) (Qoa1) in Transect A can be correlated across the entire area investigated is a truncated, well oxidized, and moderately well-developed argillic soil profile that ranges in relative age from 21 – 46 ka along the length of Transect B. The lowermost buried soil (buried soil 4) (Qoa2) that can be correlated across the entire area investigated is a truncated, stacked, and weakly to moderately well-developed argillic soil profile that ranges in relative age from 29 – 59 ka along the length of Transect B.

LIMITATIONS

The conclusions and recommendations presented herein are the results of an inherently limited scope. Specifically, the scope of services consisted of an assessment of relative age from core samples and did not participate in any drilling activities at the site. The conclusions and recommendations contained in this report are professional opinions derived in accordance with current standards of professional practice. No warranty is expressed or implied.

This report has been prepared for the exclusive use of Feffer Geological, Inc. and applies only to the Fault Rupture Hazard Study located at 461 N. Beverly Drive. In the event that significant changes in the interpretations of this study are made, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed by John Helms, CEG, and the conclusions and recommendations of this report are verified in writing.

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Table 1.1

461 N. Beverly Drive

Table 1.1 Soil Description - Transect B; Boring B 3

Depth (Ft)	Horizon	Transect B; B-3 Description
0 - 7.2	Af	Artificial Fill
7.2 - 10.0	Bw	Brown (10YR 5/4d, 10YR 4/3m), loam, slight-organics, slightly oxidized, massive, slightly hard, friable, slightly to moderately sticky, slightly plastic, medium- to coarse-grained poorly sorted sand with few fine and medium sub rounded gravel, few clay stains on ped faces, gradational lower boundary to;
10.0 - 10.5	BC	Pale Brown (10YR 6/4 d, 10YR 4/3 m), sandy loam, massive, slightly hard, friable, slightly well oxidized, slightly sticky, non-plastic, fine- to medium-grained moderately well sorted sand with few fine sub rounded gravel, abrupt lower boundary to;
10.5 - 15.0	2Bwb	Dark Yellowish Brown (10YR 4/6d, 10YR 3/4m), loam, slightly well oxidized, massive, hard, friable to firm, moderately sticky, moderately plastic, medium- to coarse-grained poorly sorted sand with few fine sub rounded gravel, clay films few thin on ped faces, calcium carbonate stage 1-, common veinlets and slightly disseminated in soil matrix, clear lower boundary to;
15.0 - 23.1	3Btb	Strong Brown to Brown (7.5YR 5/4-6d, 7.5YR 4/3m), clay loam, moderately well oxidized, massive, cumlic soil, slightly hard, friable, moderately sticky, moderately plastic, medium to coarse-grained poorly sorted sand with few fine gravel, common thin and few moderately thick clay films on ped faces, calcium carbonate stage 1-, few to common veinlets and slightly disseminated in soil matrix, gradational lower boundary to;
23.1 - 25.6	3BCb	Brown (7.5YR 5/4d, 7.5YR 4/3m), sandy loam, moderately well oxidized, massive, slightly hard, friable, moderately sticky, slightly to moderately plastic, medium- to coarse-grained poorly sorted sand, few clay stains on ped faces, clear lower boundary to;
25.6 - 28.5	4ABb	Reddish brown (5YR 4/4d, 5YR 3/3m), clay loam to clay, well oxidized, massive, organic rich, slightly hard, firm, very sticky, very plastic, fine- to medium-grained moderately well sorted sand with few fine pores, gradational lower boundary to;
28.5 - 31.5	4Btb1	Reddish brown (5YR 5/4d, 5YR 4/3m), sandy clay loam, massive, well oxidized, very hard, friable, very sticky, very plastic, medium- to coarse-grained poorly sorted sand, few highly weathered fine and medium slate rich gravel, clay films common thin and moderately thick on ped faces, gradational lower boundary to;
31.5 - 35.0	4Btb2	Reddish brown (5YR 4/4d, 5YR 3/3m), loam, well oxidized, massive to crudely stratified, very hard, friable, very sticky, very plastic, coarse-grained poorly sorted sand with common highly weathered fine and medium slate rich gravel, clay films common thin and moderately thick on ped faces and coating gravel, clear lower boundary to;
35.0 - 41.8	5Btb	Brown (7.5YR 4/3d, 7.5YR 3/2m), clay loam, slightly well oxidized, massive, hard, friable, very sticky, very plastic, fine- to medium-grained moderately well sorted sand, clay films common to many thin and common moderately thick on ped faces, gradational lower boundary to;
41.8 - 50.0+	5BCb	Pale Brown (10YR 6/3 d, 10YR 4/2 m), sandy loam to loam, crudely stratified, slightly oxidized, soft, very friable, non- to slightly sticky, non-plastic, coarse-grained poorly sorted sand with common fine and medium sub rounded slate rich gravel, common clay stains coating clasts, undetermined lower boundary.

Table 1.2

Soil Development Index Calculation Sheet
461 Beverly Drive Transect B; Boring B 3

Unit	Thickness	Color				Texture		Consistence				Clay Films		Horizon	Mean Hor.
	(Feet)	Dry		Moist				Dry		Wet				Values	Values
Raw Alluvium	*3*	*2.5Y 7/3*	*X/10*	*10YR 6/2*	*X/10*	*s*	*X/6*	*lo*	*X/5*	*so, po*	*X/6*	*0*	*X/15*		
Transect B; Boring 3															
Bw	2.8	10YR 5/4	0.2	10YR 4/3	0.1	l	0.5	sh	0.40	ss-s, ps	0.42	1vnpf	0.17	0.30	0.83
BC	0.5	10YR 6/4	0.2	10YR 4/3	0.1	sl	0.33	so	0.20	ss, po	0.17			0.17	0.08
2Bwb	4.5	10YR 4/6	0.4	10YR 3/4	0.2	l	0.5	h	0.60	s, p	0.67	1npf	0.2	0.43	1.93
3Btb	8	7.5YR 5/4-6	0.4	7.5YR 4/3-4	0.25	cl	0.67	h	0.60	s, p	0.67	2npf, 1mkpf	0.4	0.50	3.98
3BCb	2.6	7.5YR 5/4	0.3	7.5YR 4/3	0.2	sl	0.33	sh	0.40	s, ps-p	0.58	1vnpf	0.17	0.33	0.86
4ABb	2.9	5YR 4/4	0.4	5YR 3/3	0.3	cl - c	0.92	sh	0.40	vs, vp	1.00			0.50	1.46
4Btb1	3	5YR 5/4	0.4	5YR 4/3	0.3	scl	0.67	vh	0.80	vs, vp	1.00	2npf, 2mkpf	0.47	0.61	1.82
4Btb2	4.5	5YR 4/4	0.4	5YR 3/3	0.3	l	0.5	vh	0.80	vs, vp	1.00	2npf, 2mkpf	0.47	0.58	2.60
5Btb	6.8	7.5YR 4/3	0.2	7.5YR 3/2	0.1	cl	0.67	h	0.60	vs, vp	1.00	2npf, 1mkpf	0.4	0.50	3.37
5BCb	8.2	10YR 6/3	0.1	10YR 4/2	0	ls - l	0.42	so	0.20	so-ss, po	0.08	2vnpf	0.23	0.17	1.41

INDEX VALUES AND DETERMINED AGES (ka)

Soil Member	MHI	Mean Soil Index	SDI @ 7 feet	Color Index	Clay Film Index	Soil Age Estimate ka	Section Age Estimate ka	Stratigraphic Unit
Surface Soil	**0.30**	**0.92**	**1.94**	**0.60**	**0.20**	**2 - 4**	**2 - 4**	**Qal1**
Buried Soil 1	**0.43**	**1.93**	**2.99**	**0.60**	**0.43**	**2 - 4**	**4 - 8**	
Buried Soil 2	**0.87**	**4.84**	**3.20**	**1.20**	**0.85**	**4 - 8**	**8 - 16**	**Qal2**
Buried Soil 3	**0.61**	**5.88**	**3.96**	**1.00**	**0.40**	**13 - 30**	**21 - 46**	**Qoa1**
Buried Soil 4	**0.50**	**4.78**	**2.23**	**1.30**	**0.66**	**8 - 13**	**29 - 59**	**Qoa2**

Table 2.1 - Soil Summary Sheet
461 N. Beverly Drive Transect B - Boring B 1

Depth (Ft)	Horizon	Summary Description of Transect B; Boring B 1
0 - 8.0	NR & Af	No Recovery and Artificial Fill
8.0 - 11.0	Bw	truncated weakly developed soil with slight organics, slightly hard, coarse-grained, few thin clay films
11.0 - 12.5	BC	transitional horizon, massive, medium- to coarse-grained, sandy basal scour deposit
12.5 - 15.0	2Bwb	truncated weak soil, medium- to coarse-grained, few thin clay films
15.0 - 24.0	3Btb	truncated weak to moderate cumlic argillic, fine- to medium-grained, few to common thin clay films
24.0 - 25.5	3BCb	transitional horizon, massive, coarse-grained with gravel, basal scour deposit
25.5 - 27.7	4Btb	truncated, moderately strong argillic, moderately well oxidized, fine- to medium-grained, common thin clay films
27.7 - 28.4	5ABb	truncated transitional surface soil, organic rich, fine- to medium, grained, few to common fine and medium pores
28.4 - 33.0	5Btb1	strongly developed argillic horizon, well oxidized, very hard, medium to coarse-grained, common thin and moderately thick clay films
33.0 - 34.3	5Btb2	strongly developed sub surface argillic horizon, well oxidized, very hard, coarse-grained with gravel, common thin and moderately thick clay films
34.3 - 35.0	6Btb1	truncated, moderately strong argillic, moderately well oxidized, fine-grained, common thin and moderately thick clay films
35.0 - 43.1	6Btb2	moderately well developed sub surface argillic horizon, moderately well oxidized, medium- to coarse-grained with gravel, common thin and moderately thick clay films
43.1 - 48.4	6BCb lam	transitional horizon, crudely stratified, coarse-grained with gravel, basal scour deposit
48.4 - 50.0+	7Btb	truncated, moderately strong argillic, moderately well oxidized, fine- to medium-grained, common thin and moderately thick clay films

Table 2.2 - Soil Summary Sheet
461 N. Beverly Drive Transect B - Boring B 2

Depth (Ft)	Horizon	Summary Description of Transect B; Boring B 2
0 - 7.8	NR & Af	No Recovery and Artificial Fill
7.8 - 10.0	Bw	truncated weakly developed soil with slight organics, slightly hard, coarse-grained, few clay stains
10.0 - 10.5	BC	transitional horizon, massive, coarse-grained with gravel, sandy basal scour deposit
10.5 - 15.0	2Bwb	truncated weak soil, medium- to coarse-grained, common clay stains
15.0 - 24.0	3Btb	truncated weak to moderate cumlic argillic, medium- to coarse-grained, few to common thin clay films
24.0 - 26.6	3BCb	transitional horizon, massive, coarse-grained with gravel, basal scour deposit
26.6 - 27.0	4ABb	truncated transitional surface soil, organic rich, fine- to medium, grained, few to common fine and medium pores
27.0 - 31.2	4Btb1	strongly developed argillic horizon, well oxidized, very hard, medium to coarse-grained, common thin and moderately thick clay films
31.2 - 32.7	4Btb2	strongly developed sub surface argillic horizon, well oxidized, very hard, coarse-grained with gravel, common thin and moderately thick clay films
32.7 - 42.0	5Btb1	truncated, moderately strong argillic, moderately well oxidized, fine-grained, common thin and moderately thick clay films
42.0 - 44.2	5BCb lam	transitional horizon, crudely stratified, coarse-grained with gravel, basal scour deposit
44.2 - 46.0	6Btb	truncated, moderately strong argillic, moderately well oxidized, fine- to medium-grained, common thin and moderately thick clay films
46.0 - 50.0+	6BCb	transitional horizon, crudely stratified, coarse-grained with gravel, basal scour deposit

Table 2.3 - Soil Summary Sheet
461 N. Beverly Drive Transect B - Boring B 4

Depth (Ft)	Horizon	Summary Description of Transect B; Boring B 4
0 - 6.9	NR & Af	No Recovery and Artificial Fill
6.9 - 10.0	Bw	truncated weakly developed soil with slight organics, slightly hard, coarse-grained, common clay stains
10.0 - 15.0	2Bwb	truncated weak soil, medium- to coarse-grained, few thin clay films
15.0 - 22.5	3Btb	truncated weak to moderate cumlic argillic, medium- to coarse-grained, few to common thin clay films
22.5 - 25.0	3BCb	transitional horizon, massive, coarse-grained with gravel, basal scour deposit
25.0 - 26.6	4ABb	truncated transitional surface soil, organic rich, fine- to medium, grained, few to common fine and medium pores
26.6 - 34.0	4Btb	strongly developed argillic horizon, well oxidized, very hard, coarse-grained with gravel, common thin and moderately thick clay films
34.0 - 40.0	5Btb	truncated, moderately strong argillic, moderately well oxidized, fine-grained, common thin and few moderately thick clay films
40.0 - 41.0	5BCb	transitional horizon, massive, coarse-grained with gravel, basal scour deposit
41.0 - 46.1	6Btb	truncated, moderately strong argillic, moderately well oxidized, fine- to medium-grained, common thin and moderately thick clay films
46.1 - 48.0	6BCb	transitional horizon, crudely stratified, coarse-grained with gravel, basal scour deposit
48.0 - 50.0+	7Btb	truncated, moderately strong argillic, moderately well oxidized, fine- to medium-grained, common to many thin and common moderately thick clay films

Table 2.4 - Soil Summary Sheet
461 N. Beverly Drive Transect B - Boring B 5

Depth (Ft)	Horizon	Summary Description of Transect B; Boring B 5
0 - 8.2	NR & Af	No Recovery and Artificial Fill
8.2 - 10.8	Bw	truncated weakly developed soil with slight organics, slightly hard, coarse-grained, common clay stains
10.8 - 14.5	2Bwb	truncated weak soil, medium- to coarse-grained, few thin clay films
14.5 - 21.5	3Btb	truncated weak to moderate cumlic argillic, medium- to coarse-grained, common thin and few moderately thick clay films
21.5 - 24.4	3BCb	transitional horizon, massive, medium- to coarse-grained with gravel, basal scour deposit
24.5 - 26.7	4ABb	truncated transitional surface soil, organic rich, fine- to medium, grained, few to common fine and medium pores
26.7 - 33.2	4Btb	strongly developed argillic horizon, well oxidized, very hard, coarse-grained with gravel, common thin and moderately thick clay films
33.2 - 40.2	5Btb	truncated, moderately strong argillic, moderately well oxidized, fine-grained, common thin and few moderately thick clay films
40.2 - 41.4	5BCb	transitional horizon, massive, coarse-grained with gravel, basal scour deposit
41.4 - 46.7	6Btb	truncated, moderately strong argillic, moderately well oxidized, fine- to medium-grained, common thin and moderately thick clay films
46.7 - 47.8	6BCb	transitional horizon, crudely stratified, coarse-grained with gravel, basal scour deposit
47.8 - 50.0+	7Btb	truncated, moderately strong argillic, moderately well oxidized, fine- to medium-grained, common to many thin and common moderately thick clay films

Table 3. Soil Surface Relative-Age Estimates
461 N. Beverly Drive - Summary Age Table

Profile Number	Soil Member	Stratigraphic Unit	MHI Value	SDI Value	Clay Film	Relative Age (ka)
Transect B Boring B-3	Surface Soil	Qal1	0.30	1.94	0.20	2 - 4
	Buried Soil 1		0.43	2.99	0.43	4 - 8
	Buried Soil 2	Qal2	0.87	3.20	0.85	8 - 16
	Buried Soil 3	Qoa1	0.61	3.96	0.40	21 - 46
	Buried Soil 4	Qoa2	0.50	2.23	0.66	29 - 59

Table 4. Comparison Soil Data Indices Value Summary

(McFadden) Mission Creek Soils	SDI At 7'	MHI	Reddening Index	Clay Film Index
S7 0-1000 yrbp	0.59	0.12	0	0
S5 4-13 ka	1.02	0.3	0.1	0
S4 13-70 ka	3.14	0.37	3.94	7.37
S2 70-250 ka	5.61	0.61	4.80	6.24
S2 250-700 ka	2.57	0.39	6.20	10.31

(Rockwell) Ventura River Basin Soils	SDI At 7'	MHI	Reddening Index	Clay Film Index
Qt3 4 - 8 ka	1.7	0.17	0.5	0
Qt4 10 -15 ka	2.7	0.43	2	4
Qt5a 15 – 20 ka	2.8	0.37	3.5	4.2
Qt5b 30 ka	3.2	0.46	5	7

(WLA) West Hollywood Buried Soils	SDI At 7'	MHI	Reddening Index	Clay Film Index
Qol1 100 ka	2.1	0.42	1.05	1.99
Qol2 100-300 ka	7.3	0.8	8.2	13.2

TABLE 5. Soil Field Description Abbreviation Key

Texture		Structure		Consistence						Clay Films		Calcium Carbonate	
				Dry		Moist		Wet				(Pedogenic CaCO3)	
S	- sand	m	- massive	l	- loose	vfr	-very friable	so	non stickey	v1	veryfew	sl dis	slightly dissemenated
LS	- loamy sand	sg	- single grained	so	-soft	fr	-friable	ss	slightly stickey	1	few	I	slight coatings common on clast bottoms
SL	- sandy loam	**OR**		sh	-slightly hard	fi	-firm	s	moderately siteckey	2	common	II	moderately thick coatings on clast bottoms; few medium common fine nooduses
L	- loam	1	- weak	h	-hard	vfi	-very firm	vs	very stickey	3	continuous	III	thick coatings common on clast bottoms, common medium nodules, common fine pendants, many fine nodules
CL	- clay loam	2	- moderate	vh	-very hard			**AND**		**AND**		VI	many thick coatings on clasts bottoms common coarse pendants few clasts completely enveloped
SCL	- sandy clay loam	3	- strong	eh	-extremely hard			po	non plastci	vn	stains	V	many thick coatings on clasts bottoms, many coarse pendants common clasts completely enveloped- petrocalcic
C	- clay	**AND**						ps	slightly plastic	n	thin	V+	many thick coatings on clasts bottoms, many coarse pendants many clasts completely enveloped, completely disseminated in matrix - petrocalcic
Si	- silt	vf	- very fine					p	moderately plastic	mk	moderately thick		
SiL	- silt loam	f	- fine					vp	very plastic	k	thick		
SiCL	- silt clay loam	m	- medium							**AND**			
SiC	- silty clay	c	- coarse							cl	coating clasts		
		vc	- very coarse							pf	ped faces		
		AND								br	brodgeing sand grains		
		gr	- granular							po	lining pores		
		pl	- platty										
		pr	-prismatic										
		abk	-angular blockey										
		sbk	- sub angular blockey										

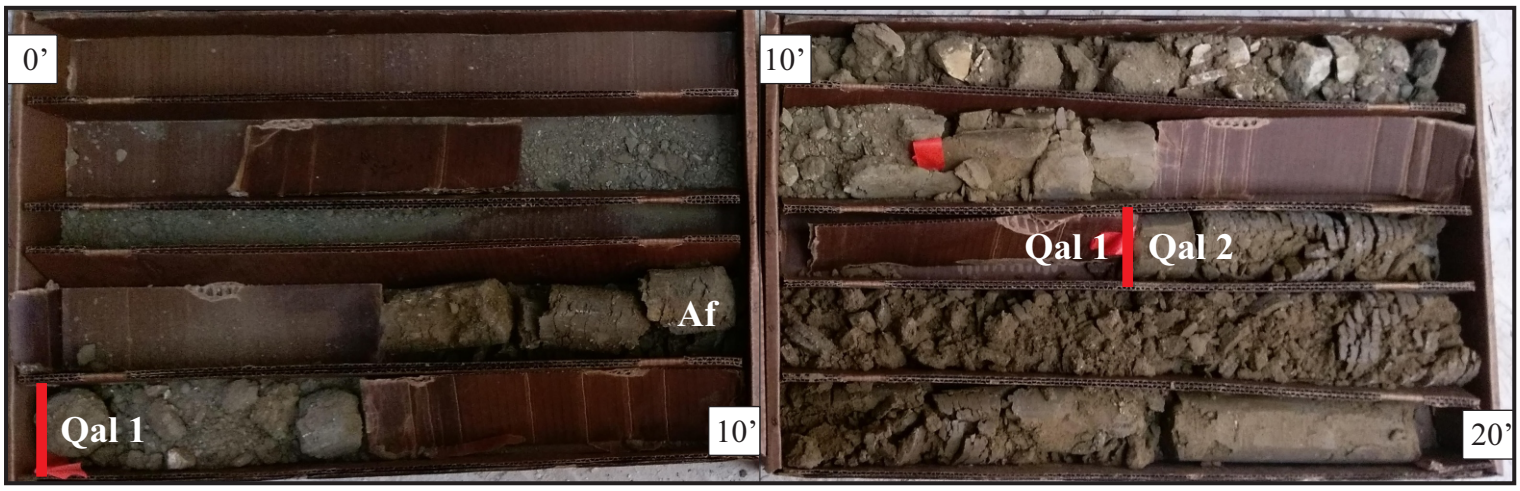
Table 6. Geological Cross Section Unit Age

Cross Sec. Unit	Transect B Description	Age (ka)
Qal1	Truncated surficial weakly developed thin soils (Surface Soil and Buried Soil 1)	4 - 8
Qal2	Truncated thick diffuse moderately well to weakly developed Alfisol soil (Buried Soil 2)	8 - 16
Qoa1	Truncated thick, well oxidized, moderately well developed Alfisol soil (Buried Soil 3)	21 - 46
Qoa2	Truncated thin weakly to moderately well developed Alfisol soil (Buried soil 4)	29 - 59

Cross Sec. Unit	Transect A Description	Age (ka)
Qal1	Truncated surficial weakly developed thin soil (Surface Soil)	4 - 8
Qal2	Truncated thick diffuse moderately well to weakly developed Alfisol soil (Buried Soil 1)	12 - 21
Qoa1	Truncated thick, well oxidized, moderately well developed Alfisol soil (Buried Soil 2)	25 - 51
Qoa2	Truncated thin weakly to moderately well developed Alfisol soil (Buried soil 3)	33 - 64
Qoa3	Truncated moderately well developed Alfisol soil (Buried soil 4)	46 - 94

Continuous Core Photographic Detail

Boring: 1







EXPLANATION

Af: Artificial fill

Qal 1: Holocene alluvium
Qal 2: Holocene alluvium

Qoa 1: Pleistocene alluvium
Qoa 2: Pleistocene alluvium
Qoa 3: Pleistocene alluvium

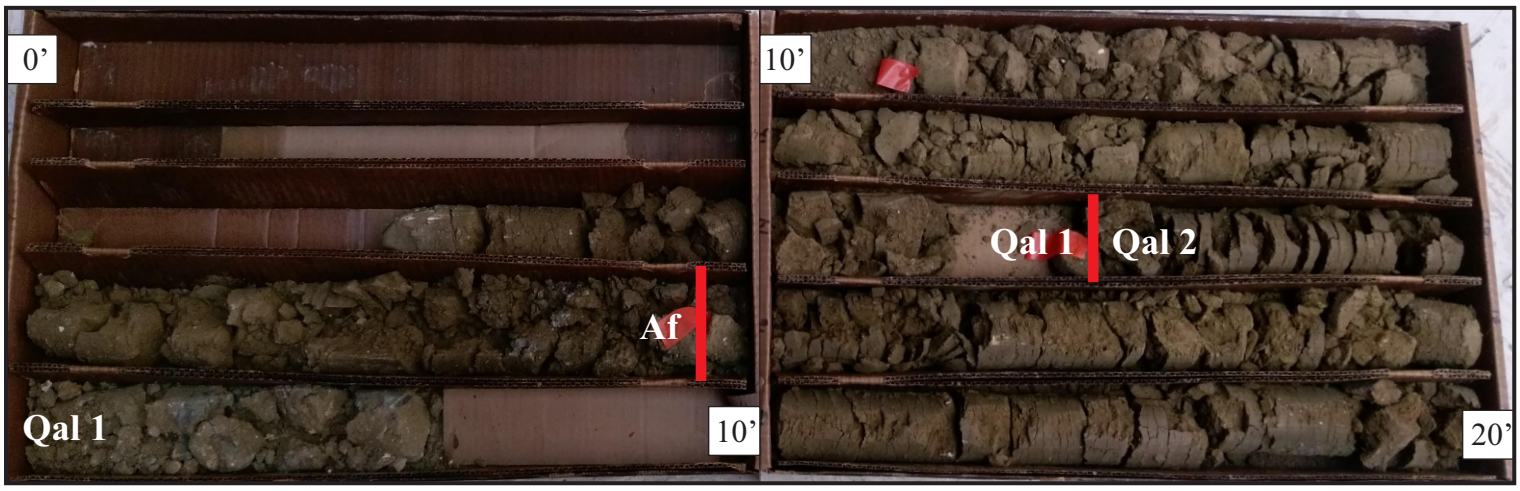
See detailed soil descriptions in Appendix B

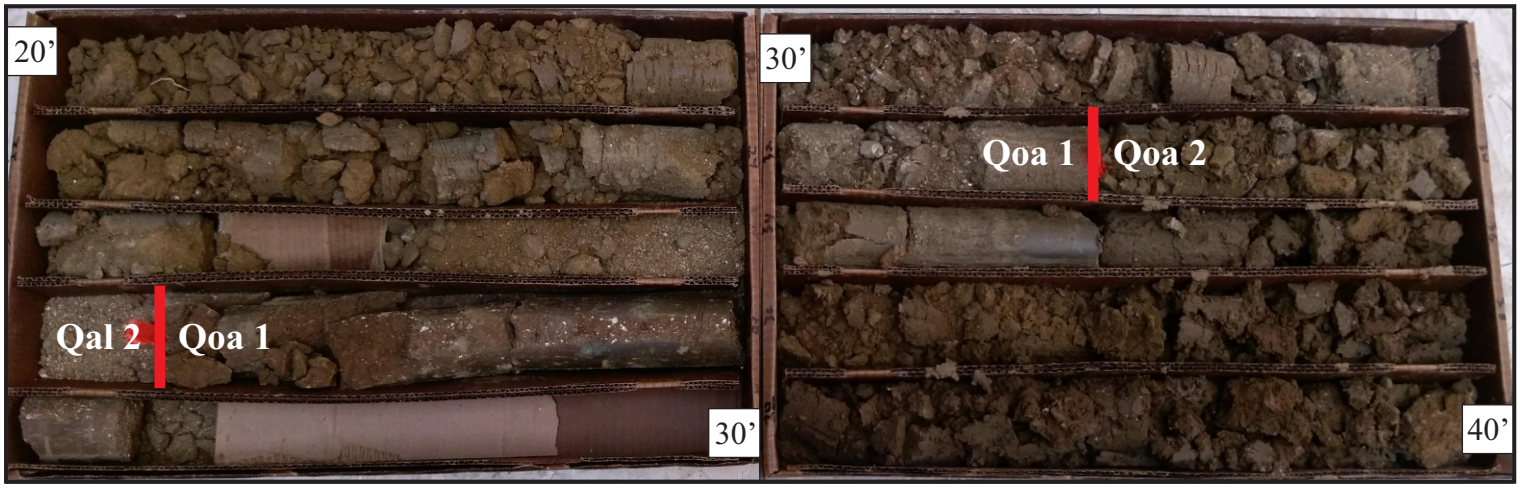
FEFFER GEOLOGICAL CONSULTING

0’ 1’ 2’
Feet

Continuous Core Photographic Detail

Boring: 2







EXPLANATION

Af: Artificial fill

Qal 1: Holocene alluvium
Qal 2: Holocene alluvium

Qoa 1: Pleistocene alluvium
Qoa 2: Pleistocene alluvium
Qoa 3: Pleistocene alluvium

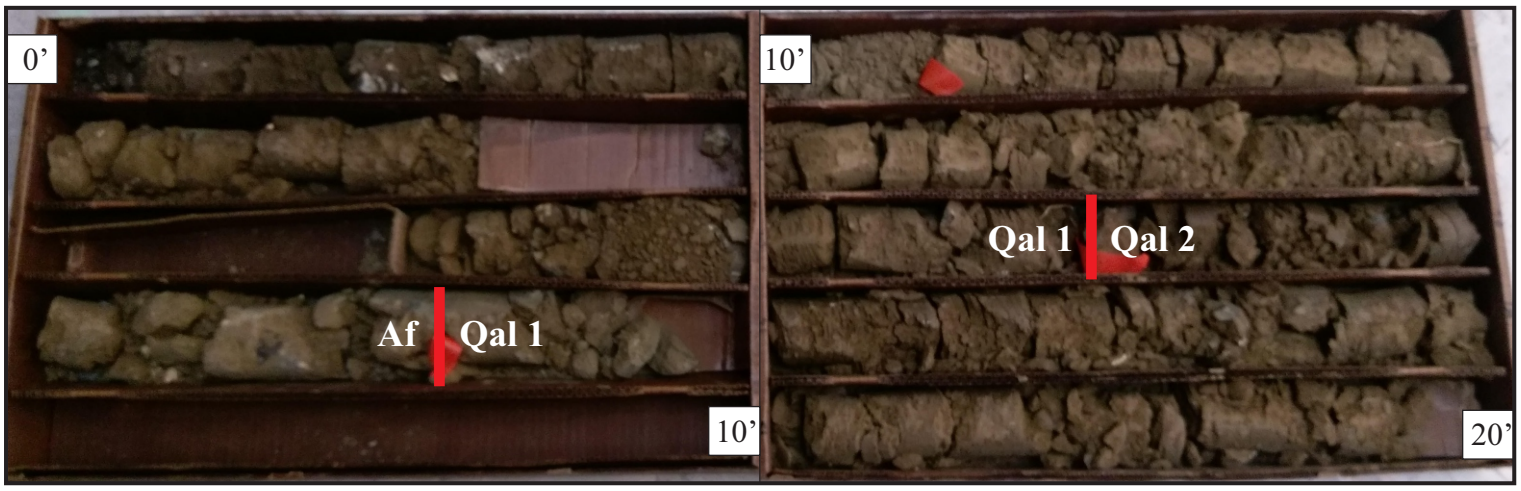
See detailed soil descriptions in Appendix B

FEFFER GEOLOGICAL CONSULTING

0’ 1’ 2’
Feet

Continuous Core Photographic Detail

Boring: 3







EXPLANATION

Af: Artificial fill

Qal 1: Holocene alluvium
Qal 2: Holocene alluvium

Qoa 1: Pleistocene alluvium
Qoa 2: Pleistocene alluvium
Qoa 3: Pleistocene alluvium

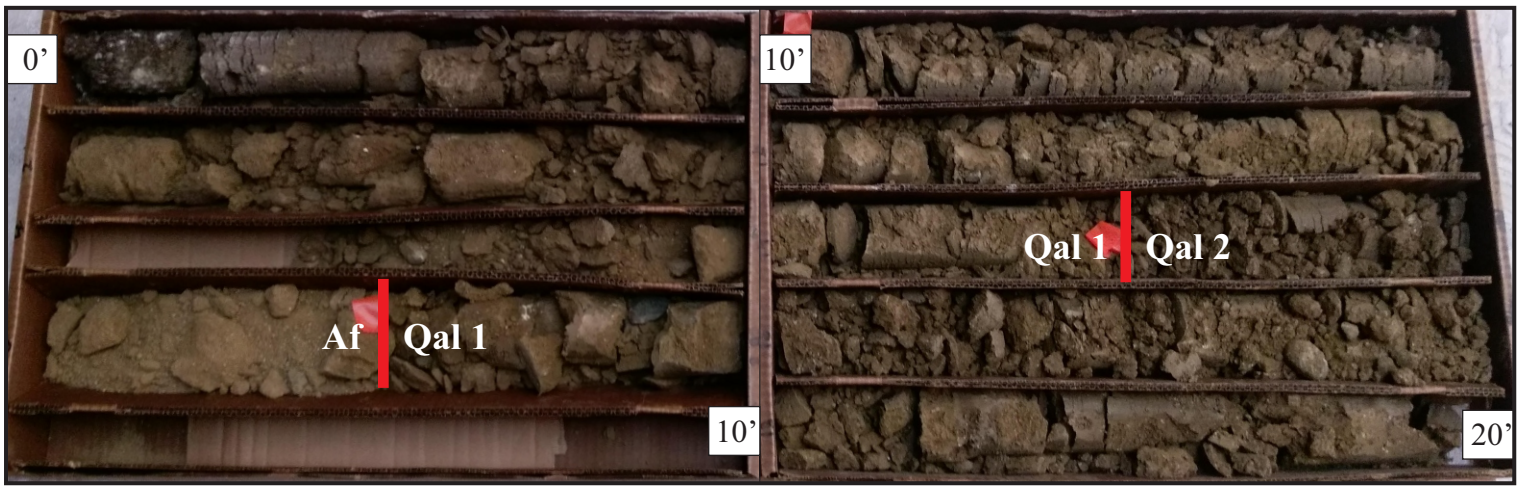
See detailed soil descriptions in Appendix B

FEFFER GEOLOGICAL CONSULTING

0’ 1’ 2’
Feet

Continuous Core Photographic Detail

Boring: 4







EXPLANATION

Af: Artificial fill

Qal 1: Holocene alluvium
Qal 2: Holocene alluvium

Qoa 1: Pleistocene alluvium
Qoa 2: Pleistocene alluvium
Qoa 3: Pleistocene alluvium

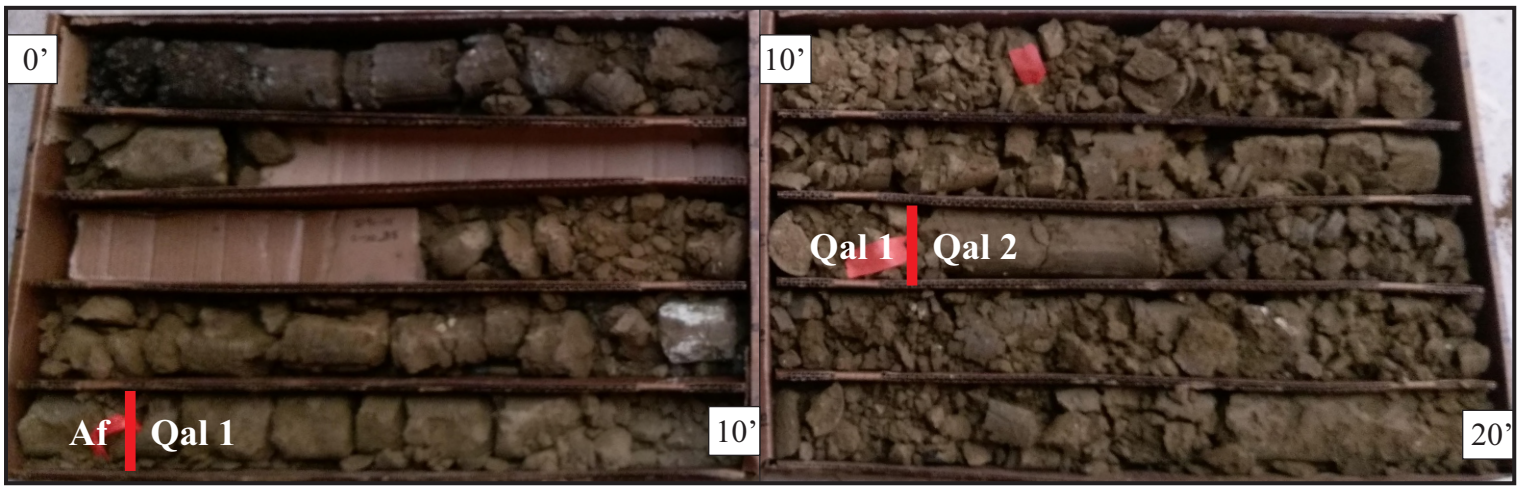
See detailed soil descriptions in Appendix B

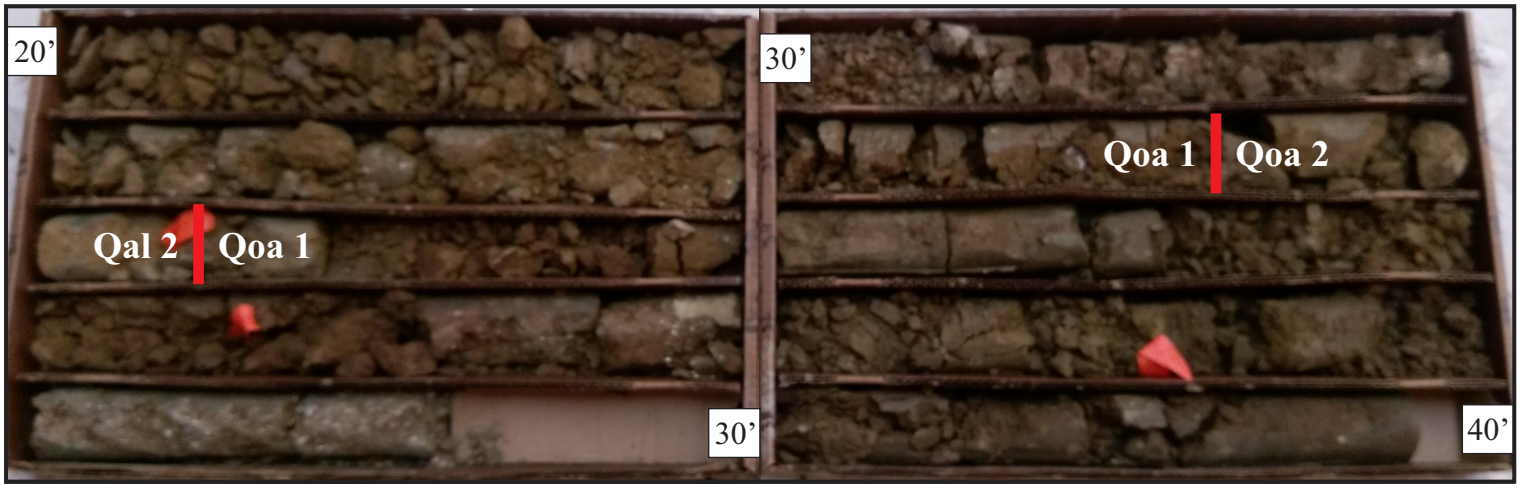
FEFFER GEOLOGICAL CONSULTING

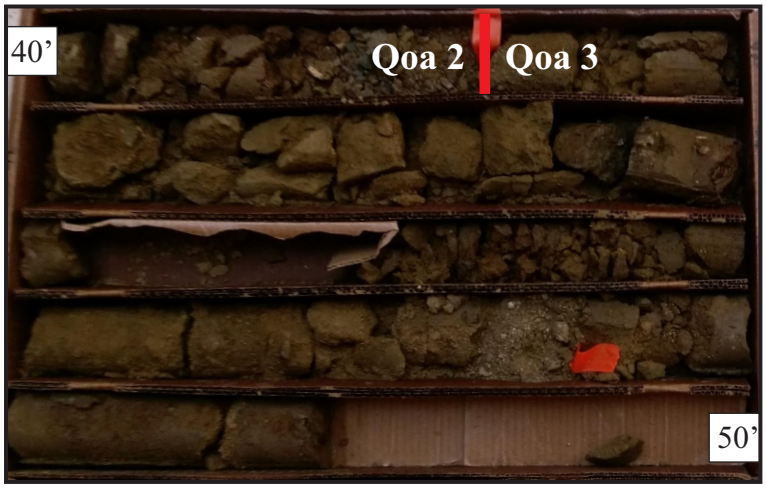
0’ 1’ 2’
Feet

Continuous Core Photographic Detail

Boring: 5







EXPLANATION

Af: Artificial fill

Qal 1: Holocene alluvium
Qal 2: Holocene alluvium

Qoa 1: Pleistocene alluvium
Qoa 2: Pleistocene alluvium
Qoa 3: Pleistocene alluvium

See detailed soil descriptions in Appendix B

FEFFER GEOLOGICAL CONSULTING

0’ 1’ 2’
Feet

APPENDIX 'C'

CPT Reporting

8/3/18

Feffer Geological Consulting
Attn: Alexander Greene

Subject: CPT Site Investigation
468 Rodeo Drive
Beverly Hills, California
GREGG Project Number: 180590SH

Dear Mr. Greene:

The following report presents the results of GREGG Drilling & Testing's Cone Penetration Test investigation for the above referenced site. The following testing services were performed:

1	Cone Penetration Tests	(CPTU)	☒
2	Pore Pressure Dissipation Tests	(PPD)	☐
3	Seismic Cone Penetration Tests	(SCPTU)	☐
4	UVOST Laser Induced Fluorescence	(UVOST)	☐
5	Groundwater Sampling	(GWS)	☐
6	Soil Sampling	(SS)	☐
7	Vapor Sampling	(VS)	☐
8	Pressuremeter Testing	(PMT)	☐
9	Vane Shear Testing	(VST)	☐
10	Dilatometer Testing	(DMT)	☐

A list of reference papers providing additional background on the specific tests conducted is provided in the bibliography following the text of the report. If you would like a copy of any of these publications or should you have any questions or comments regarding the contents of this report, please do not hesitate to contact our office at (562) 427-6899.

Sincerely,
GREGG Drilling & Testing, Inc.



Frank Stolfi
HRSC Division Manager, Gregg Drilling & Testing, Inc.

Cone Penetration Test Sounding Summary

-Table 1-

CPT Sounding Identification	Date	Termination Depth (feet)	Depth of Groundwater Samples (feet)	Depth of Soil Samples (feet)	Depth of Pore Pressure Dissipation Tests (feet)
CPT-1	7/31/2018	49.87	-	-	-
CPT-2	7/30/2018	49.87	-	-	-
CPT-3	7/31/2018	49.87	-	-	-
CPT-4	7/31/2018	49.87	-	-	-
CPT-5	7/31/2018	49.87	-	-	-
CPT-6	7/31/2018	49.87	-	-	-
CPT-7	7/30/2018	49.87	-	-	-

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Copies of ASTM Standards are available through www.astm.org

Cone Penetration Testing Procedure (CPT)

Gregg Drilling carries out all Cone Penetration Tests (CPT) using an integrated electronic cone system, *Figure CPT*.

The cone takes measurements of tip resistance (q_c), sleeve resistance (f_s), and penetration pore water pressure (u_2). Measurements are taken at either 2.5 or 5 cm intervals during penetration to provide a nearly continuous profile. CPT data reduction and basic interpretation is performed in real time facilitating on-site decision making. The above mentioned parameters are stored electronically for further analysis and reference. All CPT soundings are performed in accordance with revised ASTM standards (D 5778-12).

The 5mm thick porous plastic filter element is located directly behind the cone tip in the u_2 location. A new saturated filter element is used on each sounding to measure both penetration pore pressures as well as measurements during a dissipation test (*PPDT*). Prior to each test, the filter element is fully saturated with oil under vacuum pressure to improve accuracy.

When the sounding is completed, the test hole is backfilled according to client specifications. If grouting is used, the procedure generally consists of pushing a hollow tremie pipe with a "knock out" plug to the termination depth of the CPT hole. Grout is then pumped under pressure as the tremie pipe is pulled from the hole. Disruption or further contamination to the site is therefore minimized.

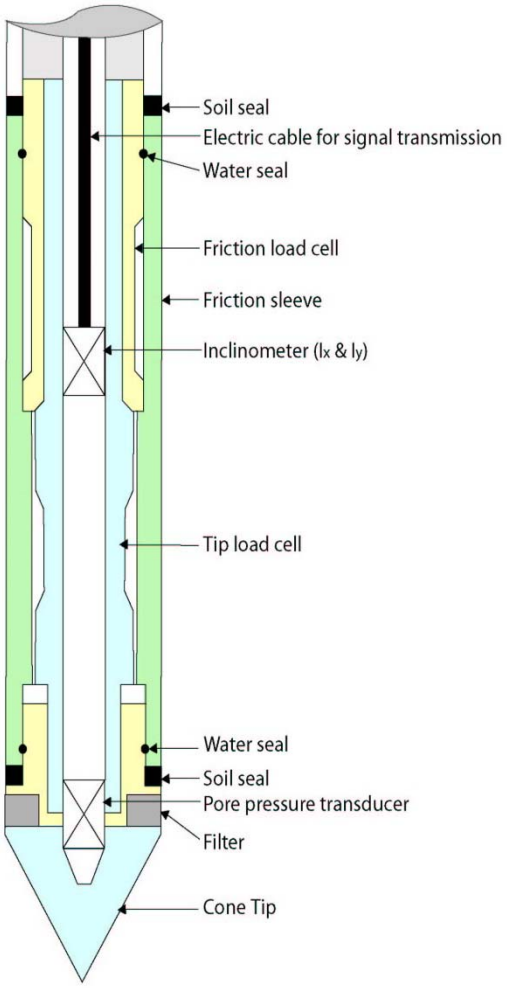


Figure CPT

Gregg 15cm^2 Standard Cone Specifications

Dimensions	
Cone base area	15 cm^2
Sleeve surface area	225 cm^2
Cone net area ratio	0.80
Specifications	
Cone load cell	
Full scale range	180 kN (20 tons)
Overload capacity	150%
Full scale tip stress	120 MPa (1,200 tsf)
Repeatability	120 kPa (1.2 tsf)
Sleeve load cell	
Full scale range	31 kN (3.5 tons)
Overload capacity	150%
Full scale sleeve stress	1,400 kPa (15 tsf)
Repeatability	1.4 kPa (0.015 tsf)
Pore pressure transducer	
Full scale range	7,000 kPa (1,000 psi)
Overload capacity	150%
Repeatability	7 kPa (1 psi)

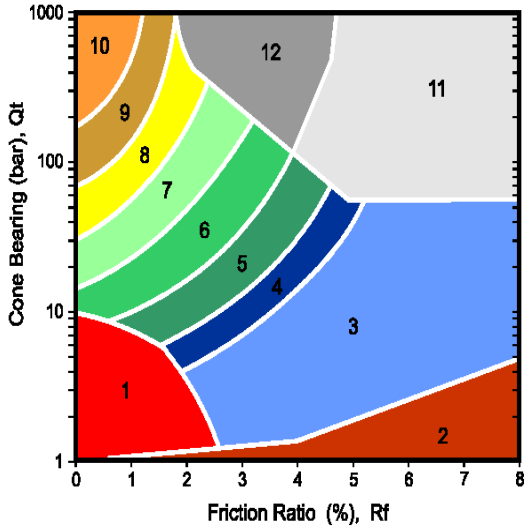
Note: The repeatability during field use will depend somewhat on ground conditions, abrasion, maintenance and zero load stability.

Cone Penetration Test Data & Interpretation

The Cone Penetration Test (CPT) data collected are presented in graphical and electronic form in the report. The plots include interpreted Soil Behavior Type (SBT) based on the charts described by Robertson (1990). Typical plots display SBT based on the non-normalized charts of Robertson et al (1986). For CPT soundings deeper than 30m, we recommend the use of the normalized charts of Robertson (1990) which can be displayed as SBTn, upon request. The report also includes spreadsheet output of computer calculations of basic interpretation in terms of SBT and SBTn and various geotechnical parameters using current published correlations based on the comprehensive review by Lunne, Robertson and Powell (1997), as well as recent updates by Professor Robertson (Guide to Cone Penetration Testing, 2015). The interpretations are presented only as a guide for geotechnical use and should be carefully reviewed. Gregg Drilling & Testing Inc. does not warranty the correctness or the applicability of any of the geotechnical parameters interpreted by the software and does not assume any liability for use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used in the software. Some interpretation methods require input of the groundwater level to calculate vertical effective stress. An estimate of the in-situ groundwater level has been made based on field observations and/or CPT results, but should be verified by the user.

A summary of locations and depths is available in Table 1. Note that all penetration depths referenced in the data are with respect to the existing ground surface.

Note that it is not always possible to clearly identify a soil type based solely on q_t, f_s, and u_2. In these situations, experience, judgment, and an assessment of the pore pressure dissipation data should be used to infer the correct soil behavior type.



ZONE		SBT
1		Sensitive, fine grained
2		Organic materials
3		Clay
4		Silty clay to clay
5		Clayey silt to silty clay
6		Sandy silt to clayey silt
7		Silty sand to sandy silt
8		Sand to silty sand
9		Sand
10		Gravely sand to sand
11		Very stiff fine grained*
12		Sand to clayey sand*

*over consolidated or cemented

Figure SBT (After Robertson et al., 1986) – Note: Colors may vary slightly compared to plots

Cone Penetration Test (CPT) Interpretation

Gregg uses a proprietary CPT interpretation and plotting software. The software takes the CPT data and performs basic interpretation in terms of soil behavior type (SBT) and various geotechnical parameters using current published empirical correlations based on the comprehensive review by Lunne, Robertson and Powell (1997). The interpretation is presented in tabular format using MS Excel. The interpretations are presented only as a guide for geotechnical use and should be carefully reviewed. Gregg does not warranty the correctness or the applicability of any of the geotechnical parameters interpreted by the software and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used in the software.

The following provides a summary of the methods used for the interpretation. Many of the empirical correlations to estimate geotechnical parameters have constants that have a range of values depending on soil type, geologic origin and other factors. The software uses 'default' values that have been selected to provide, in general, conservatively low estimates of the various geotechnical parameters.

Input:

1 Units for display (Imperial or metric) (atm. pressure, p_a = 0.96 tsf or 0.1 MPa)
2 Depth interval to average results (ft or m). Data are collected at either 0.02 or 0.05m and can be averaged every 1, 3 or 5 intervals.
3 Elevation of ground surface (ft or m)
4 Depth to water table, z_w (ft or m) – input required
5 Net area ratio for cone, a (default to 0.80)
6 Relative Density constant, C_{Dr} (default to 350)
7 Young's modulus number for sands, α (default to 5)
8 Small strain shear modulus number
  a. for sands, S_G (default to 180 for SBT_n 5, 6, 7)
  b. for clays, C_G (default to 50 for SBT_n 1, 2, 3 & 4)
9 Undrained shear strength cone factor for clays, N_{kt} (default to 15)
10 Over Consolidation ratio number, k_{ocr} (default to 0.3)
11 Unit weight of water, (default to γ_w = 62.4 lb/ft^3 or 9.81 kN/m^3)

Column

1 Depth, z, (m) – CPT data is collected in meters
2 Depth (ft)
3 Cone resistance, q_c (tsf or MPa)
4 Sleeve resistance, f_s (tsf or MPa)
5 Penetration pore pressure, u (psi or MPa), measured behind the cone (i.e. u_2)
6 Other – any additional data
7 Total cone resistance, q_t (tsf or MPa) $q_t = q_c + u\,(1-a)$

8	Friction Ratio, R_f (%)	$R_f = (f_s/q_t) \times 100\%$
9	Soil Behavior Type (non-normalized), SBT	see note
10	Unit weight, γ (pcf or kN/m^3)	based on SBT, see note
11	Total overburden stress, σ_v (tsf)	$\sigma_{vo} = \sigma\, z$
12	In-situ pore pressure, u_o (tsf)	$u_o = \gamma_w (z - z_w)$
13	Effective overburden stress, σ'_{vo} (tsf)	$\sigma'_{vo} = \sigma_{vo} - u_o$
14	Normalized cone resistance, Q_{t1}	$Q_{t1} = (q_t - \sigma_{vo}) / \sigma'_{vo}$
15	Normalized friction ratio, F_r (%)	$F_r = f_s / (q_t - \sigma_{vo}) \times 100\%$
16	Normalized Pore Pressure ratio, B_q	$B_q = u - u_o / (q_t - \sigma_{vo})$
17	Soil Behavior Type (normalized), SBT_n	see note
18	SBT_n Index, I_c	see note
19	Normalized Cone resistance, Q_{tn} (n varies with I_c)	see note
20	Estimated permeability, k_{SBT} (cm/sec or ft/sec)	see note
21	Equivalent SPT N_{60}, blows/ft	see note
22	Equivalent SPT $(N_1)_{60}$ blows/ft	see note
23	Estimated Relative Density, D_r, (%)	see note
24	Estimated Friction Angle, ϕ', (degrees)	see note
25	Estimated Young's modulus, E_s (tsf)	see note
26	Estimated small strain Shear modulus, Go (tsf)	see note
27	Estimated Undrained shear strength, s_u (tsf)	see note
28	Estimated Undrained strength ratio	s_u/σ_v'
29	Estimated Over Consolidation ratio, OCR	see note

Notes:

1 Soil Behavior Type (non-normalized), SBT (Lunne et al., 1997 and table below)

2 Unit weight, γ either constant at 119 pcf or based on Non-normalized SBT (Lunne et al., 1997 and table below)

3 Soil Behavior Type (Normalized), SBT_n Lunne et al. (1997)

4 SBT_n Index, I_c $I_c = ((3.47 - \log Q_{t1})^2 + (\log F_r + 1.22)^2)^{0.5}$

5 Normalized Cone resistance, Q_{tn} (n varies with Ic)

$Q_{tn} = ((q_t - \sigma_{vo})/pa)\ (pa/(\sigma'_{vo})^n$ and recalculate I_c, then iterate:

When $I_c < 1.64$, n = 0.5 (clean sand)
When $I_c > 3.30$, n = 1.0 (clays)
When $1.64 < I_c < 3.30$, $n = (I_c - 1.64)0.3 + 0.5$
Iterate until the change in n, $\Delta n < 0.01$

6 Estimated permeability, k_{SBT} based on Normalized SBT_n (Lunne et al., 1997 and table below)

7 Equivalent SPT N_{60}, blows/ft Lunne et al. (1997)

$$\frac{(q_t/p_a)}{N_{60}} = 8.5\left(1 - \frac{I_c}{4.6}\right)$$

8 Equivalent SPT $(N_1)_{60}$ blows/ft $(N_1)_{60} = N_{60}\, C_N$,
where $C_N = (pa/\sigma'_{vo})^{0.5}$

9 Relative Density, D_r, (%) $D_r^2 = Q_{tn} / C_{Dr}$
Only SBT_n 5, 6, 7 & 8 *Show 'N/A' in zones 1, 2, 3, 4 & 9*

10 Friction Angle, ϕ', (degrees) $\tan\phi' = \frac{1}{2.68}\left[\log\left(\frac{q_c}{\sigma'_{vo}}\right) + 0.29\right]$
Only SBT_n 5, 6, 7 & 8 *Show'N/A' in zones 1, 2, 3, 4 & 9*

11 Young's modulus, E_s $E_s = \alpha\, q_t$
Only SBT_n 5, 6, 7 & 8 *Show 'N/A' in zones 1, 2, 3, 4 & 9*

12 Small strain shear modulus, Go

a. $G_o = S_G\,(q_t\ \sigma'_{vo}\ pa)^{1/3}$ *For SBT_n 5, 6, 7*

b. $G_o = C_G\, q_t$ *For SBT_n 1, 2, 3& 4*

Show 'N/A' in zones 8 & 9

13 Undrained shear strength, s_u $s_u = (q_t - \sigma_{vo}) / N_{kt}$
Only SBT_n 1, 2, 3, 4 & 9 *Show 'N/A' in zones 5, 6, 7 & 8*

14 Over Consolidation ratio, OCR $OCR = k_{ocr}\, Q_{t1}$
Only SBT_n 1, 2, 3, 4 & 9 *Show 'N/A' in zones 5, 6, 7 & 8*

The following updated and simplified SBT descriptions have been used in the software:

SBT Zones		**SBT_n Zones**	
1	sensitive fine grained	1	sensitive fine grained
2	organic soil	2	organic soil
3	clay	3	clay
4	clay & silty clay	4	clay & silty clay
5	clay & silty clay		
6	sandy silt & clayey silt		

7	silty sand & sandy silt	5	silty sand & sandy silt
8	sand & silty sand	6	sand & silty sand
9	sand		
10	sand	7	sand
11	very dense/stiff soil*	8	very dense/stiff soil*
12	very dense/stiff soil*	9	very dense/stiff soil*

*heavily overconsolidated and/or cemented

Track when soils fall with zones of same description and print that description (i.e. if soils fall only within SBT zones 4 & 5, print 'clays & silty clays')

Estimated Permeability (see Lunne et al., 1997)

SBT_n	Permeability (ft/sec)	(m/sec)
1	$3x\ 10^{-8}$	$1x\ 10^{-8}$
2	$3x\ 10^{-7}$	$1x\ 10^{-7}$
3	$1x\ 10^{-9}$	$3x\ 10^{-10}$
4	$3x\ 10^{-8}$	$1x\ 10^{-8}$
5	$3x\ 10^{-6}$	$1x\ 10^{-6}$
6	$3x\ 10^{-4}$	$1x\ 10^{-4}$
7	$3x\ 10^{-2}$	$1x\ 10^{-2}$
8	$3x\ 10^{-6}$	$1x\ 10^{-6}$
9	$1x\ 10^{-8}$	$3x\ 10^{-9}$

Estimated Unit Weight (see Lunne et al., 1997)

SBT	Approximate Unit Weight (lb/ft^3)	(kN/m^3)
1	111.4	17.5
2	79.6	12.5
3	111.4	17.5
4	114.6	18.0
5	114.6	18.0
6	114.6	18.0
7	117.8	18.5
8	120.9	19.0
9	124.1	19.5
10	127.3	20.0
11	130.5	20.5
12	120.9	19.0

Pore Pressure Dissipation Tests (PPDT)

Pore Pressure Dissipation Tests (PPDT's) conducted at various intervals can be used to measure equilibrium water pressure (at the time of the CPT). If conditions are hydrostatic, the equilibrium water pressure can be used to determine the approximate depth of the ground water table. A PPDT is conducted when penetration is halted at specific intervals determined by the field representative. The variation of the penetration pore pressure (*u)* with time is measured behind the tip of the cone and recorded.

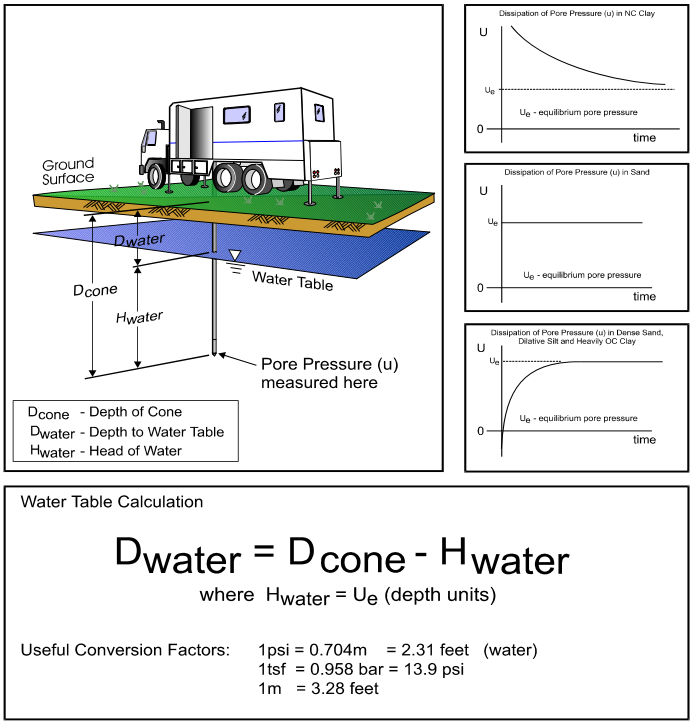
Pore pressure dissipation data can be interpreted to provide estimates of:

- Equilibrium piezometric pressure
- Phreatic Surface
- In situ horizontal coefficient of consolidation (c_h)
- In situ horizontal coefficient of permeability (k_h)

In order to correctly interpret the equilibrium piezometric pressure and/or the phreatic surface, the pore pressure must be monitored until it reaches equilibrium, *Figure PPDT*. This time is commonly referred to as t_{100}, the point at which 100% of the excess pore pressure has dissipated.

A complete reference on pore pressure dissipation tests is presented by Robertson et al. 1992 and Lunne et al. 1997.

A summary of the pore pressure dissipation tests are summarized in Table 1.



Water Table Calculation

$$D_{water} = D_{cone} - H_{water}$$

where $H_{water} = U_e$ (depth units)

Useful Conversion Factors: 1psi = 0.704m = 2.31 feet (water)
1tsf = 0.958 bar = 13.9 psi
1m = 3.28 feet

Figure PPDT

Seismic Cone Penetration Testing (SCPT)

Seismic Cone Penetration Testing (SCPT) can be conducted at various intervals during the Cone Penetration Test. Shear wave velocity (Vs) can then be calculated over a specified interval with depth. A small interval for seismic testing, such as 1-1.5m (3-5ft) allows for a detailed look at the shear wave profile with depth. Conversely, a larger interval such as 3-6m (10-20ft) allows for a more average shear wave velocity to be calculated. Gregg's cones have a horizontally active geophone located 0.2m (0.66ft) behind the tip.

To conduct the seismic shear wave test, the penetration of the cone is stopped and the rods are decoupled from the rig. An automatic hammer is triggered to send a shear wave into the soil. The distance from the source to the cone is calculated knowing the total depth of the cone and the horizontal offset distance between the source and the cone. To calculate an interval velocity, a minimum of two tests must be performed at two different depths. The arrival times between the two wave traces are compared to obtain the difference in time (Δt). The difference in depth is calculated (Δd) and velocity can be determined using the simple equation: $v = \Delta d/\Delta t$

Multiple wave traces can be recorded at the same depth to improve quality of the data.

A complete reference on seismic cone penetration tests is presented by Robertson et al. 1986 and Lunne et al. 1997.

A summary the shear wave velocities, arrival times and wave traces are provided with the report.

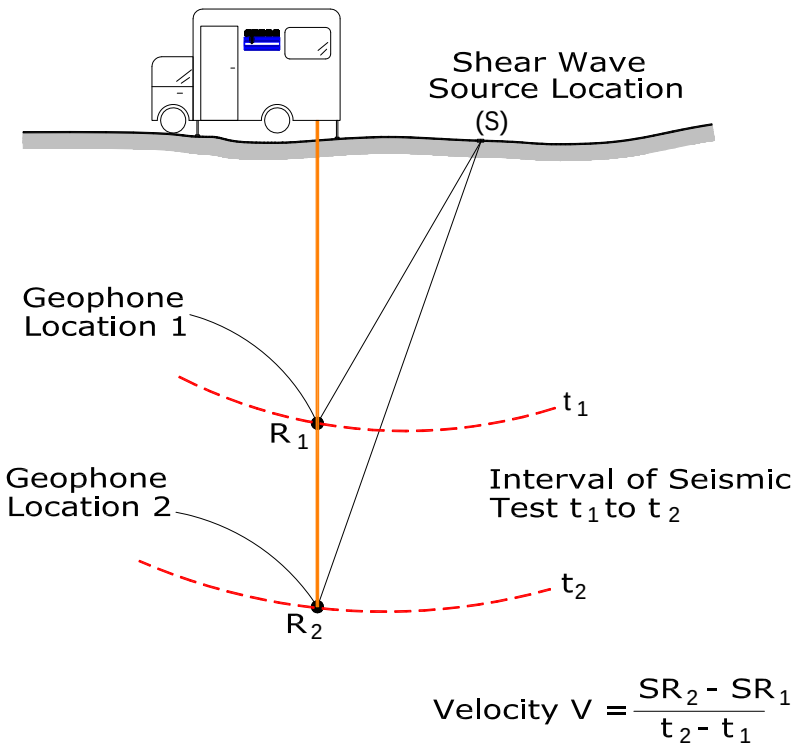


Figure SCPT

Groundwater Sampling

Gregg Drilling & Testing, Inc. conducts groundwater sampling using a sampler as shown in *Figure GWS*. The groundwater sampler has a retrievable stainless steel or disposable PVC screen with steel drop off tip. This allows for samples to be taken at multiple depth intervals within the same sounding location. In areas of slower water recharge, provisions may be made to set temporary PVC well screens during sampling to allow the pushing equipment to advance to the next sample location while the groundwater is allowed to infiltrate.

The groundwater sampler operates by advancing 44.5mm (1¾ inch) hollow push rods with the filter tip in a closed configuration to the base of the desired sampling interval. Once at the desired sample depth, the push rods are retracted; exposing the encased filter screen and allowing groundwater to infiltrate hydrostatically from the formation into the inlet screen. A small diameter bailer (approximately ½ or ¾ inch) is lowered through the push rods into the screen section for sample collection. The number of downhole trips with the bailer and time necessary to complete the sample collection at each depth interval is a function of sampling protocols, volume requirements, and the yield characteristics and storage capacity of the formation. Upon completion of sample collection, the push rods and sampler, with the exception of the PVC screen and steel drop off tip are retrieved to the ground surface, decontaminated and prepared for the next sampling event.

For a detailed reference on direct push groundwater sampling, refer to Zemo et. al., 1992.

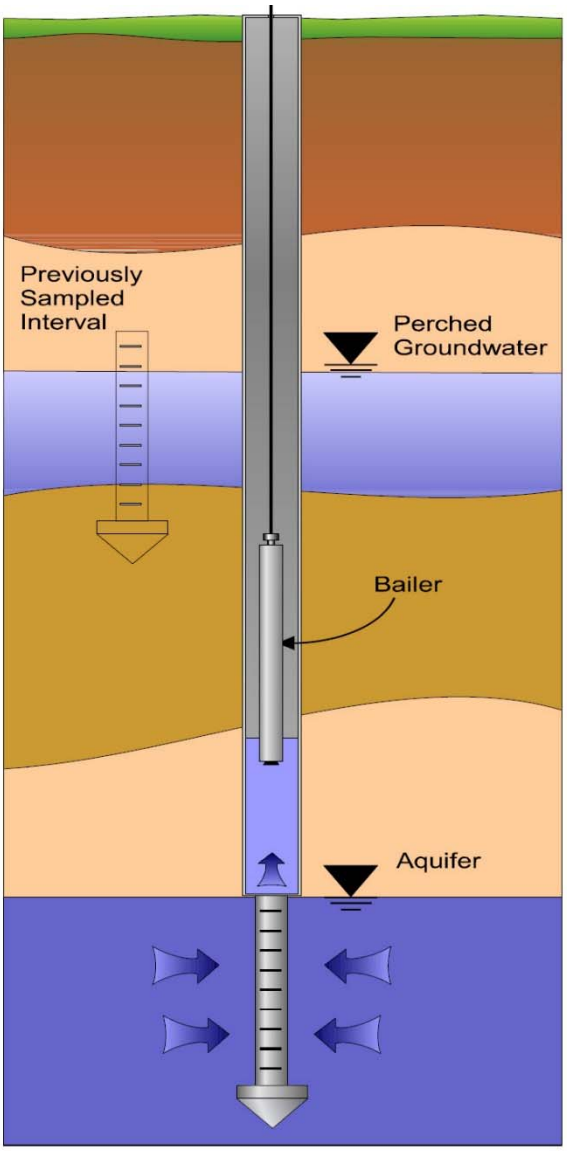


Figure GWS

Soil Sampling

Gregg Drilling & Testing, Inc. uses a piston-type push-in sampler to obtain small soil samples without generating any soil cuttings, *Figure SS*. Two different types of samplers (12 and 18 inch) are used depending on the soil type and density. The soil sampler is initially pushed in a "closed" position to the desired sampling interval using the CPT pushing equipment. Keeping the sampler closed minimizes the potential of cross contamination. The inner tip of the sampler is then retracted leaving a hollow soil sampler with inner 1¼" diameter sample tubes. The hollow sampler is then pushed in a locked "open" position to collect a soil sample. The filled sampler and push rods are then retrieved to the ground surface. Because the soil enters the sampler at a constant rate, the opportunity for 100% recovery is increased. For environmental analysis, the soil sample tube ends are sealed with Teflon and plastic caps. Often, a longer "split tube" can be used for geotechnical sampling.

For a detailed reference on direct push soil sampling, refer to Robertson et al, 1998.

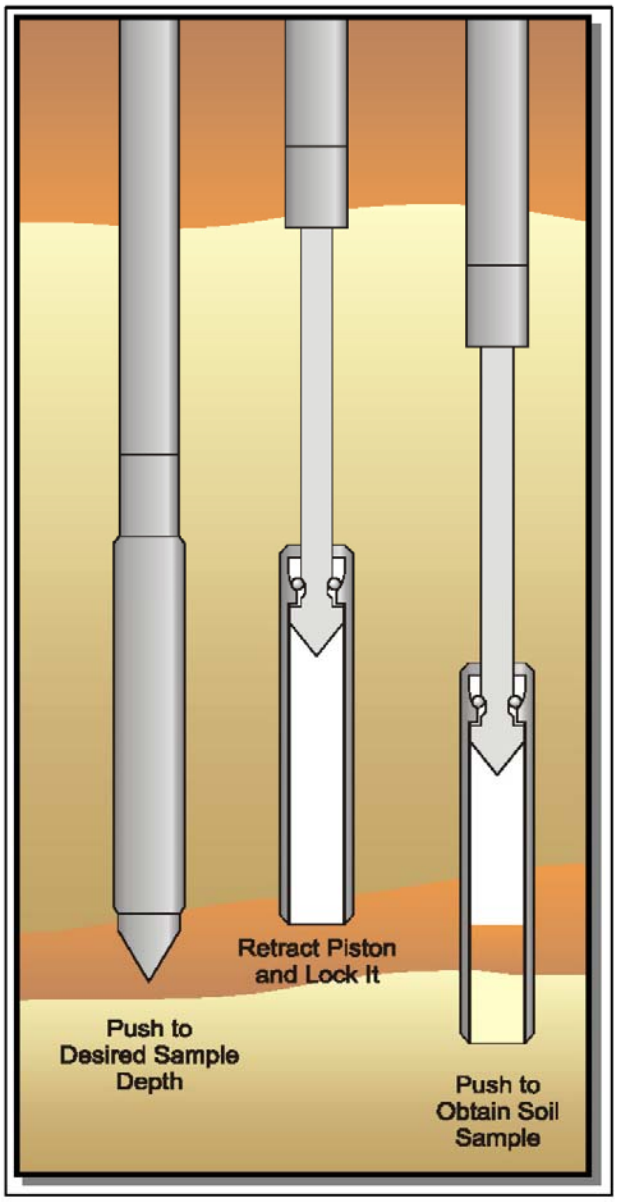


Figure SS

GREGG DRILLING, INC.
www.greggdrilling.com

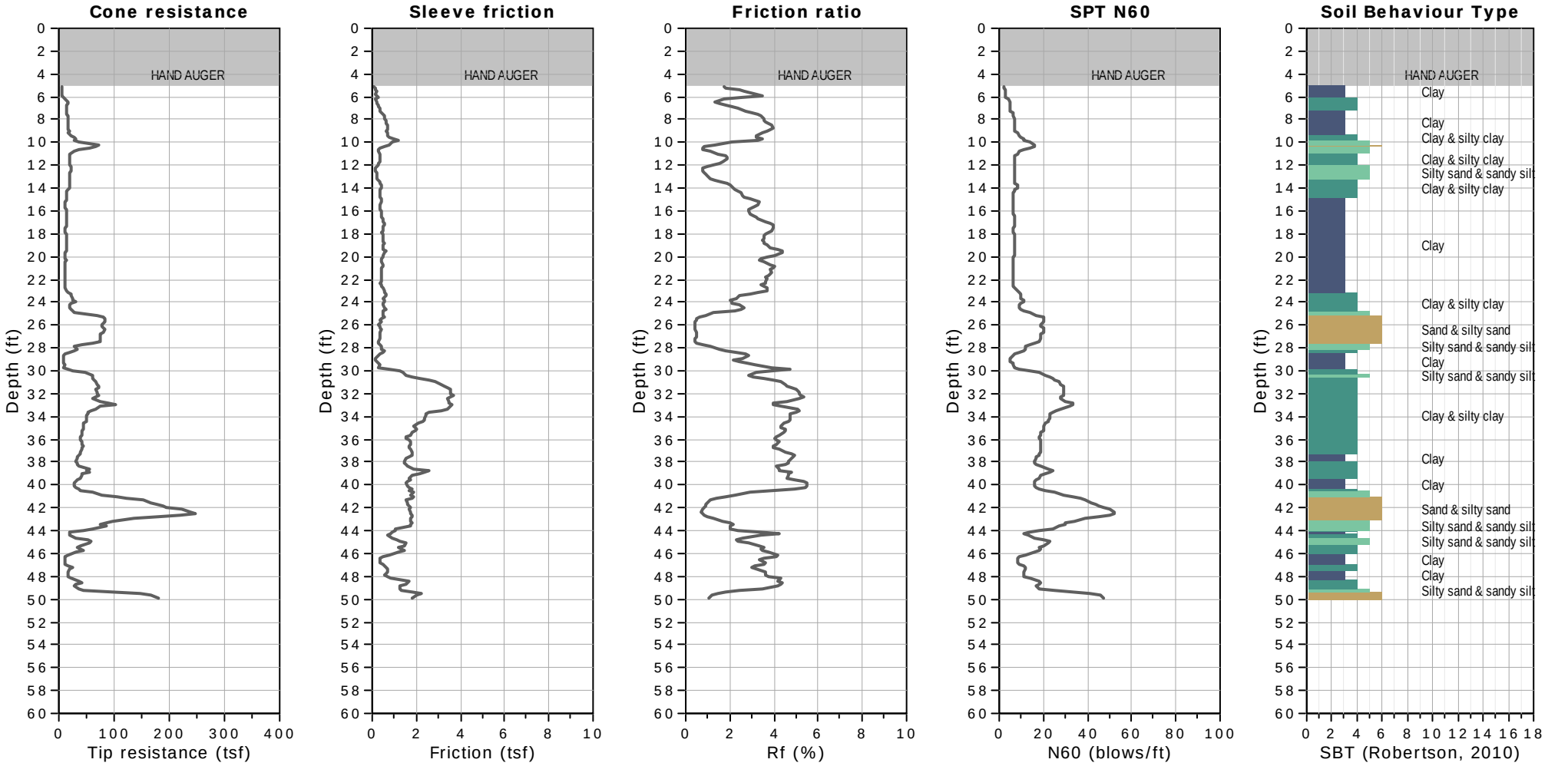
CPT: CPT-1

CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/31/2018

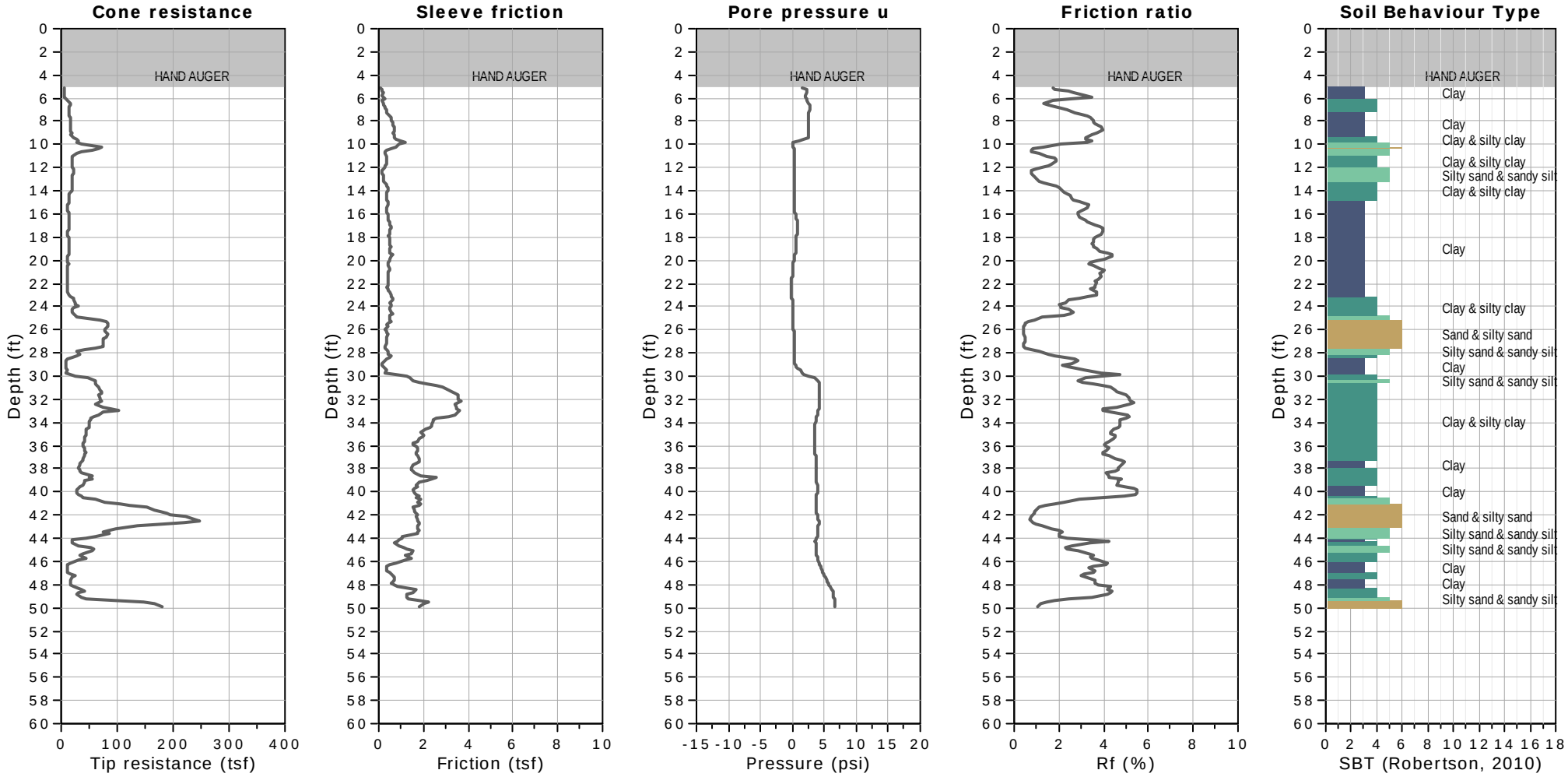


CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/31/2018



WATER TABLE FOR ESTIMATING PURPOSES ONLY

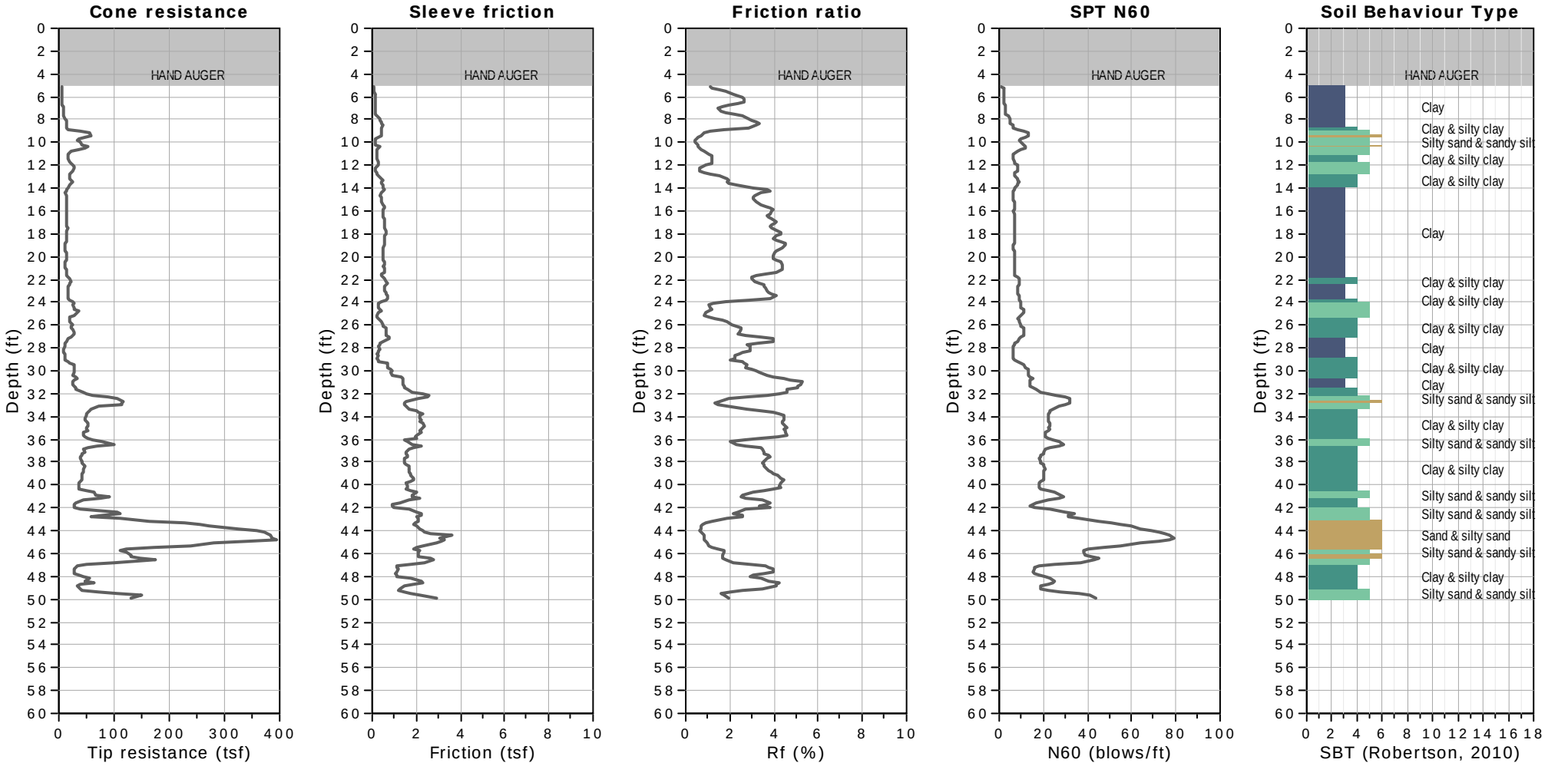
CPT: CPT-2

CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/30/2018

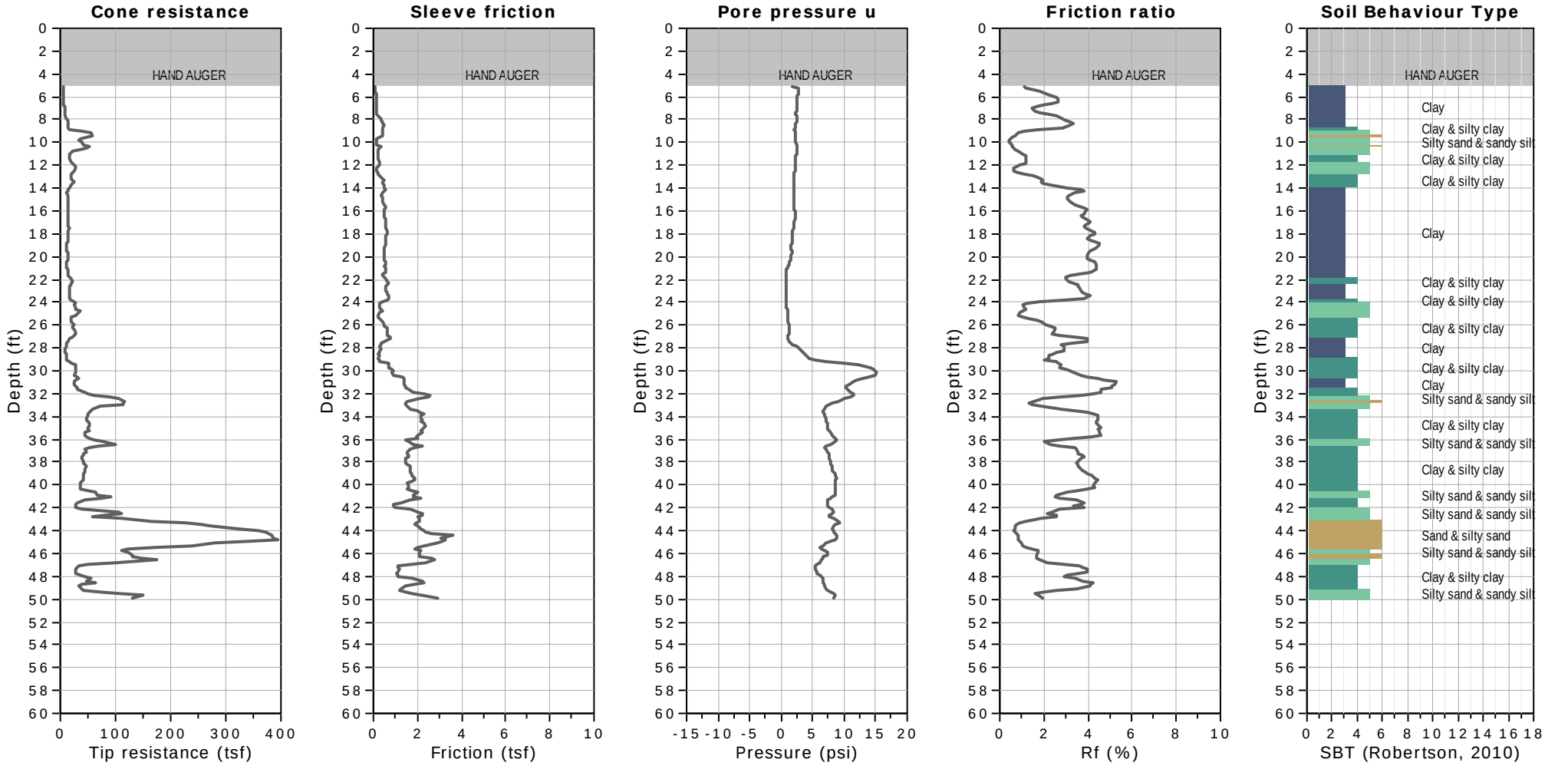


CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/30/2018



WATER TABLE FOR ESTIMATING PURPOSES ONLY

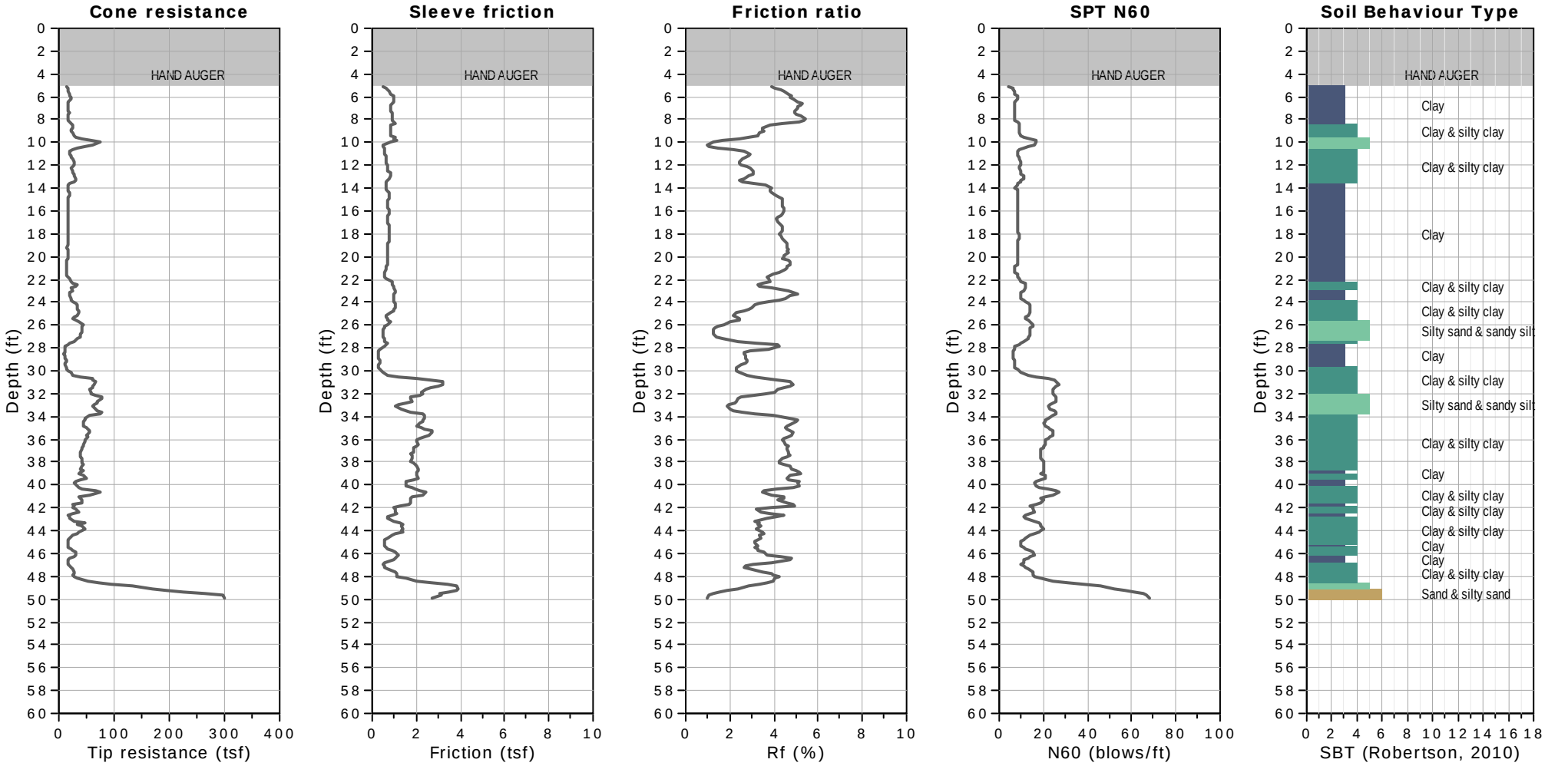
CPT: CPT-3

CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/31/2018

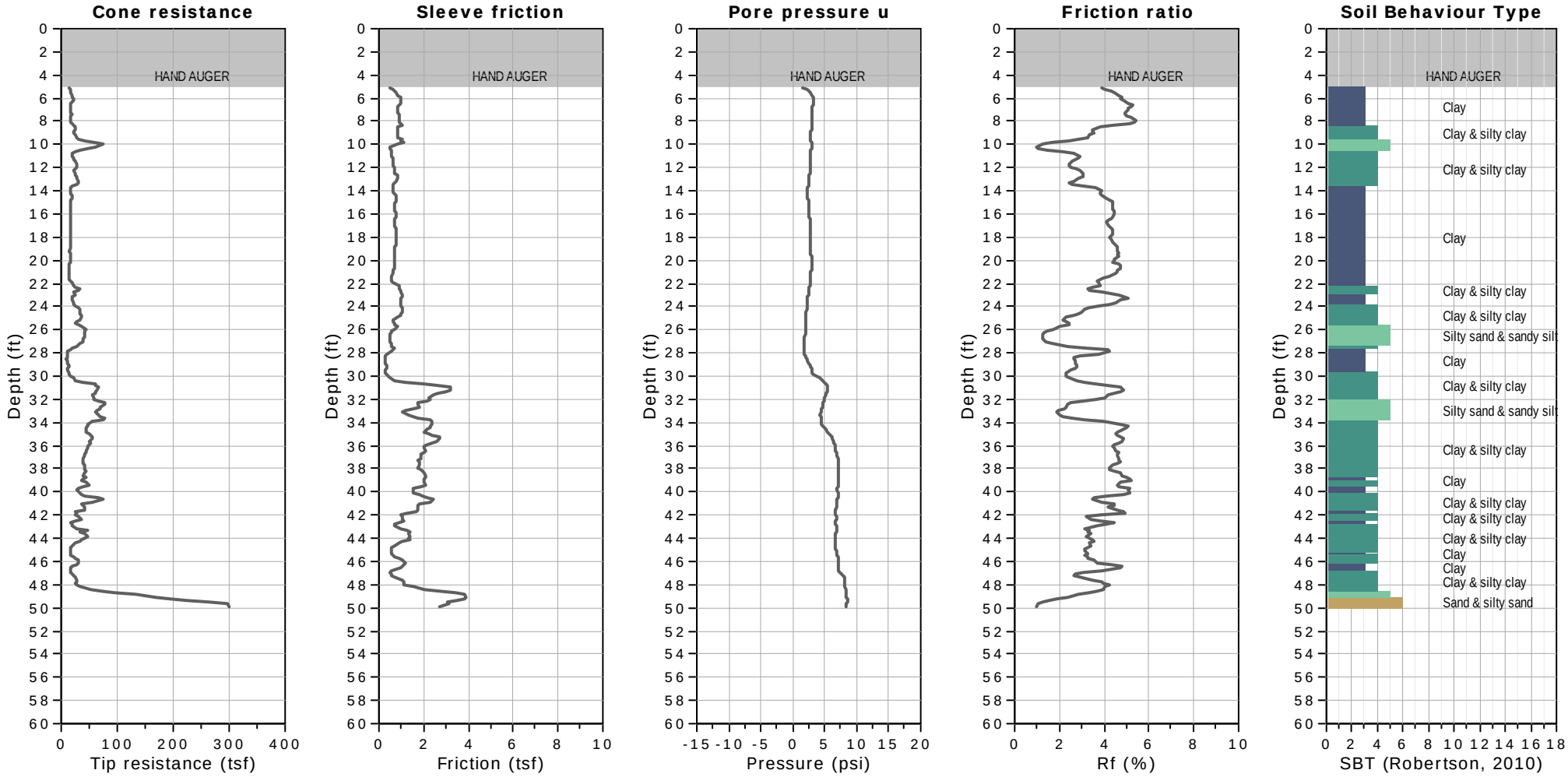


CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/31/2018



WATER TABLE FOR ESTIMATING PURPOSES ONLY

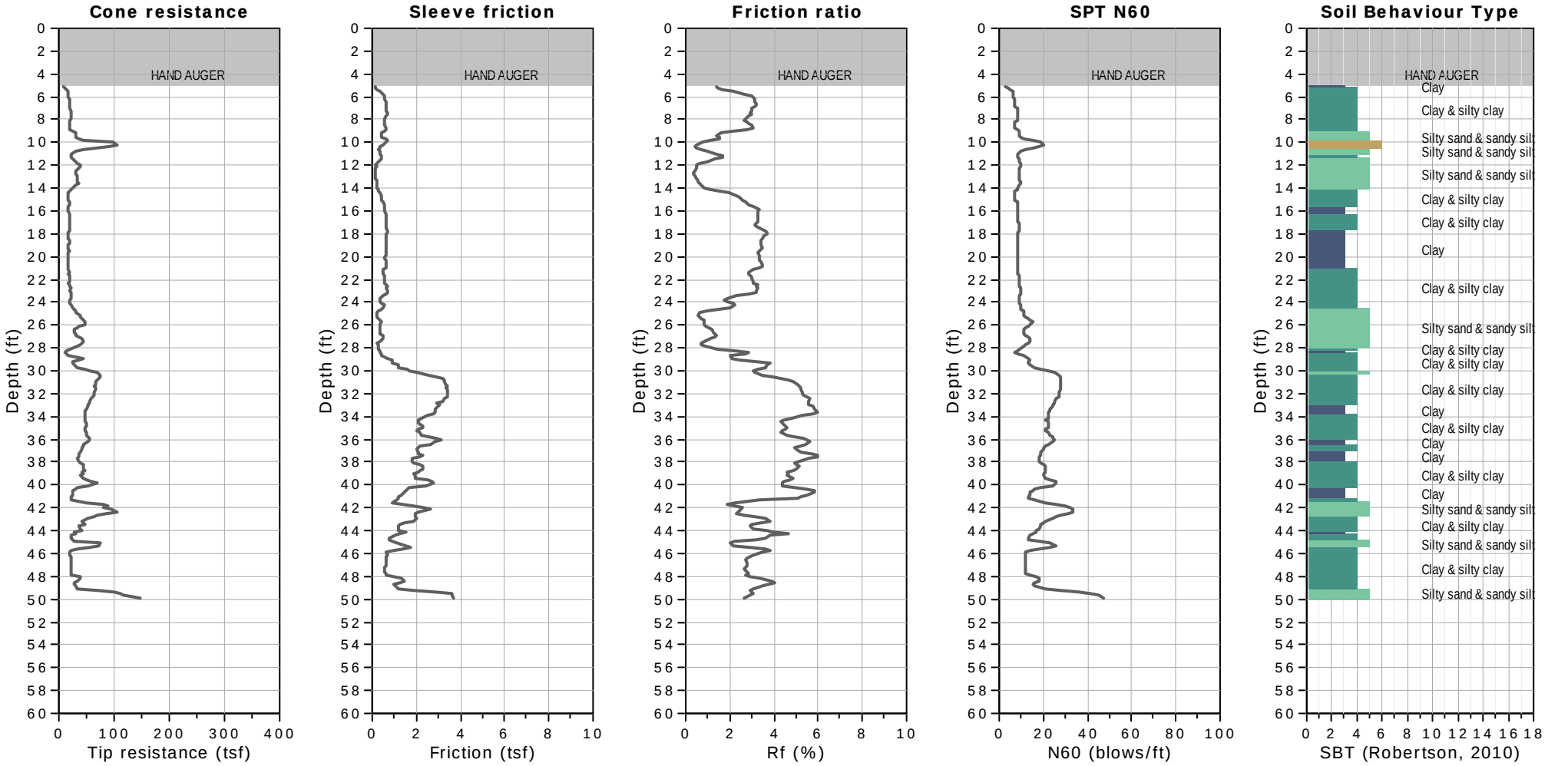
CPT: CPT-4

CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/31/2018

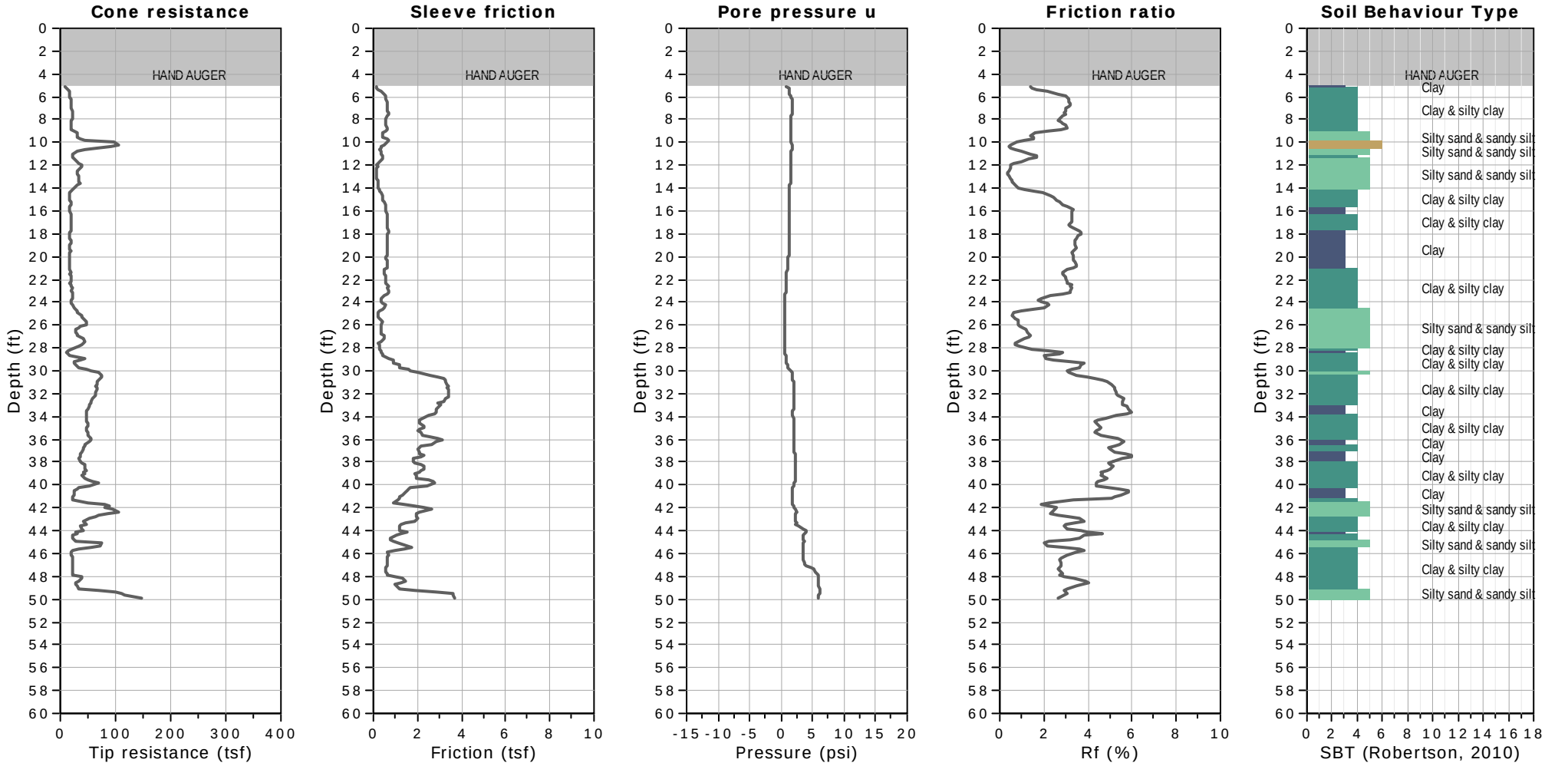


CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/31/2018



WATER TABLE FOR ESTIMATING PURPOSES ONLY

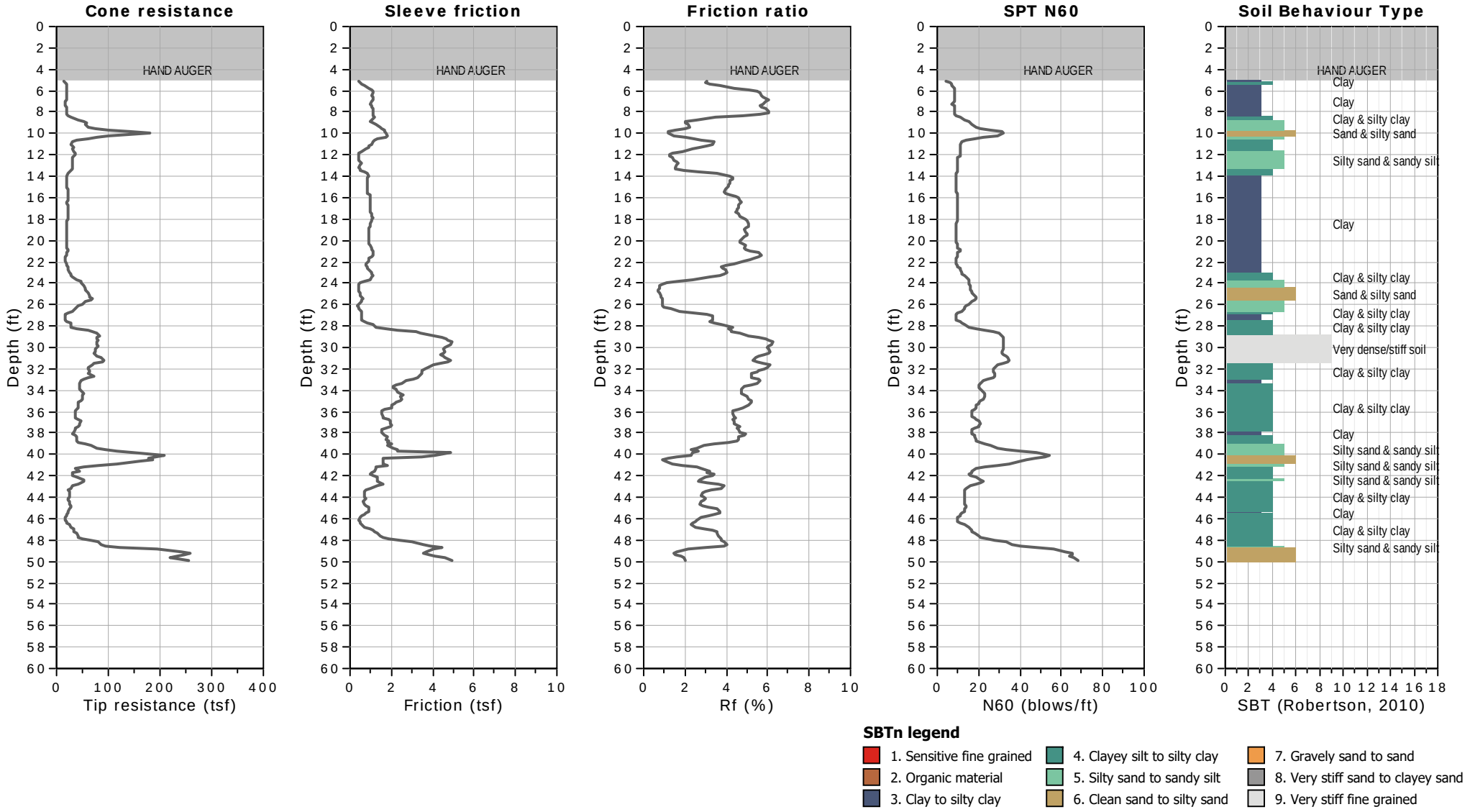
CPT: CPT-5

CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/31/2018

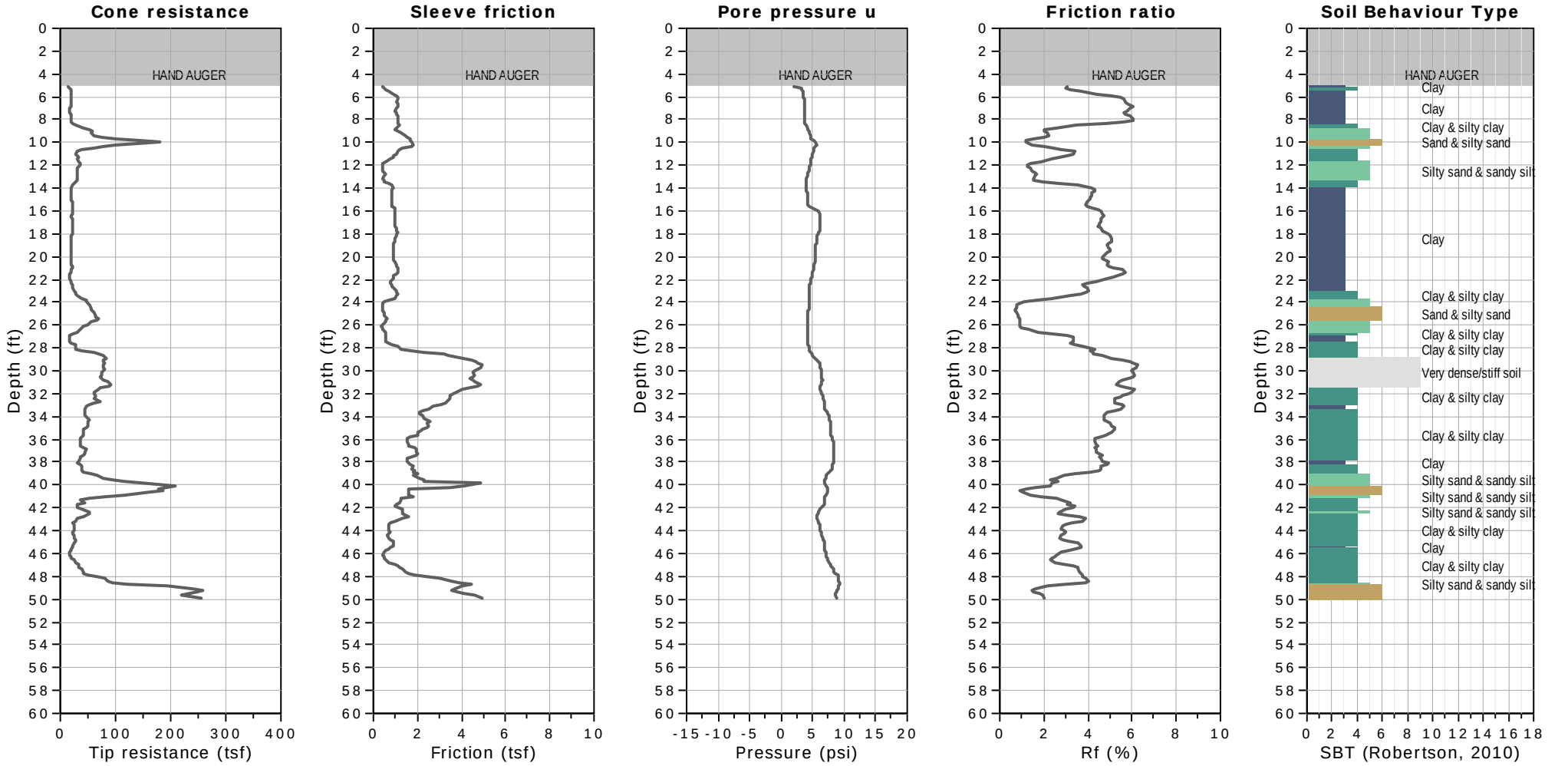


CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/31/2018



WATER TABLE FOR ESTIMATING PURPOSES ONLY

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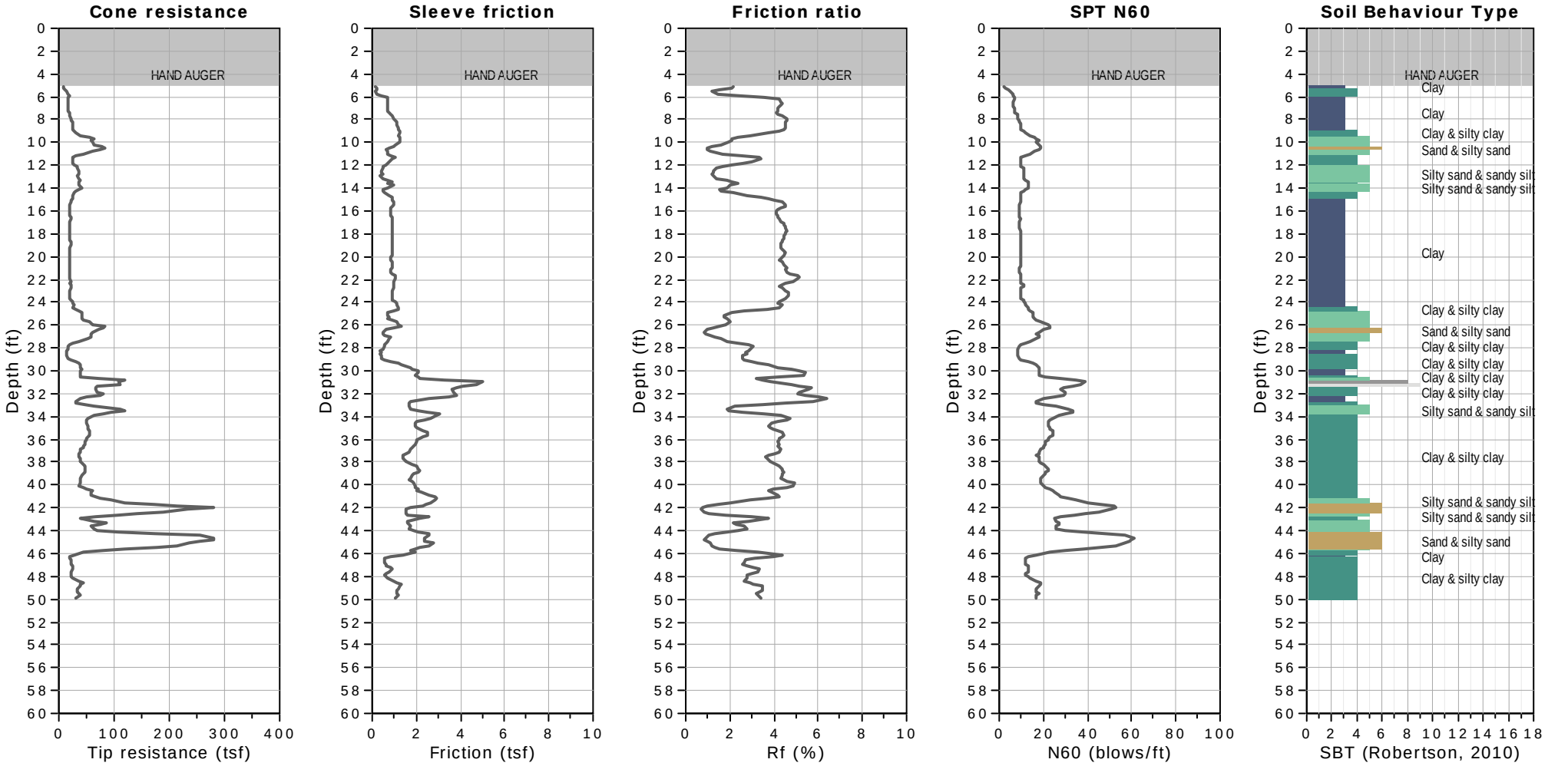
SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/31/2018

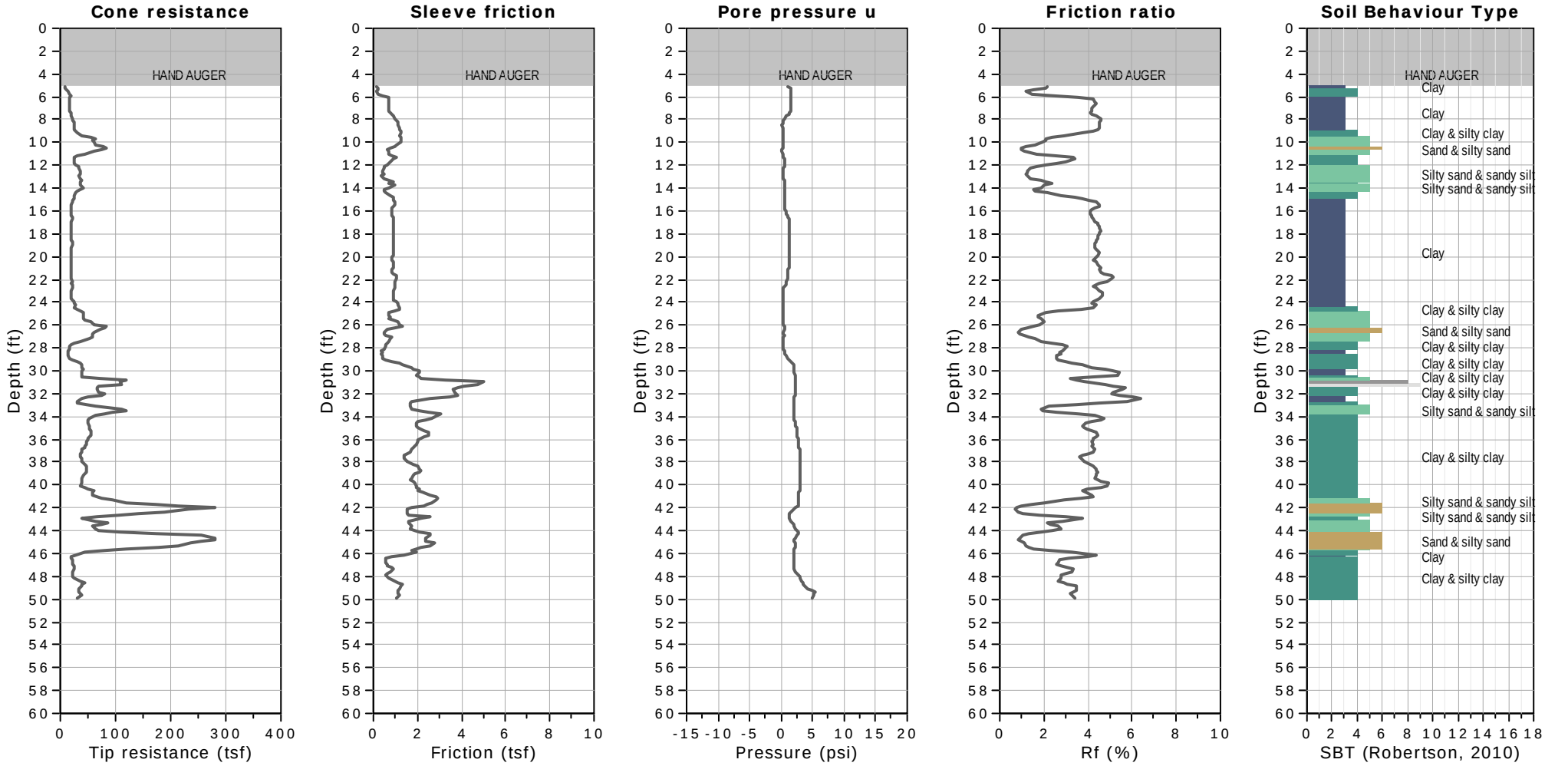


CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/31/2018



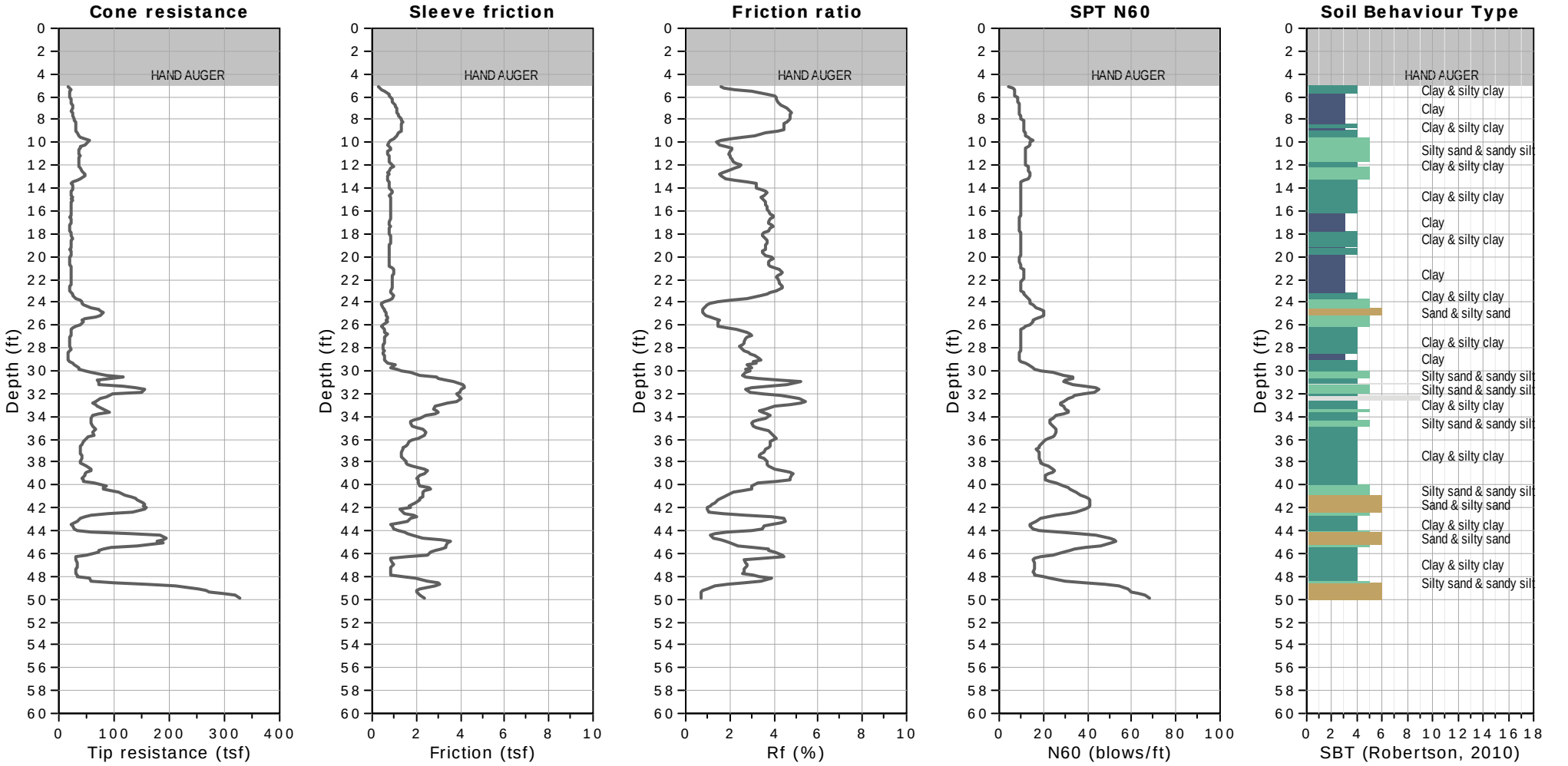
WATER TABLE FOR ESTIMATING PURPOSES ONLY

CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/30/2018

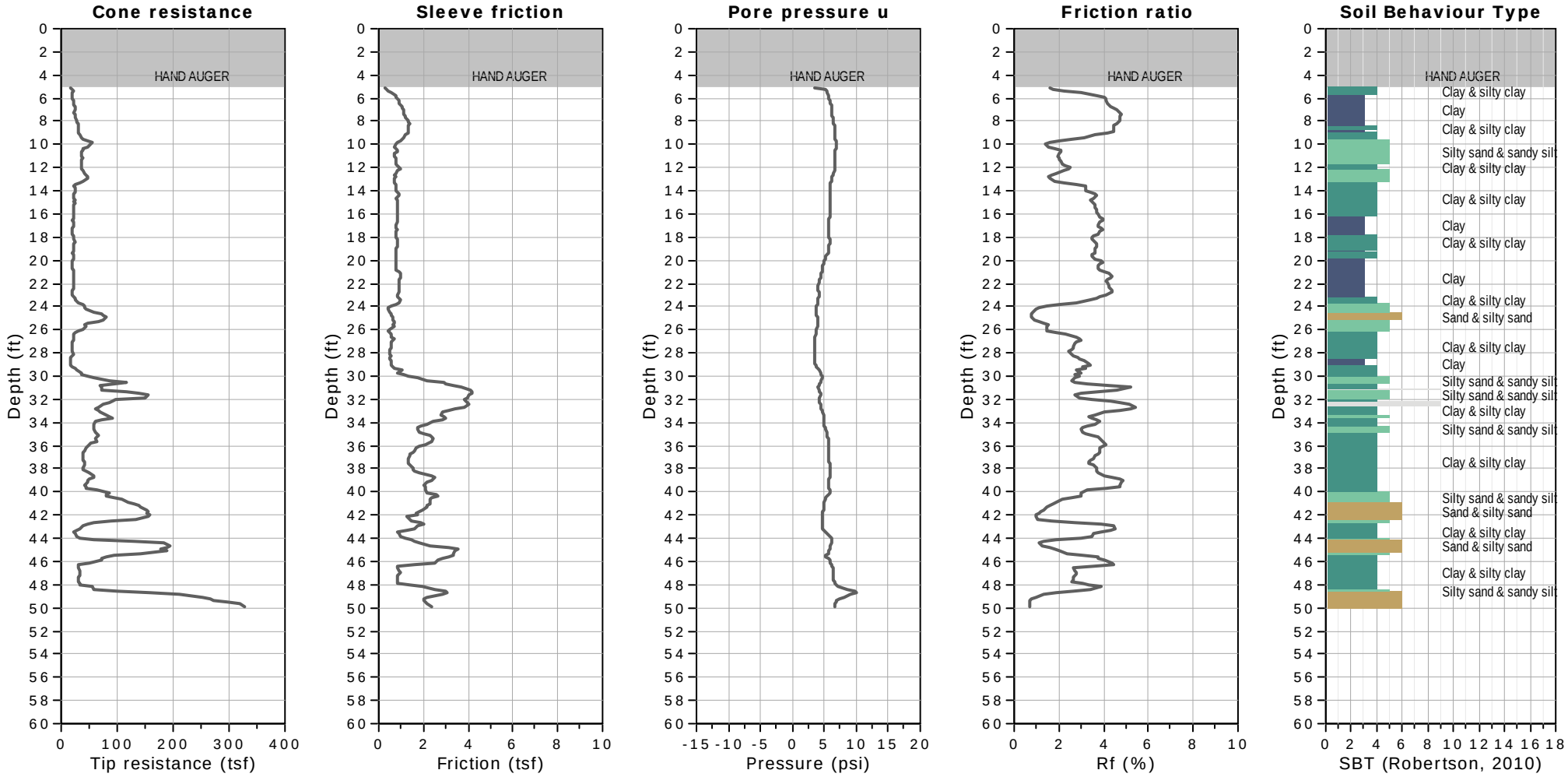


CLIENT: FEFFER GEOLOGICAL CONSULTING

SITE: 468 NORTH RODEO DRIVE, BEVERLY HILLS, CA

Field Rep: ALEX

Total depth: 49.87 ft, Date: 7/30/2018



WATER TABLE FOR ESTIMATING PURPOSES ONLY

SUMMARY

OF

CONE PENETRATION TEST DATA

Project:

456 N. Rodeo Drive
Beverly Hills, CA
July 11-13, 2018

Prepared for:

Mr. Alexander Greene
Feffer Geological Consulting
1990 S. Bundy Drive, Ste 400
Los Angeles, CA 90025
Office (310) 207-5048 / Fax (310) 826-0182

Prepared by:



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

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3. **FIELD EQUIPMENT & PROCEDURES**
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- CPT Classification/Soil Behavior Chart
- Interpretation Output (CPeT-IT)
- CPeT-IT Calculation Formulas

SUMMARY
OF
CONE PENETRATION TEST DATA

1. INTRODUCTION

This report presents the results of a Cone Penetration Test (CPT) program carried out for the project located at 456 N. Rodeo Drive in Beverly Hills, California. The work was performed by Kehoe Testing & Engineering (KTE) on July 11-13, 2018. The scope of work was performed as directed by Feffer Geological Consulting personnel.

2. SUMMARY OF FIELD WORK

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

LOCATION	DEPTH OF CPT (ft)	COMMENTS/NOTES:
CPT-5	39	Refusal, hole open to 36 ft (dry)
CPT-6	50	Hole open to 48 ft (dry)
CPT-7	50	Hole open to 46 ft (dry)
CPT-8	30	Refusal, hole open to 30 ft (dry)

TABLE 2.1 - Summary of CPT Soundings

3. FIELD EQUIPMENT & PROCEDURES

The CPT soundings were carried out by **KTE** using an integrated electronic cone system manufactured by Vertek. The CPT soundings were performed in accordance with ASTM standards (D5778). The cone penetrometers were pushed using a 30-ton CPT rig and a direct push rig anchored with an eight-inch diameter ground anchor. The direct push rig has a pushing capacity of approximately 15 tons. The cone used during the program was a 15 cm^2 cone and a 10 cm^2 was used with the direct push rig. Both recorded the following parameters at approximately 2.5 cm depth intervals:

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

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

4. CONE PENETRATION TEST DATA & INTERPRETATION

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

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

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

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

Sincerely,

KEHOE TESTING & ENGINEERING



Richard W. Koester, Jr.
General Manager

07/19/18-hh-9580

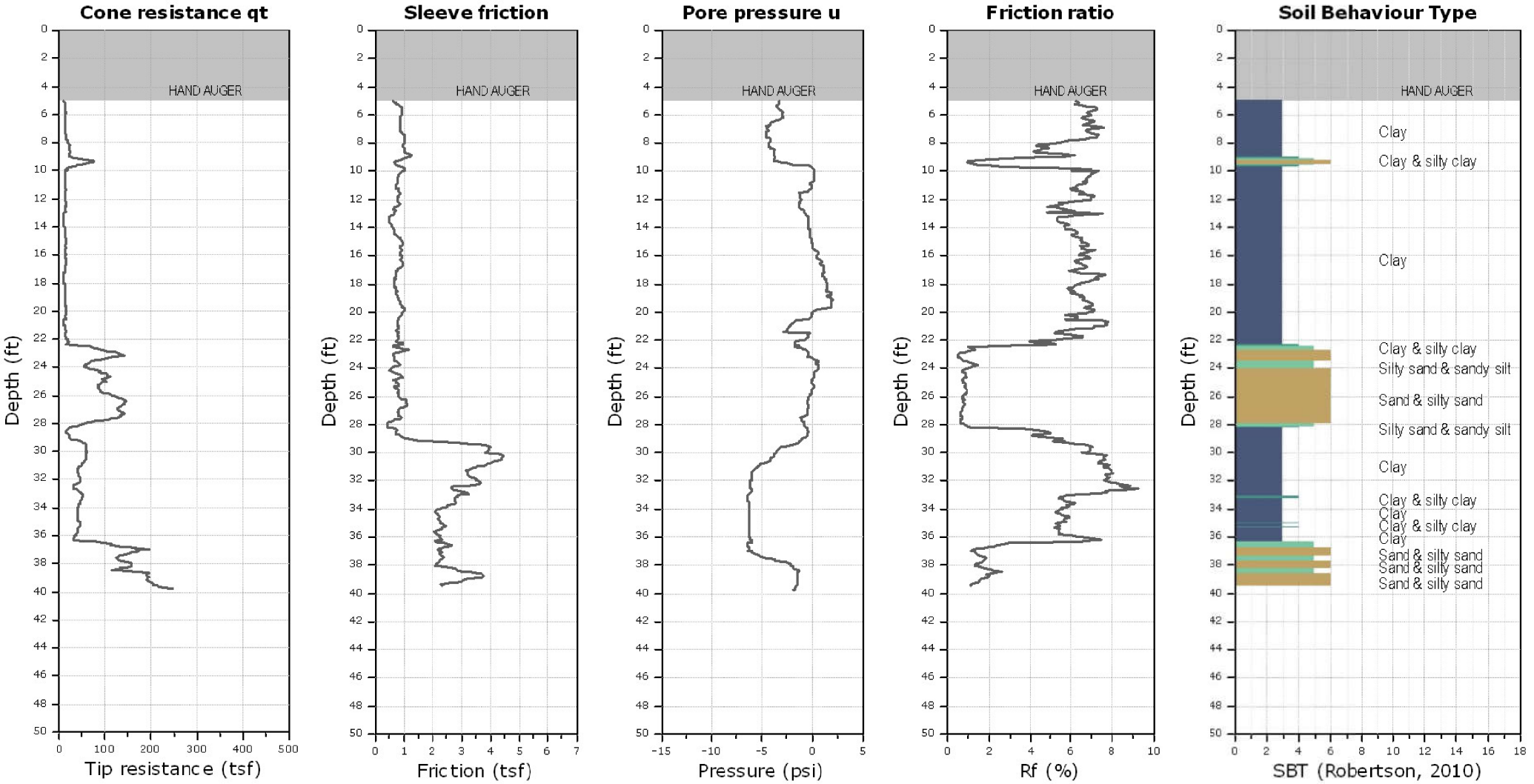
APPENDIX

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

CPT-5

Project: **Feffer Geological Consulting**
Location: **456 N. Rodeo Drive Beverly Hills, Ca**

Total depth: 39.77 ft, Date: 7/12/2018
Cone Type: Vertek



Kehoe Testing and Engineering
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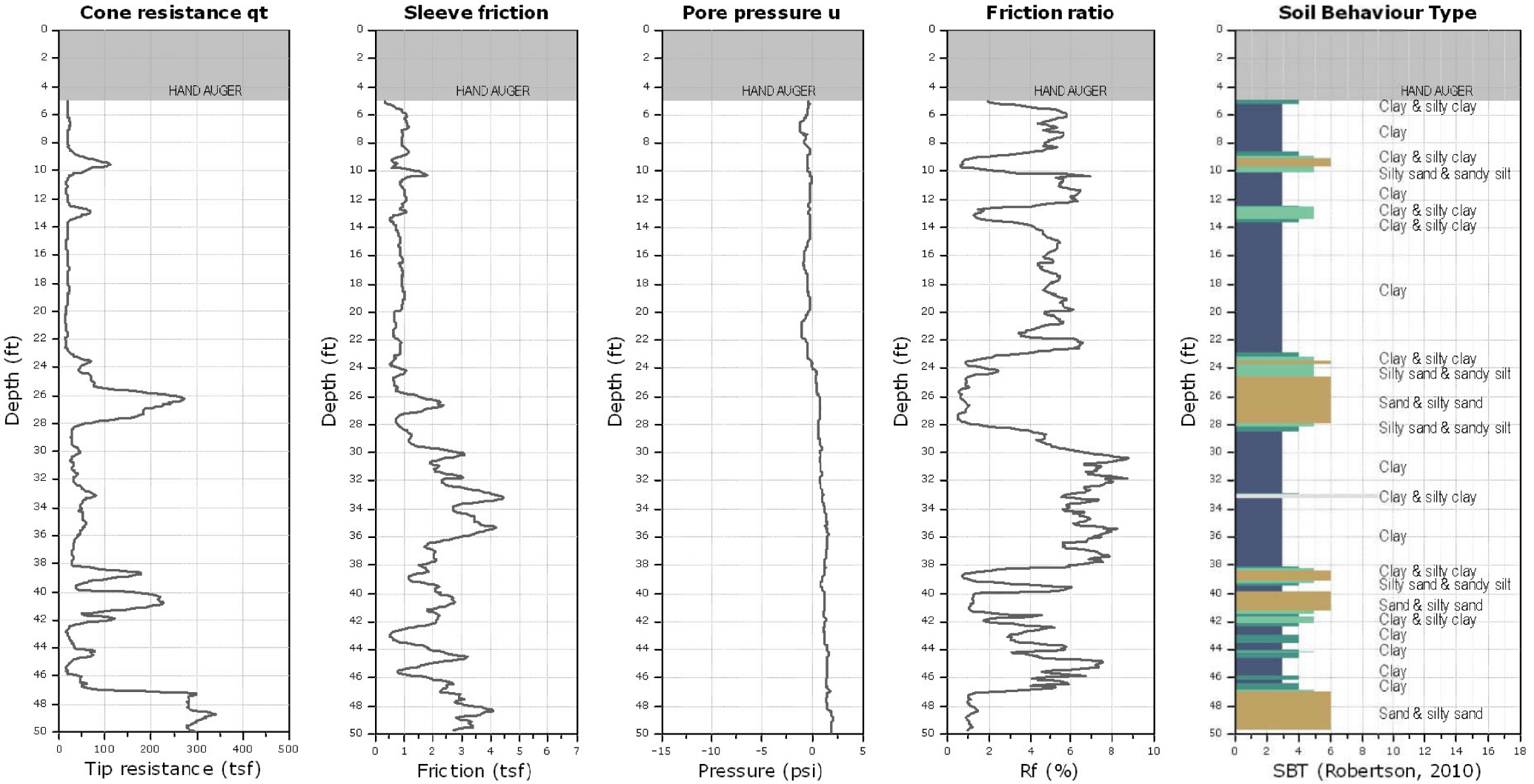
CPT-6

Project: **Feffer Geological Consulting**
Location: **456 N. Rodeo Drive Beverly Hills, Ca**

Total depth: 50.15 ft, Date: 7/11/2018
Cone Type: Vertek



Kehoe Testing and Engineering
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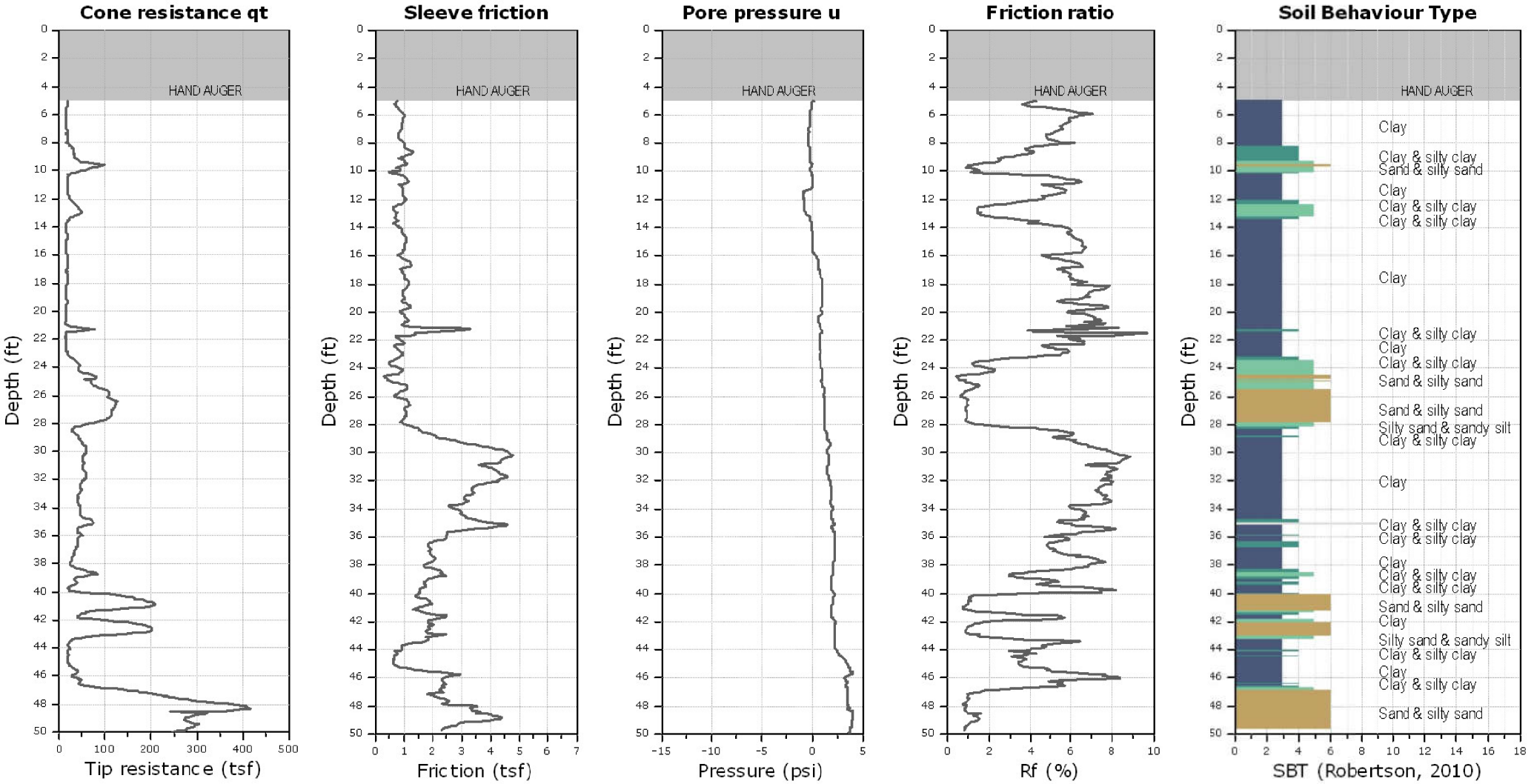
CPT-7

Project: **Feffer Geological Consulting**
Location: **456 N. Rodeo Drive Beverly Hills, Ca**

Total depth: 50.07 ft, Date: 7/11/2018
Cone Type: Vertek



Kehoe Testing and Engineering
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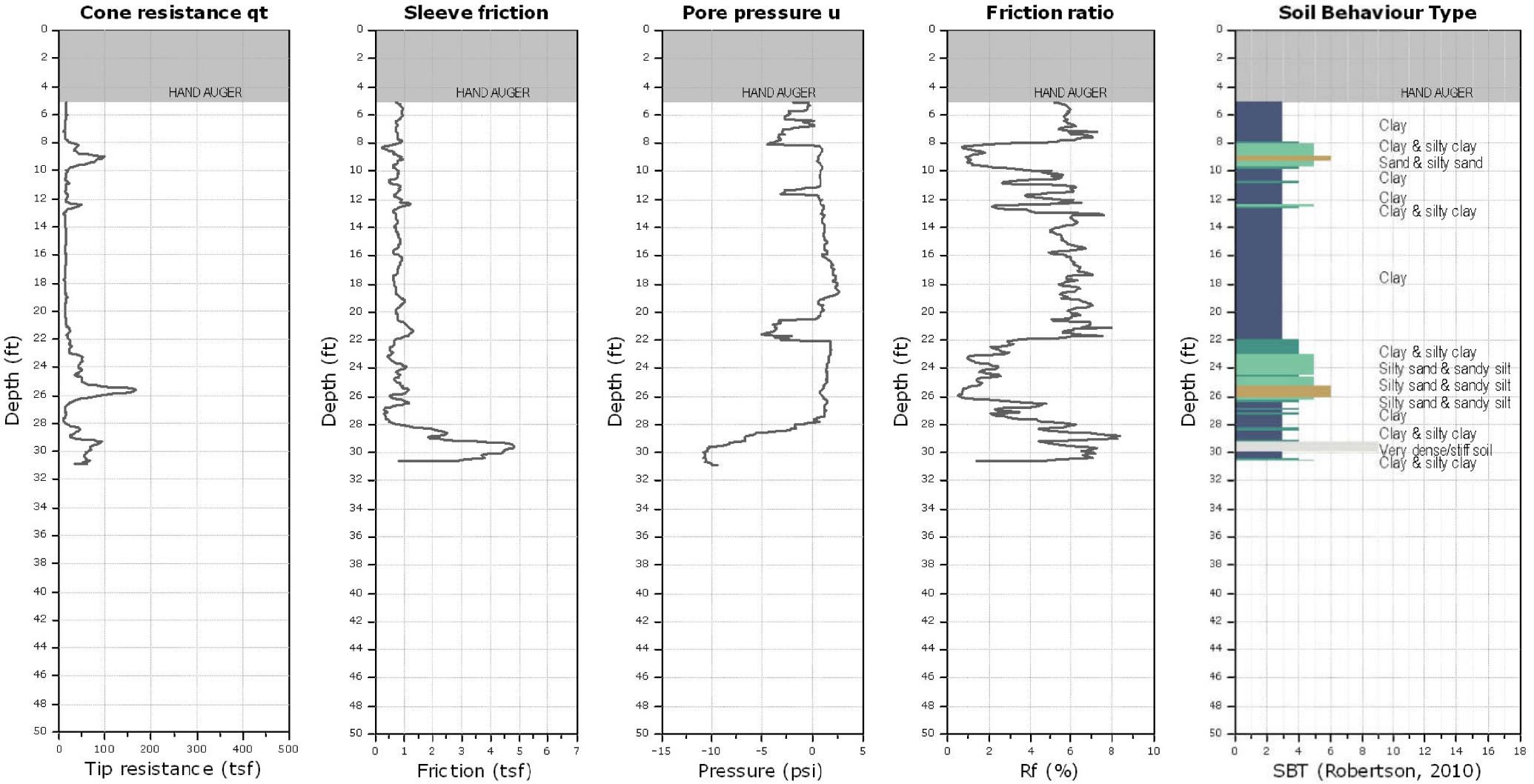
CPT-8

Project: **Feffer Geological Consulting**
Location: **456 N. Rodeo Drive Beverly Hills, Ca**

Total depth: 30.91 ft, Date: 7/12/2018
Cone Type: Vertek



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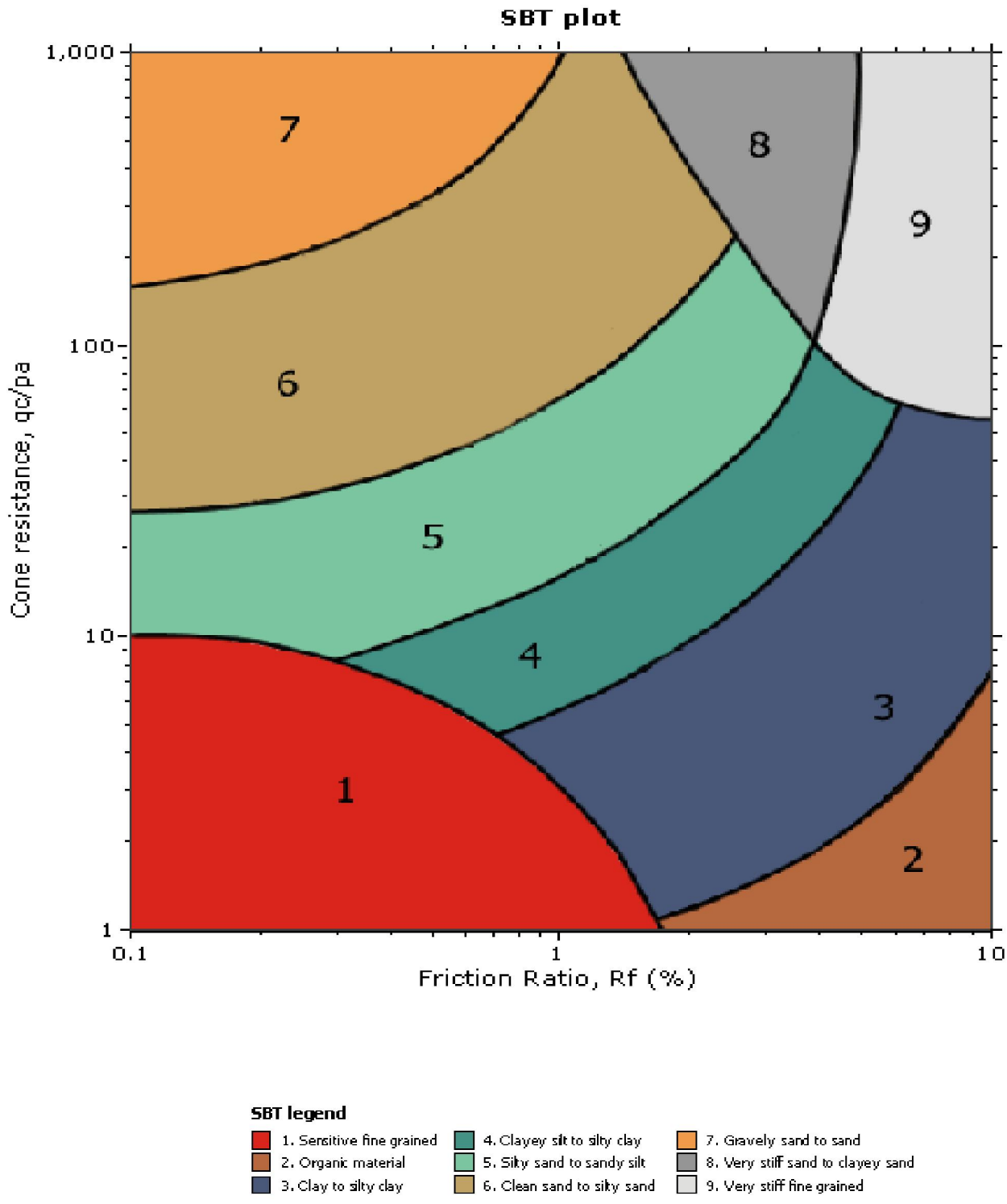

	CPT-5	In situ data							Basic output data													
Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ã (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn	U2	I(B)	Mod. SBTn
1	34.79	0.89	1.39	2.32	34.84	2.55	4	2.54	18.56	0.01	0	0.01	3750.4	2.55	0	8	0.54	13.2	1.83	434.32	10.78	37.75	7
2	6.88	0.55	-0.75	2.87	6.85	7.98	3	3.4	17.38	0.02	0	0.02	380.15	8	-0.01	9	0.79	25.06	2.47	161.88	-2.99	12.58	3
3	7.15	0.37	-0.53	2.47	7.14	5.14	3	3.27	16.93	0.03	0	0.03	268.99	5.16	-0.01	9	0.76	16.7	2.4	112.21	-1.44	18.84	3
4	8.08	0.44	-0.9	2.22	8.05	5.43	3	3.24	17.19	0.04	0	0.04	228.96	5.46	-0.01	9	0.78	14.1	2.43	106.87	-1.85	17.89	3
5	10.37	0.63	-3.21	2.47	10.27	6.09	3	3.19	17.69	0.04	0	0.04	233.17	6.11	-0.02	9	0.79	12.2	2.45	117.98	-5.27	16.17	3
6	13.39	0.9	-3	2.12	13.3	6.75	3	3.13	18.2	0.05	0	0.05	249.98	6.78	-0.02	9	0.79	10.61	2.45	132.82	-4.07	14.71	3
7	12.54	0.9	-4.5	1.7	12.4	7.27	3	3.18	18.18	0.06	0	0.06	198.79	7.31	-0.03	9	0.81	9.98	2.51	116.43	-5.22	13.72	3
8	20.02	1.03	-4.39	1.25	19.88	5.16	3	2.93	18.51	0.07	0	0.07	277.81	5.18	-0.02	9	0.75	7.51	2.34	140.52	-4.43	18.86	3
9	24.05	1.04	-3.75	1.37	23.93	4.33	3	2.81	18.6	0.08	0	0.08	295.87	4.35	-0.01	9	0.72	6.4	2.27	144.38	-3.35	22.13	5
10	13.29	0.89	0.11	1.68	13.29	6.68	3	3.13	18.19	0.09	0	0.09	147.11	6.73	0	9	0.82	7.58	2.54	94.54	0.09	14.81	3
11	11.29	0.79	-0.11	1.7	11.28	7.02	3	3.2	18	0.1	0	0.1	113.29	7.08	0	9	0.85	7.44	2.6	78.64	-0.08	14.15	3
12	11.33	0.79	-1.13	1.48	11.3	6.96	3	3.2	17.99	0.11	0	0.11	103.9	7.03	-0.01	9	0.85	6.96	2.62	73.64	-0.76	14.24	3
13	9.06	0.59	-0.62	2	9.05	6.55	3	3.25	17.58	0.12	0	0.12	76.65	6.63	0	3	0.87	6.8	2.66	57.35	-0.38	14.96	3
14	10.6	0.61	-0.32	2.61	10.59	5.75	3	3.17	17.67	0.13	0	0.13	83.49	5.82	0	4	0.85	6.09	2.61	60.24	-0.18	16.7	3
15	14.39	0.87	-0.11	2.53	14.38	6.05	3	3.08	18.2	0.13	0	0.13	105.99	6.11	0	9	0.83	5.56	2.56	74.82	-0.06	16.09	3
16	13.57	0.91	0.43	2.4	13.58	6.73	3	3.13	18.23	0.14	0	0.14	93.59	6.8	0	9	0.85	5.5	2.62	69.78	0.21	14.65	3
17	12.54	0.87	1.18	2.14	12.58	6.91	3	3.16	18.14	0.15	0	0.15	81.39	6.99	0.01	9	0.87	5.37	2.66	63.01	0.55	14.3	3
18	10.46	0.71	1.5	2.42	10.5	6.75	3	3.21	17.84	0.16	0	0.16	64.02	6.86	0.01	3	0.89	5.29	2.7	51.75	0.67	14.54	3
19	11.78	0.81	1.79	2.6	11.84	6.86	3	3.18	18.04	0.17	0	0.17	68.39	6.96	0.01	3	0.88	5.01	2.69	55.18	0.75	14.35	3
20	13.75	0.92	0	2.84	13.75	6.66	3	3.12	18.24	0.18	0	0.18	75.5	6.75	0	3	0.87	4.68	2.66	59.96	0	14.74	3
21	11.06	0.78	-2.21	2.68	10.99	7.09	3	3.21	17.97	0.19	0	0.19	57.26	7.21	-0.01	3	0.9	4.74	2.74	48.36	-0.84	13.94	3
22	16.79	0.9	-1.11	2.88	16.76	5.36	3	2.99	18.29	0.2	0	0.2	83.72	5.42	0	4	0.84	4.07	2.57	63.66	-0.4	17.74	3
23	125.41	1.09	-0.32	2.21	125.41	0.87	6	1.81	19.28	0.21	0	0.21	603.52	0.87	0	6	0.46	2.12	1.58	250.91	-0.11	90.7	7
24	54.66	0.9	0.54	2.47	54.67	1.65	5	2.27	18.75	0.22	0	0.22	251.15	1.66	0	6	0.61	2.63	1.97	135.29	0.18	49.35	7
25	101.32	0.82	-0.11	2.18	101.32	0.81	6	1.87	18.88	0.23	0	0.23	446.76	0.82	0	6	0.48	2.1	1.63	200.56	-0.03	90.19	7
26	114.6	0.87	-0.32	2.35	114.59	0.76	6	1.81	18.99	0.24	0	0.24	485.01	0.76	0	6	0.46	2.01	1.58	216.8	-0.1	96.71	7
27	125.53	0.92	-0.54	2.49	125.51	0.73	6	1.77	19.09	0.25	0	0.25	510.6	0.73	0	6	0.45	1.94	1.55	229.54	-0.16	100.72	7
28	57.9	0.66	-0.86	2.41	57.88	1.14	5	2.15	18.42	0.25	0	0.25	226.4	1.15	0	6	0.58	2.28	1.88	124.18	-0.24	63.09	7
29	20.01	1.7	-1.07	2.43	19.97	8.5	3	3.07	19.09	0.26	0	0.26	74.64	8.61	0	9	0.9	3.48	2.72	64.8	-0.29	11.91	3
30	58.85	3.95	-3.53	2.2	58.75	6.73	3	2.68	20.48	0.27	0	0.27	213.15	6.76	0	9	0.78	2.87	2.41	158.65	-0.93	14.77	3
31	46.93	3.79	-5.46	2.37	46.77	8.11	3	2.8	20.34	0.28	0	0.28	163.4	8.16	-0.01	9	0.83	2.96	2.53	129.97	-1.38	12.38	3
32	46.62	3.18	-6.21	2.91	46.43	6.84	3	2.75	20.14	0.29	0	0.29	156.61	6.88	-0.01	9	0.81	2.81	2.48	122.51	-1.52	14.51	3
33	47.87	2.74	-6.36	2.57	47.67	5.75	3	2.69	19.98	0.3	0	0.3	155.55	5.79	-0.01	9	0.79	2.67	2.42	119.34	-1.5	17	3
34	40.15	2.41	-6.31	2.31	39.96	6.04	3	2.75	19.76	0.31	0	0.31	126.09	6.09	-0.01	9	0.81	2.68	2.49	100.29	-1.45	16.2	3
35	44.24	2.14	-6.31	2.24	44.04	4.87	4	2.66	19.66	0.32	0	0.32	134.83	4.9	-0.01	9	0.78	2.51	2.4	103.88	-1.4	19.66	3
36	35.19	2.18	-6.28	0.91	35	6.24	3	2.8	19.6	0.33	0	0.33	103.76	6.3	-0.01	9	0.83	2.61	2.54	85.54	-1.35	15.7	3
37	180.86	2.37	-6.25	0.65	180.67	1.31	6	1.82	20.32	0.34	0	0.34	523.86	1.31	0	6	0.5	1.75	1.67	299.06	-1.31	66.78	7
38	156.79	2.66	-2.06	2.29	156.73	1.7	6	1.95	20.4	0.35	0	0.35	441.23	1.7	0	6	0.55	1.82	1.79	268.73	-0.42	52.79	7
39	194.2	0	-1.51	2.75	194.15	0	0	0	13.73	0.36	0	0.36	536.42	0	0	0	1	2.93	0	536.42	-0.3	780.59	0

	CPT-6	In situ data						Basic output data														
Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ã (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn	U2	I(B)	Mod. SBTn
1	13.89	0.06	0.19	0.79	13.89	0.41	5	2.5	15.06	0.01	0	0.01	1842.6	0.41	0	6	0.46	9.55	1.61	125.3	1.82	111.05	7
2	20.91	0.15	0.1	0.91	20.91	0.73	5	2.43	16.34	0.02	0	0.02	1330	0.73	0	6	0.49	7.94	1.67	156.69	0.44	90.42	7
3	14.3	0.18	0	0.93	14.3	1.25	4	2.68	16.37	0.02	0	0.02	597.9	1.25	0	6	0.58	8.95	1.91	120.76	0	59.15	7
4	14.12	0.28	-0.19	1.04	14.12	1.97	4	2.79	16.88	0.03	0	0.03	435.79	1.97	0	5	0.63	9.16	2.05	121.93	-0.42	42.49	7
5	18.6	0.54	-0.38	1.08	18.59	2.93	4	2.79	17.76	0.04	0	0.04	450.23	2.93	0	5	0.66	8.54	2.13	149.72	-0.67	31.37	5
6	18.5	0.98	-0.59	1.1	18.49	5.28	3	2.96	18.43	0.05	0	0.05	365.71	5.29	0	9	0.74	9.39	2.31	163.62	-0.85	18.56	3
7	21.07	1.05	-1.24	1.16	21.06	4.98	3	2.9	18.56	0.06	0	0.06	351.68	4.99	0	9	0.73	8.14	2.3	161.44	-1.49	19.57	3
8	19.23	1.02	-0.76	1.2	19.22	5.29	3	2.94	18.49	0.07	0	0.07	277.83	5.31	0	9	0.75	7.77	2.35	140.54	-0.8	18.46	3
9	52.05	0.97	-0.57	1.27	52.04	1.87	5	2.32	18.82	0.08	0	0.08	663.3	1.87	0	6	0.57	4.41	1.87	216.62	-0.53	47.64	7
10	57.86	0.73	-0.48	1.27	57.86	1.27	5	2.18	18.54	0.09	0	0.09	659.32	1.27	0	6	0.53	3.7	1.76	202.02	-0.39	64.89	7
11	16.74	0.96	-0.19	1.35	16.74	5.77	3	3.01	18.38	0.1	0	0.1	171.87	5.8	0	9	0.79	6.64	2.46	104.42	-0.14	16.94	3
12	17	0.96	-0.29	1.43	17	5.66	3	3	18.38	0.11	0	0.11	159.38	5.69	0	9	0.79	6.22	2.46	99.32	-0.19	17.21	3
13	65.84	0.77	-0.38	1.58	65.84	1.17	5	2.11	18.64	0.12	0	0.12	570.02	1.17	0	6	0.52	3.18	1.74	197.51	-0.24	68.8	7
14	17.02	0.69	-0.19	1.62	17.02	4.07	3	2.91	18	0.12	0	0.12	135.92	4.1	0	4	0.77	5.21	2.4	83.26	-0.11	22.65	5
15	16.21	0.85	-0.42	1.66	16.21	5.24	3	3	18.22	0.13	0	0.13	120.47	5.29	0	9	0.81	5.32	2.49	80.77	-0.23	18.26	3
16	18.93	0.86	-0.81	1.66	18.92	4.54	3	2.91	18.29	0.14	0	0.14	131.68	4.57	0	9	0.78	4.8	2.43	85.24	-0.41	20.72	3
17	20.1	0.88	-0.7	1.66	20.09	4.38	3	2.88	18.34	0.15	0	0.15	131.4	4.41	0	9	0.78	4.54	2.42	85.47	-0.33	21.36	3
18	18.59	0.95	-0.48	1.68	18.59	5.13	3	2.95	18.4	0.16	0	0.16	114.5	5.18	0	9	0.81	4.56	2.49	79.34	-0.21	18.58	3
19	18.01	0.97	-0.29	1.72	18.01	5.4	3	2.97	18.41	0.17	0	0.17	104.84	5.46	0	9	0.82	4.46	2.52	75.2	-0.12	17.74	3
20	14.16	0.82	-0.38	1.74	14.15	5.78	3	3.07	18.12	0.18	0	0.18	77.99	5.86	0	4	0.85	4.54	2.61	59.95	-0.15	16.61	3
21	15.47	0.65	-1.05	1.64	15.45	4.21	3	2.95	17.89	0.19	0	0.19	81.13	4.26	0	4	0.81	4.08	2.51	58.89	-0.4	21.46	3
22	13.3	0.72	-0.67	1.58	13.29	5.4	3	3.07	17.95	0.2	0	0.2	66.42	5.48	0	4	0.86	4.24	2.63	52.42	-0.24	17.48	3
23	25.72	0.76	-0.57	1.62	25.71	2.95	4	2.68	18.26	0.21	0	0.21	123.66	2.97	0	5	0.74	3.34	2.3	80.6	-0.2	29.26	5
24	44.92	0.61	0.05	1.56	44.92	1.36	5	2.29	18.23	0.22	0	0.22	207.59	1.37	0	6	0.61	2.64	1.97	111.49	0.02	54.64	7
25	71.81	0.68	0.29	1.58	71.81	0.95	6	2.03	18.53	0.22	0	0.22	318.7	0.95	0	6	0.53	2.27	1.76	153.85	0.09	75.74	7
26	246.04	1.31	0.67	1.31	246.05	0.53	6	1.45	19.75	0.23	0	0.23	1048.2	0.53	0	7	0.35	1.7	1.29	394.86	0.2	144.67	7
27	185.98	1.78	0.76	1.22	185.98	0.96	6	1.72	20.01	0.24	0	0.24	759.59	0.96	0	6	0.44	1.92	1.53	336.46	0.22	88.09	7
28	58.3	0.88	0.57	1.2	58.31	1.51	5	2.22	18.75	0.25	0	0.25	228.67	1.52	0	6	0.61	2.37	1.95	130.17	0.16	52.33	7
29	25.58	1.4	0.64	1.3	25.59	5.49	3	2.86	18.97	0.26	0	0.26	96.15	5.55	0	9	0.83	3.15	2.53	75.4	0.17	17.49	3
30	44.3	1.84	0.86	1.45	44.31	4.15	4	2.61	19.49	0.27	0	0.27	161.23	4.17	0	9	0.75	2.75	2.32	114.3	0.23	22.72	5
31	29.57	2.26	0.86	1.41	29.58	7.64	3	2.92	19.57	0.28	0	0.28	103.54	7.72	0	9	0.86	3.1	2.61	85.72	0.22	13.08	3
32	29.33	3.11	0.76	1.63	29.34	10.61	3	3.03	19.94	0.29	0	0.29	99.18	10.72	0	9	0.9	3.18	2.72	87.24	0.19	9.68	2
33	74.6	3.32	1.14	1.89	74.61	4.45	4	2.47	20.37	0.3	0	0.3	245.2	4.47	0	9	0.72	2.45	2.24	172.24	0.27	21.7	3
34	46.27	3.2	1.24	2.01	46.28	6.9	3	2.75	20.14	0.31	0	0.31	146.81	6.95	0	9	0.81	2.7	2.49	117.11	0.28	14.38	3
35	57.63	3.51	1.52	1.99	57.65	6.1	3	2.65	20.34	0.32	0	0.32	177.31	6.13	0	9	0.78	2.53	2.41	137.1	0.34	16.16	3
36	40.46	2.94	1.62	2.07	40.48	7.27	3	2.81	20	0.33	0	0.33	120.46	7.33	0	9	0.84	2.63	2.55	99.86	0.35	13.7	3
37	29.17	1.85	1.43	2.12	29.19	6.33	3	2.86	19.34	0.34	0	0.34	84.11	6.4	0	9	0.85	2.62	2.59	71.32	0.3	15.44	3
38	25.7	1.86	1.33	2.08	25.71	7.24	3	2.94	19.3	0.35	0	0.35	71.93	7.35	0	9	0.88	2.64	2.67	63.33	0.27	13.7	3
39	126.24	1.63	0.95	2.18	126.25	1.29	6	1.93	19.75	0.36	0	0.36	347.3	1.29	0	6	0.54	1.77	1.76	211.14	0.19	64.53	7
40	145.08	2.3	1.33	2.22	145.09	1.59	6	1.95	20.2	0.37	0	0.37	388.41	1.59	0	6	0.55	1.77	1.79	242.49	0.26	55.35	7
41	203.6	2.55	1.24	2.31	203.62	1.25	6	1.77	20.45	0.38	0	0.38	530.88	1.25	0	6	0.49	1.65	1.64	316.41	0.23	69.99	7
42	111.39	1.67	1.33	2.28	111.41	1.5	6	2.01	19.73	0.39	0	0.39	282.7	1.5	0	6	0.57	1.76	1.84	184.69	0.24	56.01	7
43	17.72	0.96	1.24	2.33	17.73	5.44	3	2.98	18.4	0.4	0	0.4	43.13	5.56	0.01	3	0.9	2.4	2.72	39.29	0.22	17.08	3
44	34.91	1.99	1.62	2.58	34.93	5.69	3	2.78	19.49	0.41	0	0.41	83.86	5.75	0	9	0.84	2.21	2.55	72.23	0.28	16.93	3
45	24.61	2.23	1.52	2.98	24.62	9.04	3	3.03	19.48	0.42	0	0.42	57.44	9.19	0	3	0.93	2.36	2.79	54.04	0.26	11.3	3
46	46.55	1.42	1.44	2.93	46.57	3.05	4	2.5	19.21	0.43	0	0.43	107.05	3.08	0	5	0.75	1.95	2.3	85.25	0.24	28.62	5
47	139.96	2.63	1.71	2.95	139.98	1.88	5	2.01	20.34	0.44	0	0.44	316.31	1.89	0	6	0.58	1.67	1.87	219.88	0.28	47.4	7
48	278.87	3.05	1.62	2.99	278.89	1.09	6	1.64	20.78	0.45	0	0.45	616.66	1.1	0	6	0.46	1.48	1.54	388.25	0.26	80.38	7
49	314.76	3.28	2.1	3.06	314.78	1.04	6	1.59	20.91	0.46	0	0.46	680.37	1.04	0	6	0.44	1.44	1.5	428.19	0.33	84.88	7
50	298.66	0	1.9	2.95	298.68	0	0	0	13.73	0.47	0	0.47	636.05	0	0	0	1	2.26	0	636.05	0.29	922.93	0

	CPT-7	In situ data						Basic output data														
Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ã (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn	U2	I(B)	Mod. SBTn
1	8.08	0.06	0.09	0.21	8.08	0.78	4	2.82	14.95	0.01	0	0.01	1079	0.78	0	6	0.54	14.24	1.81	108.6	0.91	76.86	7
2	13.47	0.21	0.03	0.44	13.47	1.54	4	2.75	16.53	0.02	0	0.02	854.55	1.54	0	6	0.58	11.47	1.92	145.94	0.15	52.8	7
3	10.22	0.29	0.09	0.42	10.22	2.88	3	3	16.82	0.02	0	0.02	422.52	2.89	0	5	0.68	12.84	2.17	123.74	0.28	31.3	5
4	10.75	0.38	0.18	0.5	10.75	3.55	3	3.03	17.14	0.03	0	0.03	327.66	3.56	0	8	0.71	11.74	2.25	118.9	0.4	26.15	5
5	17.87	0.6	0.18	0.54	17.87	3.36	3	2.84	17.85	0.04	0	0.04	428.08	3.37	0	8	0.68	8.98	2.17	151.23	0.31	27.83	5
6	15.38	0.85	-0.23	0.59	15.38	5.56	3	3.03	18.2	0.05	0	0.05	301.97	5.57	0	9	0.76	9.91	2.36	143.48	-0.33	17.65	3
7	16.38	0.88	-0.38	0.67	16.38	5.39	3	3	18.26	0.06	0	0.06	272.5	5.41	0	9	0.76	8.78	2.37	135.38	-0.46	18.13	3
8	16.78	0.98	-0.35	0.75	16.77	5.87	3	3.02	18.4	0.07	0	0.07	241.83	5.9	0	9	0.77	8.23	2.41	129.85	-0.36	16.74	3
9	32.52	1.16	-0.29	0.81	32.52	3.58	4	2.66	18.85	0.08	0	0.08	413.29	3.59	0	8	0.68	5.8	2.15	177.76	-0.26	26.52	5
10	48.74	0.98	-0.17	0.94	48.74	2.02	5	2.36	18.81	0.09	0	0.09	553.47	2.02	0	6	0.59	4.33	1.92	199.02	-0.14	44.21	7
11	18.19	1.08	0	0.91	18.19	5.93	3	2.99	18.53	0.1	0	0.1	186.14	5.96	0	9	0.79	6.57	2.45	112.26	0	16.55	3
12	22.86	0.86	-0.86	0.89	22.85	3.75	4	2.79	18.36	0.11	0	0.11	213.82	3.77	0	8	0.73	5.31	2.29	114.12	-0.58	24.81	5
13	47.63	0.62	-0.67	0.88	47.62	1.29	5	2.25	18.26	0.12	0	0.12	411.42	1.29	0	6	0.56	3.46	1.85	155.55	-0.42	61	7
14	14.68	0.75	-0.08	0.89	14.68	5.09	3	3.02	18.03	0.12	0	0.12	116.9	5.13	0	9	0.81	5.63	2.5	77.37	-0.05	18.71	3
15	16.14	1.01	0.09	0.89	16.14	6.26	3	3.05	18.41	0.13	0	0.13	119.69	6.32	0	9	0.82	5.51	2.55	83.27	0.05	15.65	3
16	17.42	1.07	0.29	0.91	17.42	6.16	3	3.02	18.51	0.14	0	0.14	120.84	6.21	0	9	0.82	5.18	2.54	84.52	0.14	15.89	3
17	16.62	1.17	0.66	0.95	16.63	7.01	3	3.07	18.59	0.15	0	0.15	108.19	7.07	0	9	0.84	5.14	2.6	80.09	0.31	14.15	3
18	17.99	1.01	0.95	0.98	18	5.59	3	2.98	18.45	0.16	0	0.16	110.47	5.64	0	9	0.82	4.65	2.52	78.41	0.42	17.25	3
19	15.15	1.05	0.95	1.04	15.17	6.92	3	3.1	18.43	0.17	0	0.17	87.85	7	0	9	0.86	4.81	2.63	68.16	0.4	14.29	3
20	14.85	1.18	0.95	1.06	14.86	7.95	3	3.14	18.56	0.18	0	0.18	81.58	8.04	0	9	0.88	4.78	2.69	66.26	0.38	12.65	3
21	17.69	1.19	0.76	1.14	17.7	6.73	3	3.04	18.64	0.19	0	0.19	92.5	6.8	0	9	0.85	4.34	2.61	71.8	0.29	14.66	3
22	14.56	1.12	0.67	3.02	14.57	7.66	3	3.14	18.49	0.2	0	0.2	72.37	7.76	0	9	0.89	4.43	2.7	60.1	0.24	13.07	3
23	17.47	0.68	0.76	3.14	17.48	3.87	3	2.89	17.98	0.21	0	0.21	83.24	3.91	0	4	0.8	3.7	2.48	60.33	0.26	22.99	5
24	42.59	0.44	0.92	3.26	42.6	1.03	5	2.24	17.83	0.22	0	0.22	195.84	1.04	0	6	0.59	2.55	1.91	102.17	0.3	63.74	7
25	70.47	0.56	0.95	3.31	70.48	0.79	6	1.99	18.29	0.23	0	0.23	311.42	0.79	0	6	0.52	2.22	1.72	147.24	0.3	84.34	7
26	108.08	0.98	1.15	3.43	108.09	0.91	6	1.88	19.11	0.24	0	0.24	458.67	0.91	0	6	0.49	2.08	1.64	212.12	0.35	84.51	7
27	116.18	1.09	1.25	3.35	116.2	0.94	6	1.86	19.26	0.24	0	0.24	473.68	0.94	0	6	0.49	2.04	1.64	223.2	0.37	83.27	7
28	67.24	1.26	1.33	3.41	67.26	1.87	5	2.24	19.21	0.25	0	0.25	263.4	1.87	0	6	0.61	2.4	1.97	151.84	0.38	45.66	7
29	42.96	2.6	1.53	3.47	42.98	6.06	3	2.73	19.88	0.26	0	0.26	161.6	6.1	0	9	0.79	3	2.44	120.93	0.42	16.22	3
30	57.8	4.12	1.62	3.43	57.82	7.13	3	2.7	20.52	0.27	0	0.27	209.57	7.17	0	9	0.79	2.9	2.43	157.87	0.42	13.97	3
31	49.92	4.41	1.59	3.22	49.94	8.84	3	2.81	20.54	0.28	0	0.28	174.32	8.89	0	9	0.83	2.98	2.54	139.73	0.4	11.41	3
32	54.16	4.14	1.81	3.12	54.18	7.64	3	2.74	20.5	0.3	0	0.3	182.6	7.68	0	9	0.81	2.81	2.48	143.13	0.44	13.1	3
33	43.57	3.21	1.91	2.98	43.59	7.37	3	2.79	20.13	0.31	0	0.31	141.84	7.42	0	9	0.83	2.79	2.52	114.16	0.45	13.53	3
34	44.65	3.08	2.1	2.85	44.67	6.89	3	2.76	20.09	0.32	0	0.32	140.72	6.94	0	9	0.82	2.69	2.5	112.85	0.48	14.4	3
35	73.3	3.02	2.1	2.81	73.33	4.11	4	2.45	20.25	0.33	0	0.33	224.4	4.13	0	8	0.71	2.32	2.23	160.25	0.47	23.26	5
36	48.33	2.28	2.19	2.62	48.36	4.72	4	2.62	19.77	0.34	0	0.34	143.26	4.75	0	9	0.77	2.42	2.37	110	0.47	20.25	3
37	35.46	1.9	2.29	2.58	35.49	5.36	3	2.75	19.44	0.34	0	0.34	101.88	5.41	0	9	0.82	2.5	2.49	82.93	0.48	17.91	3
38	24.56	2.14	2.1	2.54	24.59	8.72	3	3.02	19.44	0.35	0	0.35	68.33	8.85	0.01	9	0.91	2.71	2.74	61.98	0.43	11.64	3
39	39.54	2.08	1.91	2.31	39.56	5.26	3	2.71	19.59	0.36	0	0.36	107.56	5.31	0	9	0.81	2.37	2.47	87.75	0.38	18.23	3
40	35.43	1.67	2.12	2.2	35.45	4.72	4	2.71	19.3	0.37	0	0.37	93.77	4.77	0	9	0.81	2.32	2.47	76.91	0.41	19.9	3
41	200.44	2.07	2	2.12	200.47	1.04	6	1.72	20.21	0.38	0	0.38	520.74	1.04	0	6	0.47	1.61	1.58	304.41	0.38	81.52	7
42	95.74	2.16	2.36	2.1	95.77	2.26	5	2.18	19.97	0.39	0	0.39	241.93	2.27	0	5	0.63	1.87	2.01	168.39	0.43	39.48	7
43	139.15	1.47	2.28	2.1	139.18	1.06	6	1.84	19.68	0.4	0	0.4	343.48	1.06	0	6	0.51	1.64	1.69	214.62	0.41	75.37	7
44	22.67	0.86	2.42	1.98	22.7	3.8	3	2.79	18.36	0.41	0	0.41	53.92	3.87	0.01	4	0.84	2.21	2.55	46.47	0.42	22.62	5
45	18.75	1.25	3.48	1.92	18.79	6.67	3	3.02	18.72	0.42	0	0.42	43.47	6.82	0.01	3	0.93	2.34	2.77	40.65	0.59	14.58	3
46	27.94	2.37	3.24	1.85	27.98	8.48	3	2.97	19.61	0.43	0	0.43	63.7	8.61	0.01	9	0.92	2.27	2.74	59.12	0.54	11.93	3
47	151.88	2.47	3.43	1.72	151.92	1.63	6	1.94	20.3	0.44	0	0.44	342.29	1.63	0	6	0.56	1.63	1.81	233.12	0.56	53.98	7
48	370.03	3.1	3.62	1.72	370.07	0.84	6	1.47	20.91	0.45	0	0.45	815.98	0.84	0	6	0.4	1.4	1.38	489.87	0.58	103.91	7
49	273.45	3.45	3.94	1.75	273.5	1.26	6	1.69	20.91	0.46	0	0.46	589.16	1.26	0	6	0.48	1.48	1.59	382.88	0.61	70.99	7
50	247.87	0	3.64	1.85	247.92	0	0	0	13.73	0.47	0	0.47	526.14	0	0	0	1	2.25	0	526.14	0.56	765.91	0

	CPT-8	In situ data						Basic output data														
Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ã (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn	U2	I(B)	Mod. SBTn
1	22.94	0.5	1.61	0.31	22.99	2.19	4	2.64	17.75	0.01	0	0.01	2587.5	2.19	0.01	6	0.55	14.19	1.84	308.18	13.02	42.7	7
2	10.25	0.35	0.54	0.35	10.27	3.39	3	3.04	17.01	0.02	0	0.02	589.48	3.39	0	8	0.67	15.91	2.17	154.15	2.22	27.69	5
3	11.43	0.4	0	0.13	11.43	3.52	3	3.01	17.22	0.03	0	0.03	438.96	3.53	0	8	0.69	12.93	2.21	139.35	0	26.61	5
4	12.69	0.5	-0.28	0.29	12.68	3.95	3	3	17.52	0.03	0	0.03	363.94	3.96	0	8	0.71	11.32	2.26	135.32	-0.57	23.96	5
5	14.36	0.61	-0.69	0.03	14.34	4.25	3	2.98	17.79	0.04	0	0.04	327.49	4.27	0	9	0.72	10.08	2.28	136.1	-1.14	22.45	5
6	16.55	0.88	-2.29	-0.03	16.48	5.36	3	3	18.27	0.05	0	0.05	311.22	5.38	-0.01	9	0.75	9.43	2.35	146.34	-3.13	18.24	3
7	13.51	0.78	-2.51	0.33	13.43	5.82	3	3.09	18.05	0.06	0	0.06	216.31	5.85	-0.01	9	0.78	9.2	2.43	116.28	-2.92	16.83	3
8	24.43	0.74	-4.13	0.45	24.3	3.03	4	2.71	18.21	0.07	0	0.07	341.77	3.04	-0.01	5	0.68	6.21	2.15	142.22	-4.19	30.31	5
9	99.09	0.59	0.64	0.38	99.11	0.6	6	1.8	18.5	0.08	0	0.08	1235.6	0.6	0	6	0.4	2.83	1.45	264.87	0.58	120.07	7
10	16.74	0.62	0.86	0.41	16.76	3.71	3	2.89	17.87	0.09	0	0.09	187.16	3.73	0	5	0.74	6.24	2.32	98.41	0.69	24.82	5
11	14.76	0.54	0.86	0.26	14.78	3.64	3	2.93	17.66	0.1	0	0.1	149.97	3.67	0	4	0.76	6.04	2.36	83.84	0.63	24.85	5
12	16.2	0.69	0.81	0.58	16.23	4.25	3	2.94	17.98	0.11	0	0.11	150.78	4.28	0	9	0.77	5.83	2.4	88.81	0.55	21.95	5
13	10.96	0.71	0.89	0.37	10.98	6.48	3	3.19	17.86	0.12	0	0.12	93.83	6.55	0.01	9	0.85	6.55	2.62	67.33	0.55	15.13	3
14	12.97	0.78	1.29	0.67	13.01	6.01	3	3.11	18.04	0.12	0	0.12	103.19	6.07	0.01	9	0.83	5.93	2.57	72.25	0.74	16.17	3
15	14.77	0.77	1.5	0.86	14.82	5.22	3	3.03	18.07	0.13	0	0.13	109.67	5.27	0.01	9	0.81	5.39	2.51	74.75	0.81	18.27	3
16	15.11	0.68	1.03	0.74	15.14	4.49	3	2.98	17.93	0.14	0	0.14	104.95	4.53	0	4	0.8	4.98	2.48	70.61	0.52	20.66	3
17	12.13	0.79	2.17	0.82	12.19	6.46	3	3.15	18.02	0.15	0	0.15	79.28	6.54	0.01	3	0.86	5.34	2.64	60.76	1.03	15.14	3
18	12.13	0.67	2.46	0.67	12.2	5.49	3	3.1	17.84	0.16	0	0.16	74.89	5.57	0.01	4	0.85	4.97	2.61	56.52	1.1	17.29	3
19	16.68	0.74	1.17	0.49	16.72	4.45	3	2.94	18.08	0.17	0	0.17	97.45	4.5	0.01	4	0.8	4.35	2.49	68.09	0.49	20.75	3
20	11.82	0.83	0.98	0.5	11.85	7	3	3.18	18.07	0.18	0	0.18	65.25	7.1	0.01	3	0.89	4.85	2.71	53.53	0.4	14.11	3
21	16.44	0.98	-3.74	0.73	16.33	5.98	3	3.03	18.38	0.19	0	0.19	85.81	6.05	-0.02	9	0.85	4.32	2.6	65.83	-1.43	16.19	3
22	21.02	0.95	-3.07	1.35	20.93	4.55	3	2.87	18.45	0.2	0	0.2	105.08	4.59	-0.01	4	0.8	3.82	2.47	74.86	-1.12	20.5	3
23	22.93	0.63	1.82	1.31	22.99	2.74	4	2.7	18.01	0.21	0	0.21	110.44	2.77	0.01	5	0.74	3.36	2.31	72.42	0.64	30.47	5
24	43	0.82	1.51	1.28	43.05	1.91	5	2.39	18.56	0.22	0	0.22	198.71	1.92	0	5	0.65	2.8	2.07	113.41	0.5	42.83	7
25	48.74	0.86	1.44	1.41	48.78	1.77	5	2.33	18.66	0.22	0	0.22	215.9	1.78	0	5	0.63	2.65	2.02	121.8	0.46	45.98	7
26	84.14	1.02	1.07	1.51	84.17	1.21	6	2.04	19.06	0.23	0	0.23	358.05	1.22	0	6	0.54	2.26	1.78	179.34	0.33	65.69	7
27	13.18	0.58	1.36	1.37	13.22	4.42	3	3.02	17.71	0.24	0	0.24	53.33	4.5	0.01	4	0.86	3.54	2.62	43.36	0.4	20.13	3
28	13.3	1.02	-1.29	1.58	13.26	7.71	3	3.17	18.35	0.25	0	0.25	51.53	7.86	-0.01	3	0.92	3.75	2.78	46.05	-0.37	12.98	3
29	25.5	3.08	-6.74	1.73	25.3	12.17	3	3.11	19.87	0.26	0	0.26	95.43	12.3	-0.02	9	0.92	3.61	2.78	85.32	-1.85	8.52	2
30	63.27	0	-10.79	1.81	62.95	0	0	0	13.73	0.27	0	0.27	232.79	0	-0.01	0	1	3.93	0	232.79	-2.88	346.84	0

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

:: Unit Weight, g (kN/m³) ::

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

where g_w = water unit weight

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

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

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

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

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

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

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

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

(applicable only to $I_c < I_{c_cutoff}$)

:: Relative Density, Dr (%) ::

$100 \cdot \sqrt{\frac{Q_{tn}}{k_{DR}}}$ (applicable only to SBT_n: 5, 6, 7 and 8 or $I_c < I_{c_cutoff}$)

:: State Parameter, ψ ::

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

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

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

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

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

If $I_c > 2.20$

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

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

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

If $I_c \leq 2.20$

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

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

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

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

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

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

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

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

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

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

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

:: Overconsolidation Ratio, OCR ::

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

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

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

:: In situ Stress Ratio, Ko ::

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

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

:: Soil Sensitivity, S_t ::

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

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

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

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

(applicable for $0.10 < B_q < 1.00$)

References

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

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Quaternary Geology
Economic Geomorphology
Soil Stratigraphy
Geoarchaeology
PG 2867; CPG 1766; CPESC 2167

RECOMMENDATION FOR ACCEPTANCE

REPORT FOR INVESTIGATION OF POTENTIAL SURFACE FAULT RUPTURE 461 N. Beverly Drive, Beverly Hills, California 90210

As authorized by the City of Beverly Hills, this document summarizes technical (peer) reviews for a “Fault Hazard [Ground Rupture] Investigation” for proposed redevelopment of the 461 N. Beverly Drive property in the City of Beverly Hills, California. The investigations were carried by Feffer Geological Consulting, Inc. (FGC), the Consultants-of-Record, on behalf of the applicant, the 461 N. Beverly Drive, LLC. The main purpose of the FGC investigation was to determine if possible splays of the Santa Monica fault zone potentially impact the site, and if such faults were “active” (defined by the California Geological Survey [CGS] as surface or near-surface displacement within the last 11,700 years).

The site is about 130 ft northwest of the nearest, CGS-designated Earthquake Fault Zone (EFZ), the Santa Monica, and relatively near the Hollywood EFZ that extends into the City on the northeast and the West Pico EFZ that currently terminates at the City limits on the southeast (see various regional maps in the FGC report). The City requires independent fault-activity reviews in conformance with building codes, with current requirements of the CGS (2018; Special Pub. 42) and to ensure public health, safety and welfare.

The reviews included initial telephone and email discussions with applicant representatives, the consultants and City personnel about investigation requirements, scope of work and approval for the proposed investigation plan. These were followed by on-site field observation of continuous cores, interpretations of FGC preliminary cross-sections, cone penetrometer tests and site-specific soil-stratigraphic correlations. Likewise reviewed was an FGC draft report, similarly followed by meetings and discussions with FGC personnel and the applicant, and ultimately by acceptance of the final report.

Though dated 20 September 2018, the FGC final report submitted on 2 October. It documents pertinent literature and maps, summarizes field investigation procedures, provides the regional geologic framework and tectonic setting, and expounds on specific investigation procedures and technical data supporting the professional conclusions and recommendations.

In sum, the fundamental conclusions of the Consultants-of-Record are:

1. That the FGC regional assessments and site-specific investigations meet current standards-of-practice for fault-activity assessments in southern California in general and for those specifically required by the City of Beverly Hills in particular;

2. That the FGC site-specific investigations and interpretations are sufficient to identify, date and correlated subsurface stratigraphic markers (primarily buried paleosols) observed and described from five, 50-ft onsite continuous cores. The sediments are unbroken and judged as generally more than 11,700 years old;

3. That, despite diligent observation, no charcoal or other materials amenable to unequivocal radiocarbon or other numeric dating methods were recovered;

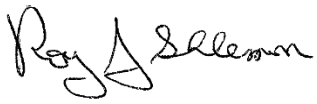
4. That the on-site sediments were dated primarily by soil-stratigraphic techniques (Appendices A and B). Identified were multiple moderately developed buried paleosols locally replete with common to many, reddish-brown moderately thick illuvial clay films all indicating a pre-11,700-yr age; and that these soils and sediments are traced across the site and, in association with onsite and adjacent property CPT “signatures,” are unbroken.

5. That, the 461 N. Beverly Drive property is not subject to potential surface or near-surface displacement associated with the Santa Monica, the Hollywood, the West Pico or any other fault reasonably projected toward it.

Accordingly, based substantially on, and in reliance of their professional interpretations and conclusions, the FGC regional summaries and site-specific investigations are judged to meet current standards-of-practice for fault-activity assessments in southern California in general and to those specifically required by the City of Beverly Hills in particular.

Please note that the FGC report focuses solely on potential surface or near-surface fault rupture and does not specifically address possible high seismic accelerations, ground deformation or other structural design and geotechnical investigations required by applicable building codes or by present professional engineering and geological standards of practice. It is therefore incumbent upon the applicant, FGC, or other consultants, to provide this information to the City of Beverly Hills for technical review and potential acceptance prior to issuance of building permits.

Recommended for Acceptance



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Roy J. Shlemon, Ph.D.
Technical Reviewer

2 October 2018

David Yelton, Deputy Building Official
Development Services Division
Community Development Department

October 8, 2018

461 N. Beverly Drive LLC,
A California limited liability company
Attention: Franklin E. Dickinson AIA
SVP Architecture & Construction for
LVMH Moët Hennessy Louis Vuitton
19 E. 57th Street
New York, NY 10022

Subject: Acceptance of City's Peer-Reviewer Recommendation For Acceptance: "Report For Investigation Of Potential Surface Fault Rupture:" 461 North Beverly Drive, Beverly Hills, California 90210

Dear 461 N. Beverly Drive LLC:

The "Fault Hazard [Ground Rupture] Investigation" (Investigation) for the proposed redevelopment of the 461 N. Beverly Drive property, in the City of Beverly Hills, California 90210. The investigations were carried out by Feffer Geological Consulting, Inc. ("FGC"), the Consultants-of-Record, on behalf of the applicant, the 461 N. Beverly Drive LLC. The main purpose of the FGC investigation was to determine if possible splays of the Santa Monica fault zone potentially impact the site, and if such faults were "active" (defined by the California Geological Survey [CGS] as surface or near-surface displacement within the last 11,700 years). The FGC investigation has been peer reviewed by the City's consultant, Roy J. Shlemon, Ph.D., PG 2867; CPG 1766; CPESC 2167, of Roy J. Shlemon & Associates, Inc. ("RSA").

The peer review included critique of the Site-Specific Fault Rupture Investigation titled "Report on a Fault Hazard Investigation for the Property Located at 461 N. Beverly Drive, Beverly Hills, California, 90210" (FGC Project File No. 2196-85 dated September 20, 2018 attached).

The geologic investigation and peer review are required by the City in conformance with the current building codes and with current geologic-standards-of practice that ensure public health, safety and welfare.

Accordingly, in reliance on the technical documentation and assurances provided by the Consultants-of-Record, including their opinions and conclusions, the City of Beverly Hills now formally accepts the technical "Recommendation For Acceptance" of the Reviewer (attached).

Sincerely,

D. Yelton

Attachments: 1) Roy J. Shlemon, Ph.D., PG 2867; CPG 1766; CPESC 2167, of Roy J. Shlemon & Associates, Inc., "Recommendation For Acceptance," October 2, 2018
2) Feffer Geological Consulting Fault Rupture Hazard Investigation Report, Project File No. 2196-85, dated October 20, 2018

cc: Joseph Dushey, Jenel Management Company