Appendix E

Geotechnical Siting Studies

GEOTECHNICAL SITING STUDY

SAN DIEGO GAS & ELECTRIC
PROPOSED OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK – PARCELS 7, 16 AND 17
OCEANSIDE, CALIFORNIA

June 26, 2012

June 26, 2012
Project No. 124202

Mr. Richard Miller
San Diego Gas & Electric
8316 Century Park Court
Suite CP 52G
San Diego, California 92123-1582

Subject: Geotechnical Siting Study
San Diego Gas & Electric
Proposed Ocean Ranch Substation
Pacific Coast Business Park - Parcels 7, 16 and 17
Oceanside, California

Dear Mr. Miller:

This report presents the results of our geotechnical siting study of three potential sites for the proposed San Diego Gas & Electric Ocean Ranch Substation to be located in the Pacific Coast Business Park in Oceanside, California. The three potential sites included Parcels 7, 16 and 17.

We appreciate this opportunity to be of continued service and look forward to future endeavors. If you have any questions about our report, please contact us at (858) 320-2000.

Very truly yours,

KLEINFELDER, INC.

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Section

1 INTRODUCTION

1.1 PURPOSE AND SCOPE OF SERVICES

San Diego Gas & Electric (SDG&E) is evaluating the suitability of three potential sites for siting a new substation within the Pacific Coast Business Park located in the Oceanside area of San Diego County. Kleinfelder has performed a siting study of Parcels 7, 16 and 17 located in the southern portion of Pacific Coast Business Park. The purpose of our siting study was to present preliminary geologic and geotechnical considerations pertaining to development of the potential substation sites in order to assist SDG&E with selecting and potentially acquiring one of the sites. Supplemental subsurface exploration, laboratory testing, analysis and design would be required during the future design-level phase.

For this current study, we performed a site reconnaissance and reviewed regional geologic literature and readily available consultant reports for the business park. In addition, we performed a limited field and laboratory investigation to further evaluate the subsurface conditions within each of the three potential sites. Using data obtained from the above activities, we evaluated geologic hazards and developed geotechnical considerations for use in evaluating the candidate sites. Specifically, we performed the following tasks:

- Review of readily available geotechnical and geologic literature including previously completed geotechnical studies, project site grading report, topographic maps, geologic maps, and stereoscopic aerial photographs.
- Perform a geologic reconnaissance of the three parcels.
- Perform a limited geotechnical subsurface field investigation and laboratory testing.
- Compilation and synthesis of the data obtained.
- Evaluation of potential geologic hazards including surface fault rupture, seismicity and ground shaking, liquefaction and seismic induced settlement, landsliding, expansive soils, unconsolidated soils, tsunamis and seiches, and flooding.

- Preparation of this report presenting our preliminary findings and conclusions, specifically those related to potential geologic and soils constraints that may impact site development and performance.

2 SITE DESCRIPTION AND HISTORY

2.1 PROJECT AND SITE DESCRIPTION

The project area for all three potential substation locations (Parcels 7, 16 and 17) is located off of Avenida del Oro in the Pacific Coast Business Park in Oceanside, California, as shown on Plate 1, Site Vicinity Map. Our understanding of the proposed development is based on our review of Concept Layout Plan for Ocean Ranch Substation, prepared by San Diego Gas & Electric. The plan for Parcel 7 was dated January 27, 2012 and the plans for Parcels 16 and 17 were dated March 1, 2012. In general, the plans include a layout of a new substation with a perimeter access road, battery storage areas and water quality areas.

Parcel 7 is located along the west side of Avenida del Oro at the south end of Blacks Beach Street. Parcels 16 and 17 share a property boundary and are located east of Parcel 7 and Avenida del Oro, at the south end of Rocky Point Drive. The three parcels are shown on Plate 1, Site Vicinity Map and on Plate 2, Field Exploration Map.

Parcel 7 is semi-rectangular in shape and sits north of an existing US Postal Office. Site elevations range from about 387 feet Mean Sea Level (MSL) in the southwest corner to about 382 feet MSL in the northeast corner. An approximate 50-foot high slope descends from the south end of the site to the post office. The site is sparsely vegetated with native grasses and small bushes. A roughly graded access road for the existing SDG&E transmission corridor is located along the western side of the parcel. Existing slopes on the south, west and east sides of the site appear to have inclinations of about 2 horizontal to 1 vertical (2H:1V). An approximate 4-foot high soil berm is located on the north end of the site. Preliminary plans provided by SDG&E indicate the substation may be located along the southwest portion of the parcel with an access road from the cul-de-sac off of Blacks Beach Street. Existing SDG&E transmission easements are located on the west and south sides of the parcel.

Parcels 16 and 17 are triangular in shape and have a common property boundary directly south of Rocky Point Drive. These parcels are moderately to densely vegetated with native grasses and bushes. Avenida del Oro borders the western property line of Parcel 16 and an existing commercial development is located to the north, south and east of Parcel 17. An approximately 4-foot high soil berm with small trees traverses through the central portion of the parcels along the property boundary, roughly in a southwest to northeast direction. Existing slopes located on the southern portion of Parcel 16 appear to have inclinations of about 2H:1V. The sites have gentle to moderately sloping topography with gradients that slope to the southwest. The total differential elevation across each parcel is approximately 4 feet, with Parcel 17 being about 4-foot higher in elevation overall. A large soil berm surrounds the cul-de-sac on the north end of each site; however, an access road for Parcel 16 is located on the west side of Rocky Point Drive. Relatively large (40 to 50 feet in diameter) stormwater desilting basins are located within the northern portion of Parcel 7 and the southwestern portion of Parcels 16 and 17. These desilting basins have a corrugated steel stand pipe within the deepest portion of the basin. The sides of the basins on Parcels 16 and 17 have several erosion gullies that are about 1 to 3 feet in depth. It is anticipated that loose soil sediments have accumulated within each of these desilting basins. Preliminary plans indicate the proposed substation for either site may be located at the northern portion of the parcels and the access road located from cul-de-sac at the south end of Rocky Point Drive.

2.2 SITE HISTORY

Our understanding of the proposed substation sites is based on our discussions with SDG&E and our review of the following documents:

- Preliminary Geotechnical Investigation, Pacific Coast Industrial Park, SW Corner of College Boulevard and Old Grove Road, Oceanside, California, prepared by Medall, Aragon Geotechnical, Inc. (MAG), dated June 14, 2004.

- Supplemental Geotechnical Investigation, Pacific Coast Business Park, Oceanside, California, by Davis Earth & Materials, Inc., dated December 9, 2005 (included as Appendix C of Christian Wheeler 2006 report).

- Report of Supplemental Geotechnical Investigation, Pacific Coast Business Park, Old Grove Road and Avenida del Oro, Oceanside, California, prepared by Christian Wheeler Engineering, dated June 14, 2006.

- Report of Mass Grading Observations and Testing, Pacific Coast Business Park, Old Grove Road and Avenida del Oro, Oceanside, California, prepared by Christian Wheeler Engineering, dated May 2, 2007.

- Rough Grading Plans for Pacific Coast Business Park, Parcels 1 through 30, City of Oceanside, California, Sheets 1 through 19, prepared by BHA Inc., As-built dated March 6, 2008.

- Concept Layout Plan for Ocean Ranch Substation, prepared by San Diego Gas & Electric Company, San Diego California, dated January 27, 2012.

- Concept Layout Plan for Ocean Ranch Substation, Parcels 16 and 17, prepared by San Diego Gas & Electric Company, San Diego California, dated March 1, 2012.

Based on our review of the referenced documents, soils placed during grading operations in the early 1980’s for the alignment of Avenida del Oro and the commercial development along the southern site boundary of the business park were identified as "offsite fills". The referenced 2004 geotechnical study by Medall, Aragon Geotechnical (MAG) indicates the fill soils were placed under controlled conditions, however, the competency of the fill needed to be further evaluated. Reports for the compaction testing during grading operations were not available for our review for these areas located along the west and southern portions of Parcels 16 and 17, respectively. The 2006 Christian Wheeler (CW) report states the fill was placed in the early 1980’s and placement of this fill was observed, tested and documented by Prater Associates in 1982. Based on this information, CW considered the fill suitable in its current condition to support new fill and/or settlement-sensitive improvements. However, the 2006 report did recommend that all residual soils, and all loose alluvial / colluvial soils be removed and replaced as properly compacted fill. Undocumented fill soil was also noted within the alignment of the 20-foot-wide easement for a 27-inch water line that bisects Parcels 16 and 17. As discussed in a following section, this undocumented fill was reportedly removed in a later phase of grading and replaced with compacted fill.

A bedding plane shear zone was identified by MAG (2004) near the base of the existing 30-foot high cut slope along the southern property boundary of Parcel 7. The bedding shear zone was characterized as a soft clayey gouge varying in thickness up to about one inch. The bedding shear is referred to as a low-angle bedding parallel shear zone. Such shear zones typically have significantly reduced strength relative to adjacent intact materials and occur in association with landslides. The MAG (2004) report recommended that a buttress, or stability fill, be placed along the existing cut slope with the key of the excavation at least 5 feet below the bedding plane shear to improve the new fill slope's stability. The 2006 report by CW concurred with the stability fill recommendation by MAG for Parcel 7.

Previous grading within the business park in the 1980s consisted of rough grading of Avenida del Oro from the southern site boundary to its intersection with Old Grove Road, between Parcel 7 and Parcel 16. Fills over 60 feet in thickness exist where Avenida del Oro bisects the parcels and crosses the previously filled canyon, or finger drainage feature, at the southern portion of the business park. Cut slopes up to about 40 feet in height were located along the southern and western property line of Parcel 7. Pre-grading elevations on the parcels varied from about 302 feet MSL within the drainage feature on Parcel 16, up to approximately 400 feet at northwest corner of Parcel 7.

The Christian Wheeler (2007) grading report documents that the mass grading operations for the business park development were performed in accordance with the geotechnical recommendations presented in the referenced reports (MAG, 2004 and Christian Wheeler, 2006). Specifically, the grading report documents the stability fill on Parcel 7 was constructed as recommended and the key excavation extended 5 feet below the base of a bedding plane shear zone. Recommended subdrains at the base of the deep canyon fills within Parcels 16 and 17 were documented as being located and tied into existing drainage systems. The deep canyon drain was also completed within a finger canyon of Parcel 7 and a heel drain was installed along the south side of Parcel 7 within the stability fill slope. Sheets 15 through 17 of the as-built grading plans by BHA, Inc. are included in Appendix C for reference

Undocumented fill soils associated with the 27-inch water line traversing Parcels 16 and 17 were addressed during the removal and relocation of the water line. However, in some areas of the parcels, the alluvial / colluvial soils were evaluated and deemed competent by Christian Wheeler (2007) by utilizing in-place density testing during grading. This slightly contradicts the recommendations provided in the referenced geotechnical reports that all of the alluvium / colluvium should be removed prior to fill placement, but was based on direct observation and testing during grading. Due to the deep canyon fills (nearly 80 feet) in some areas of Parcel 16 and 17, settlement monuments were installed. Results of the settlement monitoring were not included in the Christian Wheeler (2007) grading report and supplemental monitoring results have not been provided for our review. Based on the final graded surface elevations, a cut / fill transition was documented traversing Parcel 7 and possibly the extreme northern corner of Parcel 16. Undercutting within the cut portion of these parcels was not completed at the time of grading, as the location of proposed improvements was not known at that time. Undercuts are typically performed with the cut portion of cut / fill transitions in order to limit potential differential settlement within structures by having all foundation elements or slab-on-grade within compacted fill.

3 INVESTIGATION METHODS

3.1 GEOLOGIC EVALUATION

Our geologic evaluation consisted of reviewing aerial photographs, geologic reports and maps reasonably available to our office, previous geotechnical and as-graded reports provided by SDG&E, and observation of the geotechnical conditions in the field at the time of our field reconnaissance and subsurface investigation. The geology of the site area is shown Regional Geologic Map, Plate 3.

Based on the results of our initial desktop review, we focused our investigation on the primary geotechnical issues including the stability fill slope on the south end of Parcel 7, the existing condition of the fill material, the alluvium / colluvium within the canyon drainages below engineered fill, potential settlement of deep fills placed within the drainage features within Parcels 16 and 17, and the cut / fill transitions within the graded pads.

3.2 FIELD RECONNAISSANCE

A certified engineering geologist from Kleinfelder conducted a site reconnaissance of the three parcels to assess and document current surface conditions. The graded pads are undeveloped and topography is relatively gently sloping. Vegetation varies from sparse to locally dense. Surficial soils show signs of desiccation or shrinkage and some surface cracking, which are indicative of near-surface clayey soil which has dried. Desilting basins are present in Parcels 7, 16 and 17. Several deeply eroded channels leading to and within the desilting basins have developed. All three parcels have semi-circle gravel bags placed on the surface at intervals across the sites for reducing surface runoff velocity and associated erosion. Relatively soft and moist soil conditions were observed at the ground surface in some areas during the site reconnaissance.

3.3 LIMITED SUBSURFACE INVESTIGATION

Kleinfelder conducted a limited subsurface investigation of the three parcels that included six borings and seven test pits. The borings were excavated between the dates of April 24 and April 26, 2012 to depths between 50 and 80 feet. The 8-inch diameter borings were excavated with a truck-mounted drill rig equipped with hollow stem augers and operated by Scott's Drill Company of Oceanside, California.

Seven backhoe test pits were excavated on April 25, 2012. The depth of the excavations ranged from about 5 to 10 feet. The test pit excavations were performed by Cut'N Core Inc., of San Diego, California. The test pit excavations were backfilled with compactive effort applied by the backhoe with a sheeps foot wheel attachment. The approximate location of each boring and test pit excavation is shown on Plate 2, Field Exploration Map, and logs of borings and test pit excavations are included in Appendix A, along with additional details of the field investigation.

3.4 LABORATORY TESTING

A limited laboratory testing program was conducted to evaluate physical characteristics of select soils encountered. The limited testing primarily consisted of moisture content and unit weight to evaluate the fill, consolidation testing of the alluvium that remained in place below the fill, and expansion index tests. The testing was performed in general accordance with the applicable ASTM test methods. Details of the laboratory testing program are presented in Appendix B.

4 SITE CONDITIONS

4.1 REGIONAL GEOLOGIC SETTING

The project site is situated in the western San Diego County section of the Peninsular Ranges geomorphic province of California. This province is characterized by mountainous terrain on the east composed mostly of Mesozoic igneous and metamorphic rocks, and relatively low-lying coastal terraces to the west underlain by late Cretaceous-, Tertiary-, and Quaternary-age sedimentary rocks. The portion of the province in San Diego County that includes the project sites generally consists of Tertiary-age sedimentary rocks and Quaternary-age alluvial materials deposited in the inland valleys. The proposed sites are underlain by the Eocene-age Santiago Formation consisting of interbedded sandstone, siltstone and claystone, according to Tan and Kennedy (2005).

4.2 REGIONAL FAULTING AND SEISMICITY

The Peninsular Ranges are traversed by several major active faults. The Whittier-Elsinore, San Jacinto, and the San Andreas faults are major active fault systems located northeast of the site and the Rose Canyon, Newport-Inglewood (offshore), Coronado Bank, and San Diego Trough are active faults located to the west-southwest. Tectonic activity associated with these and other faults is predominantly right-lateral strike-slip movement. These faults, as well as other faults in the region, have the potential for generating earthquakes and associated strong ground motions at the proposed sites. The nearest of these fault systems, the Rose Canyon fault, lies approximately 8 miles to the west and is the most significant fault to the site with respect to the potential for seismic activity. Lindvall and Rockwell (1995) have described the Rose Canyon fault system in terms of several segments that each has distinctive earthquake potential. The closest segment is the Delmar segment located about 8 miles to the west, which extends from La Jolla on the south to Oceanside on the north where it apparently merges with the Newport-Inglewood fault zone.

4.3 SITE GEOLOGY

The site is underlain by the Eocene-age Santiago Formation and surficial units consisting of fill and undifferentiated alluvium / colluvium. Detailed descriptions of these units are provided in Appendix A (Boring Logs and Test Pit Excavations), and generalized descriptions are provided in the subsequent sections below as described in the cited literature and as observed on the sites.

4.3.1 Fill

Fill materials are present throughout each of the three parcels and are associated with the mass grading operations for the Pacific Coast Business Park in 2007 and construction of Avenida del Oro in the 1980s. Our review of previous topographic maps and our limited field investigation indicates that the fill depth is up to about 50, 80 and 85 feet within Parcels 7, 16 and 17, respectively. Compaction of this fill was observed and tested by Christian Wheeler (2007) and was reported to be a minimum 90 percent relative compaction based on the ASTM D1557 modified proctor maximum dry density. For fills deeper than 50 feet, as noted for Parcels 16 and 17, the fill was reported to have been compacted to a minimum of 95 percent relative compaction per ASTM D1557. Standard Penetration Test (SPT) and California Sampler blow counts for fill soils encountered at the three parcels ranged from 24 to 92 blows per foot, which are generally consistent with the reported levels of compaction. The fills were likely derived from the on-site materials and generally consist of clayey sand, sandy clay and silty sand. The specified Expansion Index for grading was for a maximum EI of 90 within the upper 5 feet. The majority of fills throughout each parcel are documented and considered engineered fill, with the exception of older fills associated with construction of Avenida del Oro and the neighboring commercial development along the southern portion of Parcel 17.

Limited laboratory test results for moisture content of fill soils collected during our field investigation ranged between 5.5 and 31.9 percent with an average of about 12 percent. Reported optimum moisture contents for soils used as fill material during the 2006 and 2007 grading operations ranged between 9.7 and 21.7 percent (Christian Wheeler, 2007). The high moisture content of 31.9 percent is likely attributed to the depth of the sample tested being just above the fill / formation contact where perched water may accumulate. The in-situ dry density test results of the soil samples tested from our study were between 115 and 125 pounds per cubic foot (pcf), with an average of about 121 pcf. The Christian Wheeler grading report documented the maximum dry density of the fill soils tested and placed during the earthwork operations at the three parcels between 110 and 123 pcf.

4.3.2 Alluvium / Colluvium

Alluvium / Colluvium accumulates on and near the bottom of the natural slopes and drainages on the site through a combination of stream deposition and gravitational processes. These materials were identified in the referenced geotechnical reports to be located in drainage features and consist primarily of sandy clays and clays. Complete removal and recompaction was recommended. However, as previously discussed in this report, in-situ relative density testing and observation was performed during grading by Christian Wheeler (2007) in some areas where the material was encountered and determined by Christian Wheeler that they were of suitable density and depth so that complete removal was not required. The thickness of these soils was about 10 feet at three of the exploratory boring locations (B-4, B-5 and B-6) in Parcels 16 and 17. SPT and California Sampler blow counts for these soils ranged from 55 to 87 blows per foot.

4.3.3 Santiago Formation

The Cretaceous-age Santiago Formation has been mapped underlying the subject site (Kennedy and Tan, 2005), and was encountered in the previous consultant investigations and all of our explorations performed during our subsurface evaluation. Data from the exploratory borings and trenches and examination of the numerous cut slopes on and near the site indicate the Santiago Formation consists primarily of interbedded fine to coarse, light gray to light brown, massively bedded sandstone, clayey siltstone, and claystone. The sandstones vary from very highly cemented with thin concretionary beds to moderately cemented and friable. Siltstones are massive to locally thinly bedded, and moderately well-cemented. Recorded SPT and California Sampler blow counts for the Santiago Formation were relatively high, having a range of penetration of 2 to 5 inches for 50 blows.

4.4 GROUNDWATER

Groundwater was not encountered in any of our borings or test pit excavations. We anticipate that groundwater is located well below the proposed construction elevations. The depth to the regional groundwater table is anticipated to be significantly deeper than anticipated grading depths. The groundwater table may fluctuate with seasonal variations and irrigation. Groundwater is not expected to be a constraint to development at any of the sites.

5 DISCUSSIONS, CONCLUSIONS, AND RECOMMENDATIONS

5.1 POTENTIAL GEOLOGIC HAZARDS

Potential geologic hazards considered in our study include, fault surface rupture, seismic shaking, landslides, liquefaction, seismically induced settlement, tsunamis, seiches, flooding, and expansive soils. The following sections discuss these hazards and their potential at this site in more detail.

5.1.1 Seismic Shaking

The project area is considered to be seismically active, as is most of southern California. Based on our review of the referenced geologic maps, stereoscopic aerial photographs, and geologic reconnaissance, the subject sites are not underlain by known active or potentially active faults (i.e., faults that exhibit evidence of ground displacement in the last 11,000 years and 1,600,000 years, respectively), nor do the sites lie within an Alquist-Priolo Earthquake Fault Zone.

The Rose Canyon, Newport Inglewood Fault (offshore segment) is the closest active fault with an approximate distance of about 8 miles to the west of the site. The maximum moment magnitude associated with the offshore segment of the Rose Canyon, Newport Inglewood Fault is 7.1 (Cao et. al., 2003). The seismic shaking hazard is essentially the same for all three parcels.

5.1.2 Fault Surface Rupture

As previously discussed, the subject sites are not underlain by known active or potentially active faults. Therefore, the potential for ground rupture due to faulting at the sites is considered low for all three parcels.

5.1.3 Landslides and Slope Stability

Landslides are deep-seated ground failures (several tens to hundreds of feet deep) in which a large arcuate shaped section of a slope detaches and slides downhill. Landslides should not be confused with minor slope failures (slumps), which are usually limited to the topsoil zone and can occur on slopes composed of almost any geologic material. Landslides can cause damage to structures both above and below the slide mass. Structures above the slide area are typically damaged by undermining of foundations. Areas below a slide mass can be damaged by being overridden and crushed by the failed slope material.

Several formations within the San Diego region are particularly prone to landsliding. These formations generally have high clay content and are more prone to mobilize when they become saturated with water. Other factors, such as steeply dipping bedding that project out of the face of the slope and/or the presence of fracture planes, will also increase the potential for landsliding.

No surficial indications of deep-seated landsliding were noted at the three sites during our field reconnaissance or in topographic maps we reviewed. There were no mapped landslides in the geologic literature we reviewed. As discussed earlier, prior to mass grading at the site a bedding plane shear zone was identified by MAG (2004) near the base of the currently existing 30-foot high cut slope along the southern property boundary of Parcel 7. The bedding shear zone was characterized as a low-angle bedding plane composed of soft clayey gouge varying in thickness up to about one inch. Such shear zones typically have significantly reduced strength relative to adjacent intact materials and can occur in association with landslides. To address the presence of the shear zone and its potential effect on slope stability, a buttress fill was placed along the southern side of Parcel 7. Slope stability analyses performed by MAG (2004) concluded that the buttressed fill slope achieved a factor of safety in excess of 1.5.

Kleinfelder performed a cursory review of the static and seismic slope stability analyses in the report for the stability fill slope north of the existing US Post Office complex. Soil strength parameters used in the initial analyses by MAG for the slope stability check were confirmed from the results of our field investigation, direct shear testing, and engineering judgment.

The external static and seismic factors of safety calculated from the slope stability analyses were above the generally accepted minimum factors of safety of 1.5 and 1.1, respectively. Based on the results of our review, field investigation and limited engineering evaluations indicating the calculated factors of safety exceed the industry minimum, it is our opinion that the potential for significant large-scale slope instability is considered low for all three parcels.

5.1.4 Liquefaction and Seismic Settlement

The term liquefaction describes a phenomenon in which saturated, cohesionless soils temporarily lose shear strength (liquefy) due to increased pore water pressures induced by strong, cyclic ground motions during an earthquake. Structures founded on or above potentially liquefiable soils may experience bearing capacity failures due to the temporary loss of foundation support, vertical settlements (both total and differential), and undergo lateral spreading. The factors known to influence liquefaction potential include soil type, relative density, grain size, confining pressure, depth to groundwater, and the intensity and duration of the seismic ground shaking. The cohesionless soils most susceptible to liquefaction are loose, saturated sands and some silts.

Seismic settlement can occur either as a result of post-liquefaction reconsolidation as porewater pressure dissipates, or in unsaturated, predominantly granular and loose soils that tend to densify during seismic shaking.

The majority of the subject site is underlain at depth by weakly to moderately cemented formational sandstone and claystone at depth, or by well-compacted engineered fill. Based on the dense/firm and clayey/plastic nature of the on-site formational deposits and compacted fill as well as the absence of a shallow groundwater in those areas, it is our opinion that the potential for liquefaction and seismic settlement is very low for all three parcels.

5.1.5 Expansive Soils

Expansive soils are characterized by their ability to undergo significant volume changes (shrink or swell) due to variations in moisture content. Changes in soil moisture content can result from precipitation, landscape irrigation, utility leakage, roof drainage, perched groundwater, drought, or other factors and may result in unacceptable settlement or heave of structures or concrete slabs supported on grade.

Based on the results of our review, limited investigation, and experience with similar materials, the fill soils used for all three sites are expected to have a low to medium potential for expansive soils. A sample of the fill material from Boring B-1 at Parcel 7 was tested for expansion index (ASTM D4829). This test result indicates an expansion index (EI) of 54. Based on this result, our visual evaluation of samples from our borings and our review of previous reports, these materials may be classified in the medium expansion range (between 50 and 90 EI). However, it is possible that there is a potential for some highly expansive soils in some lifts of fill or areas of the sites. The granular materials of the Santiago Formation were tested from test pits TP1 and TP3 in the cut portion of Parcel 7 and indicated expansion indices of 5 and 29, respectively. The test results indicate the formational soils at this near-surface elevation of Parcel 7 have a very low to low expansion potential. However, more expansive soils should be expected at other elevations of the formation.

Based on the recommendations provided by Christian Wheeler (2006), selective grading was to be performed for soils placed within the upper 5 feet of each parcel. The selective grading was recommended to provide a cap of fill material with an expansion index of less than 90. The Christian Wheeler (2007) grading report references an expansion index test result on one sample of fill collected from each of the three parcels. The test results of the samples collected range between 50 and 61, which correspond to low to medium expansion potential. However, the sample number and soil type number documented in the report do not correlate with the in-place density tests data recorded for each of the parcels, so the location of these samples is not clear. Based on the test data recorded for expansion potential and soil type in the grading report, the actual expansion potential of soils used as fill in each of the three parcels is not clear. As stated above, we anticipate soils used as fill within the parcels to have a medium expansion range, but highly expansive soils may be encountered in localized areas or lifts of fill. We were not able to differentiate the lots with respect to expansion potential of the near-surface soils. Therefore, the hazard for expansive soil is essentially the same for all three parcels. The maximum expansion index of 90 specified during the previous grading exceeds the typically specified value of 50 in San Diego County, due to characteristics of the on-site Santiago Formation. Depending on the actual near–surface soils present, possible measures to mitigate the potential impacts of expansion and shrinkage may include compacting near-surface soils in excess of optimum moisture content, providing surface drainage to minimize infiltration and fluctuations in moisture content near settlement sensitive improvements, deepening foundations, and providing additional reinforcement within concrete.

5.1.6 Tsunamis and Seiches

Tsunamis are long wavelength seismic sea waves (long compared to the ocean depth) generated by sudden movements of the ocean bottom during submarine earthquakes, landslides, or volcanic activity. A seiche is an oscillation (wave) of a body of water in an enclosed or semi-enclosed basin that varies in period, depending on the physical dimensions of the basin, from a few minutes to several hours, and in height from several inches to several feet. A seiche is caused chiefly by local changes in atmospheric pressure, aided by winds, tidal currents, and occasionally earthquakes. Based on the inland location and elevation of the three parcels, the potential for damage due to either a tsunami or seiche is considered nil.

5.1.7 Flood Hazard

According to a Federal Emergency Management Agency (FEMA) flood insurance rate maps (FEMA map panels numbers 0758F), the sites are considered to be outside of 100-year and 500-year floodplains. Based on review of topographic maps, the three parcels are not located downstream of a dam or within a dam inundation area. Based on this review and our site reconnaissance, the potential for flooding of the three parcels is considered low.

5.2 SETTLEMENT OF DEEP FILLS

Settlement of deep fills occurs from self-weight of the fill. This occurs slowly, even when subsurface and surface drainage is provided, and is a function of a number of variables including depth, soil type, age of fill, degree of initial compaction, and degree of wetting. Experience has shown that this consolidation may approach from 0.2 percent (for granular soils) to 0.5 percent (for clayey soils) of the fill thickness. The settlement may be larger if the fine grained soil from underlying alluvium/colluvium is considered along with the fill thickness. This settlement is in addition to the static settlements due to loading from structures or new fill loading. Specific settlement estimates can be provided once the site is selected and locations of the proposed substation improvements are known. Although the actual magnitude and rate of settlement is dependent on several variables, experience has shown this can take about 10 to 20 years to occur with about half the settlement occurring in the first 5 years.

Based on the estimated maximum fill depths of 80 to 85 feet on Parcels 16 and 17, we estimate maximum total settlement that would occur to be on the order of 3 to 5 inches. It is difficult to speculate on how much settlement has occurred and how much more may occur. As previously discussed in this report, settlement monitoring points were recommended and reportedly installed within Parcels 16 and 17. Kleinfelder recommends that SDG&E make additional attempts to obtain and review the settlement monitoring results for the parcels if these are considered in selection and acquisition process. It should also be noted that SDG&E typically utilizes decomposed granite or aggregate base rather than pavement over much of their substations, and the higher infiltration rate of these materials can lead to potentially larger settlements occurring over a shorter time period than sites covered with pavements and buildings.

Differential settlement between equipment pads within the substation will be dependent on the depth of fill below the proposed substation layout in each parcel. Based on our review of the referenced concept layout plans and as-built grading sheets, the range of fill depth in the general area below each of the proposed substations are approximately 0 to 34 feet at Parcel 7, 8 to 66 feet at Parcel 16, and 20 to 61 feet at Parcel 17.

5.3 GEOTECHNICAL CONSIDERATIONS FOR SITE SELECTION AND DEVELOPMENT

Based on the results of our review, geologic reconnaissance and limited field and laboratory investigation, it is our opinion that substation construction is feasible at any of the three proposed sites from a geotechnical perspective. Although there are geotechnical differences between the sites, it is our opinion that they are not significant enough to establish a clear ranking of sites. The similarities and differences of the sites are discussed below along with the associated implications to site development.

- The three sites are located adjacent to each other within the Pacific Coast Business Park. Mass grading occurred at about the same time in 2006 and 2007 with the same design team and contractor. The three sites are located in an area with similar geotechnical conditions with variable depths of compacted fill placed over very dense/firm Santiago Formation.

- The maximum depth of fill varies from 55, 80 and 85 on Parcels 7, 16 and 17, respectively. Based on a potential total settlement of about 0.4 to 0.5 percent of the fill depth for clayey fill soil, we estimate maximum settlements may be on the order of 3 to 5 inches. However it is difficult to estimate how much may have occurred since the completion of grading in 2006 and how much more may occur in the future. Settlement can be a function of the variation of fill depth and the inclination of natural slope the fill was placed on. Based on our review of the grading plans, both Parcels 16 and 17 appear to have underlying natural slope inclinations of approximately 3H:1V to the south. Parcel 7 appears to have a natural slope inclination that is typically flatter than 5:1, however slope geometry is more irregular in shape and orientation. Although settlement monitoring data was not available for our review, considering the generally good level of compaction of the engineered fill and the time it will have been in place prior to development, it is unlikely that total or differential settlement would be beyond tolerable limits by SDG&E and impact structures. Potential settlement can be further evaluated if and when the post-grading settlement monitoring data is provided.

- Alluvial / colluvial soils were left in-place within the drainage features below the fill on Parcels 16 and 17 but were either not present or completely removed on Parcel 7. These types of materials are typically removed and recompacted since they may be more susceptible to settlement or consolidation due to their younger geologic age and method of deposition. The initial geotechnical reports recommended removal and recompaction, however, the lower portion was left in place since observation and in-situ testing during grading indicated they were of adequate density. Up to approximately 10 feet of this clayey material was encountered in three of our borings and uncorrected SPT and California sampler blow counts were 55 to 87 blows per foot. Due to their depth, thickness, and observed density, the potential for settlement of the alluvial / colluvial soils impacting the proposed substation is low.

- With respect to topography, Parcel 7 is bordered by three descending slopes, Parcel 16 is bordered by one descending slope and Parcel 17 is bordered by one ascending slope. Due to the presence of a bedding plane shear zone observed in a large diameter boring by MAG (2004), a large buttress or stability fill slope on the order of 30-feet in height was designed and constructed along the south side of Parcel 7. The slope was designed to have a minimum factor of safety of 1.5 for static conditions. The as-graded report states that the buttress fill was constructed as designed.

- Based on the previous grading performed at the sites, remedial grading should be anticipated in the proposed substation areas of all three parcels. The recommended extent of this grading should be established as part of the design-level geotechnical investigation. However, we expect that the cut portions would be overexcavated and recompacted so that proposed improvements do not traverse cut / fill transitions. The fill areas would be overexcavated and recompacted due to the age of fill and observed loose surficial soils during our field studies. For preliminary planning purposes, the depth of remedial grading may be up to about 3 feet in depth. Based on our prior experience with SDG&E substations traversing cut / fill transitions, the cut portion of the substation is typically overexcavated and recompacted to a depth of 3 feet. The cut area needing remedial grading is largest for Parcel 7 with a small area potentially located on Parcel 16.

- All three of the parcels have similar existing vegetation and would require a similar level of preparation prior to grading. Prior to grading at any of the proposed sites, existing trees and shrubs will require removal.

- Excavation into the on-site materials can likely be achieved with moderate to heavy effort with conventional heavy-duty excavation equipment. The formational materials of the Santiago Formation will generally break down fairly well under compactive effort, but some oversize cemented sandstone / claystone may remain. Oversize material greater than 6 inches in diameter should be placed a minimum of 8 feet below finish grade in areas outside the substation pad, a minimum of 8 feet from the face of fill slopes, and not in areas where underground construction is planned such as drilled pier foundations or trenches for utility ducts.

- Expansive soils are present on all three sites. The specification during mass grading was for an expansion index less than 90 in the upper 5 feet. Although some clay layers within the undisturbed Santiago Formation had expansion indices over 120, blending of clays, sands and silts during mass grading appears to have generally reduced the expansion index of the fill and complied with the specification. Results of 37 expansion index tests during grading of the business park (Christian Wheeler, 2007) indicate typical EIs between about 50 and 80 (low to medium expansion potential). Our limited observations and laboratory testing are consistent with this. As part of the design-level geotechnical studies of the selected site, additional laboratory testing to evaluate expansive soil potential should be performed.

- Due to the similarity in site conditions, we do not anticipate a significant difference in foundation type or size for the three parcels. We anticipate that the foundations for structures and equipment pads will be supported on shallow spread and continuous footings founded on engineered fill. Remedial grading would be required on portions of Parcel 7 so that foundations for each individual structure are supported entirely on engineered fill.

- Spread and continuous footings for proposed substation structures that will be founded on engineered fill soils can be designed using a preliminary allowable soil bearing pressure of 2,500 psf, for dead loads plus long-term live loads. These preliminary values are based on a minimum width of 12 inches and may be increased by 500 psf for each additional foot of depth up to a maximum of 4,000 psf for fill. These values are subject to confirmation during the design-level geotechnical investigation.

- Although existing slopes along the proposed sites are considered to be grossly stable, the surficial soils may be somewhat erodible due to their sandy nature. Of the three sites, Parcel 7 has the largest surface area of slopes requiring vegetation and maintenance and Parcel 17 has the least.

5.4 RECOMMENDATIONS FOR ADDITIONAL STUDY

We recommend that a design-level geotechnical investigation be performed for the selected site to support project design. The investigation should include development-specific subsurface exploration and laboratory testing. The purpose of the study would be to further evaluate the subsurface conditions at the proposed structure locations, along with the samples collected during this study, and to provide information pertaining to the engineering characteristics of earth materials at the selected project site. We also recommend that corrosion testing be performed on on-site soil types and imported soils (if any) used in the project. Based on this siting study and the results of the recommended additional geotechnical evaluation and laboratory testing for the selected site, recommendations for grading/earthwork, surface and subsurface drainage, foundations, pavement structural sections, and other pertinent geotechnical design considerations may be formulated.

6 LIMITATIONS

Recommendations contained in this siting study are based on our review of reports by others, field observations and subsurface explorations, laboratory tests, and our present knowledge of the proposed project. It is possible that soil conditions could vary between or beyond the points explored. If soil conditions are encountered during design-level geotechnical investigations or construction that differ from those described herein, we should be notified immediately in order that a review may be made and any supplemental recommendations provided. If the scope of the proposed project, including the proposed foundation systems or structural locations, changes from that described in this report, our recommendations should also be reviewed and a response issued. We have not reviewed the grading plans or foundation plans for the project. References to elevations and locations provided within this report were based upon general information provided for our use. Kleinfelder, Inc. did not provide surveying services.

Other standards or documents referenced in any given standard cited in this report, or otherwise relied upon by the authors of this report, are only mentioned in the given standard; they are not incorporated into it or "included by reference", as the latter term is used relative to contracts or other matters of law.

We have strived to prepare the findings, conclusions, and recommendations in this report in a manner consistent with the standards of care and skill ordinarily exercised by members of this profession practicing under similar conditions in the geographic vicinity and at the time the services were performed. No warranty or guarantee, express or implied, is made. The recommendations provided in this report are preliminary and not suitable for final design, and are based on the assumption that Kleinfelder will be retained to perform a design level investigation of the selected site, provide a program of tests and observations during the construction phase in order to evaluate compliance with our recommendations and to evaluate the site conditions exposed. Information and recommendations presented in this report should not be extrapolated to other areas or be used for other projects without our prior review and response.

This report may be used only by San Diego Gas & Electric and only for the purposes stated, within a reasonable time from its issuance. Land use, site conditions (both on site and off site) or other factors may change over time, and additional work may be required with the passage of time. Any party other than San Diego Gas & Electric who wishes to use this report shall notify Kleinfelder of such intended use. Based on the intended use of the report, Kleinfelder may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the client or anyone else will release Kleinfelder from any liability resulting from the use of this report by any unauthorized party.

The scope of services for this subsurface exploration and geotechnical report did not include environmental assessments or evaluations regarding the presence or absence of wetlands or hazardous substances in the soil, surface water, or groundwater at this site. Kleinfelder will assume no responsibility or liability whatsoever for any claim, damage, or injury which results from pre-existing hazardous materials being encountered or present on the project site, or from the discovery of such hazardous materials.

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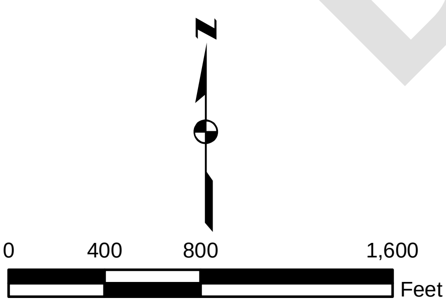
PLATES

SOURCE: Esri WORLD IMAGERY



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PROJECT NO. 124202	SITE VICINITY MAP		PLATE
DRAWN: 05/31/12			
DRAWN BY: PD			1
CHECKED BY: TG	SDG&E OCEAN RANCH SUBSTATION PACIFIC COAST BUSINESS PARK OCEANSIDE, CALIFORNIA		
FILE NAME: 124202_Vicinity.mxd			

LEGEND

B-1 APPROXIMATE BORING LOCATION

TP-1 APPROXIMATE TEST PIT LOCATION

SOURCE: Esri WORLD IMAGERY

0 150 300 600 Feet

N

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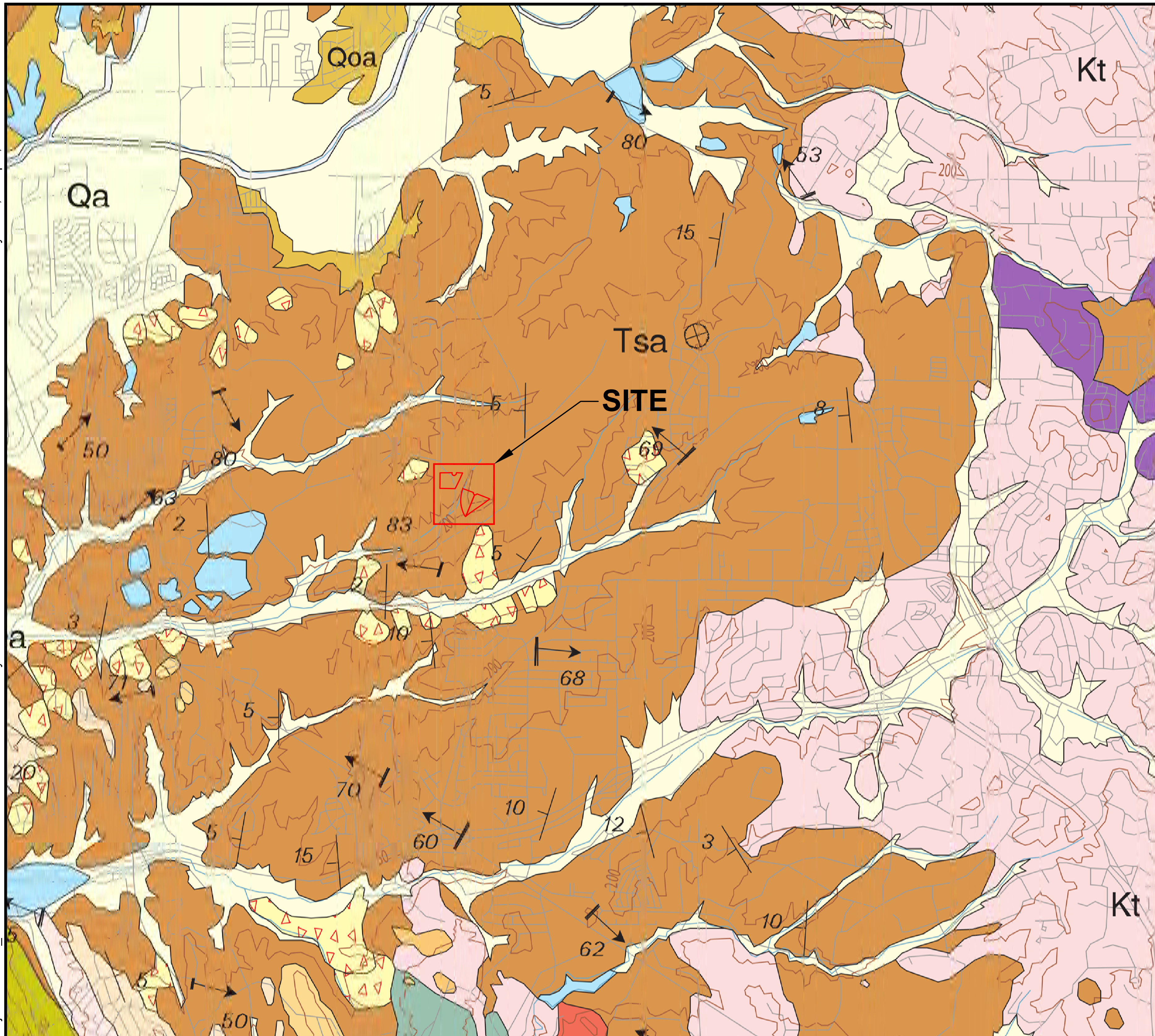
PROJECT NO.	124202	**FIELD EXPLORATION MAP**	PLATE
DRAWN:	05/15/12		**2**
DRAWN BY:	PD		
CHECKED BY:	TG	SDG&E OCEAN RANCH SUBSTATION PACIFIC COAST BUSINESS PARK OCEANSIDE, CALIFORNIA	
FILE NAME:	124202_PBH.mxd		



LEGEND

Qa — **Alluvial flood plain deposits (late Holocene)**—Active and recently active alluvial deposits along canyon floors. Consists of unconsolidated sandy, silty, or clay-bearing alluvium. Does not include alluvial fan deposits at distal ends of channels

Qls — **Landslide deposits undivided (Holocene and Pleistocene)**—Highly fragmented to largely coherent landslide deposits. Unconsolidated to moderately well consolidated. Most mapped landslides contain scarp area as well as slide deposit. In some areas scarp is shown separately. Many Pleistocene-age landslides were reactivated in part or entirely during late Holocene. Most of the landslides in the quadrangle have occurred within the Capistrano Formation, however, there are many within the Monterey and Santiago formations as well

Qoa — **Old alluvial flood plain deposits undivided (late to middle Pleistocene)**—Fluvial sediments deposited on canyon floors. Consists of moderately well consolidated, poorly sorted, permeable, commonly slightly dissected gravel, sand, silt, and clay-bearing alluvium. Where more than one number is shown (e.g., Qoa_{2-6}) those deposits are undivided (Fig. 3). Includes:

Qop_7 — **Old paralic deposits, Unit 7 (late to middle Pleistocene)**—Mostly poorly sorted, moderately permeable, reddish-brown, interfingered strandline, beach, estuarine and colluvial deposits composed of siltstone, sandstone and conglomerate. These deposits rest on the 9-11 m Bird Rock terrace (Fig. 3)

Qop_6 — **Old paralic deposits, Unit 6 (late to middle Pleistocene)**—Mostly poorly sorted, moderately permeable, reddish-brown, interfingered strandline, beach, estuarine and colluvial deposits composed of siltstone, sandstone and conglomerate. These deposits rest on the 22-23 m Nestor terrace (Fig. 3)

Qop_3 — **Old paralic deposits, Unit 3 (late to middle Pleistocene)**—Mostly poorly sorted, moderately permeable, reddish-brown, interfingered strandline, beach, estuarine and colluvial deposits composed of siltstone, sandstone and conglomerate. These deposits rest on the 45-46 m Guy Fleming terrace (Fig. 3)

Tsa — **Santiago Formation (middle Eocene)**—Named by Woodring and Popenoe (1945) for Eocene deposits of northwestern Santa Ana Mountains. There are three distinctive parts. A basal member that consists of buff and brownish-gray, massive, coarse-grained, poorly sorted arkosic sandstone and conglomerate (sandstone generally predominating). In some areas the basal member is overlain by gray and brownish-gray (salt and pepper) central member that consists of soft, medium-grained, moderately well-sorted arkosic sandstone. An upper member consists of gray, coarse-grained arkosic sandstone and grit. Throughout the formation, both vertically and laterally, there exists greenish-brown, massive claystone interbeds, tongues and lenses of often fossiliferous, lagoonal claystone and siltstone. The lower part of the Santiago Formation interfingers with the Delmar Formation and Torrey Sandstone in the Encinitas quadrangle

Kt — **Tonalite undivided (mid-Cretaceous)**—Mostly massive, coarse-grained, light-gray hornblende-biotite tonalite

Kgb — **Gabbro undivided (mid-Cretaceous)**—Mostly massive, coarse-grained, dark-gray and black biotite-hornblende-hypersthene gabbro

Contact—Contact between geologic units; dotted where concealed.

70 U D **Fault**—Solid where accurately located; dashed where approximately located; dotted where concealed. U = upthrown block, D = downthrown block. Arrow and number indicate direction and angle of dip of fault plane.

Anticline—Solid where accurately located; dotted where concealed.

Syncline—Solid where accurately located; dotted where concealed.

Kgd—granite pegmatite dike

Closed depression—Closed depression in Elsinore fault zone.

Qls? **Landslide**—Arrows indicate principal direction of movement. Queried where existence is questionable.

Strike and dip of beds

- 70 **Inclined**
- 70 **Overturned**
- **Vertical**
- **Horizontal**

Strike and dip of igneous foliation

- 45 **Inclined**
- **Vertical**

Strike and dip of igneous joints

- 60 **Inclined**
- **Vertical**

Strike and dip of metamorphic foliation

- 55 **Inclined**

Strike and dip of sedimentary joints

- **Vertical**

SOURCE: GEOLOGIC MAP OF THE OCEANSIDE 30'X60' QUADRANGLE, CALIFORNIA
1) CALIFORNIA DIVISION OF MINES AND GEOLOGY, LOS ANGELES, CALIFORNIA
2) U. S. GEOLOGICAL SURVEY, RIVERSIDE, CALIFORNIA

3500 0 1750 3500 ft

APPROXIMATE SCALE: 1 inch = 3500 ft

N

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DRAWN BY:	PD
CHECKED BY:	DH
FILE NAME:	124202_Geo.dwg

REGIONAL GEOLOGIC MAP

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CALIFORNIA

PLATE

3

APPENDIX A

FIELD EXPLORATION AND BORING LOGS

APPENDIX A
FIELD EXPLORATION AND BORING LOGS

Prior to any subsurface exploration, Kleinfelder notified Underground Service Alert (USA) to clear proposed boring locations of conflicts with utilities. In addition, Kleinfelder subcontracted a private utility locating company to sweep the proposed boring locations for underground utilities at the site. As required by the County of San Diego department of Environmental Health (DEH), explorations deeper than 20 feet were permitted. In addition, the field activities were monitored by a paleontologist.

The subsurface investigation included six borings and seven test pits. The borings were excavated to depths between 50 and 80 feet. The 8-inch diameter borings were excavated with a truck-mounted drill rig equipped with hollow stem augers and operated by Scott's Drill Company of Oceanside, California. An engineer from our office supervised the field operations and logged the borings. Selected bulk, disturbed, and intact samples were retrieved from the borings, sealed, and transported to our laboratory for further evaluation. Our typical vertical sampling interval was five feet; however, due to the extent of the deep canyon fills and knowledge of the previous grading operations, our sampling interval was increased to 10 feet in some of the deeper fill soils. The borings were backfilled using bentonite chips and soil cuttings.

In-place soil samples were obtained at the test boring locations using a California penetration sampler driven a total of 18-inches (or until practical refusal), into the undisturbed soil at the bottom of the boring. The soil sampled by the California sampler (3-inch O.D., 2.4 inches I.D.) was retained in 6-inch long brass tubes for laboratory testing. The samplers were driven using a 140 pound automatic hammer falling 30 inches. The total number of hammer blows required to drive the sampler the final 12 inches is termed the blow count and is recorded on the Logs of Borings. The blow counts presented on the Logs have not been adjusted for the effects of overburden pressure, input driving energy, rod length, sampler correction, or boring diameter correction.

Seven backhoe test pits were excavated to depths ranging from about 5 to 10 feet. An engineer from our office supervised the field operations and logged the pits. Selected bulk samples were retrieved from the excavations and transported to our laboratory for further evaluation. The test pit excavations were backfilled with compactive effort applied by the backhoe with a sheeps foot wheel attachment. The approximate location of each boring and test pit excavation is shown on Plate 2, Field Exploration Map.

Soil was classified in the field according to the Unified Soil Classification System (USCS) using the visual-manual procedure in accordance with ASTM D 2488. Field descriptions and classifications were reviewed against the laboratory descriptions (ASTM D2487) and adjusted where laboratory data was available.

A Unified Soil Classification System (USCS) chart and a Boring Log legend are presented as Plates A1a and A1b, respectively. The Logs of Borings and test pits are presented as Plates A1 through A23. The Logs of Borings and test pit excavations describe the earth materials encountered, samples obtained, and show field and laboratory tests performed. The logs also show the general location, boring number, drilling date, and the names of the logger and drilling subcontractor. The boundaries between soil types shown on the logs are approximate because the transition between different soil layers may be gradual.

SAMPLER GRAPHICS

	HYDRO-EXCAVATION
	HAND AUGER
	BULK / BAG SAMPLE
	CALIFORNIA SAMPLER (3 inch outside diameter)
	MODIFIED CALIFORNIA SAMPLER (2 OR 2-1/2 inch outside diameter)
	STANDARD PENETRATION SPLIT SPOON SAMPLER (2 inch outside and 1.4 inch diameter)
	SHELBY TUBE SAMPLER OR PUSH TUBE SAMPLER
	TEXAS CONE PENETRATION
	DYNAMIC CONE PENETRATION
	VANE SHEAR
	GEO-PROBE / MACROCORE SAMPLER
	SONIC SAMPLER
	CONTINUOUS CORE SAMPLE
	HQ CORE SAMPLE (2.500 inch (63.5 mm) core diameter)
	NQ CORE SAMPLE (1.874 inch (47.6 mm) core diameter)
	NX CORE SAMPLE (2.154 inch (54.7 mm) core diameter)

WATER LEVEL
(level where first observed)

WATER LEVEL
(level after exploration completion)

WATER LEVEL
(additional levels after exploration)

OBSERVED SEEPAGE

1. The report and log key are an integral part of these logs. All data and interpretations in this log are subject to the stated explanations and limitations stated in the report.

2. Lines separating strata on the logs represent approximate boundaries only. Actual transitions may be gradual.

3. No warranty is provided as to the continuity of soil or rock conditions between individual sample locations.

4. Logs represent general soil or rock conditions observed at the point of exploration on the date indicated.

5. In general, Unified Soil Classification System designations presented on the logs were based on visual classification in the field and were modified where appropriate by visual classification in the office and/or laboratory gradation and index property testing.

6. Fine grained soils that plot within the hatched area on the Plasticity Chart, and coarse grained soils with between 5% and 12% passing the No. 200 sieve require dual USCS symbols, ie., GW-GM, GP-GM, GW-GC, GP-GC, GC-GM, SW-SM, SP-SM, SW-SC, SP-SC, SC-SM.

7. 50/X indicates number of blows required to drive the identified sampler X inches with a 140 pounds hammer falling 30 inches.

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487)

COARSE GRAINED SOILS (More than half of material is larger than the #200 sieve)	GRAVELS (More than half of coarse fraction is larger than the #4 sieve)	CLEAN GRAVEL WITH <5% FINES	$Cu \geq 4$ and $1 \leq Cc \leq 3$	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
			$Cu < 4$ and/ or $1 > Cc > 3$	GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
		GRAVELS WITH 5% TO 12% FINES	$Cu \geq 4$ and $1 \leq Cc \leq 3$	GW-GM	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE FINES
				GW-GC	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE CLAY FINES
			$Cu < 4$ and/ or $1 > Cc > 3$	GP-GM	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE FINES
				GP-GC	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE CLAY FINES
		GRAVELS WITH > 12% FINES		GM	SILTY GRAVELS, GRAVEL-SILT-SAND MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
				SW	CLAYEY GRAVELS, GRAVEL-SAND-CLAY-SILT MIXTURES
	SANDS (More than half of coarse fraction is smaller than the #4 sieve)	CLEAN SANDS WITH <5% FINES	$Cu \geq 6$ and $1 \leq Cc \leq 3$	SW	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
			$Cu < 6$ and/ or $1 > Cc > 3$	SP	POORLY GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
		SANDS WITH 5% TO 12% FINES	$Cu \geq 6$ and $1 \leq Cc \leq 3$	SW-SM	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE FINES
				SW-SC	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE CLAY FINES
			$Cu < 6$ and/ or $1 > Cc > 3$	SP-SM	POORLY GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE FINES
				SP-SC	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE CLAY FINES
		SANDS WITH > 12% FINES		SM	SILTY SANDS, SAND-GRAVEL-SILT MIXTURES
				SC	CLAYEY SANDS, SAND-GRAVEL-CLAY MIXTURES
				SC-SM	CLAYEY SANDS, SAND-SILT-CLAY MIXTURES

FINE GRAINED SOILS (More than half of material is smaller than the #200 sieve)	SILTS AND CLAYS (Liquid Limit less than 50)	ML	INORGANIC SILTS AND VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS, SILTS WITH SLIGHT PLASTICITY
		CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
		CL-ML	INORGANIC CLAYS-SILTS OF LOW PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
		OL	ORGANIC SILTS & ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS (Liquid Limit greater than 50)	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILT
		CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
		OH	ORGANIC CLAYS & ORGANIC SILTS OF MEDIUM-TO-HIGH PLASTICITY

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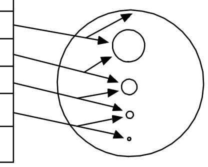
PROJECT NO. 124202	GRAPHICS KEY	PLATE
DRAWN BY: EK		
CHECKED BY: DH	SDG&E OCEAN RANCH SUBSTATION PACIFIC COAST BUSINESS PARK OCEANSIDE, CALIFORNIA	A-1a
DATE: May. 07, 2012		
REVISED:		

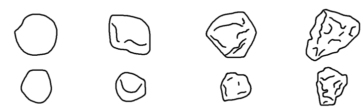
GRAIN SIZE

DESCRIPTION		SIEVE SIZE	GRAIN SIZE	APPROXIMATE SIZE
Boulders		>12"	>12"	Larger than basketball-sized
Cobbles		3 - 12'	3 - 12"	Fist-sized to basketball-sized
Gravel	coarse	3/4 -3"	3/4 -3"	Thumb-sized to fist-sized
	fine	#4 - 3/4"	0.19 - 0.75"	Pea-sized to thumb-sized
Sand	coarse	#10 - #4	0.079 - 0.19"	Rock salt-sized to pea-sized
	medium	#40 - #10	0.017 - 0.079"	Sugar-sized to rock salt-sized
	fine	#200 - #10	0.0029 - 0.017"	Flour-sized to sugar-sized
Fines		Passing #200	<0.0029	Flour-sized and smaller



ANGULARITY

DESCRIPTION	CRITERIA
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces
Subangular	Particles are similar to angular description but have rounded edges
Subrounded	Particles have nearly plane sides but have well-rounded corners and edges
Rounded	Particles have smoothly curved sides and no edges



PLASTICITY

DESCRIPTION	LL	FIELD TEST
Non-plastic	NP	A 1/8-in. (3 mm) thread cannot be rolled at any water content.
Low (L)	< 30	The thread can barely be rolled and the lump or thread cannot be formed when drier than the plastic limit.
Medium (M)	30 - 50	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump or thread crumbles when drier than the plastic limit
High (H)	> 50	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump or thread can be formed without crumbling when drier than the plastic limit

MOISTURE CONTENT

DESCRIPTION	FIELD TEST
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

REACTION WITH HYDROCHLORIC ACID

DESCRIPTION	FIELD TEST
None	No visible reaction
Weak	Some reaction, with bubbles forming slowly
Strong	Violent reaction, with bubbles forming immediately

APPARENT / RELATIVE DENSITY - COARSE-GRAINED SOIL[1]

APPARENT DENSITY	SPT-N_{60} (# blows/ft)	MODIFIED CA SAMPLER (# blows/ft)	CALIFORNIA SAMPLER (# blows/ft)	RELATIVE DENSITY (%)
Very Loose	<4	<4	<5	0 - 15
Loose	4 - 10	5 - 12	5 - 15	15 - 35
Medium Dense	10 - 30	12- 35	15 - 40	35 - 65
Dense	30 - 50	35 - 60	40 - 70	65 - 85
Very Dense	>50	>60	>70	85 - 100

[1]NOTE: AFTER TERZAGHI AND PECK, 1948

CONSISTENCY - FINE-GRAINED SOIL

CONSISTENCY	UNCONFINED COMPRESSIVE STRENGTH (Qu)(psf)	CRITERIA
Very Soft	< 1000	Thumb will penetrate soil more than 1 in. (25 mm)
Soft	1000 - 2000	Thumb will penetrate soil about 1 in. (25 mm)
Firm	2000 < 4000	Thumb will indent soil about 1/4 in. (6 mm)
Hard	4000 < 8000	Thumb will not indent soil but readily indented with thumbnail
Very Hard	> 8000	Thumbnail will not indent soil

STRUCTURE

DESCRIPTION	CRITERIA
Stratified	Alternating layers of varying material or color with layers at least 1/4 in. thick, note thickness
Laminated	Alternating layers of varying material or color with the layer less than 1/4 in. thick, note thickness
Fissured	Breaks along definite planes of fracture with little resistance to fracturing
Slickensided	Fracture planes appear polished or glossy, sometimes striated
Blocky	Cohesive soil that can be broken down into small angular lumps which resist further breakdown
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay; note thickness
Homogeneous	Same color and appearance throughout

CEMENTATION

DESCRIPTION	FIELD TEST
Weakly	Crumbles or breaks with handling or slight finger pressure
Moderately	Crumbles or breaks with considerable finger pressure
Strongly	Will not crumble or break with finger pressure

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PROJECT NO. 124202	SOIL DESCRIPTION KEY		PLATE
DRAWN BY: EK			
CHECKED BY: DH	SDG&E OCEAN RANCH SUBSTATION PACIFIC COAST BUSINESS PARK OCEANSIDE, CALIFORNIA		A-1b
DATE: May. 07, 2012			
REVISED:			

Date Begin - End:	4/25/12	**Drill Company:**	Scott's Drilling	**BORING LOG B-1**
Logged By:	E. Koprulu	**Drill Crew:**		
Hor.-Vert. Datum:	NAD83 - NAD83	**Drill Equipment:**	CME-55	**Hammer Type - Drop:** 140 lb. Automatic - 30"
Angle from Vert.:	0 degrees	**Exploration Method:**	Hollow Stem Auger	
Weather:	Overcast	**Auger Diameter:**	8 inches	

FIELD EXPLORATION								LABORATORY RESULTS							
Approximate Elevation (feet)	Depth (feet)	Graphical Log	Latitude: 33.21237° N Longitude: 117.29526° W Approximate Surface Elevation (ft): 385.0 Surface Condition: Bare Earth and Grass	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. blows/6 in	Recovery	USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
			<u>**Artificial Fill**</u> **Silty SAND (SM)**: fine to coarse grained, non-plastic fines, gray, moist	1											
			Clayey SAND (SC): fine to coarse grained, non-plastic fines, gray, moist, dense	2		BC=16 25 27			8.0	125					Expansion Index (54)
380	5		**Silty SAND (SM)**: trace clay, fine to coarse grained, non-plastic fines, gray, moist, very dense	3		BC=18 26 36									
375	10		Non-plastic fines, gray, moist, medium dense	4		BC=10 10 15									
370	15		Non-plastic fines, gray, moist, very dense, decrease in Clay content, increase in Sand content, isolated chuncks of Clay	5		BC=18 41 50			8.0	127					
365	20		Non-plastic fines, gray, moist, dense, becomes coarser grained Sand	6		BC=10 18 22									
360	25		**Sandy CLAY (CL)**: fine to medium grained, low plasticity fines, light brown to light gray, moist, firm, intermixed chunks of firm to hard Clay	7		BC=10 18 26			16.0	115					
355	30		Low plasticity fines, light brown to light gray, moist, firm, 4-inch thick SM lense within sample	8		BC=10 17 22									

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PROJECT NO. 124202	BORING LOG B-1		PLATE
DRAWN BY: EK			A-1
CHECKED BY: DH	SDG&E OCEAN RANCH SUBSTATION PACIFIC COAST BUSINESS PARK OCEANSIDE, CALIFORNIA		
DATE: 5/7/2012			
REVISED:			PAGE: 1 of 2

Date Begin - End:	4/25/12	**Drill Company:**	Scott's Drilling		**BORING LOG B-1**
Logged By:	E. Koprulu	**Drill Crew:**			
Hor.-Vert. Datum:	NAD83 - NAD83	**Drill Equipment:**	CME-55	**Hammer Type - Drop:**	140 lb. Automatic - 30"
Angle from Vert.:	0 degrees	**Exploration Method:**	Hollow Stem Auger		
Weather:	Overcast	**Auger Diameter:**	8 inches		

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 33.21237° N
Longitude: 117.29526° W
Approximate Surface Elevation (ft): 385.0

Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. blows/6 in	Recovery	USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
			Sandy Lean to Fat CLAY (CL-CH): fine grained, medium plasticity fines, dark brown to black, strong organic smell odor, moist, very hard, some rootlets	9		BC=22 50			6.0	122					
345	40		**Sandy CLAY (CL)**: fine grained, low plasticity fines, light brown, moist, hard	10		BC=9 17 21									
340	45		Low plasticity fines, light brown to white, moist, very hard, caliche	11		BC=15 27 28									
335	50		**Sandy Lean CLAY (CL)**: trace gravel, fine to coarse grained, low plasticity fines, gray, moist, hard	12		BC=9 13 17			32.0						
			<u>Santiago Formation</u>												
330	55		**Sandy CLAY (CL)**: fine to coarse grained, low plasticity fines, brown, moist, very hard	13		BC=10 22 37									
325	60														
320	65		Fine grained, low plasticity fines, grayish brown, moist, very hard, moderately cemented	14		BC=28 50/3"									

The boring was terminated at approximately 66 feet below ground surface. Boring was backfilled with bentonite on April 25, 2012.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling.
GENERAL NOTES:
The boring location and elevation are approximate and were estimated by BHA, Inc.
A Garmin etrex GPS unit was used to locate the boring with an accuracy of 5 to 10 feet.

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PROJECT NO.	124202	BORING LOG B-1	PLATE
DRAWN BY:	EK		A-2
CHECKED BY:	DH	SDG&E OCEAN RANCH SUBSTATION PACIFIC COAST BUSINESS PARK OCEANSIDE, CALIFORNIA	
DATE:	5/7/2012		
REVISED:			PAGE: 2 of 2

Date Begin - End:	4/25/12	**Drill Company:**	Scott's Drilling		**BORING LOG B-2**
Logged By:	E. Koprulu	**Drill Crew:**			
Hor.-Vert. Datum:	NAD83 - NAD83	**Drill Equipment:**	CME-55	**Hammer Type - Drop:**	140 lb. Automatic - 30"
Angle from Vert.:	0 degrees	**Exploration Method:**	Hollow Stem Auger		
Weather:	Overcast	**Auger Diameter:**	8 inches		

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 33.21187° N
Longitude: 117.29539° W
Approximate Surface Elevation (ft): 386.0

Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. blows/6 in	Recovery	USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
385			**Artificial Fill**												
			Clayey SAND (SC): fine to coarse grained, non-plastic fines, gray, moist, predominantly coarse grained Sand												
380	5		Fine to coarse grained, non-plastic fines, moist, dense	1		BC=12 18 22			10.0	115					
375	10		**Sandy CLAY (CL)**: fine grained, low plasticity fines, gray to dark gray, moist, very hard	2		BC=22 25 37			11.0	121					
370	15														
365	20		**Clayey SAND (SC)**: fine to coarse grained, non-plastic fines, gray, moist, firm	3		BC=8 12 12									
360	25		**Sandy CLAY (CL)**: fine to coarse grained, low plasticity fines, gray, moist, very hard												
355	30			4		BC=9 22 50			9.0	124					

Date Begin - End:	4/25/12	**Drill Company:**	Scott's Drilling
Logged By:	E. Koprulu	**Drill Crew:**	
Hor.-Vert. Datum:	NAD83 - NAD83	**Drill Equipment:**	CME-55
Angle from Vert.:	0 degrees	**Exploration Method:**	Hollow Stem Auger
Weather:	Overcast	**Auger Diameter:**	8 inches

BORING LOG B-2

Hammer Type - Drop: 140 lb. Automatic - 30"

Latitude: 33.21187° N
Longitude: 117.29539° W
Approximate Surface Elevation (ft): 386.0

Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	FIELD EXPLORATION: Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. blows/6 in	Recovery	LABORATORY RESULTS: USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
350			**Sandy CLAY (CL)**: fine to coarse grained, low plasticity fines, gray, moist, very hard *(continued)*												
			Santiago Formation												
345	40		**Sandy Lean CLAY (CL)**: fine grained, low plasticity fines, light brown, moist, very hard	5		BC=9 25 39			12.0						
340	45		Medium plasticity fines, grayish brown to gray, moist, very hard, fissured, iron-oxide staining	6		BC=14 27 38			14.0						
335	50		Medium plasticity fines, grayish brown, moist, very hard	7		BC=23 50									
330	55														
325	60														
320	65														

The boring was terminated at approximately 51 feet below ground surface. Boring was backfilled with bentonite on April 25, 2012.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling.
GENERAL NOTES:
The boring location and elevation are approximate and were estimated by BHA, Inc.
A Garmin etrex GPS unit was used to locate the boring with an accuracy of 5 to 10 feet.

Date Begin - End:	4/26/12 - 4/27/12	Drill Company:	Scott's Drilling	BORING LOG B-3
Logged By:	E. Koprulu	Drill Crew:		
Hor.-Vert. Datum:	NAD83 - NAD83	Drill Equipment:	CME-55	Hammer Type - Drop: 140 lb. Automatic - 30"
Angle from Vert.:	0 degrees	Exploration Method:	Hollow Stem Auger	
Weather:	Sunny	Auger Diameter:	8 inches	

Latitude: 33.21081° N
Longitude: 117.29389° W
Approximate Surface Elevation (ft): 367.0
Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	FIELD EXPLORATION	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. blows/6 in	Recovery	USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
365			**Artificial Fill** **Clayey SAND (SC)**: fine to coarse grained, non-plastic fines, gray, moist												
	5														
360															
	10		**Sandy CLAY (CL)**: fine to medium grained, medium plasticity fines, gray to brown, moist, very hard	1		BC=17 32 44									
355															
	15														
350															
	20		Fine to coarse grained, low plasticity fines, gray, moist, very hard	2		BC=13 27 40									
345															
	25														
340															
	30		Fine to medium grained, medium plasticity fines, grayish brown, moist, very hard, decrease in grain size	3		BC=20 30 50/5"									
335															

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PROJECT NO.	124202
DRAWN BY:	EK
CHECKED BY:	DH
DATE:	5/7/2012
REVISED:	

BORING LOG B-3

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CALIFORNIA

PLATE
A-5

Date Begin - End:	4/26/12 - 4/27/12	**Drill Company:**	Scott's Drilling		**BORING LOG B-3**
Logged By:	E. Koprulu	**Drill Crew:**			
Hor.-Vert. Datum:	NAD83 - NAD83	**Drill Equipment:**	CME-55	**Hammer Type - Drop:**	140 lb. Automatic - 30"
Angle from Vert.:	0 degrees	**Exploration Method:**	Hollow Stem Auger		
Weather:	Sunny	**Auger Diameter:**	8 inches		

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 33.21081° N
Longitude: 117.29389° W
Approximate Surface Elevation (ft): 367.0
Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. blows/6 in	Recovery	USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
330			**Sandy CLAY (CL)**: fine to medium grained, medium plasticity fines, gray to brown, moist, very hard *(continued)*												
325	40		Fine to coarse grained, low plasticity fines, moist, very hard, intermixed color from light gray - dark brown to reddish brown, some scattered sand lenses	4		BC=13 18 24									
320	45														
315	50		Fine to medium grained, medium plasticity fines, moist, very hard, intermixed color from light gray to reddish brown, some brown lenses of sand	5		BC=21 25 35									
310	55														
305	60		**Santiago Formation** **Sandy CLAY (CL)**: fine grained, medium plasticity fines, gray, moist, very hard												
300	65														

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PROJECT NO.	124202
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BORING LOG B-3

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CALIFORNIA

PLATE
A-6

Date Begin - End:	4/26/12 - 4/27/12	**Drill Company:**	Scott's Drilling
Logged By:	E. Koprulu	**Drill Crew:**	
Hor.-Vert. Datum:	NAD83 - NAD83	**Drill Equipment:**	CME-55
Angle from Vert.:	0 degrees	**Exploration Method:**	Hollow Stem Auger
Weather:	Sunny	**Auger Diameter:**	8 inches

BORING LOG B-3

Hammer Type - Drop: 140 lb. Automatic - 30"

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 33.21081° N
Longitude: 117.29389° W
Approximate Surface Elevation (ft): 367.0

Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. blows/6 in	Recovery	USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
295			**Santiago Formation** *(continued)* **Sandy CLAY (CL)**: fine grained, medium plasticity fines, gray, moist, very hard, iron-oxide staining	6		BC=28 45 50/4"									
	75														
290															
	80														
285															
	85														
280															
	90														
275															
	95														
270															
	100														
265															

The boring was terminated at approximately 71.5 feet below ground surface. The Boring was backfilled with bentonite on April 27, 2012.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling.

GENERAL NOTES:
The boring location and elevation are approximate and were estimated by BHA, Inc.
A Garmin etrex GPS unit was used to locate the boring with an accuracy of 5 to 10 feet.

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PROJECT NO.	124202
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CHECKED BY:	DH
DATE:	5/7/2012
REVISED:	

BORING LOG B-3

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CALIFORNIA

PLATE

A-7

Date Begin - End:	4/24/12	**Drill Company:**	Scott's Drilling		**BORING LOG B-4**
Logged By:	E. Koprulu	**Drill Crew:**			
Hor.-Vert. Datum:	NAD83 - NAD83	**Drill Equipment:**	CME-55	**Hammer Type - Drop:**	140 lb. Automatic - 30"
Angle from Vert.:	0 degrees	**Exploration Method:**	Hollow Stem Auger		
Weather:	Sunny	**Auger Diameter:**	8 inches		

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 33.21102° N
Longitude: 117.29288° W
Approximate Surface Elevation (ft): 374.0

Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. blows/6 in	Recovery	USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
			<u>**Artificial Fill**</u> **Silty SAND (SM)**: fine to coarse grained, non-plastic fines, gray, moist, dense	1											
			Trace Clay	2		BC=9 20 28									
370			Increase in Clay content												
	5		**Clayey SAND (SC)**: fine to coarse grained, non-plastic fines, dark gray, moist, dense	3		BC=14 26 40									
365	10		Fine to coarse grained, low plasticity fines, dark gray, moist, very dense, some lenses of dark brown Lean Clay	4		BC=12 31 42									
360	15		**Sandy CLAY (CL)**: fine to medium grained, low plasticity fines, moist, very hard, intermixed color from light gray to light tan, some lenses of dark brown Lean Clay	5		BC=18 32 42									
355	20		Fine grained, medium plasticity fines, light yellowish brown to light gray, moist, very hard, increase in clay content, decrease in sand content, lenses of Sand	6		BC=18 35 50/5.5"									
350	25		Fine to coarse grained, low plasticity fines, gray to brown, trace organic smell odor, moist, very hard, lenses of Sand throughout, dark brown to black lenses of old Top Soil	7		BC=16 35 42									
345	30		Fine grained, medium plasticity fines, gray to dark brown, trace organic smell odor, moist, very hard, black lenses of old Top Soil	8		BC=12 31 48									
340															

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PROJECT NO.	124202	BORING LOG B-4	PLATE
DRAWN BY:	EK		
CHECKED BY:	DH	SDG&E OCEAN RANCH SUBSTATION PACIFIC COAST BUSINESS PARK OCEANSIDE, CALIFORNIA	A-8
DATE:	5/7/2012		
REVISED:			PAGE: 1 of 3

Date Begin - End:	4/24/12	**Drill Company:**	Scott's Drilling		**BORING LOG B-4**
Logged By:	E. Koprulu	**Drill Crew:**			
Hor.-Vert. Datum:	NAD83 - NAD83	**Drill Equipment:**	CME-55	**Hammer Type - Drop:**	140 lb. Automatic - 30"
Angle from Vert.:	0 degrees	**Exploration Method:**	Hollow Stem Auger		
Weather:	Sunny	**Auger Diameter:**	8 inches		

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 33.21102° N
Longitude: 117.29288° W
Approximate Surface Elevation (ft): 374.0
Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. blows/6 in	Recovery	USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
				9		BC=20 40 50/5"									
335			**Silty SAND (SM)**: fine grained, non-plastic fines, gray, moist, very dense												
	40		**Clayey SAND (SC)**: fine grained, low plasticity fines, white to light brown, moist, very dense, caliche	10		BC=17 42 50									
330	45		**Sandy CLAY (CL)**: fine grained, medium plasticity fines, dark gray to black, moist, very hard	11		BC=19 38 50									
325	50		Fine grained, low plasticity fines, dark gray, moist, very hard, increase in Sand content, reddish brown and gray sand lenses	12		BC=15 29 46									
320	55		Fine to medium grained, low plasticity fines, gray, moist, hard, black colored CL-CH at shoe of sampler	13		BC=12 26 28									
315	60		**Lean to Fat CLAY (CL-CH)**: fine grained, medium plasticity fines, dark gray to black, moist, hard	14		BC=16 22 34									
310	65		Fine grained, medium plasticity fines, dark gray to black, moist, very hard, increase in sand content	15		BC=19 30 40									
305															

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PROJECT NO.	124202	BORING LOG B-4	PLATE
DRAWN BY:	EK		A-9
CHECKED BY:	DH	SDG&E OCEAN RANCH SUBSTATION PACIFIC COAST BUSINESS PARK OCEANSIDE, CALIFORNIA	
DATE:	5/7/2012		
REVISED:			PAGE: 2 of 3

Date Begin - End:	4/24/12	**Drill Company:**	Scott's Drilling
Logged By:	E. Koprulu	**Drill Crew:**	
Hor.-Vert. Datum:	NAD83 - NAD83	**Drill Equipment:**	CME-55
Angle from Vert.:	0 degrees	**Exploration Method:**	Hollow Stem Auger
Weather:	Sunny	**Auger Diameter:**	8 inches

BORING LOG B-4

Hammer Type - Drop: 140 lb. Automatic - 30"

FIELD EXPLORATION — LABORATORY RESULTS

Latitude: 33.21102° N
Longitude: 117.29288° W
Approximate Surface Elevation (ft): 374.0

Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. blows/6 in	Recovery	USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
			Alluvium **Fat CLAY (CH)**: fine grained, high plasticity fines, black, moist, very hard *(continued)*	16		BC=15 32 40									
300	75		Fine grained, high plasticity fines, black, moist, very hard	17		BC=18 37 50									CONSOL
295	80			18		BC=39 50/4"									
			Santiago Formation **Sandy CLAY (CL)**: fine to medium grained, low plasticity fines, gray, moist, very hard												
290	85		The boring was terminated at approximately 81 feet below ground surface. Boring was backfilled with bentonite on April 24, 2012.												
285	90														
280	95														
275	100														
270															

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling.
GENERAL NOTES:
The boring location and elevation are approximate and were estimated by BHA, Inc.
A Garmin etrex GPS unit was used to locate the boring with an accuracy of 5 to 10 feet.

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PROJECT NO.	124202	BORING LOG B-4	PLATE
DRAWN BY:	EK		A-10
CHECKED BY:	DH	SDG&E OCEAN RANCH SUBSTATION PACIFIC COAST BUSINESS PARK OCEANSIDE, CALIFORNIA	
DATE:	5/7/2012		
REVISED:			PAGE: 3 of 3

Date Begin - End:	4/24/12 - 4/25/12	**Drill Company:**	Scott's Drilling		**BORING LOG B-5**
Logged By:	E. Koprulu	**Drill Crew:**			
Hor.-Vert. Datum:	NAD83 - NAD83	**Drill Equipment:**	CME-55	**Hammer Type - Drop:**	140 lb. Automatic - 30"
Angle from Vert.:	0 degrees	**Exploration Method:**	Hollow Stem Auger		
Weather:	Sunny	**Auger Diameter:**	8 inches		

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 33.21074° N
Longitude: 117.29347° W
Approximate Surface Elevation (ft): 372.0
Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. blows/6 in	Recovery	USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
370			**Artificial Fill** **Silty SAND (SM)**: fine to coarse grained, non-plastic fines, gray, moist, dense												
365	5		Fine to coarse grained, non-plastic fines, gray, moist, dense, increase in grain size	1		BC=15 24 29									
360	10		**Clayey SAND (SC)**: fine to coarse grained, non-plastic fines, gray to dark gray, moist, very dense	2		BC=18 28 38									
355	15														
350	20		Fine grained, low plasticity fines, gray to dark gray, moist, medium dense, increase in Clay content	3		BC=10 12 13									
345	25														
340	30		**Sandy CLAY (CL)**: fine grained, low plasticity fines, light brown to light gray, moist, firm	4		BC=8 11 13									

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PROJECT NO.	124202	BORING LOG B-5	PLATE
DRAWN BY:	EK		A-11
CHECKED BY:	DH	SDG&E OCEAN RANCH SUBSTATION PACIFIC COAST BUSINESS PARK OCEANSIDE, CALIFORNIA	
DATE:	5/7/2012		
REVISED:			PAGE: 1 of 3

Date Begin - End:	4/24/12 - 4/25/12	Drill Company:	Scott's Drilling	BORING LOG B-5
Logged By:	E. Koprulu	Drill Crew:		
Hor.-Vert. Datum:	NAD83 - NAD83	Drill Equipment:	CME-55	Hammer Type - Drop: 140 lb. Automatic - 30"
Angle from Vert.:	0 degrees	Exploration Method:	Hollow Stem Auger	
Weather:	Sunny	Auger Diameter:	8 inches	

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 33.21074° N
Longitude: 117.29347° W
Approximate Surface Elevation (ft): 372.0
Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Description	Sample Number	Blow Counts(BC)= Uncorr. blows/6 in	Recovery	USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
335													
	40	Fine to medium grained, low plasticity fines, light gray to reddish brown, moist, hard, trace caliche, 3-inch thick lense of Sand	5	BC=10 15 21									
330													
	45												
325													
	50	**CALICHE**: dense, entire sample Caliche	6	BC=23 19 15									
320													
	55												
315													
	60	Fine to coarse grained, low plasticity fines, light gray to brown, moist, hard, some rootlets	7	BC=8 13 15									
310													
		<u>**Alluvium**</u> **Fat CLAY (CH)**: high plasticity fines, black, organic odor, moist, hard											
	65												
305													

Date Begin - End:	4/24/12 - 4/25/12	**Drill Company:**	Scott's Drilling		**BORING LOG B-5**
Logged By:	E. Koprulu	**Drill Crew:**			
Hor.-Vert. Datum:	NAD83 - NAD83	**Drill Equipment:**	CME-55	**Hammer Type - Drop:**	140 lb. Automatic - 30"
Angle from Vert.:	0 degrees	**Exploration Method:**	Hollow Stem Auger		
Weather:	Sunny	**Auger Diameter:**	8 inches		

Approximate Elevation (feet)	Depth (feet)	Graphical Log	FIELD EXPLORATION Latitude: 33.21074° N Longitude: 117.29347° W Approximate Surface Elevation (ft): 372.0 Surface Condition: Bare Earth and Grass	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. blows/6 in	Recovery	LABORATORY RESULTS USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
300			**Santiago Formation** **Sandy CLAY (CL)**: fine grained, medium plasticity fines, gray, moist, very hard, strongly cemented	8		BC=15 50/3"									
	75		The boring was terminated at approximately 71 feet below ground surface. The Boring was backfilled with bentonite on April 25, 2012.												
295															
	80														
290															
	85														
285															
	90														
280															
	95														
275															
	100														
270															

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling.

GENERAL NOTES:
The boring location and elevation are approximate and were estimated by BHA, Inc.
A Garmin etrex GPS unit was used to locate the boring with an accuracy of 5 to 10 feet.

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PROJECT NO.	124202	BORING LOG B-5	PLATE
DRAWN BY:	EK		A-13
CHECKED BY:	DH	SDG&E OCEAN RANCH SUBSTATION PACIFIC COAST BUSINESS PARK OCEANSIDE, CALIFORNIA	
DATE:	5/7/2012		
REVISED:			PAGE: 3 of 3

Date Begin - End:	4/26/12	**Drill Company:**	Scott's Drilling
Logged By:	E. Koprulu	**Drill Crew:**	
Hor.-Vert. Datum:	NAD83 - NAD83	**Drill Equipment:**	CME-55
Angle from Vert.:	0 degrees	**Exploration Method:**	Hollow Stem Auger
Weather:	Sunny	**Auger Diameter:**	8 inches

BORING LOG B-6

Hammer Type - Drop: 140 lb. Automatic - 30"

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 33.21047° N
Longitude: 117.29423° W
Approximate Surface Elevation (ft): 366.0

Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. blows/6 in	Recovery	USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
365			**Artificial Fill** **Clayey SAND (SC)**: fine to coarse grained, non-plastic fines, gray, moist, dense												
360	5		Fine to coarse grained, non-plastic fines, gray, moist, very dense	1		BC=16 24 42									
355	10		Coarse grained, non-plastic fines, gray, moist, very dense, decrease in fines content, predominantly coarse grained sand	2		BC=16 37 45									
350	15														
345	20		Coarse grained, non-plastic fines, gray, moist, very dense	3		BC=16 25 39									
340	25		**Sandy CLAY (CL)**: fine to coarse grained, low plasticity fines, grayish brown, moist, very hard	4		BC=20 30 38									
335	30		Fine grained, low plasticity fines, light brown, moist, very hard, gray colored Sand lenses throughout	5		BC=23 47 50									

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BORING LOG B-6

SDG&E OCEAN RANCH SUBSTATION
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PLATE
A-14

Date Begin - End:	4/26/12	**Drill Company:**	Scott's Drilling		**BORING LOG B-6**
Logged By:	E. Koprulu	**Drill Crew:**			
Hor.-Vert. Datum:	NAD83 - NAD83	**Drill Equipment:**	CME-55	**Hammer Type - Drop:**	140 lb. Automatic - 30"
Angle from Vert.:	0 degrees	**Exploration Method:**	Hollow Stem Auger		
Weather:	Sunny	**Auger Diameter:**	8 inches		

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 33.21047° N
Longitude: 117.29423° W
Approximate Surface Elevation (ft): 366.0
Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. blows/6 in	Recovery	USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
330			**Sandy CLAY (CL)**: fine to coarse grained, low plasticity fines, grayish brown, moist, very hard *(continued)*												
325	40		Fine grained, low plasticity fines, light brown to white, moist, very hard, abundant caliche	6		BC=8 15 19									
			Pieces of debris (metal pieces) observed in soil cuttings												
320	45		**Fat CLAY (CH)**: high plasticity fines, dark brown to black, trace organic odor, moist, hard, some reddish brown to gray colored Sand lenses, some rootlets	7		BC=8 11 18									
315	50		**Sandy CLAY (CL)**: fine grained, medium plasticity fines, grayish brown, moist, hard	8		BC=13 25 35									
310	55		Soil cuttings indcate black colored Clay with strong organic smell from approximately 50 to 58 feet												
305	60		Fine grained, low plasticity fines, grayish brown, moist, very hard	9		BC=17 18 28									
300	65		Becomes firm to hard	10		BC=6 10 14									
			<u>**Alluvium**</u> **Fat CLAY (CH)**: trace fine grained, high plasticity fines, black, organic smell odor, moist, firm to hard												

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BORING LOG B-6

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CALIFORNIA

PLATE
A-15

Date Begin - End: 4/26/12	**Drill Company:** Scott's Drilling		**BORING LOG B-6**
Logged By: E. Koprulu	**Drill Crew:**		
Hor.-Vert. Datum: NAD83 - NAD83	**Drill Equipment:** CME-55	**Hammer Type - Drop:** 140 lb. Automatic - 30"	
Angle from Vert.: 0 degrees	**Exploration Method:** Hollow Stem Auger		
Weather: Sunny	**Auger Diameter:** 8 inches		

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 33.21047° N
Longitude: 117.29423° W
Approximate Surface Elevation (ft): 366.0

Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. blows/6 in	Recovery	USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
295			**Alluvium** **Fat CLAY (CH)**: trace fine grained, high plasticity fines, black, organic smell odor, moist, firm to hard *(continued)*												
290	75		**Sandy CLAY (CL)**: fine grained, medium plasticity fines, brown, moist, very hard	11		BC=16 24 31									CONSOL
			Santiago Formation												
285	80		**Sandy CLAY (CL)**: fine grained, low plasticity fines, gray, moist, very hard, iron-oxide staining	12		BC=18 50/5"									
280	85														
275	90														
270	95														
265	100														

The boring was terminated at approximately 81 feet below ground surface. Boring was backfilled with bentonite on April 26, 2012.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling.
GENERAL NOTES:
The boring location and elevation are approximate and were estimated by BHA, Inc.
A Garmin etrex GPS unit was used to locate the boring with an accuracy of 5 to 10 feet.

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PROJECT NO.	124202	BORING LOG B-6	PLATE
DRAWN BY:	EK		A-16
CHECKED BY:	DH	SDG&E OCEAN RANCH SUBSTATION PACIFIC COAST BUSINESS PARK OCEANSIDE, CALIFORNIA	
DATE:	5/7/2012		
REVISED:			PAGE: 3 of 3

Date Begin - End:	4/23/12	Excavation Co.:	Cut N Core	TEST PIT LOG TP-1
Logged By:	E. Koprulu	Excavation Crew:		
Hor.-Vert. Datum:	NAD83 - NAD83	Excavation Equip.:	CAT 430E Backhoe	
Angle from Vert.:	0 degrees	Excav. Dimensions:	36 inches	
Weather:	Sunny			

Approximate Elevation (feet)	Depth (feet)	Graphical Log	FIELD EXPLORATION: Latitude: 33.21286° N; Longitude: 117.29625° W; Approximate Surface Elevation (ft): 384.0; Surface Condition: Bare Earth and Grass	Sample Number	Sample Type	USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
380	5		**Santiago Formation** **Clayey SAND (SC)**: fine to coarse grained, low plasticity fines, gray, moist, dense, homogeneous, weakly to moderately cemented, some Clay inseams	1									Expansion Index (5)

Elevation scale: 380, 375, 370, 365, 360, 355, 350. Depth scale: 5, 10, 15, 20, 25, 30.

The test pit was terminated at approximately 5 feet below ground surface. Test Pit was backfilled with excavated material on April 23, 2012.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during excavation.
GENERAL NOTES:
The test pit location and elevation are approximate and were estimated by BHA, Inc.
A Garmin etrex GPS unit was used to locate the test pit with an accuracy of 5 to 10 feet.
There was no shoring used for the test pit exploration.

TP-1

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PROJECT NO.	124202	TEST PIT LOG TP-1	PLATE
DRAWN BY:	EK		
CHECKED BY:	DH	SDG&E OCEAN RANCH SUBSTATION PACIFIC COAST BUSINESS PARK OCEANSIDE, CALIFORNIA	A-17
DATE:	5/7/2012		
REVISED:			PAGE: 1 of 1

Date Begin - End:	4/23/12	**Excavation Co.:**	Cut N Core
Logged By:	E. Koprulu	**Excavation Crew:**	
Hor.-Vert. Datum:	NAD83 - NAD83	**Excavation Equip.:**	CAT 430E Backhoe
Angle from Vert.:	0 degrees	**Excav. Dimensions:**	36 inches
Weather:	Sunny		

TEST PIT LOG TP-2

Approximate Elevation (feet)	Depth (feet)	Graphical Log	FIELD EXPLORATION: Latitude: 33.21283° N; Longitude: 117.29574° W; Approximate Surface Elevation (ft): 382.0; Surface Condition: Bare Earth and Grass	Sample Number	Sample Type	USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
380			**Santiago Formation** **Clayey SAND (SC)**: fine to coarse grained, low plasticity fines, gray, moist, very dense, fissured, moderately cemented	1									Expansion Index (29)
375	5		**CLAYSTONE (CL-CH)**: fine grained, medium to high plasticity fines, brown to reddish brown, moist, very hard, blocky, strongly cemented	2									

Depth scale: 10, 15, 20, 25, 30. Elevation scale: 370, 365, 360, 355, 350.

The test pit was terminated at approximately 8 feet below ground surface. Test Pit was backfilled with excavated material on April 23, 2012.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during excavation.
GENERAL NOTES:
The test pit location and elevation are approximate and were estimated by BHA, Inc.
A Garmin etrex GPS unit was used to locate the test pit with an accuracy of 5 to 10 feet.
There was no shoring used for the test pit exploration.

TP-2

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TEST PIT LOG TP-2

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CALIFORNIA

PLATE
A-18

Date Begin - End:	4/23/12	**Excavation Co.:**	Cut N Core
Logged By:	E. Koprulu	**Excavation Crew:**	
Hor.-Vert. Datum:	NAD83 - NAD83	**Excavation Equip.:**	CAT 430E Backhoe
Angle from Vert.:	0 degrees	**Excav. Dimensions:**	36 inches
Weather:	Sunny		

TEST PIT LOG TP-3

Approximate Elevation (feet)	Depth (feet)	Graphical Log	FIELD EXPLORATION: Latitude: 33.21221° N Longitude: 117.29648° W Approximate Surface Elevation (ft): 386.0 Surface Condition: Bare Earth and Grass	Sample Number	Sample Type	USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
385			**Santiago Formation** **Clayey SAND (SC)**: fine to coarse grained, low plasticity fines, gray, moist, very dense, blocky, moderately cemented	1									
	5		**CLAYSTONE (CL-CH)**: fine grained, medium to high plasticity fines, brown to reddish brown, moist, very hard, blocky, strongly cemented	2									
380													
	10												
375													
	15												
370													
	20												
365													
	25												
360													
	30												
355													

The test pit was terminated at approximately 6 feet below ground surface. Test Pit was backfilled with excavated material on April 23, 2012.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during excavation.
GENERAL NOTES:
The test pit location and elevation are approximate and were estimated by BHA, Inc.
A Garmin etrex GPS unit was used to locate the test pit with an accuracy of 5 to 10 feet.
There was no shoring used for the test pit exploration.

TP-3

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PROJECT NO.	124202
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TEST PIT LOG TP-3

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CALIFORNIA

PLATE
A-19

Date Begin - End:	4/23/12	**Excavation Co.:**	Cut N Core
Logged By:	E. Koprulu	**Excavation Crew:**	
Hor.-Vert. Datum:	NAD83 - NAD83	**Excavation Equip.:**	CAT 430E Backhoe
Angle from Vert.:	0 degrees	**Excav. Dimensions:**	36 inches
Weather:	Sunny		

TEST PIT LOG TP-4

Approximate Elevation (feet)	Depth (feet)	Graphical Log	FIELD EXPLORATION: Latitude: 33.21125° N Longitude: 117.29421° W Approximate Surface Elevation (ft): 368.0 Surface Condition: Bare Earth and Grass	Sample Number	Sample Type	LABORATORY RESULTS: USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
			Artificial Fill **Clayey SAND (SC)**: fine to coarse grained, low plasticity fines, light brown, moist, dense, chunks of clay throughout	1									
365	5		**Santiago Formation** **Clayey SAND (SC)**: fine to coarse grained, low plasticity fines, gray, moist, dense	2									

Elevation scale: 365, 360, 355, 350, 345, 340, 335. Depth scale: 5, 10, 15, 20, 25, 30.

The test pit was terminated at approximately 6 feet below ground surface. Test Pit was backfilled with excavated material on April 23, 2012.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during excavation.
GENERAL NOTES:
The test pit location and elevation are approximate and were estimated by BHA, Inc.
A Garmin etrex GPS unit was used to locate the test pit with an accuracy of 5 to 10 feet.
There was no shoring used for the test pit exploration.

TP-4

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PROJECT NO. 124202	TEST PIT LOG TP-4	PLATE
DRAWN BY: EK		
CHECKED BY: DH	SDG&E OCEAN RANCH SUBSTATION PACIFIC COAST BUSINESS PARK OCEANSIDE, CALIFORNIA	A-20
DATE: 5/7/2012		
REVISED:		PAGE: 1 of 1

Date Begin - End:	4/23/12	**Excavation Co.:**	Cut N Core
Logged By:	E. Koprulu	**Excavation Crew:**	
Hor.-Vert. Datum:	NAD83 - NAD83	**Excavation Equip.:**	CAT 430E Backhoe
Angle from Vert.:	0 degrees	**Excav. Dimensions:**	36 inches
Weather:	Sunny		

TEST PIT LOG TP-5

Approximate Elevation (feet)	Depth (feet)	Graphical Log	FIELD EXPLORATION: Latitude: 33.21126° N; Longitude: 117.29373° W; Approximate Surface Elevation (ft): 368.0; Surface Condition: Bare Earth and Grass	Sample Number	Sample Type	USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
			Artificial Fill **Sandy CLAY (CL)**: fine to coarse grained, low plasticity fines, light brown, moist, dense, chunks of clay throughout	1									
365			**Santiago Formation** **Silty SAND (SM)**: fine to coarse grained, low plasticity fines, gray, moist, dense, pockets of dark gray Clay, concreteion observed at approximately 5.5 feet	2									
	5												

Elevation scale: 365, 360, 355, 350, 345, 340, 335; Depth scale: 5, 10, 15, 20, 25, 30

The test pit was terminated at approximately 6 feet below ground surface. Test Pit was backfilled with excavated material on April 23, 2012.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during excavation.
GENERAL NOTES:
The test pit location and elevation are approximate and were estimated by BHA, Inc.
A Garmin etrex GPS unit was used to locate the test pit with an accuracy of 5 to 10 feet.
There was no shoring used for the test pit exploration.

TP-5

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PROJECT NO. 124202	TEST PIT LOG TP-5		PLATE
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DATE: 5/7/2012			
REVISED:			PAGE: 1 of 1

Date Begin - End:	4/23/12	**Excavation Co.:**	Cut N Core
Logged By:	E. Koprulu	**Excavation Crew:**	
Hor.-Vert. Datum:	NAD83 - NAD83	**Excavation Equip.:**	CAT 430E Backhoe
Angle from Vert.:	0 degrees	**Excav. Dimensions:**	36 inches
Weather:	Sunny		

TEST PIT LOG TP-6

Approximate Elevation (feet)	Depth (feet)	Graphical Log	FIELD EXPLORATION Latitude: 33.21125° N Longitude: 117.29333° W Approximate Surface Elevation (ft): 374.0 Surface Condition: Bare Earth and Grass	Sample Number	Sample Type	USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
			Artificial Fill **Clayey SAND (SC)**: trace gravel, fine to coarse grained, non-plastic fines, light brown, moist, dense	1									
370	5		**Silty SAND (SM)**: fine to coarse grained, non-plastic fines, gray, moist, dense, weakly cemented chunks mixed	2									
365	10												

The test pit was terminated at approximately 9.5 feet below ground surface. Test Pit was backfilled with excavated material on April 23, 2012.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during excavation.
GENERAL NOTES:
The test pit location and elevation are approximate and were estimated by BHA, Inc.
A Garmin etrex GPS unit was used to locate the test pit with an accuracy of 5 to 10 feet.
There was no shoring used for the test pit exploration.

360 — 15 — 355 — 20 — 350 — 25 — 345 — 30 — 340

TP-6

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San Diego, CA 92122
www.kleinfelder.com PH. 858-320-2000 FAX. 858-320-2001

PROJECT NO.	124202
DRAWN BY:	EK
CHECKED BY:	DH
DATE:	5/7/2012
REVISED:	

TEST PIT LOG TP-6

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CALIFORNIA

PLATE A-22

Date Begin - End:	4/23/12	**Excavation Co.:**	Cut N Core	**TEST PIT LOG TP-7**
Logged By:	E. Koprulu	**Excavation Crew:**		
Hor.-Vert. Datum:	NAD83 - NAD83	**Excavation Equip.:**	CAT 430E Backhoe	
Angle from Vert.:	0 degrees	**Excav. Dimensions:**	36 inches	
Weather:	Sunny			

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 32.21111° N
Longitude: 117.29319° W
Approximate Surface Elevation (ft): 373.0

Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Description	Sample Number	Sample Type	USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
			Artificial Fill	1									
			Clayey SAND (SC): fine to coarse grained, non-plastic fines, light brownish gray, moist, dense	2									
370			**Silty SAND (SM)**: fine to medium grained, non-plastic fines, light gray, moist, dense										
			Silty SAND (SM): coarse grained, non-plastic fines, gray, moist, dense	3									
	5		**Clayey SAND (SC)**: fine to coarse grained, non-plastic fines, gray, moist, dense	4									
365													

Elevation scale: 370, 365, 360, 355, 350, 345, 340; Depth scale: 5, 10, 15, 20, 25, 30

The test pit was terminated at approximately 8 feet below ground surface. Test Pit was backfilled with excavated material on April 23, 2012.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during excavation.
GENERAL NOTES:
The test pit location and elevation are approximate and were estimated by BHA, Inc.
A Garmin etrex GPS unit was used to locate the test pit with an accuracy of 5 to 10 feet.
There was no shoring used for the test pit exploration.

TP-7

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5015 Shoreham Place
San Diego, CA 92122
www.kleinfelder.com PH. 858-320-2000 FAX. 858-320-2001

PROJECT NO. 124202	TEST PIT LOG TP-7	PLATE	
DRAWN BY: EK			
CHECKED BY: DH	SDG&E OCEAN RANCH SUBSTATION PACIFIC COAST BUSINESS PARK OCEANSIDE, CALIFORNIA	A-23	
DATE: 5/7/2012			
REVISED:		PAGE: 1 of 1	

APPENDIX B

LABORATORY TESTRESULTS

APPENDIX B
LABORATORY TEST RESULTS

GENERAL

Laboratory tests were performed on selected, representative samples as an aid in classifying the soils and to evaluate the condition of the existing soils and physical properties of the soils that may affect foundation design and construction procedures. A description of our laboratory testing program is presented below.

CLASSIFICATION

Soils were visually and texturally classified in accordance with the Unified Soil Classification System (USCS) in general accordance with ASTM D 2488. Soil classifications are indicated on the Boring Log and Test Pit excavation sheets in Appendix A.

MOISTURE CONTENT AND DRY UNIT WEIGHT

Natural moisture content and dry unit weight tests were performed on eleven drive samples collected from the borings in accordance with ASTM D 2216 and D 2937, respectively. The results of these tests are presented on the Logs of Borings in Appendix A.

EXPANSION INDEX TEST

Three expansion index (EI) tests were performed on select samples obtained during our investigation. The tests were performed in general accordance with ASTM D4829. The corrected expansion index for the samples are presented in Table B1. The test results indicate a very low to medium expansion potential when compared to Table B2 to qualitatively evaluate the expansion potential of the site soils.

Table B1
Expansion Index Test Results

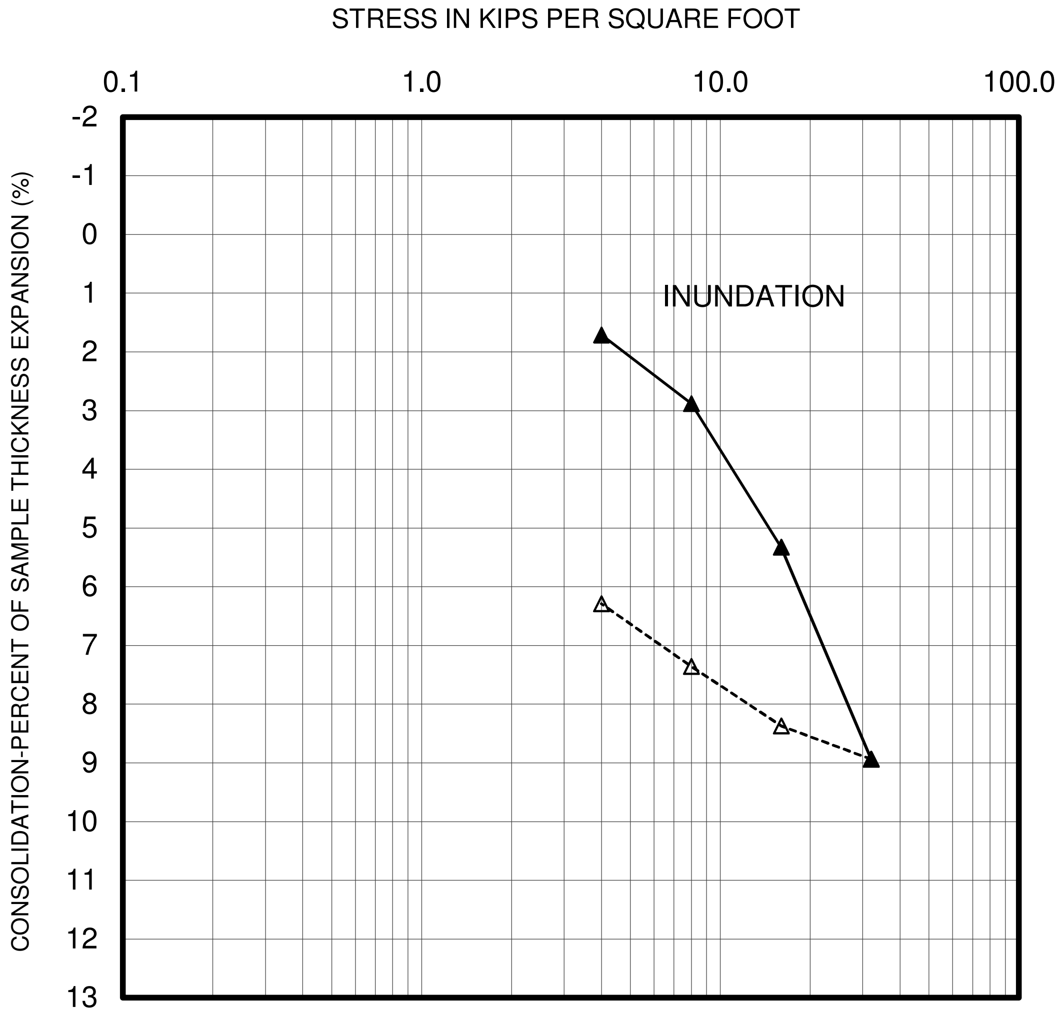
Boring	Depth (ft)	Soil Type	EI
B-1	0.5-4	Clayey Sand	54
TP-1	0-5	Silty Sand	5
TP-3	0-3	Clayey Sand	29

Table B2
ASTM D 4829 Expansion Index and Potential

Expansion Index	Potential Expansion
0-20	Very Low
21-50	Low
51-90	Medium
91-130	High
Above 130	Very High

CONSOLIDATION TEST

Two consolidation tests were performed on soils samples of the alluvium / colluvium to aid in evaluating the compressibility of the soils when subjected to new loads. The tests were performed in general accordance with ASTM Test Method D 2435. The results of the test are presented on Plates B1 and B2.



Seating Cycle	
Loading Prior to Inundation	
Loading After Inundation	
Rebound Cycle	

Boring No.	**B4**
Sample No.	**17**
Depth	**75'-76.5'**
Sample Description	very dark brown clay

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2435

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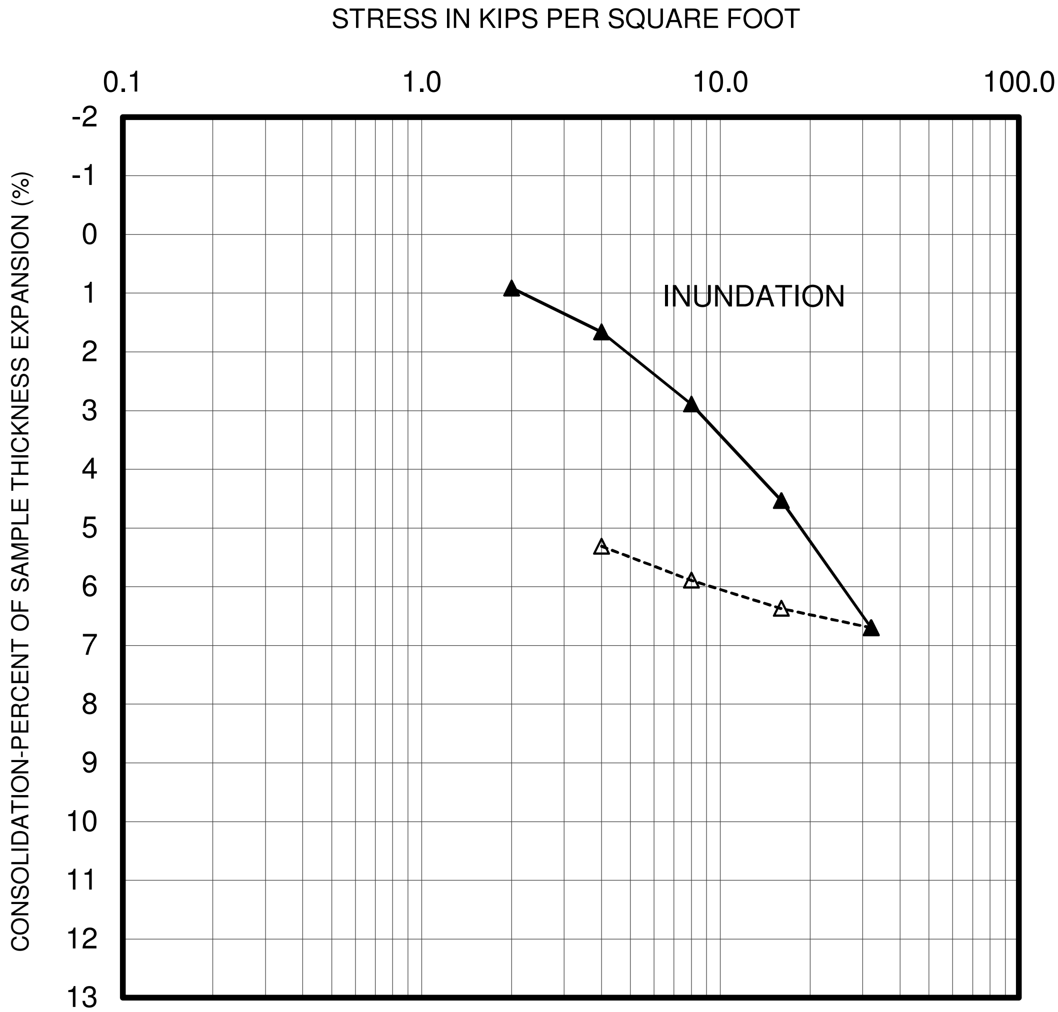
CONSOLIDATION TEST

SDG&E Ocean Ranch Substation
Pacific Coast Business Park
Oceanside, California

Plate

B1

Checked by:		Tech	Uly
Project No.	124202	Date:	5/24/2012



Symbol	Legend		
- - ● - - -	Seating Cycle	**Boring No.**	**B6**
—●—	Loading Prior to Inundation	**Sample No.**	**11**
—▲—	Loading After Inundation	**Depth**	**75'-76.5'**
- - △ - - -	Rebound Cycle	**Sample Description**	dark yellowish brown sandy clay

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2435

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Checked by:		Tech	Uly
Project No.	124202	Date:	5/24/2012

CONSOLIDATION TEST

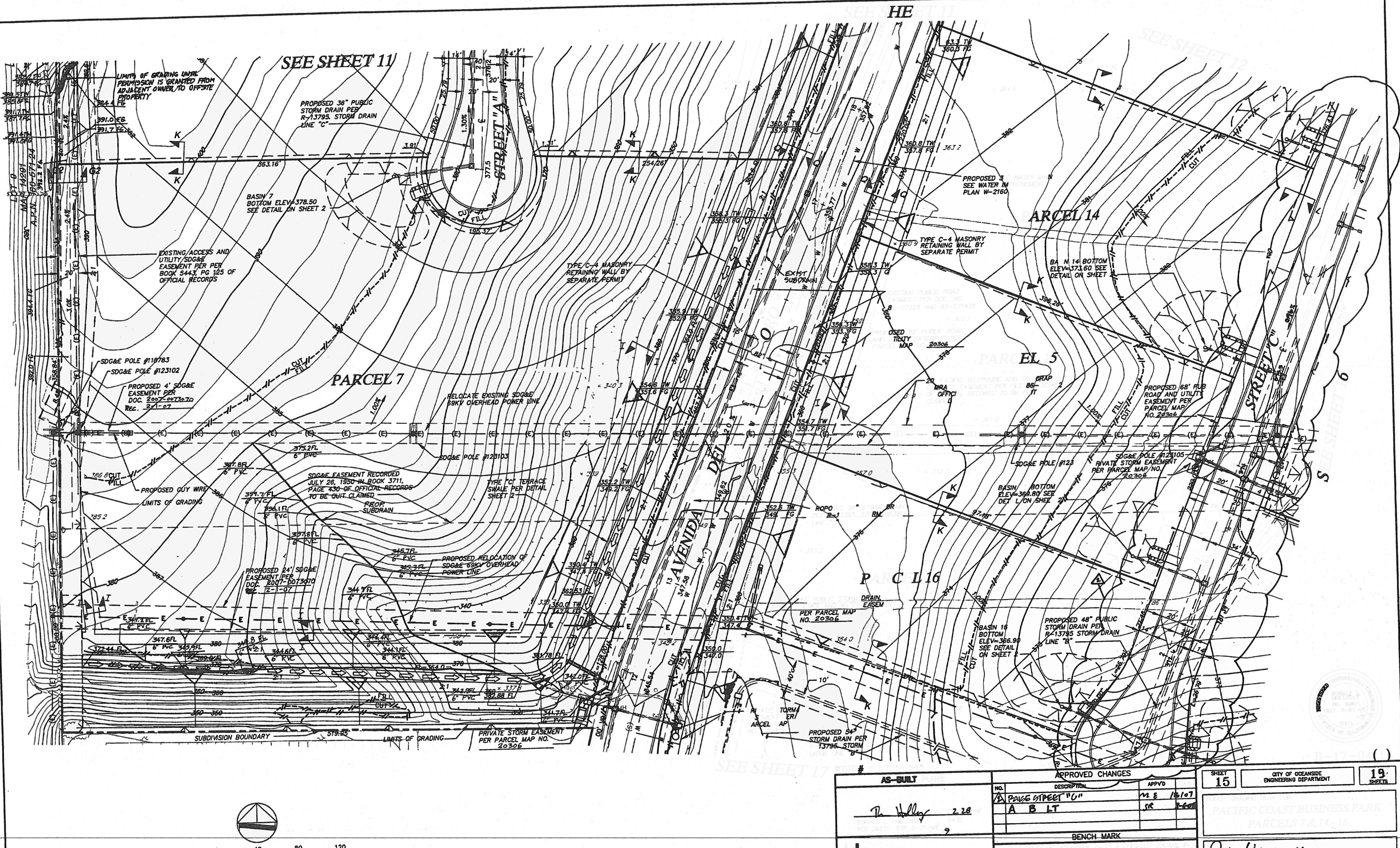
SDG&E Ocean Ranch Substation
Pacific Coast Business Park
Oceanside, California

Plate

B2

APPENDIX C

AS-BUILT GRADING PLANS (2008)



AS-BUILT	APPROVED CHANGES			
	NO.	DESCRIPTION	APPV'D	DATE
[signature] 2 28 9	2	RAISE STREET "C"	ME	10/07
		AS BUILT	SR	

BENCH MARK

DESCRIPTION: CITY OF OCEANSIDE D-23 A CHISELED SQUARE IN THE TOP OF THE CURB AT THE NORTHEAST CURB RETURN AT OCEANSIDE BOULEVARD AND PEACOCK

RECORD FROM: CITY OF OCEANSIDE LEVEL BOOK

ELEVATION: 336.175 DATUM: NAVD 29

bHA, Inc.
land planning, civil engineering, surveying
5115 AVENIDA ENCINAS SUITE "L" CARLSBAD, CA. 92008-4387 (760) 931-8700

SHEET 15 | CITY OF OCEANSIDE ENGINEERING DEPARTMENT | 19 SHEETS

ROUGH GRADING PLAN FOR:
PACIFIC COAST BUSINESS PARK
PARCELS 7 & 14 - 16

[signature] 8-22-06
PETER A. WEISS - RCE 43161 CITY ENGINEER

ENGINEER OF WORK: [signature] RONALD L. HOLLOWAY R.C.E. 29271

Checked By: FT
Approval
PLAN NUMBER 2597

D-17-04(1)

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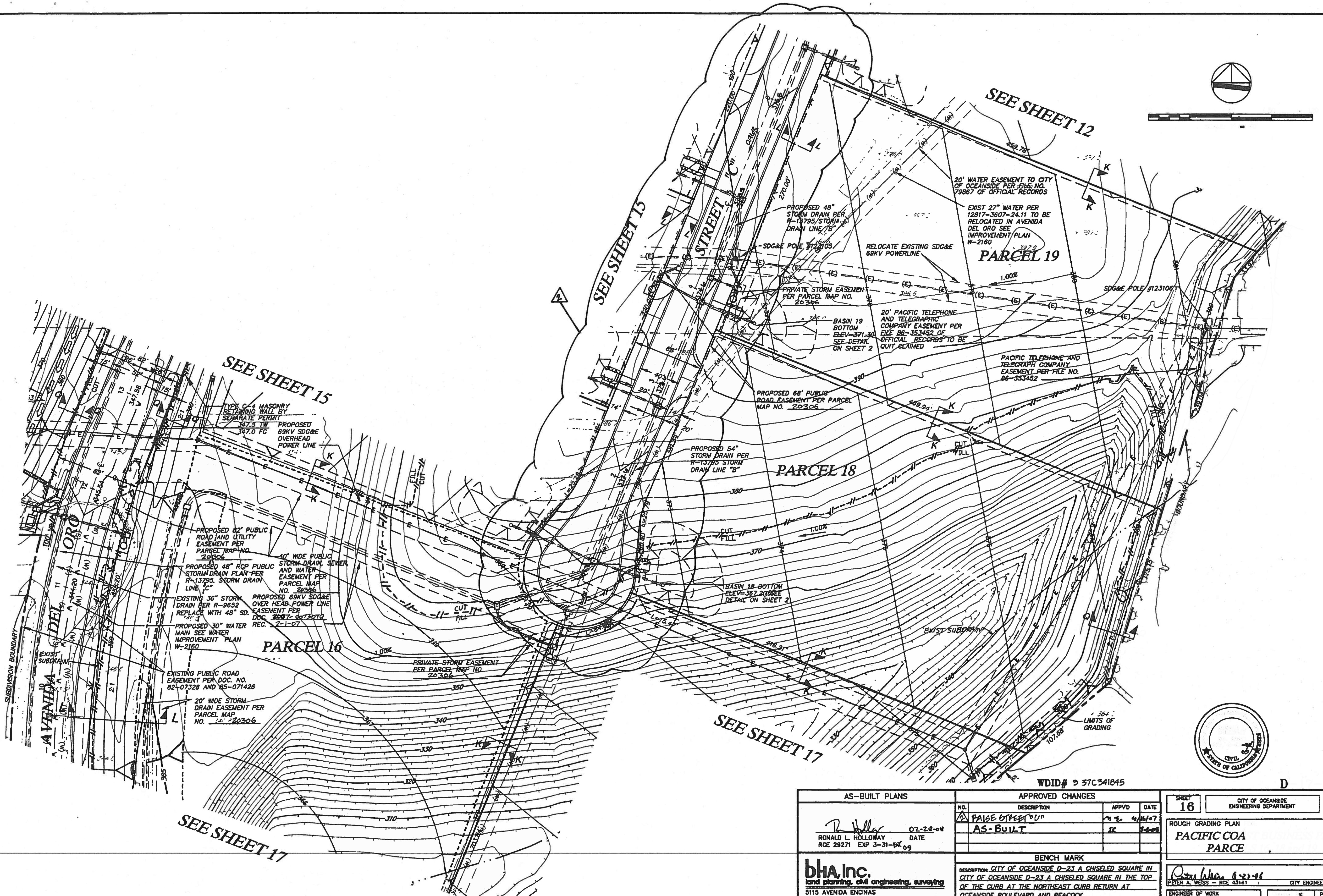

WDID# 9 37C341845

D ( )

AS-BUILT PLANS				
RONALD L. HOLLOWAY RCE 29271 EXP 3-31-09	DATE 02-28-08			

APPROVED CHANGES			
NO.	DESCRIPTION	APPV'D	DATE
2	RAISE STREET "U"	M.E.	4/16/07
	AS-BUILT	SK	3-6-08

BENCH MARK

DESCRIPTION: CITY OF OCEANSIDE D-23 A CHISELED SQUARE IN CITY OF OCEANSIDE D-23 A CHISELED SQUARE IN THE TOP OF THE CURB AT THE NORTHEAST CURB RETURN AT OCEANSIDE BOULEVARD AND PEACOCK

RECORD FROM: CITY OF OCEANSIDE LEVEL BOOK US PAGE 21

ELEVATION: 338.175 DATUM: NAVD 29

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land planning, civil engineering, surveying
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SUITE "L"
CARLSBAD, CA. 92008-4387
(760) 931-8700

SHEET 16 | CITY OF OCEANSIDE ENGINEERING DEPARTMENT | 19 SHEETS

ROUGH GRADING PLAN
PACIFIC COA
PARCE ,

PETER A. WEISS - RCE 43181 CITY ENGINEER 6-27-06

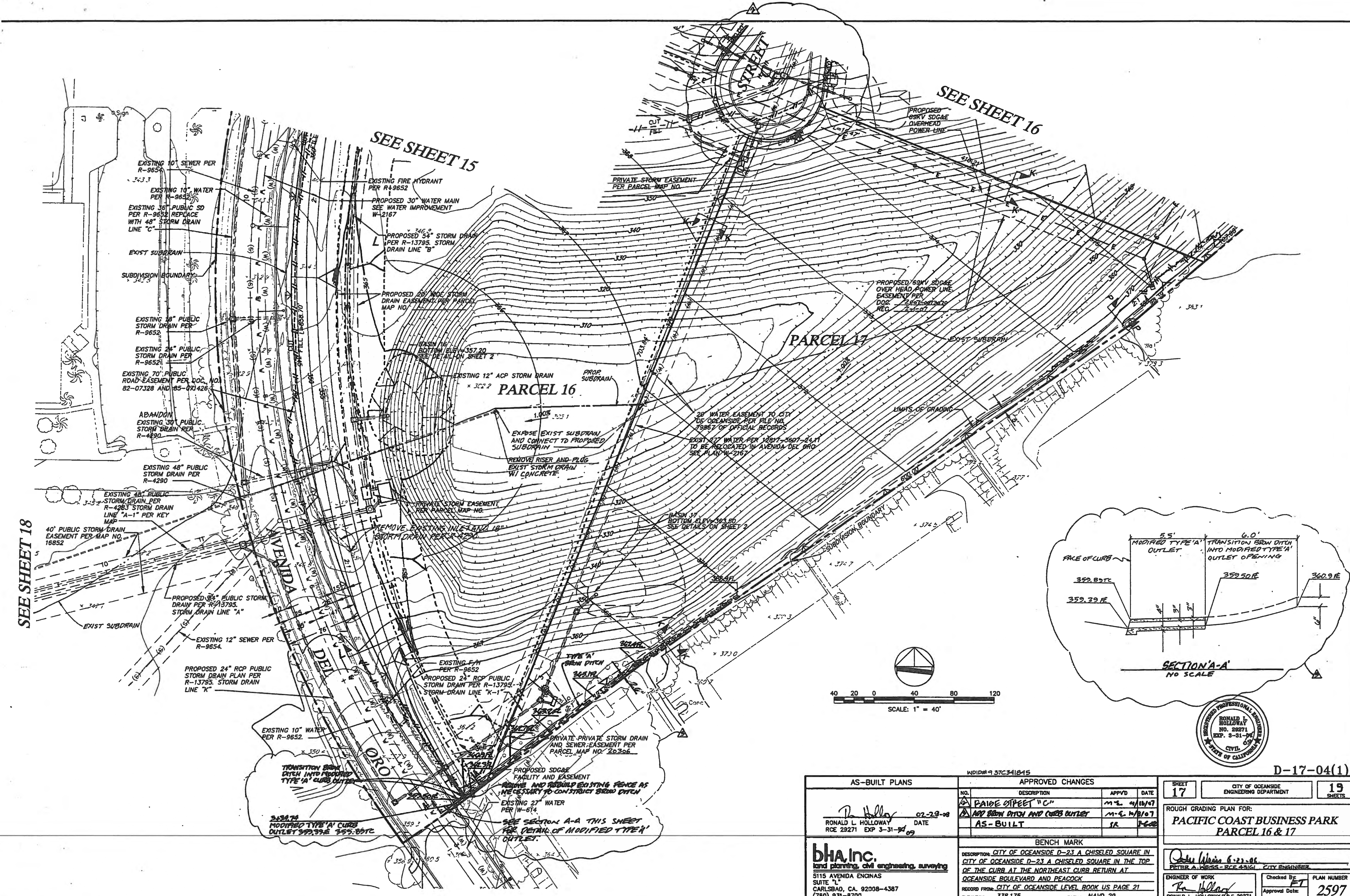
ENGINEER OF WORK
RONALD L. HOLLOWAY R.C.E. 29271

Approval Date:

PLAN NUMBER 2597

K:\Land Projects 3\707-0957-400\DWG\RGP\Rough Grading Plans\ACAD-RGP-SHT-16.dwg 4/20/2006 5:12:14 PM PDT

GOD 11757



D-17-04(1)

WDID#9 37C341845

AS-BUILT PLANS	APPROVED CHANGES				
	NO.	DESCRIPTION	APPV'D	DATE	
RONALD L. HOLLOWAY 02-29-08 DATE	2	RAISE STREET "C"	M.E.	9/18/07	
RCE 29271 EXP 3-31-09	3	ADD BROW DITCH AND CURB OUTLET	M.E.	10/8/07	
		AS-BUILT	SR	3-6-08	

bHA, Inc.
land planning, civil engineering, surveying
5115 AVENIDA ENCINAS
SUITE "L"
CARLSBAD, CA. 92008-4387
(760) 931-8700

BENCH MARK

DESCRIPTION: CITY OF OCEANSIDE D-23 A CHISELED SQUARE IN CITY OF OCEANSIDE D-23 A CHISELED SQUARE IN THE TOP OF THE CURB AT THE NORTHEAST CURB RETURN AT OCEANSIDE BOULEVARD AND PEACOCK

RECORD FROM: CITY OF OCEANSIDE LEVEL BOOK US PAGE 21

ELEVATION: 338.175 DATUM: NAVD 29

SHEET 17 — CITY OF OCEANSIDE ENGINEERING DEPARTMENT — 19 SHEETS

ROUGH GRADING PLAN FOR:

PACIFIC COAST BUSINESS PARK PARCEL 16 & 17

PETER A. WEISS - RCE 43161 CITY ENGINEER 6-23-08

ENGINEER OF WORK: RONALD L. HOLLOWAY R.C.E. 29271

Checked By: FT

Approval Date:

PLAN NUMBER 2597

2597(17)

Land Projects 3\707-0957-400\DWG\RGP\Rough Grading Plans\ACAD-RGP-SHT-17.dwg 2/14/2006 8:45:57 AM PST

APPENDIX D

ASFE INSERT

Important Information about Your

Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely, on Your ASFE-Member Geotechncial Engineer for Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your ASFE-member geotechnical engineer for more information.

ASFE
THE BEST PEOPLE ON EARTH

8811 Colesville Road/Suite G106, Silver Spring, MD 20910
Telephone: 301/565-2733 Facsimile: 301/589-2017
e-mail: info@asfe.org www.asfe.org

IIGER06085.0MRP

Geotechnical Study 2015

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KLEINFELDER
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November 12, 2015
Project No. 20154777.001A

Ms. Sarah Marijana
San Diego Gas & Electric
Civil/Structural Engineering
8316 Century Park Court, CP-52G
San Diego, California 90123

Subject: **Geotechnical Study**
SDG&E Ocean Ranch Substation
Pacific Coast Business Park
Oceanside, California

Dear Ms. Marijana:

Kleinfelder is pleased to present this geotechnical study for the proposed Ocean Ranch Substation project. The site is located at the southerly terminus of Rocky Point Drive and northeast of Avenida del Oro, within Parcels 16 and 17 of the existing Pacific Coast Business Park in Oceanside, California. The purpose of our geotechnical study was to evaluate subsurface soil conditions beneath the site and to provide geotechnical recommendations for design and construction. The conclusions and recommendations presented in this report are subject to the limitations presented in Section 6.

We appreciate the opportunity to provide geotechnical engineering services to you on this project. If you have any questions regarding this report or if we can be of further service, please do not hesitate to contact us at (619) 831-4600.

Respectfully submitted,

KLEINFELDER

Trampus Grindstaff
Project Engineer

Scott Rugg, PG, CEG
Senior Engineering Geologist

REGISTERED GEOLOGIST
SCOTT H. RUGG
NO. 1601
CERTIFIED
ENGINEERING
GEOLOGIST
STATE OF CALIFORNIA

Kevin Crennan, PE, GE
Senior Project Manager

REGISTERED PROFESSIONAL ENGINEER
KEVIN M. CRENNAN
No. 2511
EXP. 12/31/15
GEOTECHNICAL
STATE OF CALIFORNIA

550 West C Street, Suite 1200, San Diego, CA 92101 p | 619.831.4600 f | 619.232.1039

GEOTECHNICAL STUDY
SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CALIFORNIA
20154777.001A

NOVEMBER 12, 2015

A Report Prepared for:

Ms. Sarah Marijana
San Diego Gas & Electric
Civil/Structural Engineering
8316 Century Park Court, CP-52G
San Diego, California 90123

GEOTECHNICAL STUDY
SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CALIFORNIA

Prepared by:

Trampus Grindstaff
Project Engineer

Scott Rugg, PG, CEG
Senior Engineering Geologist

Kevin Crennan, PE, PG
Senior Project Manager

Reviewed by:

Robert A. Torres, PE
Senior Program Manager

KLEINFELDER
550 West C Street, Suite 1200
San Diego, California 92101
Phone: 619-831-4600
Fax: 619-232-1039

November 12, 2015
20154777.001A

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TABLES

FIGURES

APPENDICES

1 INTRODUCTION

This report presents the results of our geotechnical study for the proposed San Diego Gas and Electric (SDG&E) Ocean Ranch Substation located in Oceanside, California. The approximate location of the project site is presented on Figure 1, Site Vicinity Map. The purpose of our geotechnical study was to evaluate subsurface soil conditions beneath the site and provide geotechnical recommendations for design and construction. The scope of our services was presented in our proposal titled, "Proposal for Update Geotechnical Study, Proposed Ocean Ranch Substation, Pacific Coast Business Park – Parcels 16 and 17, Oceanside, California," dated February 3, 2015. Our services were performed under our master services agreement with Richard Brady & Associates, Inc. (Brady) as part of SDG&E Master Services Agreement (MSA) 6360040035.

Our report includes a description of the work performed, a discussion of the general geotechnical conditions observed at the site, and recommendations developed from our engineering analyses of field and laboratory data.

1.1 SITE AND PROJECT DESCRIPTION

1.1.1 1.1.1 Site Description

Kleinfelder understands SDG&E plans to construct a new 69/12kV substation within Parcels 16 and 17 of the existing Pacific Coast Business Park. The site is also being considered for a new 138kV substation. The proposed configuration based on an ultimate arrangement plan for the 69/12KV station is presented in Figure 2, Boring Location Map.

The site is triangular in shape and has a common property boundary directly south and inline of Rocky Point Drive, which previously separated the parcels. At the time of our siting study in 2012, the parcels were moderately to densely vegetated with native grasses and bushes. However, recent clearing of vegetation was performed at Parcel 16 in the general area where the majority substation improvements will be constructed. The graded area is now covered with both 3/4- and 3-inch sized gravel.

The site has gentle to moderately sloping topography with a gradient that generally slopes to the southwest. An approximate 4- to 7-foot high slope with small trees splits the two parcels. The existing site elevations range from approximately 364 feet MSL at Parcel 16 to about 375 feet MSL at Parcel 17. Existing slopes located on the southern portion of the site appear to have inclinations of about 2H:1V. Two 40- to 50-foot diameter stormwater desilting basins are located within the southern portion of the site. These desilting basins have corrugated steel stand pipes within the deepest portion. During our site visit we observed erosion gullies on the side slopes on the order of 1 to 3 feet in depth.

The latitude and longitude coordinates for the approximate center of the site are listed below, and the site and vicinity are shown on Figure 1.

Latitude: 33.21071 N

Longitude: -117.29378 W

1.1.2 Project Description

The proposed construction will be primarily situated on Parcel 16 of the existing Pacific Coast Business Park, with future expansion area proposed to the east on Parcel 17. Proposed improvements will consist of transformers, switch stands, circuit breakers, capacitor banks, switchgear, single-story concrete masonry control shelter, and access improvements including new concrete asphalt paved drive lanes. The entire substation pad area will be secured with a 6-foot high privacy wall with gates at several perimeter locations. Other general site improvements will consist of concrete headwalls at two locations and new attenuation/bioretention basins. Based on the referenced civil development plan, the existing western desilting basin will be filled as part of the station pad grading and the existing eastern basin will be modified into a biotention facility.

The proposed finish pad elevations will range from 370 feet at the southwest corner to 375 feet MSL at the northeast side. Grading for the substation pad will mainly consist of placing fill soils across the site, creating fill slopes up to about 10 feet high at the southwest corner of the pad. The site will be accessed from the cul-de-sac area at the south end of Rocky Point Drive via two separate drives entries. An additional access point will be constructed off of Avenida Del Oro to the southwest corner of the pad where cuts up to approximately 10 feet will be required to meet existing elevations along the roadway. Proposed cut and fill slopes will be graded to an inclination of 2:1 (horizontal to vertical).

1.2 SCOPE OF SERVICES

The purpose of our investigation was to evaluate the surface and subsurface soil and geologic conditions at the currently proposed substation and access road area, and to provide geotechnical information and recommendations to facilitate design of the project development.

The scope of our services for this phase of the project consisted of:

- Review of our 2012 preliminary investigation which included four borings and four test pit excavations within the proposed site.
- Field exploration of the subsurface conditions by drilling ten borings;
- Laboratory testing of selected samples of soil and geologic materials;
- Engineering analysis of field and laboratory data; and
- Preparation of this report presenting our compiled findings, conclusions, and recommendations.

The recommendations contained within this report are subject to the limitations presented in Section 6.0. An information sheet prepared by ASFE (the Association of Engineering Firms Practicing in the Geosciences) is also included in Appendix D. We recommend that all individuals using this report read the limitations along with the attached document.

2 METHODS OF STUDY

2.1 BACKGROUND DATA REVIEW

Task 1 – Background Data Review. We reviewed readily-available published and unpublished geologic literature and aerial photographs in our files and the files of public agencies. In addition, we reviewed previous geotechnical and as-graded reports provided by SDG&E, and our prior studies. The documents reviewed are presented in Section 7, References.

2.2 FIELD INVESTIGATION

Task 2 – Field Exploration. Subsurface conditions at the site were recently explored by drilling ten geotechnical borings. The borings were drilled to depths of approximately 6½ to 91½ feet below the existing ground surface (bgs) using a truck-mounted drill rig equipped with 6-inch-diameter hollow-stem augers. As part of our prior substation siting study, additional explorations were completed between April 24 and April 26, 2012. Those explorations consisted of three borings to depths ranging between approximately 50 to 80 feet bgs and four test pits ranging from about 5 to 10 feet. The approximate locations of the current and previous borings and test pits are presented on Figure 2, Boring Location Map. A summary of our field investigations are presented in Appendix A and A-1.

2.3 GEOTECHNICAL LABORATORY TESTING

Laboratory testing was performed on selected bulk and drive samples to substantiate field classifications and to provide engineering parameters for geotechnical design. Laboratory testing consisted of in-situ moisture content and dry unit weight, sieve analysis, #200 wash sieve, Atterberg limits, direct shear, R-value, and corrosivity (pH, electrical resistivity, water-soluble sulfates, and water-soluble chlorides). A description of the testing performed and the results are presented in Appendix B.

2.4 GEOTECHNICAL ANALYSES

Field and laboratory data were analyzed in conjunction with the proposed finished grades, structures layout, and estimated structural loads to provide geotechnical recommendations for design and construction. We evaluated foundation systems, lateral earth pressures for retaining structures, pavement design, and earthwork. Potential geologic hazards, including ground shaking, liquefaction potential, flood hazard, fault rupture hazard, and seismically-induced settlement were also evaluated. Seismic design parameters in accordance with the 2013 California Building Code (CBC) are also presented.

2.5 REPORT PREPARATION

This report summarizes the work performed, data acquired, and our findings, conclusions, and geotechnical recommendations for the design and construction of the proposed substation. Our report includes the following items:

- Vicinity map and location plan showing the approximate boring locations and locations of the geologic cross sections;
- Logs of borings (Appendix A and A-1);
- Results of laboratory tests (Appendix B);
- Discussion of general site conditions;
- Discussion of general subsurface conditions as encountered in our field exploration;
- Discussion of regional and local geology;
- Discussion of geologic and seismic hazards;
- Recommendations for seismic design parameters in accordance with the 2013 CBC;
- Recommendations for shallow foundation design, allowable bearing pressures, and embedment depths;
- Recommendations for drilled pier design, including MFAD parameters, axial capacities and minimum embedment depths;
- Recommendations for site preparation, earthwork, temporary slope inclinations, fill placement and compaction, and excavation characteristics of subsurface soil deposits and formational materials;
- Recommendations for support of concrete slabs-on-grade;
- Recommendations for flexible pavement structural sections; and
- Preliminary evaluation of the corrosion potential of the on-site soils.

3 GEOLOGY AND SOILS

3.1 REGIONAL GEOLOGIC AND GEOTECTONIC SETTING

San Diego County resides within the southern portion of California's Peninsular Ranges Geomorphic Province. This province is characterized as an assemblage of north to northwest trending, high-relief ranges stretching south from the Santa Monica Mountains in Los Angeles, through San Diego County and south into Baja, California. Some of the notable ranges of Southern California include the Santa Ana Mountains, the Laguna Mountains and the Cuyamaca Mountains. The development of this mountain system is closely tied to the transform tectonisim of the San Andreas Fault System.

The County encompasses three geomorphic sub-zones set in a series of north-to-northwest trending belts, roughly parallel to the coastline. From west to east, these zones are comprised of a relatively narrow, low-relief coastal plain; a central high-relief mountainous zone; and a low-lying desert zone. The coastal plain and mountainous zones are part of a more extensive geomorphic province of the Peninsular Ranges. The desert zone is part of a larger geomorphic province known as the Colorado Desert.

Most of the western portion of San Diego County, including the project site is situated within the eastern side coastal subzone near the transition boundary with central mountainous zone. The coastal subzone is characterized by Quaternary to Mesozoic age sedimentary rock material. The sedimentary deposits are configured in a wedge shape mass which thickens to the west across the coastal plain from the edge of the mountainous terrain toward the coastline. The sediments are comprised of a variety of claystones, siltstones, sandstones and conglomerates. Older granitic and metamorphic bedrock occupies the mountainous terrain toward the east and consists of numerous plutonic igneous masses and smaller patches of metamorphic rock into which the granitic rock intruded.

The landscape was eroded during Pleistocene time by a system of generally west flowing large scale drainage systems and associated tributary drainages which resulted in the formation of the canyons/valleys that dominate the regional terrain of San Diego County. These processes also resulted in the accumulation of alluvial soils along drainage pathways and as wedge shape masses along the bottom of eroding hillslopes specifically described as colluvial deposits.

3.2 REGIONAL FAULTING AND SEISMICITY

Southern California straddles the boundary between two global tectonic plates known as the North American Plate (on the east) and the Pacific Plate (on the west). The main plate boundary is represented by the San Andreas fault which stretches northwest from the Gulf of California in Mexico, through the desert region of the Imperial Valley, through the San Bernardino region, and into Northern California where it eventually trends offshore north of San Francisco (Jennings and Bryant, 2010). Within Southern California, the San Andreas fault is a complex system of numerous faults known as the San Andreas Fault System (SAFS) that span a 150-mile wide zone from the main San Andreas fault in the Imperial Valley westward to offshore of San Diego (Powell et. al., 1993; Wallace, 1990). The major faults east of the San Diego region (from east to west) include the San Andreas Fault, the San Jacinto fault, and the Elsinore fault. Major faults west of San Diego include the Palos Verdes-Coronado Bank fault, the San Diego Trough fault, and the San Clemente fault.

The most dominant zone of faulting within the San Diego region are several faults associated with the Rose Canyon Fault Zone (RCFZ), as presented in Figure 4, Regional Fault Map and Earthquake Epicenters. The site is located between the RCFZ approximately 9¼ miles to the southwest and the Elsinore Fault Zone (EFZ) located approximately 18½ miles to the northeast. Although activity on any of the known and unknown faults within the SAFS affect the seismicity of the San Diego region, activity within both the RCFZ and the EFZ dominates most aspects of the seismic hazard at the project site.

Most of the seismic energy and associated fault displacement within the SAFS occurs along the fault structures closest to the plate boundary (i.e., on the Elsinore, San Jacinto, and San Andreas faults) (Powell, et. al. 1993). Approximately 49 millimeters per year (mm/yr) (1.9 inches/year) of overall lateral displacement have been measured geodetically and as fault slip across the plate boundary. Combined, the Elsinore, San Jacinto, and San Andreas faults account for up to 41 mm/yr (1.6 inches/year) of the total plate displacement (84 percent), meaning that the remaining 8 mm/yr (0.3 inch) (16 percent) is accommodated across the faults to the west (Bennett et al., 1996). At the latitude of San Diego, most of this, about 5-8 mm/yr, is accommodated by the coastal and offshore system of faults, including the Rose Canyon fault. Farther north, a similar amount (6-8 mm/yr) is accommodated east of the San Andreas Fault in the eastern California Shear Zone (Rockwell, 2010).

3.3 SITE GEOLOGY AND SUBSURFACE CONDITIONS

Based on our review of the referenced grading reports by others, the project area prior to grading consisted of a northeast trending ridgeline with two natural drainage features trending along the slope sidewalls. One drainage feature was located on the northwest side of the property trending roughly parallel to Avenida Del Oro. The other drainage trended northeast across the middle of the site from Avenida Del Oro, where it merged with the other drainage, toward the northeast property corner. The drainage flow direction was toward the southwest with elevations of approximately 270 feet above mean sea level (MSL) at Avenida Del Oro up to approximately 315 feet MSL at the northeast corner of the site. The highest elevations on the site were approximately 380 feet MSL at the southern corner and 360 feet on the north.

There have been at least two reported phases of earthwork construction at the site which consisted primarily of infilling of the drainage feature with artificial fill. The first earthwork phase consisted of fill placement along the western side of the site for construction of Avenida Del Oro, and along the southeast side of the site during construction of the adjacent subdivision on Avenida De La Plata. That grading resulted in the formation of an enclosed basin in the central portion of the site with a bottom elevation of approximately 304 feet MSL.A subdrain was reportedly installed which allowed the basin to drain toward the southwest.

Two geologic units underlie the fill. The youngest is an alluvial deposit which consists primarily of material shed down the side slopes of the drainage feature and depositing toward the bottom. This type of alluvial deposit being due primarily to slope runoff is more specifically designated as a young colluvial deposit. The underlying bedrock material is comprised of Eocene age Santiago Formation. Descriptions of these units including the aforementioned artificial fill are provided in Appendix A (Boring Logs and Test Pit Excavations), and generalized descriptions are provided in the subsequent sections. The geometry of the subsurface units are depicted on the geologic cross-sections on Figures 5 and 6.

3.3.1 Artificial Fill (af)

Our review of the subdivision grading report (Christian Wheeler 2007) shows that two phases of earthwork construction occurred at the site, with the most recent during 2006 to 2007. Our review of previous topographic maps and site boring data indicates that up to 83 feet of fill was placed below the project site. Christian Wheeler observed and performed compaction testing during the earthwork operations during this phase of work and reported the fill to be a minimum 90 percent relative compaction based on the ASTM D1557 modified proctor maximum dry density. For fills below 50 feet, they report compaction data showing a minimum of 95 percent relative compaction per ASTM D1557. Standard Penetration Test (SPT) and California Sampler blow counts for fill soils encountered at the two parcels ranged from 9 to 48 blows per foot, which are generally consistent with the reported levels of compaction. The fills were likely derived from the on-site materials and generally consist of loose to dense, olive gray to very dark gray clayey sand to sandy clay, and olive brown to light gray silty sand. The specified Expansion Index for grading was for a maximum EI of 90 within the upper 5 feet.

Review of Christian Wheeler's test data indicates that overexcavation and recompaction of fill from the first phase grading was performed within the bottom area of the site drainage basin. The depth of removal was taken from a the existing surface elevation of approximately 304 feet MSL at that time down to a maximum depth of approximately 287 feet MSL. This removal area is shown on Figure 5, geologic cross-section A-A'. It appears that other areas of the Phase 1 fill were not reworked during the second phase of earthwork. These fills occur primarily below the western and southeastern side of the property and occur below the dotted line labeled "2007 Pre-grading Surface" on both of the geologic cross-sections. We did not review any documentation with regards to observation and testing of the Phase 1 fill.

3.3.2 Young Colluvial Deposits (Qyc)

Young colluvial deposits were encountered in borings B-4, B-5, and B-6 of the 2012 preliminary borings and boring B-4 from the current study. This material ranged in thickness between 3½ to 11½ feet between a low elevation of approximately 291½ MSL at previous boring B-6 to a high of 305 feet MSL at two of the previous borings, B-4 and B-5, and recent boring B-4. It apparently was removed from the area of the Phase 2 overexcavation work and consists of a dark gray to black fat clay and clay with sand and in hard condition. SPT and California Sampler blow counts for these soils ranged from 19 to 87 blows per foot.

3.3.3 Santiago Formation (Tsa)

Cretaceous-age Santiago Formation has been mapped underlying the subject site (Kennedy and Tan, 2005), was identified by Christian Wheeler during grading, and was encountered in our borings where the fill and young colluvial deposits were penetrated. Based on our borings, trenches and field mapping of slopes on and near the site indicate the Santiago Formation consists primarily of interbedded fine to coarse, light gray to brownish yellow, massively bedded sandstone, clayey siltstone, and claystone. The sandstones vary from very highly cemented with thin concretionary beds to moderately cemented and friable. Siltstones are massive to locally thinly bedded, and moderately well-cemented. Recorded SPT and California Sampler blow counts for the Santiago Formation were relatively high, having a range of penetration of 2 to 5 inches for 50 blows.

3.3.4 Groundwater

Groundwater was not encountered in any of our borings or test pit excavations during either field investigation. The depth to the regional groundwater table is anticipated to be significantly deeper than anticipated grading depths and proposed construction elevations. The groundwater table may fluctuate with seasonal variations and irrigation. Groundwater is not expected to be a constraint to development the site. The groundwater table may fluctuate with seasonal variations and irrigation. A local rise in the groundwater level, localized zones of perched water, and increased soil moisture content should be anticipated during and following the rainy season. Irrigation of landscaped areas on or adjacent to the site can also cause a fluctuation of local groundwater levels. It should be noted that the borings were completed following several years of below average rainfall and current groundwater levels are likely depressed.

4 SEISMIC AND GEOLOGIC HAZARDS

We have reviewed the site with respect to the presence of potential geologic and/or seismic hazards. These hazards include expansive soils, seismic shaking, liquefaction, seismic compression, fault surface rupture, landslides, and flooding. The following sections discuss these hazards and their potential at this site in more detail.

4.1 EXPANSIVE SOILS

Expansive soils are characterized by their ability to undergo significant volume changes (shrink or swell) due to variations in moisture content. Changes in soil moisture content can result from precipitation, landscape irrigation, utility leakage, roof drainage, perched groundwater, drought, or other factors and may result in unacceptable settlement or heave of structures or concrete slabs supported on grade.

Based on the recommendations provided by Christian Wheeler (2006), selective grading was to be performed for soils placed within the upper 5 feet of the site. The selective grading was recommended to provide a cap of fill material with an expansion index of less than 90. The Christian Wheeler (2007) grading report references an expansion index test result on one sample of fill collected from each parcel. The test results of the samples collected range between 50 and 61, which correspond to low to medium expansion potential. Based on the results of our review, field investigations, and experience with similar materials, the fill soils encountered at the site are expected to have a medium potential for expansive soils. No special mitigation measures for expansive soils are recommended for the site.

4.2 SEISMIC SHAKING/CALIFORNIA BUILDING CODE SEISMIC DESIGN PARAMETERS

The project site, like all Southern California, is a seismically active area and is likely to experience ground shaking as a result of earthquakes on nearby or more distant faults. Our recommendations for seismic design parameters are in accordance with the 2013 California Building Code (CBC) and ASCE 7-10 (July 2013 errata) Minimum Design Loads for Buildings and Other Structures. It should be noted that the seismic provision of the 2013 CBC are based on and refer to (for more requirements) “Minimum Design Loads for Buildings and Other Structures, ASCE Standard 7”.

Based on the soil conditions encountered and the calculated shear wave velocities within the upper 100 feet (Vs30), the project site can be classified as Site Class D. Shear wave velocities within the upper 100 feet are used to determine Site Class D according to ASCE 7-10, Section

20.3.1, Table 20.3-1. Based on our designation of Site Class D, the site is defined as “stiff soil” profile with average shear wave velocities within the upper 100 feet between 600 ft/s (180 m/s) to 1,200 ft/s (360 m/s); average SPT blowcount, 15 < N < 50, blows per foot (bpf); or average undrained shear strength 1,000 < su < 2,000 psf (50 to 100 kPa). Based on the Site Class D designation and on the site location with respect to mapped spectral acceleration parameters SS and S1, Kleinfelder developed seismic design parameters. The recommended seismic design parameters are summarized in Table 1.

Table 1

Recommended 2013 CBC Seismic Design Parameters

DESIGN PARAMETER	SYMBOL	RECOMMENDED VALUE	2013 CBC / (ASCE 7-10) REFERENCE(S)
Site Class	--	D	Section 1613.3.2 (Section 11.4.2)
Mapped MCE_R (5% damped) spectral acceleration for short periods (Site Class B)	S_s	1.053 g	Section 1613.3.1 (Section 11.4.1)
Mapped MCE_R (5% damped) spectral acceleration for a 1-second period (Site Class B)	S_1	0.411 g	Section 1613.3.1 (Section 11.4.1)
Short Period Site Coefficient	F_a	1.079	Table 1613.3.3(1) (Table 11.4-1)
Long Period Site Coefficient (at 1-second period)	F_v	1.589	Table 1613.3.3(2) (Table 11.4-2)
MCE_G Peak Ground Acceleration adjusted for site class effects (S_M at T=0)	PGA_M	0.437 g	N/A
MCE_R (5% damped) spectral response acceleration for short periods adjusted for site class (F_a*S_S)	S_{MS}	1.136 g	Section 1613.3.3 / (Section 11.4.3)
MCE_R (5% damped) spectral response acceleration at 1-second period adjusted for site class (F_v*S_1)	S_{M1}	0.653 g	Section 1613.3.3 / (Section 11.4.3)
Design spectral response acceleration (5% damped) at short periods (2/3*S_{MS})	S_{DS}	0.757 g	Section 1613.3.4 / (Section 11.4.4)
Design spectral response acceleration (5% damped) at 1-second period (2/3*S_{M1})	S_{D1}	0.435 g	Section 1613.3.4 / (Section 11.4.4)

4.3 LIQUEFACTION

Earthquake-induced soil liquefaction can be described as a significant loss of soil strength and stiffness caused by an increase in pore water pressure resulting from cyclic loading during shaking. Liquefaction is most prevalent in loose to medium dense, sandy and gravely soils below the groundwater table. The potential consequences of liquefaction to engineered structures include loss of bearing capacity, buoyancy forces on underground structures, ground oscillations or "cyclic mobility", increased lateral earth pressures on retaining walls, post liquefaction settlement, lateral spreading and "flow failures" in slopes.

In general, the subject site is underlain by loose to medium dense fill, medium dense to very dense, or hard to very hard, colluvium, and at depth by very dense formational soils. Based on the nature of these deposits, and the absence of shallow groundwater, it is our opinion that the potential for liquefaction across the site is low.

4.4 SEISMIC COMPRESSION

Seismic compression results from the accumulation of contractive volumetric strains in unsaturated soil during earthquake shaking. Loose to medium dense granular material with no fines, or with low plasticity fines, are most susceptible to seismic compression.

Based on the stratigraphy and generally high SPT blow counts in the borings performed at the project site, the seismic related settlement of the soil above groundwater is less than ½ inch. Therefore, no mitigation measures are recommended.

4.5 FAULT SURFACE RUPTURE

Review of readily available geologic and fault maps does not show any active or potentially active fault features passing through or nearby the site. An active fault is one which has undergone displacement within the last approximate 11,000 years. A potentially active fault (aka: Pre-Holocene fault) is one in which movement has occurred at sometime between 1.6 million years and 11,000 years before present. The closest active fault to the site is the Rose Canyon Fault, which is located approximately 9.2 kilometers offshore to the southwest. The site is not located within an Alquist-Priolo Earthquake Fault Zone. The closest potentially active fault is located approximately 0.5 miles to the southeast (Kennedy and Tan 2005). This is small discontinuous structure and does not trend toward the site. Based on these relationships, the hazard with respect to fault rupture is considered low.

4.5.1 Landslides and Slope Stability

Landslides are deep-seated ground failures in which a large section (tens to hundreds of feet deep) of a slope detaches and slides downhill. Landslides are not to be confused with minor surficial slope failures (slumps), which are usually limited to the topsoil zone and can occur on slopes composed of almost any geologic material. Landslides can cause damage to structures both above and below the slide mass. Undermining of foundations can occur to structures above the slide area. Areas below a slide can be damaged by being overridden and crushed by the failed slope material.

Several formations within the San Diego region are particularly prone to landsliding on steep slope surfaces. One of these is the Santiago Formation which underlies the site. These formations generally have high clay content and mobilize when they become saturated with water. However, the previous grading has resulted in a relatively flat-lying surface topography all around the site. No surficial indications of deep-seated landsliding were noted at the site during our field reconnaissance or in topographic maps we reviewed. There were no reported mapped landslides in the geologic literature we reviewed. Due to this low-lying surface condition within and around the site, the hazard with respect to landsliding is considered low.

Kleinfelder performed static and seismic slope stability analyses for the existing fill slopes along areas of the site adjacent to existing slopes as depicted by the two cross-section lines shown on Figure 2, A-A' and B-B'. The external static and seismic factors of safety calculated from the slope stability analyses were above the generally accepted minimum factors of safety of 1.5 and 1.1, respectively. Based on the results of our review, field investigation and engineering evaluations indicating the calculated factors of safety exceed the industry minimum, it is our opinion that the potential for significant large-scale slope instability is considered low.

4.5.2 Tsunami, Seiche and Flooding

Tsunamis are large sea waves that are most often generated by displacement of the ocean floor along submarine faults. They can also develop in response to other events, such as submarine landslides. The State of California through the California Emergency Management Agency, (2009), publishes a set of tsunami inundation maps for the California coastline. Review of the San Luis Rey quadrangle shows the maximum tsunami inundation line closest to the site is approximately 3.4 miles to the southwest at the eastern end of Buena Vista Lagoon.

A seiche is an oscillatory wave that develops in an enclosed or partially enclosed body of water, such as a bay or lake, in response to seismic shaking from an earthquake. The nearest body of water to the site is Guajome Lake which is approximately 2.6 miles to the northeast. Based in this distance, the hazard with respect to seiche inundation is low.

The flood hazard potential at the site was evaluated based on flood hazard maps available through the FEMA Map Service Center Web site. Based on FEMA Map Number, 06073C0758G, the proposed development area of the Ocean Ranch substation site is not located within a mapped flood area. The closest flood area is located approximately 0.5 miles south of the site and is designated as a high flood risk. The project site is well outside of this area and at a significantly higher elevation. Therefore, the hazard with respect to flooding is low.

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 GENERAL

Based on the results of our field exploration, laboratory testing and engineering analyses conducted during this study, it is our professional opinion that the proposed project is geotechnically feasible, provided the recommendations presented in this report are incorporated into the project design and construction. We identified the following key geotechnical considerations during our study.

- The site is mostly underlain by deep fill, colluvium and Santiago formational soils at depth.
- Groundwater was not encountered at the site within any of the exploratory borings or test pits.
- The site is located in the seismically active Southern California area. The structures should be designed in accordance with the American Society of Civil Engineers (ASCE) 113 Substation Structure Design Guide.
- There are no known active or potentially active faults crossing the site. Based on this information it is our opinion that the hazard with respect to fault rupture is low.
- Foundations supporting the proposed improvements should be constructed upon recompacted and engineered fill soils.
- The on-site soils are suitable for re-use as engineered fill, provided highly expansive soils are kept below 3 feet of finished grade elevation, are properly moisture conditioned, and oversize or deleterious material are removed.

The following opinions, conclusions, and recommendations are based on the properties of the materials encountered in the borings, the results of the laboratory-testing program, and our engineering analyses. If the design grades are substantially different than what was assumed in our analyses or the proposed improvements configuration changes, our recommendations will have to be modified accordingly. Final project drawings and specifications should be reviewed by Kleinfelder Inc. prior to the commencement of construction.

5.2 SITE AND SUBGRADE PREPARATION

5.2.1 General

Site preparation and earthwork operations should be performed in general accordance with applicable codes, including SDG&E Specifications for Site Development, County of San Diego Municipal Code, 2013 California Building Code (CBC) and Standard Specifications for Public Works Construction (Greenbook, latest edition). All reference in this report to maximum dry density is established in accordance with American Society for Testing and Materials (ASTM) ASTM D 1557.

5.2.2 Construction Observation

The recommendations presented in this report are based on our understanding of the proposed project and on our evaluation of the data collected. The interpolated subsurface conditions should be evaluated in the field during construction. A representative from our firm should be present during site preparation, fill placement, and foundation construction to evaluate the suitability of the various soils types exposed during excavation, and to evaluate the minimum recommended compaction of the fills is achieved.

5.2.3 Excavation Characteristics

The results of our field exploration program indicate the project site is underlain by fill and colluvium over formational soils at depth. Fill soils should excavate with typical heavy-duty earthwork equipment. Excavations are anticipated for installation of utility lines and the construction of new foundations for the proposed improvements. Most excavations will likely be in the existing and recommended engineered fill.

5.2.4 Site Preparation

Based on the results of our investigation and review of the referenced site improvement plan, foundation excavations for site improvements will be within existing fill soils and or newly placed fill material. Therefore, we recommend that existing fill beneath proposed new fill or improvements be excavated to a minimum depth of 2 feet and be replaced by engineered fill compacted to a minimum relative compaction of 90%. In addition, existing fill soils may require deeper removals where erosion and rutting is present within existing basins.

Proposed fill slopes should be properly keyed and benched into firm materials. Benches should be a minimum of 10 feet in width and spaced at no more than 4-foot vertical height intervals.

Excavations may also be extended deeper for removal and recompaction of existing wash ravines around the basin areas. Additional fill should be placed in order to extend fill depths horizontally, approximately 4 feet to 5 feet. After final grading is completed, the additional fill soils should be trimmed back to expose the newly compacted fill for the finish slope grade.

A representative from our firm should be present during construction to evaluate the suitability of the various soils types exposed during excavation at the site for use as engineered fill, and to evaluate the recommended depth of overexcavation and recompaction.

Prior to placing engineered fill, all surficial vegetation and deleterious material should be stripped and completely removed. The stripping work should include the removal of soil that is dry, compressible, collapsible, or contains significant voids in the judgment of Kleinfelder's geotechnical engineer or geologist.

Man-made structures, including buried pipes, utilities, etc., should be completely removed within the improvement areas. The excavations for removal of any man-made improvements should be backfilled with properly compacted engineered fill per Section 5.2.5. Abandoned utilities (if any) should be completely removed, and the loose backfill removed and replaced. Any trench created by relocating the existing utilities should be backfilled with properly compacted fill.

5.2.5 Engineered Fill

Fill soils within the upper 3 feet below structural foundations should consist of granular material. In general, the onsite fill soils can be reused as materials for placement as compacted fill, provided they have a very low to low expansion index (expansion index of 50 or less), are free of oversized rock, clay clods, organic materials, and deleterious debris.

Material greater than 3 inches in maximum dimension should not be placed within the upper 3 feet of the improvement areas. The onsite soil placed as engineered fill should be moisture conditioned between 0 and 3 percent above optimum moisture content, and compacted to a minimum of 90 percent relative compaction based on ASTM D 1557. The upper 12 inches of subgrade and overlying aggregate base course should be compacted to a minimum of 95 percent.

Although the optimum lift thickness for fill soils will be dependent on the size and type of compaction equipment utilized, fill should generally be placed in uniform lifts not exceeding approximately 8 inches in loose thickness. Oversized material, rocks, or hard clay lumps greater than 6 inches in dimension should not be used in compacted fills.

5.2.6 Import Materials

We recommend that import material consist of granular, very low to low expansive material (expansion index of 50 or less) as evaluated by ASTM D 4829, minimum R-value of 15, no greater than 30 percent of the particles passing the No. 200 sieve, no particles greater than 3 inches in dimension, and with low corrosivity characteristics. Low corrosivity material is defined as having a minimum resistivity of more than 2,000 ohm-cm when tested in accordance with California Test 643, unless defined otherwise by the corrosion consultant. Import material should be evaluated by the geotechnical consultant at the borrow site for its suitability as fill prior to importation to the project site.

5.3 UTILITY TRENCH EXCAVATIONS

5.3.1 Temporary Trench Excavations

We recommend that trenches and excavations be designed and constructed in accordance with Cal-OSHA regulations. These regulations provide trench sloping and shoring design parameters for trenches up to 20 feet deep based on a description of the soil types encountered. For planning purposes, we recommend the OSHA soil Type C be used for fill soils and OSHA Type B for the Santiago Formation.

Temporary excavations should be constructed in accordance with OSHA recommendations. Excavations deeper than 5 feet should be shored or laid back on a slope no steeper than 1.5H:1V (horizontal:vertical). In the case of trench excavations, OSHA requirements regarding personnel safety should be met using appropriate shoring (including trench boxes), or by laying back the slopes in accordance with OSHA requirements. Temporary excavations that encounter seepage should be evaluated in the field by our geologist or engineer to develop suitable recommendation alternatives. On-site safety of personnel is the responsibility of the contractor, and their designated “competent person” should perform regular inspections of all temporary excavations.

Heavy construction loads, such as those resulting from stockpiles and equipment, should be kept a sufficient distance away from the top of the excavation or shoring to prevent unanticipated surcharge loading. All surface water should be diverted away from excavations.

5.3.2 Pipe Bedding and Trench Backfill

Pipe bedding should consist of sand or similar granular material having a sand equivalent (SE) value of 30 or more. The sand should be placed in the pipe zone which extends a minimum of 6 inches below and 12 inches above the pipe for the full trench width. The bedding material should be compacted to a minimum of 90 percent of the maximum dry density. The sand should be brought up evenly on each side of the pipe to avoid unbalanced loads. Onsite silty and clayey sand materials will generally not meet bedding requirements. Compaction by jetting or flooding is not recommended. Trench backfill above pipe zone may consist of approved onsite or import soils placed in lifts no greater than 8 inches loose thickness and compacted to 90 percent of the maximum dry density.

Based on our experience with other substation projects, deep excavations greater than 5 feet may be required for electrical conduit. We understand that conduits may be encased in a cement slurry and that a firm bottom is not needed. However, aggregate base and/or a geotextile filter fabric may be beneficial to provide a firm bottom if soft or unstable soils are encountered to support other construction activity during installation of the conduits. As with many substation sites, a cement slurry is typically used as backfill above the pipe zone to within about 12- to 24-inches of the ground surface and is acceptable fill from a geotechnical perspective.

5.4 SHALLOW FOUNDATION AND SLAB RECOMMENDATIONS

5.4.1 General

The proposed equipment pads for the substation expansion may be supported on shallow spread, mat or continuous footings founded within either engineered fill or undisturbed formational soils. The soils below the improvements should be prepared in accordance with the recommendations in Section 5.2. We have also included parameters for structures to be supported by drilled piers in Section 5.8.

5.4.2 Shallow Foundations

Based on current grading plans, the majority of the proposed structures will be founded on engineered fill. However, any improvement with shallow foundations to be constructed along the most northwestern portion of the site in the area of test pits TP-4 and TP-5 may encounter dense formational material and should be evaluated during construction. We recommend footings founded entirely in compacted fill soils be designed for an allowable soil contact pressure of 3,000 pounds per square foot (psf). This allowable pressure is based on a Safety Factor of 3. The recommended design bearing value may be increased by 1/3 for transient loading (due to seismic or wind loading). Shallow foundations should contain reinforcing steel as determined by the project structural engineer. Foundations should have a minimum width of 18 inches and a minimum depth of embedment of 12 inches below the lowest adjacent grade.

Resistance to horizontal loadings should be developed by passive earth pressure on the sides of footings and frictional resistance developed along the footing bottoms. Passive resistance to lateral earth pressures may be calculated using an equivalent fluid unit weight of 350 pcf. An allowable frictional coefficient of 0.30 may be used along the footing bottoms. Frictional and passive pressures may be combined without reduction.

Based on our understanding of the proposed improvements and the allowable soil bearing pressure recommendations discussed above, total settlements are expected to be 1/2 inch or less, while differential settlements over a 40-foot span are not expected to exceed 75 percent of the total settlement. Footings may experience a reduction in bearing capacity or an increased potential to settle when located in close proximity to existing or future utility trenches. Furthermore, stresses imposed by the footings on the utility lines may cause cracking, collapse, and/or loss of serviceability of the utility. To reduce this risk, utility excavations should not extend below a 2H:1V plane projected downward from 9 inches above the bottom of the outside edge of the footing. Also, no parallel utility excavations should be made within a lateral distance of 18 inches outside the footing.

Footing excavations should be cleaned of all debris, loose or soft soil, and/or water prior to placing reinforcing steel or concrete. All footing excavations should be observed by a representative of the project geotechnical engineer immediately prior to placement of reinforcing steel and concrete to evaluate the soil bearing conditions and verify that the recommendations contained in this report are implemented during construction.

5.4.3 Exterior Concrete Slabs-On-Grade

Concrete slabs-on-grade can be used for housekeeping pads adjacent to equipment pads or for light equipment pads to support structure improvements. These pads should be supported by a minimum of 18-inches of approved engineered fill. The engineered fill material should be compacted to at least 90 percent of ASTM D 1557. SDG&E housekeeping pads typically omit reinforcing with steel rebar and only utilized fiber within the concrete. Additional reinforcement should be placed as required by the structural engineer.

5.5 INTERIOR CONCRETE SLABS-ON-GRADE

Subgrade soil supporting concrete slabs should be prepared in accordance with the recommendations of Section 5.2 of this report. A subgrade modulus, k, of 150 pounds per cubic inch (pci) may be used for engineered fill soils supporting the slabs. Floor slabs should be designed by the project structural engineer. However, we recommend a minimum thickness of 5 inches and a minimum reinforcement of No. 3 bars at 18-inch spacing in both directions. The reinforcement should be placed near the center of the concrete slab. We strongly recommend that concrete used in slabs-on-grade have a maximum water cement ratio of 0.45. To reduce the effects of cracking, we recommend that expansion relief joints be spaced no greater than 15 feet in both directions. We recommend that all concrete placement, joint spacing, and curing operations be performed in accordance with the recommended guidelines of the American Concrete Institute (ACI).

In cases where the floor may have a vapor/moisture sensitive coverings, may be in a humidity controlled environment, or may likely have one or both of these conditions in the future, we recommend a polyolefin vapor barrier membrane be utilized between the prepared subgrade and the bottom of the floor slab. Based on our experience with other substation structures, proposed switch houses for the substations will not have any floor covering. Thus, a vapor barrier will not be required to reduce moisture vapor transmission through the slab. If moisture protection is desired in selected floor slab areas, an impermeable membrane (minimum 10 mil polyethylene sheeting) should be placed over the compacted subgrade. Care should be taken to properly lap and seal the membrane, particularly around utilities, to provide a uniform barrier.

To promote more uniform curing of the slab and provide protection of the membrane during construction, fine-to-medium-grained clean sand (SP or SW), 2- to 4-inches thick, should be placed on top of the membrane prior to placing slab concrete. This sand should be moistened immediately prior to concrete placement.

5.6 RECOMMENDATIONS FOR RETAINING WALLS

Masonry block barrier/retaining walls may be supported on shallow continuous footings per the foundation recommendations in Section 5.4. Lateral pressures acting against masonry and poured-in-place concrete retaining walls can be calculated using soil equivalent fluid weight (efw). The efw value used for design depends on allowable wall movement. Walls that are free to rotate at least 0.5 percent of the wall height can be designed for the active efw. Retaining walls that are restrained at the top (such as basement walls), or are sensitive to movement and tilting should be designed for the at-rest efw.

Values given in Table 2 below are in terms of equivalent fluid weight and assume a triangular distribution for fill soils. These values assume that imported, sandy soils (SP, SM, SC) will be used as backfill, and the backfill is well drained. If walls with undrained backfill are to be used, Kleinfelder should be consulted for additional evaluation and recommendations.

Table 2
Equivalent Fluid Weights (efw)
For Calculating Lateral Earth Pressures

CONDITIONS	LEVEL BACKFILL	2:1 SLOPING BACKFILL
At-Rest	55 pcf	80 pcf
Active	30 pcf	55 pcf

Fifty and thirty percent of any uniform areal surcharge placed at the top of the wall may be assumed to act as a uniform horizontal pressure. for the at-rest and active cases, respectively. As a minimum, a traffic surcharge equivalent to 120 psf may be assumed to act as a uniform horizontal pressure over the retained height of the wall, H. We should be contacted where point or line loads are expected so we can provide recommendations for additional wall stresses.

Retaining walls should be designed to resist earthquake loading with the following recommendations. An estimate of lateral pressures due to seismic loading was evaluated using the Mononobe-Okabe method and one-half of the estimated peak ground acceleration. Based on the design peak horizontal ground acceleration of 0.4g discussed in Section 4.2, the resultant seismic force (in pounds) for each linear foot of wall can be estimated as 9*H2 within fill soils with a level backfill, where H is the height of the wall (in feet) above its base. The resultant seismic force acts at H/3 above the wall base.

Allowable bearing pressure values described in previous sections of this report can be increased by one-third when calculating resistance caused by loads of short duration, such as earthquake loads. Restraining passive pressure and friction values should not be increased by this amount, but a lower factor of safety than is normally applied to static loads could be used. The factor of safety for dynamic load conditions should not be less than 1.2.

5.7 WALL DRAINAGE

Drainage should be provided for walls which retain soil to prevent the development of hydrostatic forces behind the wall. Either a geosynthetic composite drainage mat or crushed stone wrapped in filter fabric can be used for drainage. If a geosynthetic composite drainage mat is used, the PVC pipe or composite drainage should be routed to discharge at a suitable location that is protected from erosion. If crushed stone drainage if used, it should consist of a zone of crushed, open-graded, ¾-inch gravel at least 12 inches wide from the base of the wall to within 2 feet of the ground surface. The gravel should be separated from all soil with Mirafi 140N geosynthetic fabric or an approved equivalent. A 4-inch diameter Schedule 40 PVC pipe should be placed at the bottom of the gravel zone and sloped to drain at 1 percent. The pipe should have two rows of 3/8-inch diameter holes spaced at about 6 inches and on an arc of 120 degrees, facing downward. Kleinfelder should be notified to observe the final tie-in of the outlet pipe to its discharge point.

The wall designer should determine the damp proofing requirements.

5.8 DRILLED PIER FOUNDATIONS

Drilled pier lengths should be designed based on downward, uplift and lateral loading. We understand that proposed pier lengths are typically governed by lateral loading and that SDG&E will utilize computer program Moment Foundation Analysis Design (MFAD) for design. The recommended soil values below are based on average soil conditions in the generalized layer and the best fit line in Figures 5-8 and 5-14 of the EPRI Manual on Estimating Soil Parameters for Foundation Design (1990). Due to the wide scatter in correlations of pressuremeter modulus data to SPT blow counts and the limited data collected in our study, designers may consider use of more conservative modulus values than the best fit line. These values are intended for use in computer program MFAD only and should be applicable for all versions of the program.. Design values for other methods of analyses can be provided upon request.

The locations for transmission poles were not specified at the time of this report and the substation limits cover a large area. Due to the variable depth of compacted fill over Santiago Formation, the estimated depth of fill at a specific pole location can be provided by Kleinfelder in and addendum when the location is specified. However, we are providing a range of values for the large substation area based on the conditions depicted on the geologic cross-sections between borings. As shown on Figures 5 and 6 respectively, depths of the fill material within the proposed substation varies between 74 and 83 feet (B5, B5 and B6) along cross-section line A-A' in a northwest direction through the substation limits and are between 37 and 80 feet (B2, B3 and B5) along cross-section line B-B' from west to east. The depth of fill likely exceeds the depth of most if not all foundations. We are providing design parameters for both anticipated geologic units.

Table 3
Recommended Soil Parameters for MFAD Analysis

SOIL TYPE	UNIT COHESION (PSF)	FRICTION ANGLE (DEGREES)	UNIT WEIGHT (PCF)	DEFORMATION MODULUS E_{PMT} (KSI)	STRENGTH REDUCTION FACTOR
Fill	0	32	125	1.0	1.0
Santiago Formation	0	38	130	4.0	1.0

Notes: Surficial discount of 2 feet is recommended.

Figures 7 and 8 provide allowable capacity curves for both compression and uplift, respectively. End bearing is included in the provided curves but should be neglected if design lengths encounter groundwater. The potential presence of groundwater may be further addressed in project planning and construction but was not observed during either field investigation for the proposed substation. It should be noted that our borings were completed following several years of drought conditions and could fluctuate if piers are constructed following seasonal precipitation.

5.9 CORROSION POTENTIAL

The subsurface soils that may be in contact with foundations and buried utilities are anticipated to be locally derived fill, however, the majority of the site will receive imported fill to attain proposed finish grade elevations. Laboratory testing was performed to evaluate soluble chloride, soluble sulfate content and pH of soil. Corrosion test results are summarized in Table 4.

Table 4
Soil Corrosion Test Results

BORING / SAMPLE NO.	DEPTH (FEET)	MINIMUM RESISTIVITY (OHM-CM)	PH	SULFATE CONTENT (PPM)	CHLORIDE CONTENT (PPM)
B-3 / 1	0.5 to 5	480	8.7	210	160
B-4 / 1	0.5 to 5	870	8.9	50	50
B-5 / 1	0.5 to 5	550	8.3	70	160

For reference, Caltrans considers a site to be aggressive if one or more of the following conditions exist for the representative soil samples taken at the site: chloride concentration is 500 parts per million (ppm) or greater, sulfate concentration is 2,000 ppm or greater, or the pH is 5.5 or less.

The Portland Cement Association correlates sulfate content to potential sulfate attack as presented on below:

Sulfate Content, ppm	Sulfate Attack Potential
0 to 1,000	Negligible
1,000 to 2,000	Moderate
2,000 to 20,000	Severe
Over 20,000	Very Severe

A commonly accepted correlation between soil resistivity and corrosivity towards unprotected ferrous metals (National Association of Corrosion Engineers (NACE), 1984) is provided below:

Minimum Resistivity, ohm-cm	Corrosion Potential
0 to 1,000	Severely Corrosive
1,000 to 2,000	Corrosive
2,000 to 10,000	Moderately Corrosive
Over 10,000	Mildly Corrosive

Based on the measured minimum resistivities between 480 and 550 ohm-cm, the soils tested at boring locations B-3, B-4 and B-5 are considered severely corrosive to ferrous metals by the

NACE criteria. The soluble sulfate and pH test results did not indicate adverse soil conditions per Caltrans and the Portland Cement Association (PCA) criteria. Based on the laboratory test results, we recommend that Type II or V cement with a maximum water cement ratio of 0.45 should be used for structural concrete structures in contact with soil.

We have performed preliminary laboratory corrosion screening as an initial indicator of soil corrosivity at the site. Performing corrosion engineering is excluded from Kleinfelder's scope. Based on the test results, we recommend that a corrosion engineer be retained to evaluate corrosivity at the site and to provide corrosion resistant design recommendations.

5.10 ASPHALT CONCRETE PAVEMENT

The required asphalt concrete (AC) pavement structural sections will depend on the expected wheel loads, volume of traffic, and subgrade soils. Site specific traffic indices (TI) for the site were not provided, however, we have assumed a TI of 4.5 for interior access roads within the substation and 6.0 for entrance driveways and other heavy traffic areas.

We performed resistance R-value tests on bulk soil samples of the near-surface soils from two boring locations to evaluate pavement support characteristics of the onsite soils. The R value tests were performed in general accordance with ASTM D 2844. The test results for samples collected at Borings B-7 and B-10 were 11 and 9, respectively. Due to the unknown distribution of each material, we recommend that the pavement be designed for and R-value of 9.The pavement thickness may be adjusted during design if the higher values are prevalent and the area can be delineated. Table 5 presents recommended pavement sections based on the described design criteria.

Table 5
Recommended Asphalt Concrete Pavement Sections

TRAFFIC USE	TRAFFIC INDEX, TI	ASPHALT CONCRETE (INCHES*)	AGGREGATE BASE (INCHES*)
Interior Substation	4.5	3.0	8.0
Driveway and Heavy Traffic Areas	6.0	4.0	11.0
		Or 5.0	9.0

* Table values were rounded up to the nearest 1/2 inch.

Flexible pavement sections have been evaluated in general accordance with the Caltrans method for flexible pavement design criteria, design R-value of 9 based on the R-value testing, the calculated Traffic Indices, and a theoretical design life of 20 years. The pavement sections provided above are contingent on the following recommendations being implemented during construction:

- The pavement subgrade should be prepared as recommended in earthwork section of this report.
- Aggregate base materials should be compacted to at least 95 percent relative compaction per ASTM D 1557 (Modified Proctor).
- Adequate drainage (both surface and subsurface) should be provided such that the subgrade soils and aggregate base materials are not allowed to become saturated. This includes sloping pavement surfaces to promote drainage.
- Aggregate base materials should meet current Caltrans specifications for Class 2 aggregate base. Alternatively, the aggregate base course could meet the specifications for untreated base materials (crushed aggregate base or crushed miscellaneous base) as defined in Section 200-2 of the current edition of the Standard Specifications for Public Works Construction (Greenbook).
- Asphalt paving materials and placement methods meet current Caltrans specifications for asphalt concrete or Section 400 of the current edition of the Standard Specifications for Public Works Construction (Greenbook).

Pavement sections provided above are based on the soil conditions encountered during our field investigation, our assumptions regarding final site grades, and limited laboratory testing. A representative of Kleinfelder should be on-site during paving operations to observe and test the subgrade preparation, compaction of the aggregate base, and testing of the asphalt concrete materials.

5.11 WATER INFILTRATION AND PERCOLATION

Per the scope of services for the project, no infiltration testing was performed as part of the field study. Due to the extensive depth of existing fill soils at the site (approximately 80 feet) and potential for inducing hydraulic settlement by water from the site, impermeable liners are recommended for all attenuation/bioretention basin areas.

5.12 SURFACE DRAINAGE

Foundation performance is a function of how well the runoff waters drain from the site. Drainage should be maintained both during construction and over the entire life of the project. Final elevations at the site should be planned so that positive drainage is established around the control house and other future proposed structures. Positive drainage is defined as a slope of 2 percent or more for a distance of 5 feet or more away from structure foundations.

6 LIMITATIONS

This work was performed in a manner consistent with that level of care and skill ordinarily exercised by other members of Kleinfelder's profession practicing in the same locality, under similar conditions and at the date the services are provided. Our conclusions, opinions and recommendations are based on a limited number of observations and data. It is possible that conditions could vary between or beyond the data evaluated. Kleinfelder makes no representation, guarantee or warranty, express or implied, regarding the services, communication (oral or written), report, opinion, or instrument of service provided.

This report may be used only by the Client and the registered design professional in responsible charge and only for the purposes stated for this specific engagement within a reasonable time from its issuance, but in no event later than two (2) years from the date of the report.

The work performed was based on project information provided by Client. If Client does not retain Kleinfelder to review any plans and specifications, including any revisions or modifications to the plans and specifications, Kleinfelder assumes no responsibility for the suitability of our recommendations. In addition, if there are any changes in the field to the plans and specifications, Client must obtain written approval from Kleinfelder's engineer that such changes do not affect our recommendations.

The scope of services was limited to the evaluation of the proposed improvements at the site. It should be recognized that definition and evaluation of subsurface conditions are difficult. Judgments leading to conclusions and recommendations are generally made with incomplete knowledge of the subsurface conditions present due to the limitations of data from field studies. The conclusions of this assessment are based on our subsurface exploration including borings drilled to a maximum depth of 91½ feet, laboratory testing, and engineering analyses.

Kleinfelder offers various levels of investigative and engineering services to suit the varying needs of different clients. Although risk can never be eliminated, more detailed and extensive studies yield more information, which may help understand and manage the level of risk. Since detailed study and analysis involves greater expense, our clients participate in determining levels of service, which provide information for their purposes at acceptable levels of risk. The client and key members of the design team should discuss the issues covered in this report with Kleinfelder, so that the issues are understood and applied in a manner consistent with the owner's budget, tolerance of risk and expectations for future performance and maintenance.

Recommendations contained in this report are based on our field observations and subsurface explorations, laboratory tests, and our present knowledge of the proposed construction. It is possible that soil, rock or groundwater conditions could vary between or beyond the points explored. If soil, rock or groundwater conditions are encountered during construction that differ from those described herein, the client is responsible for ensuring that Kleinfelder is notified immediately so that we may reevaluate the recommendations of this report. If the scope of the proposed construction, including the estimated loads, and the design depths or locations of the foundations, changes from that described in this report, the conclusions and recommendations contained in this report are not considered valid unless the changes are reviewed, and the conclusions of this report are modified or approved in writing, by Kleinfelder. Kleinfelder cannot be responsible for interpretation by others of this report or the conditions encountered in the field.

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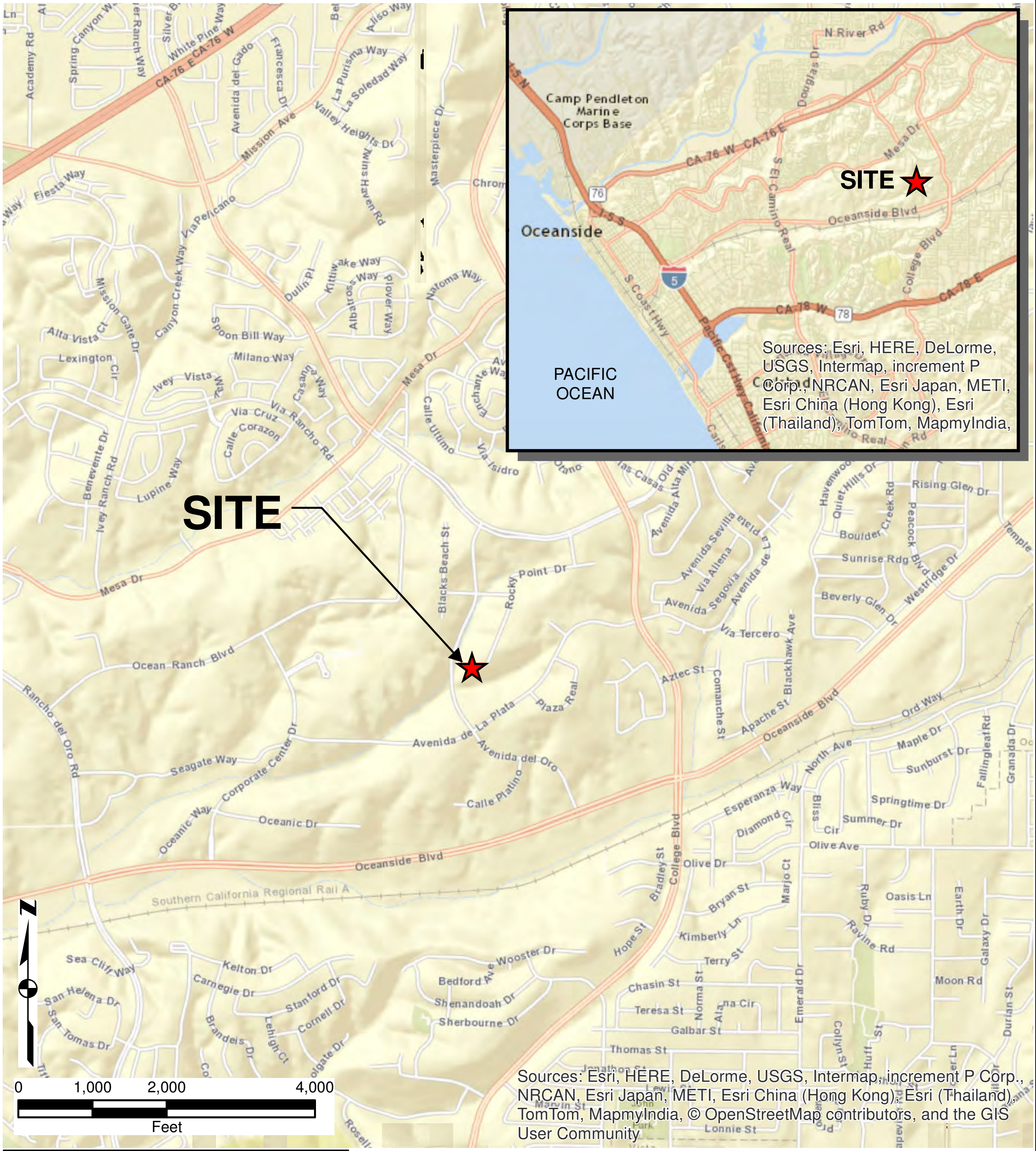
FIGURES



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PROJECT NO.	20154777
DRAWN:	6/9/2015
DRAWN BY:	JP
CHECKED BY:	JC
FILE NAME:	20154777_oRanchVic.mxd

SITE VICINITY MAP

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CALIFORNIA

FIGURE
1

Date: 6/9/2015 User: jpatay Name: 20154777_oRanchVic Path: J:_clients\SanDiegoGasAndElectric\20154777\20154777_oRanchVic.mxd

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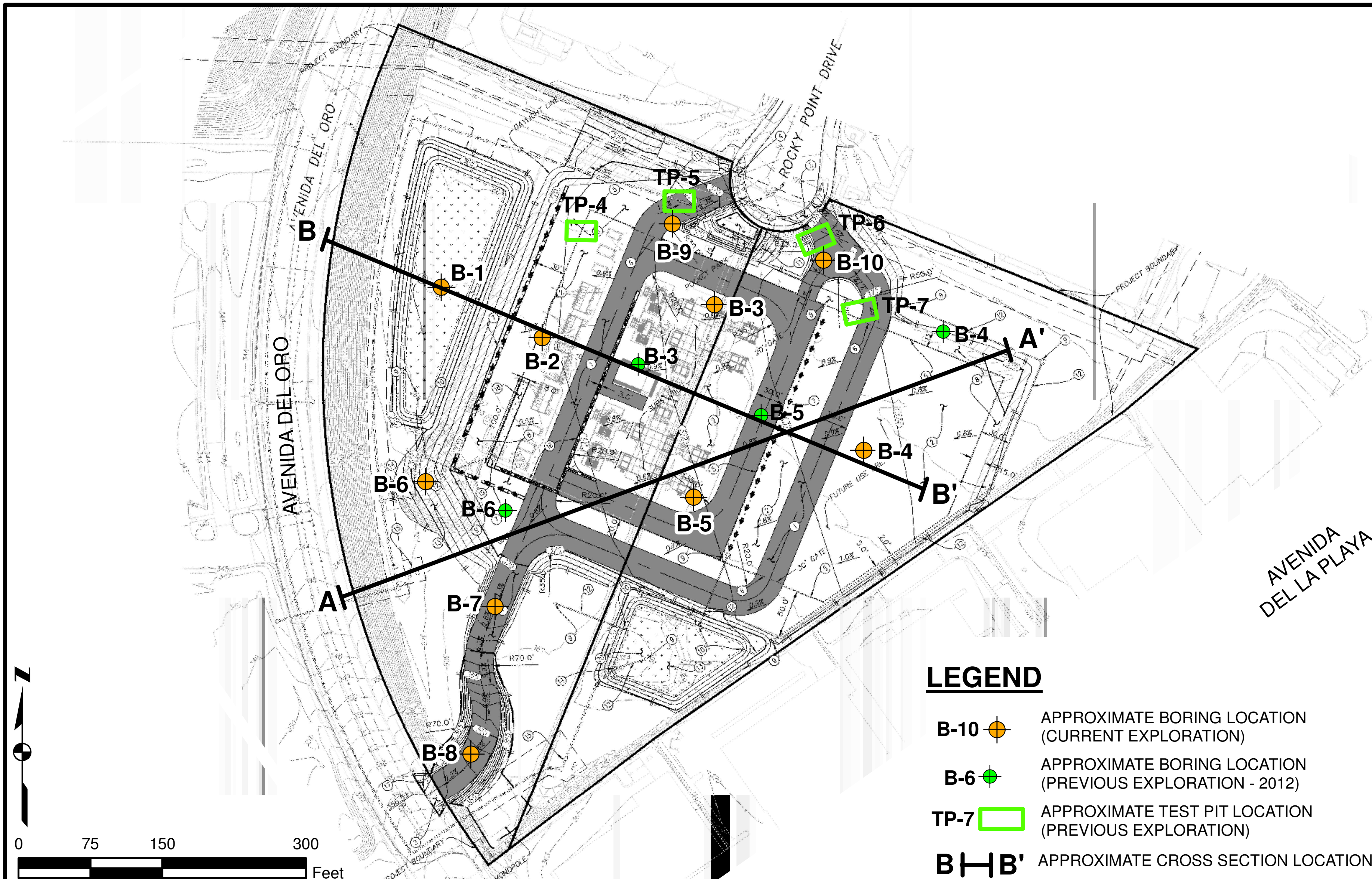

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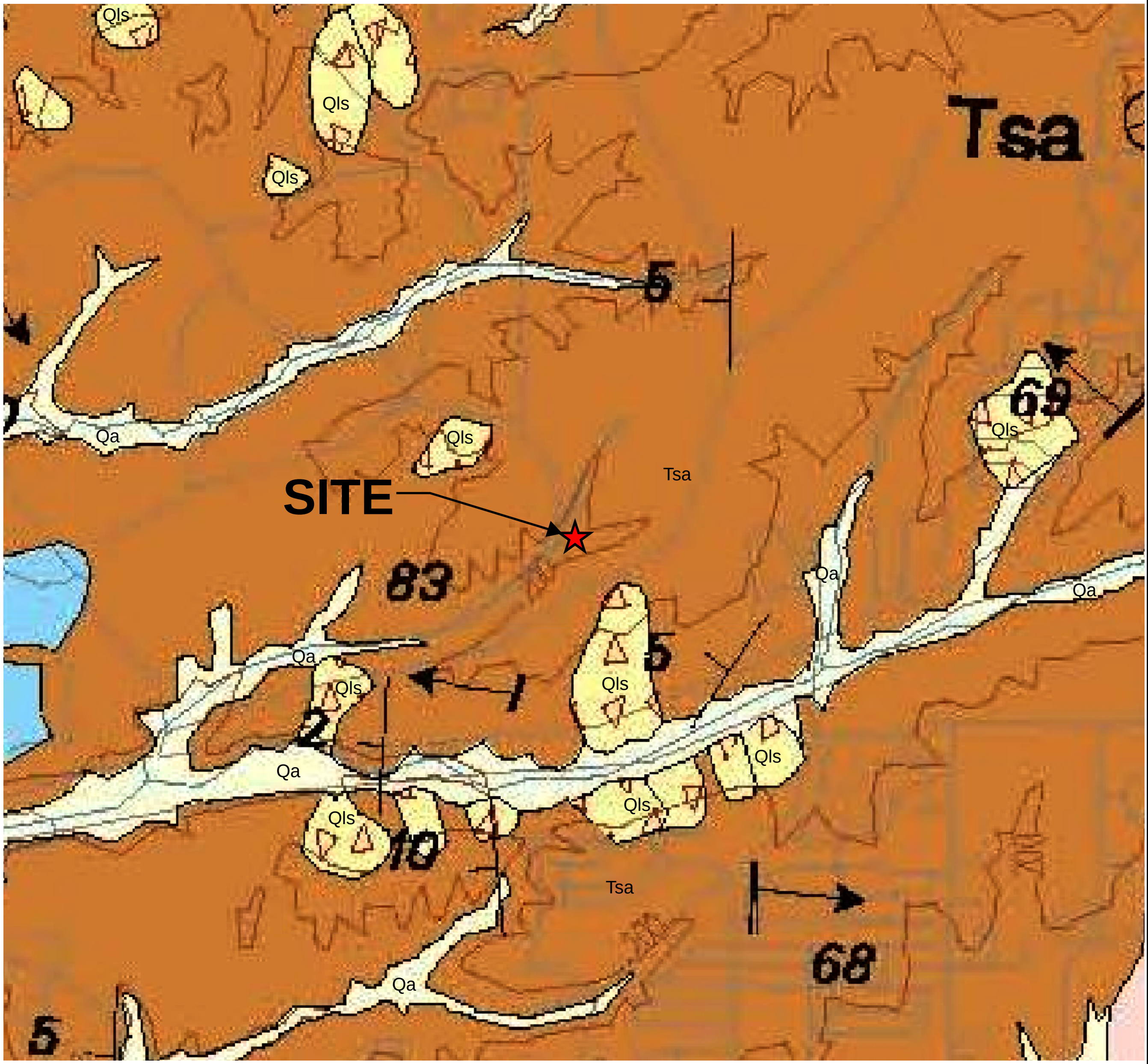
DRAWN: 6/12/2015
DRAWN BY: JP
CHECKED BY: JC
FILE NAME: 20154777_oRanchBor.mxd

BORING LOCATION MAP

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CALIFORNIA

FIGURE

2



SOURCE:
GEOLOGY OF THE OCEANSIDE 30' X 60'
QUADRANGLE, CALIFORNIA BY
M. P. KENNEDY AND S. S. TAN, 2005

0 1,000 2,000 4,000
Feet

N

LEGEND

Qa	ALLUVIAL FLOOD PLAIN DEPOSITS
Qls	LANDSLIDE DEPOSITS UNDIVIDED
Tsa	SANTIAGO FORMATION

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PROJECT NO.	20154777
DRAWN:	6/12/2015
DRAWN BY:	JP
CHECKED BY:	JC
FILE NAME:	20154777_oRanchGeo.mxd

REGIONAL GEOLOGIC MAP

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CALIFORNIA

FIGURE
3

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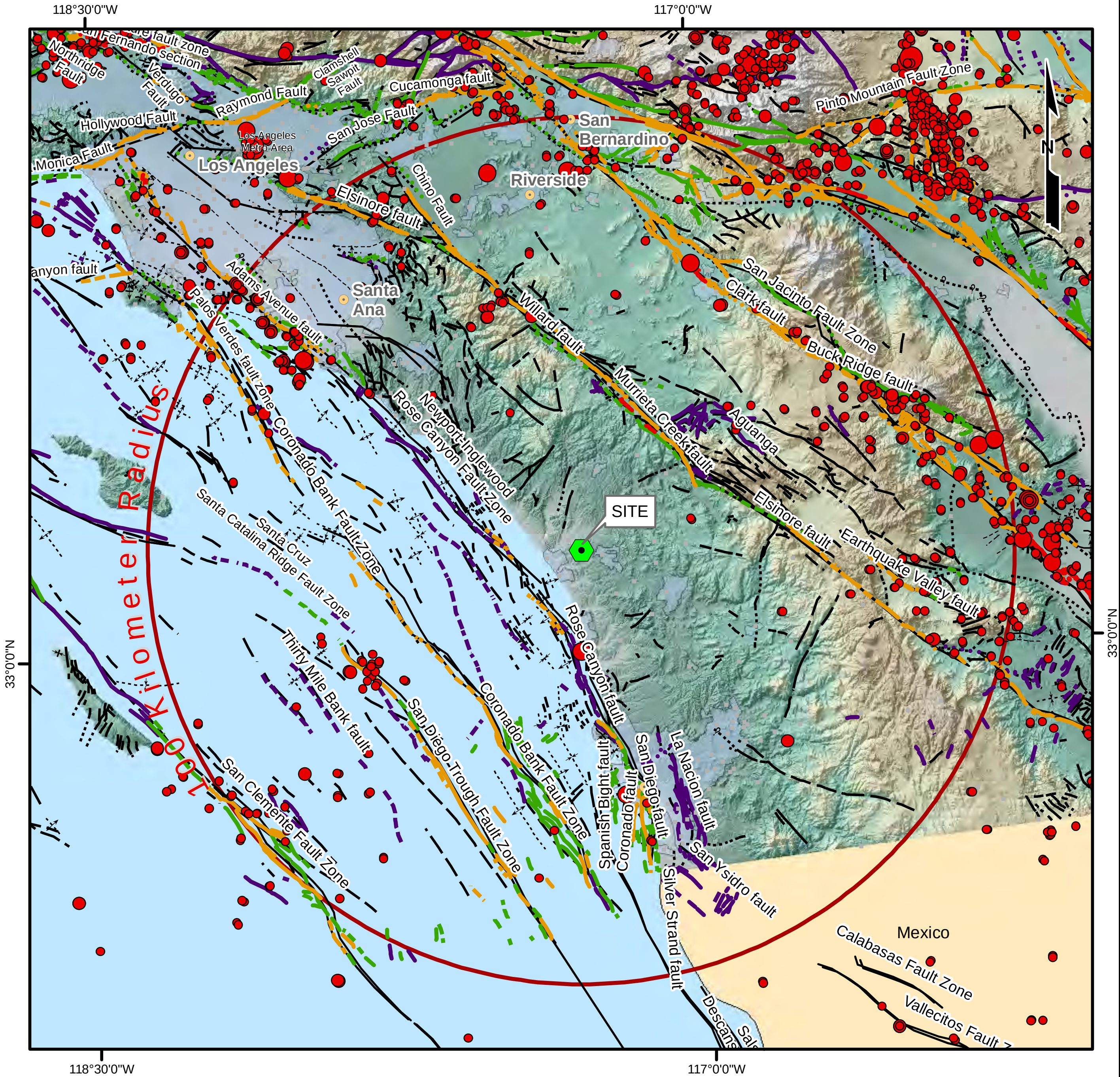

Faulting Legend

Quaternary Faults (Bryant, 2005; USGS, 2009)

Historic displacement (< 200 years)
- Mapped Fault Location
- Dashed were Approximated
- Concealed

Holocene displacement (< 11,000 years)
- Mapped Fault Location
- Dashed were Approximated
- Concealed

Late Quaternary displacement (< 750,000 years)
- Mapped Fault Location
- Dashed were Approximated
- Concealed

Quaternary displacement (< 1,600,000 years)
- Mapped Fault Location
- Dashed were Approximated
- Concealed

Pre-Quaternary Geologic Structures (CGS, 2000)
- fault, approx. located
- ?— fault, approx. located, queried
- fault, certain
- fault, concealed
- ? fault, concealed, queried
- ?— fault, inferred, queried

ANSS Earthquakes

Magnitude
- 4.0 - 4.9
- 5.0 - 5.9
- 6.0 - 6.9
- 7.0 - 7.9
- 8.0 - 8.9

35 17.5 0 35
Kilometers

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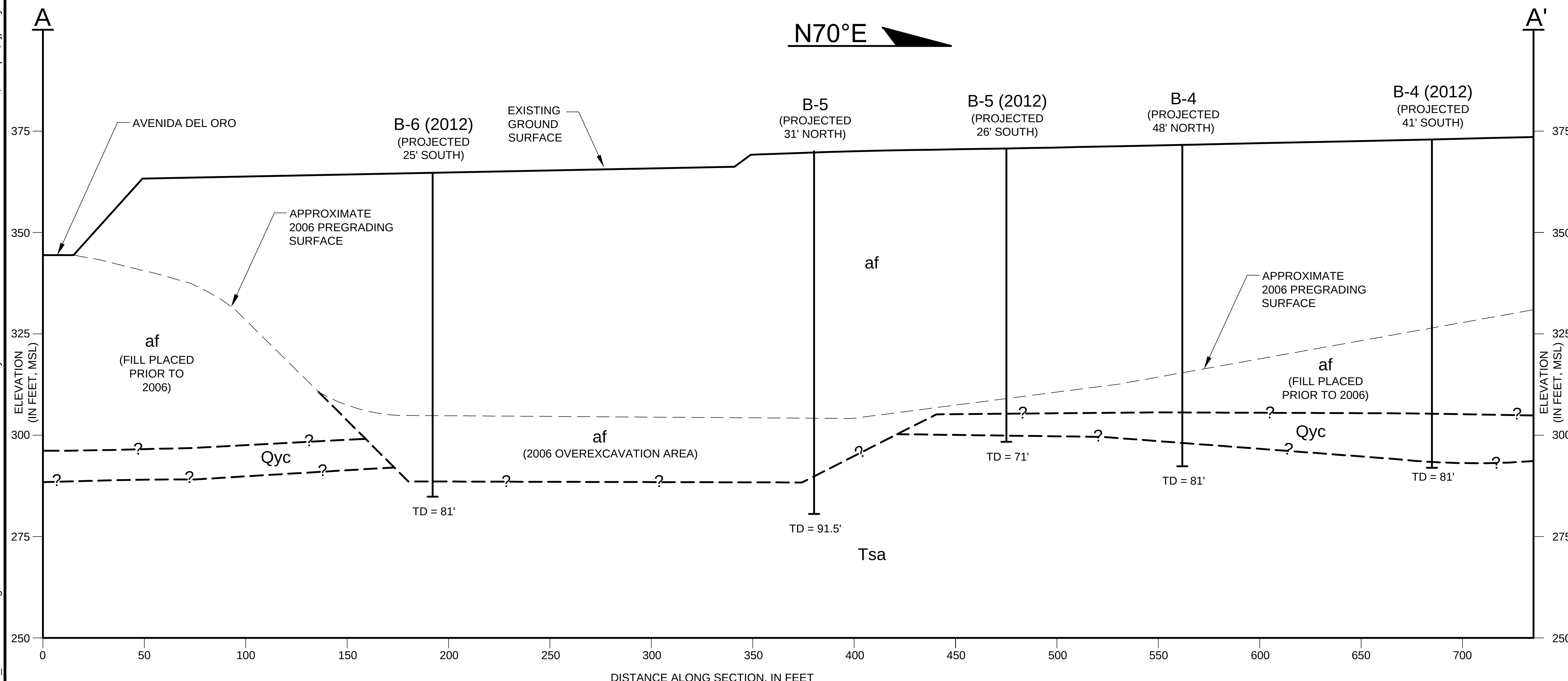
REGIONAL FAULT MAP AND EARTHQUAKE EPICENTERS (1800 - MAY 2015)

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CALIFORNIA

FIGURE 4



LEGEND

af	ARTIFICIAL FILL
Qyc	YOUNG COLLUVIAL DEPOSITS
Tsa	SANTIAGO FORMATION

- - - APPROXIMATE 2006 PREGRADING SURFACE

— ? — APPROXIMATE LOCATION OF GEOLOGIC CONTACT, QUERIED WHERE UNCERTAIN

B-5 (PROJECTED 31' NORTH) TD = 91.5' — APPROXIMATE LOCATION OF BORING SHOWING, PROJECTION AND TOTAL BORING DEPTH

25 0 25 APPROXIMATE VERTICAL SCALE (feet)

50 25 0 50 APPROXIMATE HORIZONTAL SCALE (feet)

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PROJECT NO.	20154777
DRAWN:	6/12/15
DRAWN BY:	JP
CHECKED BY:	SR
FILE NAME:	20154777_Section2.dwg

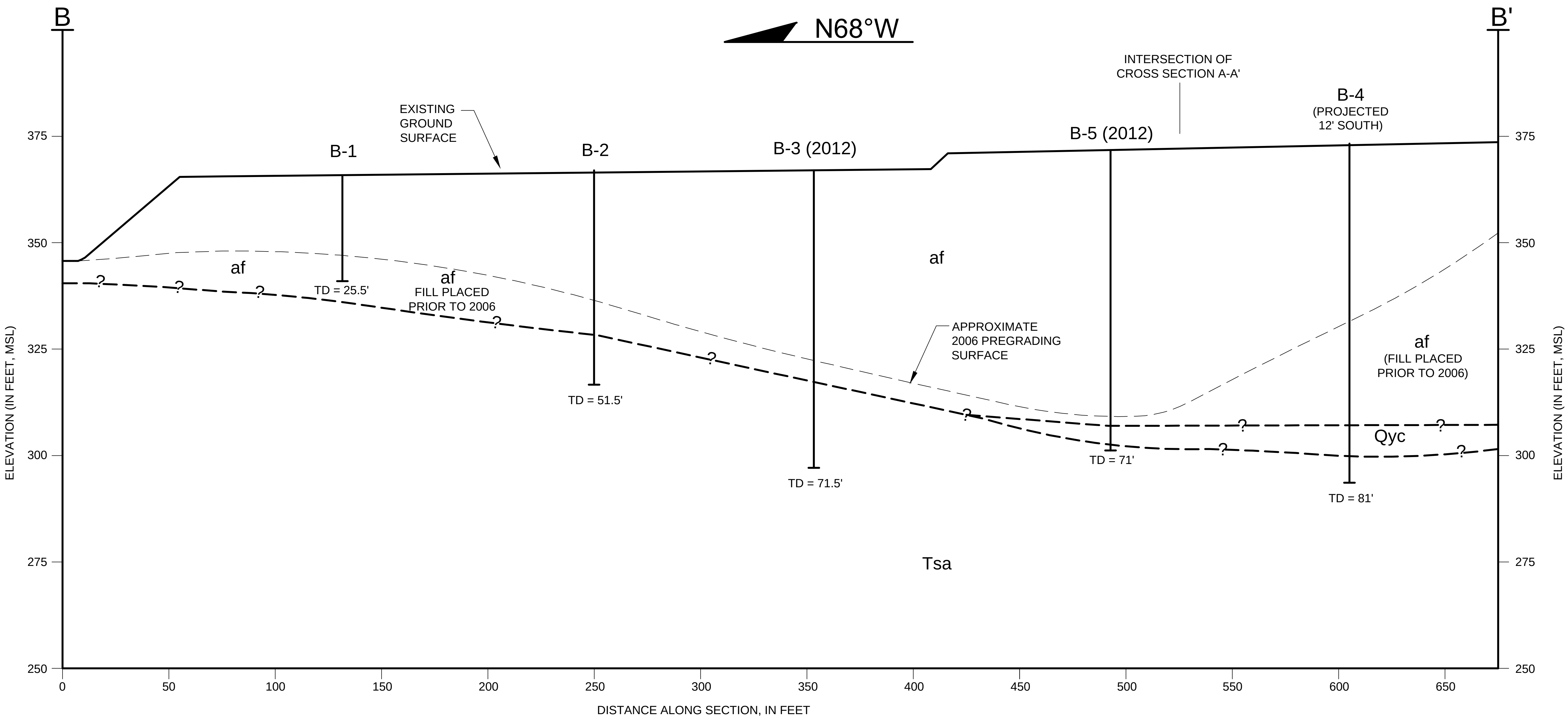
GEOLOGIC CROSS SECTION A-A'

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CALIFORNIA

FIGURE 5

CAD FILE: J:_clients\SanDiegoGasAndElectric\20154777\ LAYOUT: Layout1 PLOTTED: 12 Jun 2015, 3:51pm, jpatay

ATTACHED IMAGES:
ATTACHED XREFS:



LEGEND

af	ARTIFICIAL FILL
Qyc	YOUNG COLLUVIAL DEPOSITS
Tsa	SANTIAGO FORMATION

— — — APPROXIMATE 2006 PREGRADING SURFACE

– – ? – – APPROXIMATE LOCATION OF GEOLOGIC CONTACT, QUERIED WHERE UNCERTAIN

B-4 (PROJECTED 12' SOUTH) TD = 81' — APPROXIMATE LOCATION OF BORING SHOWING, PROJECTION AND TOTAL BORING DEPTH

25 0 25
APPROXIMATE VERTICAL SCALE (feet)

50 25 0 50
APPROXIMATE HORIZONTAL SCALE (feet)

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PROJECT NO.	20154777
DRAWN:	6/12/15
DRAWN BY:	JP
CHECKED BY:	SR
FILE NAME:	20154777_Section2.dwg

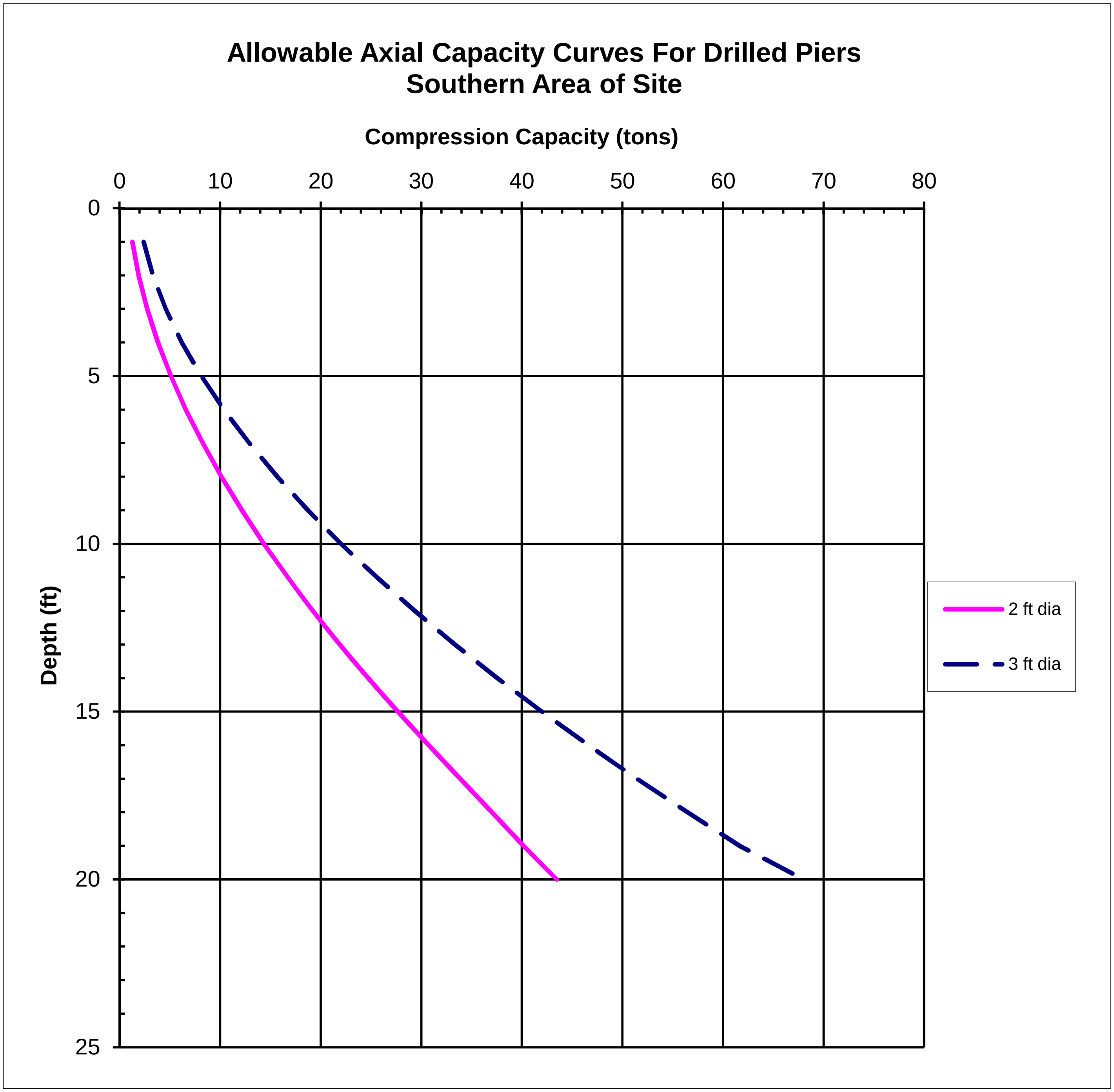
GEOLOGIC CROSS SECTION B-B'

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CALIFORNIA

FIGURE 6

PLOTTED: 12 Jun 2015, 3:51pm, jpatay LAYOUT: Layout2 CAD FILE: J:_clients\SanDiegoGasAndElectric\20154777\

ATTACHED IMAGES:
ATTACHED XREFS:

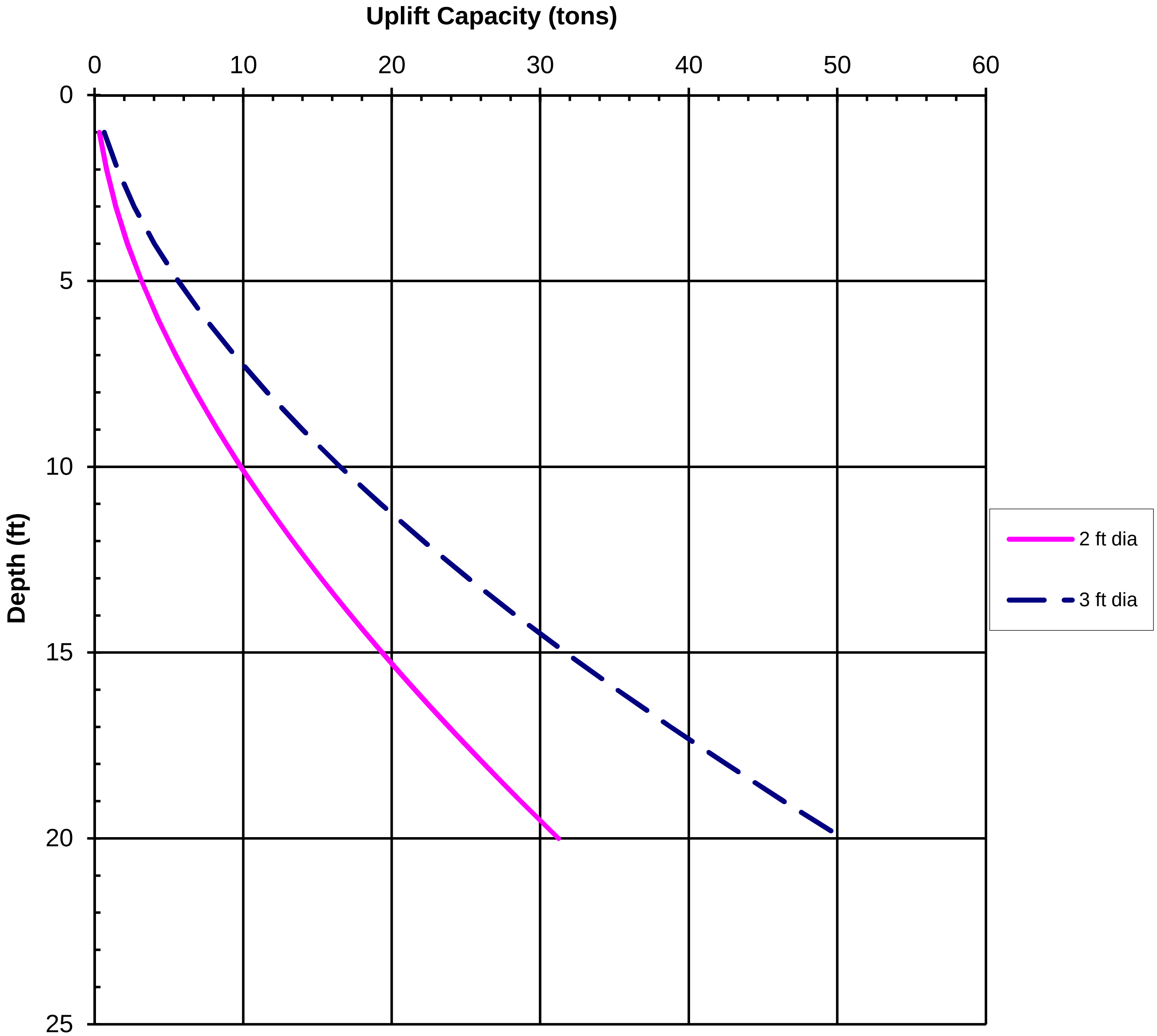


These results are based on the following assumptions and conditions. Piles with conditions different from those assumed should be re-evaluated by Kleinfelder.

- Soil profile is coarse grain fill from the ground surface to 25 feet, and then underalin by fine grained fill.
- Pile modulus of elasticity, E = 0.410E+07 lb/sq. in
- End bearing was utilized
- Ground water was not encountered

KLEINFELDER *Bright People. Right Solutions.*		**DOWNWARD AXIAL CAPACITY CURVES** SDG&E OCEAN RANCH SUBSTATION PACIFIC COAST BUSINESS PARK OCEANSIDE, CALIFORNIA	FIGURE **7**
Checked by: KC	By: JC		
Project No. { 20154777	Date: 05/22/2015		

Allowable Axial Capacity Curves For Drilled Piers
Southern Area of Site



These results are based on the following assumptions and conditions. Piles with conditions different from those assumed should be re-evaluated by Kleinfelder.

- Soil profile is coarse grain fill from the ground surface to 25 feet, and then underalin by fine grained fill.
- Pile modulus of elasticity, E = 0.410E+07 lb/sq. in
- End bearing was utilized
- Ground water was not encountered

KLEINFELDER Bright People. Right Solutions.		UPLIFT CAPACITY CURVES SDG&E OCEAN RANCH SUBSTATION PACIFIC COAST BUSINESS PARK OCEANSIDE, CALIFORNIA	FIGURE **8**
Checked by: KC	By: JC		
Project No. { 20154777	Date: 05/22/2015		

APPENDIX A

FIELD INVESTIGATION AND BORING LOGS

APPENDIX A
FIELD INVESTIGATION AND BORING LOGS

GENERAL

Our field exploration program consisted of a site reconnaissance, review of previous geotechnical borings and test pits in 2012, and drilling ten geotechnical borings between April 15, 2015 and April 17, 2015. Prior to commencement of the fieldwork, geophysical techniques were used at the boring location in order to identify potential conflicts with subsurface structures. The boring locations were also cleared for buried utilities through Underground Service Alert (USA) of Southern California. In addition, Kleinfelder subcontracted a private utility locating company to sweep the proposed boring locations for underground utilities at the site.

Borings were placed within a structure, pavement or other improvement area. The borings were drilled to depths of approximately 6½ to 91½ feet below the existing ground surface (bgs) using a truck-mounted drill rig equipped with 6-inch-diameter hollow-stem augers (HSA). In addition to our current field exploration program, four borings were drilled within the project area to depths ranging between approximately 20 to 34 feet bgs and four test pits to depths ranging approximately 5 to 10 feet by Kleinfelder, Inc. in 2012 as part of our geotechnical site study for the substation. These borings are presented in Appendix A.1.

The boring logs of our current study are presented as Figures A-3 through A-19. An explanation to the boring logs are presented as Figures A-1 and A-2. The boring logs describe the earth materials encountered, samples obtained and show field and laboratory tests performed. The logs also show the location, boring number, drilling date and the name of the drilling subcontractor. The borings were logged by a Kleinfelder engineer using the Unified Soil Classification System. The boundaries between soil types shown on the log are approximate because the transition between different soil layers may be gradual. Bulk and drive samples of selected earth materials were obtained from the borings.

A California type sampler was used to obtain drive samples of the soil encountered. This sampler consists of a 3-inch O.D., 2.4-inch I.D. split barrel shaft that is pushed or driven a total of 18 inches into the soil at the bottom of the boring. The soil was retained in 6-inch brass sleeves for laboratory testing. An additional 2 inches of soil from each drive remained in the cutting shoe and was usually discarded after visually classifying the soil. The sampler was driven using a 140-pound hammer falling 30 inches. The total number of blows required to drive the sampler the final 12 inches is termed blow count and is recorded on the Log of Boring.

Samples were also obtained using a Standard Penetration Sampler (SPT). This sampler consists of a 2-inch O.D., 1⅜-inch I.D. split barrel shaft that is advanced into the soils at the bottom of the drill hole a total of 18 inches. The sampler was driven using a 140-pound hammer falling 30 inches. The total number of hammer blows required to drive the sampler the final 12 inches is termed the blow count (N), however all blow counts for each 6-inches is recorded on the boring log. The procedures we employed in the field are generally consistent with those described in ASTM Standard Test Method D1586.

SAMPLE/SAMPLER TYPE GRAPHICS

- BULK SAMPLE
- CALIFORNIA SAMPLER (3 in. (76.2 mm.) outer diameter)
- STANDARD PENETRATION SPLIT SPOON SAMPLER (2 in. (50.8 mm.) outer diameter and 1-3/8 in. (34.9 mm.) inner diameter)

GROUND WATER GRAPHICS

- WATER LEVEL (level where first observed)
- WATER LEVEL (level after exploration completion)
- WATER LEVEL (additional levels after exploration)
- OBSERVED SEEPAGE

NOTES

- The report and graphics key are an integral part of these logs. All data and interpretations in this log are subject to the explanations and limitations stated in the report.
- Lines separating strata on the logs represent approximate boundaries only. Actual transitions may be gradual or differ from those shown.
- No warranty is provided as to the continuity of soil or rock conditions between individual sample locations.
- Logs represent general soil or rock conditions observed at the point of exploration on the date indicated.
- In general, Unified Soil Classification System designations presented on the logs were based on visual classification in the field and were modified where appropriate based on gradation and index property testing.
- Fine grained soils that plot within the hatched area on the Plasticity Chart, and coarse grained soils with between 5% and 12% passing the No. 200 sieve require dual USCS symbols, ie., GW-GM, GP-GM, GW-GC, GP-GC, GC-GM, SW-SM, SP-SM, SW-SC, SP-SC, SC-SM.
- If sampler is not able to be driven at least 6 inches then 50/X indicates number of blows required to drive the identified sampler X inches with a 140 pound hammer falling 30 inches.

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487)

Major Division	Subdivision	Fines	Gradation	Symbol	Description
COARSE GRAINED SOILS (More than half of material is larger than the #200 sieve)	GRAVELS (More than half of coarse fraction is larger than the #4 sieve)	CLEAN GRAVEL WITH <5% FINES	Cu ≥4 and 1≤ Cc≤3	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
			Cu <4 and/ or 1>Cc >3	GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
		GRAVELS WITH 5% TO 12% FINES	Cu ≥4 and 1≤ Cc≤3	GW-GM	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE FINES
				GW-GC	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE CLAY FINES
			Cu <4 and/ or 1>Cc >3	GP-GM	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE FINES
				GP-GC	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE CLAY FINES
		GRAVELS WITH > 12% FINES		GM	SILTY GRAVELS, GRAVEL-SILT-SAND MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
				GC-GM	CLAYEY GRAVELS, GRAVEL-SAND-CLAY-SILT MIXTURES
	SANDS (More than half of coarse fraction is smaller than the #4 sieve)	CLEAN SANDS WITH <5% FINES	Cu ≥6 and 1≤ Cc≤3	SW	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
			Cu <6 and/ or 1>Cc >3	SP	POORLY GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
		SANDS WITH 5% TO 12% FINES	Cu ≥6 and 1≤ Cc≤3	SW-SM	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE FINES
				SW-SC	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE CLAY FINES
			Cu <6 and/ or 1>Cc >3	SP-SM	POORLY GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE FINES
				SP-SC	POORLY GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE CLAY FINES
		SANDS WITH > 12% FINES		SM	SILTY SANDS, SAND-GRAVEL-SILT MIXTURES
				SC	CLAYEY SANDS, SAND-GRAVEL-CLAY MIXTURES
				SC-SM	CLAYEY SANDS, SAND-SILT-CLAY MIXTURES

Major Division	Subdivision	Symbol	Description
FINE GRAINED SOILS (More than half of material is smaller than the #200 sieve)	SILTS AND CLAYS (Liquid Limit less than 50)	ML	INORGANIC SILTS AND VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS, SILTS WITH SLIGHT PLASTICITY
		CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
		CL-ML	INORGANIC CLAYS-SILTS OF LOW PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
		OL	ORGANIC SILTS & ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS (Liquid Limit greater than 50)	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILT
		CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
		OH	ORGANIC CLAYS & ORGANIC SILTS OF MEDIUM-TO-HIGH PLASTICITY

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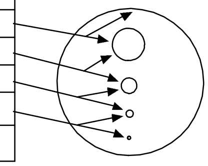
PROJECT NO.: 20154777	GRAPHICS KEY		FIGURE
DRAWN BY: JC			
CHECKED BY: SR	SDG&E OCEAN RANCH SUBSTATION PACIFIC COAST BUSINESS PARK OCEANSIDE, CA		A-1
DATE: 5/28/2015			
REVISED: 6/1/2015			

GRAIN SIZE

DESCRIPTION		SIEVE SIZE	GRAIN SIZE	APPROXIMATE SIZE
Boulders		>12 in. (304.8 mm.)	>12 in. (304.8 mm.)	Larger than basketball-sized
Cobbles		3 - 12 in. (76.2 - 304.8 mm.)	3 - 12 in. (76.2 - 304.8 mm.)	Fist-sized to basketball-sized
Gravel	coarse	3/4 -3 in. (19 - 76.2 mm.)	3/4 -3 in. (19 - 76.2 mm.)	Thumb-sized to fist-sized
	fine	#4 - 3/4 in. (#4 - 19 mm.)	0.19 - 0.75 in. (4.8 - 19 mm.)	Pea-sized to thumb-sized
Sand	coarse	#10 - #4	0.079 - 0.19 in. (2 - 4.9 mm.)	Rock salt-sized to pea-sized
	medium	#40 - #10	0.017 - 0.079 in. (0.43 - 2 mm.)	Sugar-sized to rock salt-sized
	fine	#200 - #10	0.0029 - 0.017 in. (0.07 - 0.43 mm.)	Flour-sized to sugar-sized
Fines		Passing #200	<0.0029 in. (<0.07 mm.)	Flour-sized and smaller

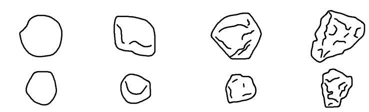


Munsell Color

NAME	ABBR
Red	R
Yellow Red	YR
Yellow	Y
Green Yellow	GY
Green	G
Blue Green	BG
Blue	B
Purple Blue	PB
Purple	P
Red Purple	RP
Black	N

ANGULARITY

DESCRIPTION	CRITERIA
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces
Subangular	Particles are similar to angular description but have rounded edges
Subrounded	Particles have nearly plane sides but have well-rounded corners and edges
Rounded	Particles have smoothly curved sides and no edges



Particles Present

Amount	Percentage
trace	<5
few	5-10
little	15-25
some	30-45
and	50
mostly	50-100

PLASTICITY

DESCRIPTION	LL	FIELD TEST
Non-plastic	NP	A 1/8-in. (3 mm.) thread cannot be rolled at any water content.
Low (L)	< 30	The thread can barely be rolled and the lump or thread cannot be formed when drier than the plastic limit.
Medium (M)	30 - 50	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump or thread crumbles when drier than the plastic limit
High (H)	> 50	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump or thread can be formed without crumbling when drier than the plastic limit

MOISTURE CONTENT

DESCRIPTION	FIELD TEST
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

REACTION WITH HYDROCHLORIC ACID

DESCRIPTION	FIELD TEST
None	No visible reaction
Weak	Some reaction, with bubbles forming slowly
Strong	Violent reaction, with bubbles forming immediately

APPARENT / RELATIVE DENSITY - COARSE-GRAINED SOIL

APPARENT DENSITY	SPT-N_{60} (# blows/ft)	MODIFIED CA SAMPLER (# blows/ft)	CALIFORNIA SAMPLER (# blows/ft)	RELATIVE DENSITY (%)
Very Loose	<4	<4	<5	0 - 15
Loose	4 - 10	5 - 12	5 - 15	15 - 35
Medium Dense	10 - 30	12 - 35	15 - 40	35 - 65
Dense	30 - 50	35 - 60	40 - 70	65 - 85
Very Dense	>50	>60	>70	85 - 100

NOTE: AFTER TERZAGHI AND PECK, 1948

CONSISTENCY - FINE-GRAINED SOIL

CONSISTENCY	UNCONFINED COMPRESSIVE STRENGTH (q_u)(psf)	CRITERIA
Very Soft	< 1000	Thumb will penetrate soil more than 1 in. (25 mm.)
Soft	1000 - 2000	Thumb will penetrate soil about 1 in. (25 mm.)
Firm	2000 - 4000	Thumb will indent soil about 1/4-in. (6 mm.)
Hard	4000 - 8000	Thumb will not indent soil but readily indented with thumbnail
Very Hard	> 8000	Thumbnail will not indent soil

STRUCTURE

DESCRIPTION	CRITERIA
Stratified	Alternating layers of varying material or color with layers at least 1/4-in. thick, note thickness
Laminated	Alternating layers of varying material or color with the layer less than 1/4-in. thick, note thickness
Fissured	Breaks along definite planes of fracture with little resistance to fracturing
Slickensided	Fracture planes appear polished or glossy, sometimes striated
Blocky	Cohesive soil that can be broken down into small angular lumps which resist further breakdown
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay; note thickness
Homogeneous	Same color and appearance throughout

CEMENTATION

DESCRIPTION	FIELD TEST
Weakly	Crumbles or breaks with handling or slight finger pressure
Moderately	Crumbles or breaks with considerable finger pressure
Strongly	Will not crumble or break with finger pressure

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PROJECT NO.: 20154777
DRAWN BY: JC
CHECKED BY: SR
DATE: 5/28/2015
REVISED: 6/1/2015

SOIL DESCRIPTION KEY

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CA

FIGURE
A-2

Date Begin - End:	4/15/2015	**Drilling Company:**	Pacific Drilling
Logged By:	J. Co	**Drill Crew:**	Gordy/Toby
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Unimog
Plunge:	-90 degrees	**Drilling Method:**	Solid Stem Auger
Weather:	Sunny and Warm	**Exploration Diameter:**	6 in. in. O.D.

BORING LOG B-1

Hammer Type - Drop: 140 lb. Auto - 30 in.

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 33.21113° N
Longitude: -117.29459° W
Approximate Ground Surface Elevation (ft.): 367
Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
365		**Artificial Fill (af)** **Clayey SAND (SC)**: fine to medium-grained, light yellowish brown (2.5 Y 6/3), moist, loose, low plasticity fines	1											
		Silty SAND (SM): fine to medium-grained, pale yellow (2.5 Y 7/3), moist, medium dense, low plasticity fines	2		BC=5 6 10	18"								
	5	mottled with olive gray, dense, becomes mottled with some clayey sand	3		BC=17 15 26	18"		12.2	117.3		33			
360														
	10	**Lean CLAY (CL)**: fine-grained, pale olive (5 Y 6/3) mottled with dark gray (2.5 Y, 4/1), moist, very hard, low plasticity	4		BC=5 13 21	14"		15.6	114.2			39	20	
355														
	15	organic odor	5		BC=7 14 20	18"								
350														
	20	**Lean CLAY (CL)**: olive gray (5 Y 5/2), moist, hard, weak cementation, low plasticity	6		BC=9 11 9	18"								
345		**Poorly-graded SAND with Silt (SP-SM)**: light gray (2.5 Y 7/2) to olive yellow (2.5Y 6/6), moist, medium dense												
	25	1 foot layers of claystone and sandstone, mottled clay in sand	7		BC=7 15 19	18"								
340														
	30													
335														

The boring was terminated at approximately 26.5 ft. below ground surface. The exploration was backfilled with bentonite on April 15, 2015.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling or after completion.

GENERAL NOTES:
The exploration elevation is approximate and was estimated from the Preliminary Civil Development Plan by SDG&E dated February 27, 2015.

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PROJECT NO.:	20154777
DRAWN BY:	JC
CHECKED BY:	SR
DATE:	5/28/2015
REVISED:	6/1/2015

BORING LOG B-1

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CA

FIGURE

A-3

Date Begin - End:	4/15/2015	**Drilling Company:**	Pacific Drilling
Logged By:	J. Co	**Drill Crew:**	Gordy/Toby
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Unimog
Plunge:	-90 degrees	**Drilling Method:**	Solid Stem Auger
Weather:	Sunny and Warm	**Exploration Diameter:**	6 in. in. O.D.

BORING LOG B-2

Hammer Type - Drop: 140 lb. Auto - 30 in.

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 33.21099° N
Longitude: -117.29424° W
Approximate Ground Surface Elevation (ft.): 367
Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
365			**Artificial Fill (af)** **Clayey SAND (SC)**: fine to coarse-grained, light yellowish brown (2.5 Y 6/3), dry to moist, loose, low plasticity fines	1											
			Silty SAND (SM): fine to coarse-grained, light yellowish brown (2.5 Y 5/3), dry to moist, medium dense, random dark gray claystone 1/2 inch chunks, low plasticity fines	2		BC=8 15 15			12.2	112.6					DS
360	5		**Poorly-graded SAND with Silt (SP-SM)**: fine to medium-grained, light gray (5 Y 7/2), dry to moist, medium dense, random 1/2 inch chunks of dark gray silty sand	3		BC=10 10 21	18"								
355	10		**Clayey SAND (SC)**: fine to medium-grained, light yellowish brown (2.5 Y 5/3) to olive gray (5Y 5/2) with very dark gray (5Y 3/1), dry to moist, medium dense, randomly mixed with silty sand and 1/2" chunks of claystone, low plasticity fines	4		BC=9 11 15	18"		14.4	106.6		38			
350	15		some mottled strong brown (7.5 YR 5/8)	5		BC=8 11 14	18"								
345	20		increase in coarse grain sand and fine gravel from 20-20.5 feet	6		BC=6 8 7	18"								
	25		3" thick weakly cemented claystone, some mica	7		BC=8 11 8	18"		7.8	106.1					
340			**Sandy CLAY (CL)**: fine to coarse-grained, very dark gray (5 Y 3/1), moist, hard, low plasticity fine, organic odor, small roots												
335	30		random sandy clay, some gray to olive yellow	8		BC=10 12 23	18"								

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PROJECT NO.:	20154777
DRAWN BY:	JC
CHECKED BY:	SR
DATE:	5/28/2015
REVISED:	6/1/2015

BORING LOG B-2

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CA

FIGURE
A-4

Date Begin - End:	4/15/2015	**Drilling Company:**	Pacific Drilling		**BORING LOG B-2**
Logged By:	J. Co	**Drill Crew:**	Gordy/Toby		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Unimog	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Solid Stem Auger		
Weather:	Sunny and Warm	**Exploration Diameter:**	6 in. in. O.D.		

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 33.21099° N
Longitude: -117.29424° W
Approximate Ground Surface Elevation (ft.): 367
Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
			Lean CLAY with Sand (CL): fine to coarse-grained, very dark gray (5 Y 3/1), moist, hard, rootlets	9		BC=8 8 10	18"		13.4			81			
330			**<u>Santiago Formation (Tsa)</u>** **SANDSTONE (excavates as):** **Silty SAND (SM)**: fine to coarse-grained, olive yellow (2.5 Y 6/6) to light gray (2.5 Y 7/2), dry to moist, very dense, 1/2" chunks of claystone at shoe, non-plastic												
	40			10		BC=14 37 50/6"	18"		10.2	111.4		23			
325															
	45		becomes light yellowish brown (2.5Y 6/3) to olive yellow (2.5 Y 6/6)	11		BC=14 19 22	18"								
320															
	50			12		BC=20 36 50/4"	16"								
315															
	55														
310															
	60														
305															
	65														
300															

The boring was terminated at approximately 51.5 ft. below ground surface. The exploration was backfilled with bentonite grout on April 15, 2015.

<u>GROUNDWATER LEVEL INFORMATION:</u>
Groundwater was not encountered during drilling or after completion.

<u>GENERAL NOTES:</u>
The exploration elevation is approximate and was estimated from the Preliminary Civil Development Plan by SDG&E dated February 27, 2015.

KLEINFELDER Bright People. Right Solutions.	PROJECT NO.: 20154777	BORING LOG B-2	FIGURE
	DRAWN BY: JC		
	CHECKED BY: SR	SDG&E OCEAN RANCH SUBSTATION PACIFIC COAST BUSINESS PARK OCEANSIDE, CA	A-5
	DATE: 5/28/2015		
	REVISED: 6/1/2015		PAGE: 2 of 2

Date Begin - End:	4/15/2015	Drilling Company:	Pacific Drilling	BORING LOG B-3
Logged By:	J. Co	Drill Crew:	Gordy/Toby	
Hor.-Vert. Datum:	Not Available	Drilling Equipment:	Unimog	Hammer Type - Drop: 140 lb. Auto - 30 in.
Plunge:	-90 degrees	Drilling Method:	Solid Stem Auger	
Weather:	Sunny and Warm	Exploration Diameter:	6 in. in. O.D.	

Latitude: 33.21109° N
Longitude: -117.29366° W
Approximate Ground Surface Elevation (ft.): 368
Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Lithologic Description	Sample Number	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Artificial Fill (af) **Sandy CLAY (CL)**: fine to coarse grained, light olive brown (2.5 Y 5/3), moist, loose, low plasticity fines	1								44	26	Corrosion
365		**Clayey SAND (SC)**: fine to coarse grained, light yellow brown (2.5 Y 6/3), moist, medium dense, low plasticity fines	2	BC=7 8 11	18"		12.8	108.9	100	26			
			1										
	5	1/2" chunks of non-uniform clay	3	BC=9 11 17	18"								
360													
	10	some light olive brown (2.5 Y 5/3), 1/2" claystone chunks	4	BC=7 9 12	18"								
355													
	15	**Sandy CLAY (CL)**: fine to medium grained, gray (2.5 Y 5/1) to light olive brown (2.5 Y 5/3), moist, hard, low plasticity fines	5	BC=7 13 14	18"		15.8	103.0					
350													
	20	mostly fine to coarse grained sandy clay with random silty sand and claystone chunks. gray to brownish yellow and dusky red	6	BC=7 6 7	16"								
345													
	25	becomes very hard, random chunks of sandy clay, olive yellow mixed with gray and dark gray	7	BC=6 16 20	18"		15.2	108.9					
340		**Santiago Formation (Tsa)** **CLAYSTONE: excavates as** **CLAY with Sand (CL)**: grayish brown (10 YR, 5/2), moist, very dense, weak cemented calcium carbonate fracture, low plasticity											
	30		8	BC=15 21 35	22"		13.0						
335		**SANDSTONE: excavates as** **Silty SAND (SM)**: fine to medium grained, olive gray to gray (5 Y 4/2) with strong brown (7.5 YR 5/6), moist, very dense, low plasticity fines, caliche filled fractures											

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PROJECT NO.:	20154777	BORING LOG B-3	FIGURE
DRAWN BY:	JC		A-6
CHECKED BY:	SR	SDG&E OCEAN RANCH SUBSTATION PACIFIC COAST BUSINESS PARK OCEANSIDE, CA	
DATE:	5/28/2015		
REVISED:	6/1/2015		PAGE: 1 of 2

Date Begin - End:	4/15/2015	Drilling Company:	Pacific Drilling		BORING LOG B-3
Logged By:	J. Co	Drill Crew:	Gordy/Toby		
Hor.-Vert. Datum:	Not Available	Drilling Equipment:	Unimog	Hammer Type - Drop:	140 lb. Auto - 30 in.
Plunge:	-90 degrees	Drilling Method:	Solid Stem Auger		
Weather:	Sunny and Warm	Exploration Diameter:	6 in. in. O.D.		

Latitude: 33.21109° N
Longitude: -117.29366° W
Approximate Ground Surface Elevation (ft.): 368
Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description (FIELD EXPLORATION)	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol (LABORATORY RESULTS)	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
			SANDSTONE: excavates as Poorly-graded SAND with Silt (SP-SM): fine to medium-grained, light yellowish brown (2.5 Y 6/4), moist, very dense, low plasticity fines	9		BC=17 34 50/4"	16"								
				10		BC=14 19 24	18"								
330															
	40														
325															
	45														
320															
	50														
315															
	55														
310															
	60														
305															
	65														
300															

The boring was terminated at approximately 38 ft. below ground surface. The exploration was backfilled with bentonite on April 15, 2015.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling or after completion.

GENERAL NOTES:
The exploration elevation is approximate and was estimated from the Preliminary Civil Development Plan by SDG&E dated February 27, 2015.

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PROJECT NO.:	20154777	BORING LOG B-3	FIGURE
DRAWN BY:	JC		A-7
CHECKED BY:	SR	SDG&E OCEAN RANCH SUBSTATION PACIFIC COAST BUSINESS PARK OCEANSIDE, CA	
DATE:	5/28/2015		
REVISED:	6/1/2015		PAGE: 2 of 2

Date Begin - End: 4/16/2015	**Drilling Company:** Pacific Drilling		**BORING LOG B-4**	
Logged By: J. Co	**Drill Crew:** Gordy/Toby			
Hor.-Vert. Datum: Not Available	**Drilling Equipment:** Unimog		**Hammer Type - Drop:** 140 lb. Auto - 30 in.	
Plunge: -90 degrees	**Drilling Method:** Solid Stem Auger			
Weather: Sunny and Warm	**Exploration Diameter:** 6 in. in. O.D.			

Latitude: 33.21067° N
Longitude: -117.29314° W
Approximate Ground Surface Elevation (ft.): 373
Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
			Artificial Fill (af) **Clayey SAND (SC)**: fine to coarse grained, light olive gray (5 Y 6/2), moist, loose, low plasticity fines	1											
370			becomes white, medium dense, random 1/2" dark olive gray	2		BC=7 10 13	16"		14.0	114.2			33	16	DS, Corrosion
				1											
	5		random 1/2" dark olive gray	3		BC=4 7 10	14"								
365															
	10		**Silty SAND (SM)**: pale yellow, moist, medium dense, 1/2" dark gray claystone chunks	4		BC=8 10 15	18"		10.8	114.1	100	29			
												29			
360															
	15		increase in 2" claystone chunks	5		BC=7 9 11	18"								
355															
	20		**Sandy CLAY (CL)**: fine grained, pale olive (5 Y 6/3) mixed with random yellowish brown (10 YR 5/8), moist, firm, 1/4" claystone chunks, low plasticity fines	6		BC=3 6 6	14"		15.1						
350															
	25		becomes hard, 1/2 to 1" chunks of weak cemented fine grained silty sand, some white 1/2"	7		BC=6 11 12	18"								
345															
			Lean CLAY (CL): yellowish brown (10 YR 5/4), moist, hard												
	30			8		BC=7 8 9	26"						41	23	
340															

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PROJECT NO.: 20154777	BORING LOG B-4	FIGURE
DRAWN BY: JC		
CHECKED BY: SR	SDG&E OCEAN RANCH SUBSTATION PACIFIC COAST BUSINESS PARK OCEANSIDE, CA	A-8
DATE: 5/28/2015		
REVISED: 6/1/2015		PAGE: 1 of 3

BORING LOG B-4

Date Begin - End:	4/16/2015	**Drilling Company:**	Pacific Drilling
Logged By:	J. Co	**Drill Crew:**	Gordy/Toby
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Unimog
Plunge:	-90 degrees	**Drilling Method:**	Solid Stem Auger
Weather:	Sunny and Warm	**Exploration Diameter:**	6 in. in. O.D.

Hammer Type - Drop: 140 lb. Auto - 30 in.

Latitude: 33.21067° N
Longitude: -117.29314° W
Approximate Ground Surface Elevation (ft.): 373
Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Sandy CLAY (CL): fine grained, pale olive (5 Y 6/3) mottled with very dark gray (5 Y 3/1) and chunks of strong brown (7.5 YR 5/6), moist, very hard, low plasticity fines	9		BC=9 13 20	18"								
335														
	40	**Silty SAND (SM)**: white, gray to strong brown, moist, dense, 1/4" piece of wood, low plasticity fines	10		BC=6 7 6	24"								
		CLAY (CL): light brownish gray (2.5 Y 6/2), moist, firm, low plasticity fines												
330														
	45	**Sandy CLAY (CL)**: fine to medium grained, pale olive with random chunks of very dark gray and strong brown, moist, hard, low plasticity fines	11		BC=5 10 15	18"		13.3	107.6					
325														
		CLAY with Sand (CL): fine to medium grained, very dark gray (2.5 Y 3/1), moist, firm to hard, low plasticity fines												
	50		12		BC=4 6 9	24"								
320														
	55	**Clayey SAND (SC)**: fine grained, light olive gray (5 Y 6/2), moist, hard, low plasticity fines	13		BC=3 8 11	14"		17.8	103.4		43			
315														
		Sandy CLAY (CL): fine to medium grained, very dark gray (2.5Y 3/1) to greenish gray (5 GY 6/1), moist, hard, organic odor, unwithered dry plants, low plasticity fines												
	60		14		BC=4 8 11	24"								
310														
	65	**CLAY with Sand (CL)**: fine grained, very dark gray (2.5 Y 3/1), moist, very hard, chunk of 2-3" wood with 1" nails in sampler, organic odor and rootlets, medium plasticity fines	15		BC=13 19 27	20"		20.1	107.5			45	27	
305		**Young Colluvial Deposits (Qyc)**												

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PROJECT NO.:	20154777
DRAWN BY:	JC
CHECKED BY:	SR
DATE:	5/28/2015
REVISED:	6/1/2015

BORING LOG B-4

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CA

FIGURE
A-9

Date Begin - End:	4/16/2015	Drilling Company:	Pacific Drilling		**BORING LOG B-4**
Logged By:	J. Co	Drill Crew:	Gordy/Toby		
Hor.-Vert. Datum:	Not Available	Drilling Equipment:	Unimog	Hammer Type - Drop:	140 lb. Auto - 30 in.
Plunge:	-90 degrees	Drilling Method:	Solid Stem Auger		
Weather:	Sunny and Warm	Exploration Diameter:	6 in. in. O.D.		

FIELD EXPLORATION | LABORATORY RESULTS

Latitude: 33.21067° N
Longitude: -117.29314° W
Approximate Ground Surface Elevation (ft.): 373
Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
300		**Young Colluvial Deposits (Qyc)** **CLAY with Sand (CL)**: fine grained, greenish black (10Y 2.5/1) and flecks of strong brown (7.5 YR 5/6), moist, hard, rootlets and wood fragments, medium plasticity fines	16		BC=6 9 10	18"								
295	75	**Santiago Formation (Tsa)** **SANDSTONE: excavates as** **Silty SAND (SM)**: fine grained, brownish yellow (10 YR 6/8) with pale yellow, light gray, and gray (5 Y, 7/3, 7/1, 5/1), moist, very dense, non-plastic	17		BC=36 50/2"	8"								
	80		18		BC=23 50/5"	11"								

Elevation scale: 300, 295, 290, 285, 280, 275, 270. Depth scale: 75, 80, 85, 90, 95, 100.

The boring was terminated at approximately 81 ft. below ground surface. The exploration was backfilled with bentonite grout on April 16, 2015.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling or after completion.

GENERAL NOTES:
The exploration elevation is approximate and was estimated from the Preliminary Civil Development Plan by SDG&E dated February 27, 2015.

KLEINFELDER Bright People. Right Solutions.	PROJECT NO.: 20154777	BORING LOG B-4	FIGURE
	DRAWN BY: JC		A-10
	CHECKED BY: SR	SDG&E OCEAN RANCH SUBSTATION PACIFIC COAST BUSINESS PARK OCEANSIDE, CA	
	DATE: 5/28/2015		
	REVISED: 6/1/2015		PAGE: 3 of 3

Date Begin - End:	4/17/2015	**Drilling Company:**	Pacific Drilling		**BORING LOG B-5**
Logged By:	J. Co	**Drill Crew:**	Gordy/Carlos		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Unimog	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Solid Stem Auger		
Weather:	Sunny and Warm	**Exploration Diameter:**	6 in. in. O.D.		

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 33.21053° N
Longitude: -117.29372° W
Approximate Ground Surface Elevation (ft.): 371
Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
370		**Artificial Fill (af)** **Silty SAND (SM)**: fine to medium grained, light olive gray (5 Y 6/2), dry to moist, loose, rootlets and roots, low plasticity fines	1											Modified Proctor, Corrosion
		fine to coarse grained, medium dense, becomes olive gray to white with 1/2" chunks of claystone	2		BC=7 14 16	16"		13.3	113.8		27			DS
			1											
365	5	becomes pale yellow (5 Y 7/3), random clayey sand and 1/2" claystone chunks,	3		BC=9 14 18	16"		12.2	111.2					
360	10		4		BC=5 8 13	18"								
355	15	**Clayey SAND (SC)**: pale yellow (5 Y 7/3), moist, medium dense, increase in clay, becomes more olive gray (5 Y 5/2) chunks of white and very dark gray	5		BC=5 5 8	18"		15.6	110.3					
350	20	moist, olive gray mixed with pale yellow	6		BC=5 5 7	20"								
345	25		7		BC=9 9 20	18"		12.2	107.6					
		Sandy CLAY (CL): fine to medium grained, olive (5 Y 5/3) and random dusk red, strong brown and gray, moist, hard, 1/2" chunks of claystone, low plasticity fines												
340	30		8		BC=8 8 7	24"								

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PROJECT NO.: 20154777	BORING LOG B-5	FIGURE
DRAWN BY: JC		
CHECKED BY: SR	SDG&E OCEAN RANCH SUBSTATION PACIFIC COAST BUSINESS PARK OCEANSIDE, CA	A-11
DATE: 5/28/2015		
REVISED: 6/1/2015		PAGE: 1 of 3

Date Begin - End:	4/17/2015	Drilling Company:	Pacific Drilling	BORING LOG B-5
Logged By:	J. Co	Drill Crew:	Gordy/Carlos	
Hor.-Vert. Datum:	Not Available	Drilling Equipment:	Unimog	Hammer Type - Drop: 140 lb. Auto - 30 in.
Plunge:	-90 degrees	Drilling Method:	Solid Stem Auger	
Weather:	Sunny and Warm	Exploration Diameter:	6 in. in. O.D.	

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 33.21053° N
Longitude: -117.29372° W
Approximate Ground Surface Elevation (ft.): 371
Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
335			**Sandy CLAY (CL)**: fine to medium grained, olive (5 Y 5/3) and random dusk red, strong brown and gray, moist, hard, 1/2" chunks of claystone, low plasticity fines moderatley cemented dusk red, random chunks of pale yellow silty sand	9		BC=8 8 9	18"		14.4	112.4					
330	40		some strong brown	10		BC=6 7 9	24"								
325	45		random chunks of dusk red, olive gray, and strong brown	11		BC=4 9 11	18"		7.8	112.8					
320	50		**Silty SAND (SM)**: fine grained, pale yellow (2.5 Y 7/4) mixed with yellow (2.5 Y 7/8), moist, medium dense	12		BC=5 7 7	24"								
315	55		**Clayey SAND (SC)**: fine grained, pale yellow (2.5 Y, 8/2) to yellow (2.5 Y 7/8), moist, dense, 1/2" chunks of claystone	13		BC=9 19 25	18"								
310	60		becomes light yellowish brown (2.5 Y 6/4) mottled with strong brown (7.5 YR 5/8). Then at 61.5 feet becomes white and light gray, low plasticity fines	14		BC=5 6 9	24"								
305	65		becomes white to light gray (5 Y 7/1) with little strong brown	15		BC=10 14 20	18"		13.4	111.5		46			

Date Begin - End: 4/17/2015	**Drilling Company:** Pacific Drilling		**BORING LOG B-5**
Logged By: J. Co	**Drill Crew:** Gordy/Carlos		
Hor.-Vert. Datum: Not Available	**Drilling Equipment:** Unimog	**Hammer Type - Drop:** 140 lb. Auto - 30 in.	
Plunge: -90 degrees	**Drilling Method:** Solid Stem Auger		
Weather: Sunny and Warm	**Exploration Diameter:** 6 in. in. O.D.		

FIELD EXPLORATION: Latitude: 33.21053° N; Longitude: -117.29372° W; Approximate Ground Surface Elevation (ft.): 371; Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
300			**Sandy CLAY (CL)**: fine to medium grained, very dark gray (2.5 Y 3/1) with some light greenish gray at 70.5 feet, organic odor, moist, firm, organic odor, low to medium plasticity fines	16		BC=6 6 7	24"					67			
295	75		olive gray (5 Y 5/2) mixed with very dark gray (2.5 Y 3/1), becomes very hard, organic odor	17		BC=10 17 31	18"								
290	80		light olive gray (5 Y 6/2) to light gray (5 Y 7/1) mottled with strong brown and very dark gray, becomes hard	18		BC=7 7 12	24"								
			<u>Santiago Formation (Tsa)</u> **SANDSTONE: excavates as Silty SAND (SM)**: fine grained, pale olive (5 Y 6/3), moist, medium dense, low plasticity fines												
285	85			19		BC=9 10 17	16"								
280	90		becomes light gray (5 Y 7/1)	20		BC=21 39 50/4"	16"								
275	95														
270	100														

The boring was terminated at approximately 91.5 ft. below ground surface. The exploration was backfilled with bentonite grout on April 17, 2015.

<u>GROUNDWATER LEVEL INFORMATION:</u>
Groundwater was not encountered during drilling or after completion.

<u>GENERAL NOTES:</u>
The exploration elevation is approximate and was estimated from the Preliminary Civil Development Plan by SDG&E dated February 27, 2015.

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PROJECT NO.: 20154777	BORING LOG B-5	FIGURE
DRAWN BY: JC		
CHECKED BY: SR	SDG&E OCEAN RANCH SUBSTATION PACIFIC COAST BUSINESS PARK OCEANSIDE, CA	A-13
DATE: 5/28/2015		
REVISED: 6/1/2015		PAGE: 3 of 3

Date Begin - End: 4/16/2015 **Drilling Company:** Pacific Drilling

BORING LOG B-6

Logged By: J. Co **Drill Crew:** Gordy/Toby

Hor.-Vert. Datum: Not Available **Drilling Equipment:** Unimog **Hammer Type - Drop:** 140 lb. Auto - 30 in.

Plunge: -90 degrees **Drilling Method:** Solid Stem Auger

Weather: Sunny and Warm **Exploration Diameter:** 6 in. in. O.D.

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 33.21057° N
Longitude: -117.29464° W
Approximate Ground Surface Elevation (ft.): 357
Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Lithologic Description	Sample Number	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
355	0	**Artificial Fill (af)** **Silty SAND (SM)**: fine to medium grained, light yellowish brown (2.5 Y 6/3) to pale yellow (5 Y, 8/3), dry to moist, medium dense, random clayey sand, low plasticity fines	1										
			2	BC=6 8 12	18"								
			1										
	5	increase in clay content	3	BC=7 11 14	18"		12.9	105.1		45			
350	10	**Poorly-graded SAND (SP)**: medium to coarse grained, pale yellow (5 Y 7/3), moist, medium dense, non-plastic	4	BC=4 8 8	18"		16.0	109.8					
345		**Clayey SAND (SC)**: fine to coarse grained, olive gray (5 Y 5/2), moist, medium dense, non-plastic											
340	15	**Sandy CLAY (CL)**: fine to medium grained, light olive brown mottled with pink, moist, hard, 1/2" chunks of claystone, low plasticity fines	5	BC=5 9 12	18"		19.5	103.9			38	18	
	20	becomes light yellow brown (2.5 Y 6/3) mottled with strong brown	6	BC=3 4 8	18"								
335		**Silty SAND (SM)**: fine grained, pale yellow (2.5 Y 7/3), moist, medium dense, low plasticity fines											
330	25	**Sandy CLAY (CL)**: fine grained, light yellow brown (2.5 Y 6/3) mottled with strong brown, moist, hard	7	BC=2 7 11	18"		18.0	108.4					
325	30	becomes light olive brown (2.5 Y 5/4), firm	8	BC=3 6 8	18"								

Date Begin - End: 4/16/2015	**Drilling Company:** Pacific Drilling		**BORING LOG B-6**
Logged By: J. Co	**Drill Crew:** Gordy/Toby		
Hor.-Vert. Datum: Not Available	**Drilling Equipment:** Unimog	**Hammer Type - Drop:** 140 lb. Auto - 30 in.	
Plunge: -90 degrees	**Drilling Method:** Solid Stem Auger		
Weather: Sunny and Warm	**Exploration Diameter:** 6 in. in. O.D.		

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 33.21057° N
Longitude: -117.29464° W
Approximate Ground Surface Elevation (ft.): 357
Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Lithologic Description	Sample Number	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Silty SAND (SM): fine grained, pale yellow (2.5 Y 7/3), very moist, medium dense	9	BC=8 12 16	18"		17.4	108.2					
320		**Sandy CLAY (CL)**: fine grained, olive yellow (2.5 Y 6/8), very moist, hard											
	40	**CLAY (CL)**: fine grained, dark gray (2.5 Y 4/1) with strong brown (7.5 YR 5/8), moist, hard, low plasticity fines	10	BC=5 8 10	18"								
315													
	45	**Sandy CLAY (CL)**: fine grained, light yellowish brown (2.5 Y 6/3) mottled with white and strong brown, very moist, hard, low plasticity fines	11	BC=5 10 14	18"		21.8	104.1					
310													
	50	moist	12	BC=7 9 12	18"								
305													
	55												
300													
	60												
295													
	65												
290													

The boring was terminated at approximately 51.5 ft. below ground surface. The exploration was backfilled with bentonite on April 16, 2015.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling or after completion.

GENERAL NOTES:
The exploration elevation is approximate and was estimated from the Preliminary Civil Development Plan by SDG&E dated February 27, 2015.

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PROJECT NO.: 20154777	BORING LOG B-6	FIGURE
DRAWN BY: JC		A-15
CHECKED BY: SR	SDG&E OCEAN RANCH SUBSTATION PACIFIC COAST BUSINESS PARK OCEANSIDE, CA	
DATE: 5/28/2015		
REVISED: 6/1/2015		PAGE: 2 of 2

PLOTTED: 06/11/2015 04:45 PM BY: jco

gINT FILE: PROJECTWISE: Ocean Ranch Substation.gpj
gINT TEMPLATE: PROJECTWISE: KLF_STANDARD_GINT_LIBRARY_2015.GLB [KLF_BORING/TEST PIT SOIL LOG]

Date Begin - End:	4/17/2015	**Drilling Company:**	Pacific Drilling
Logged By:	J. Co	**Drill Crew:**	Gordy/Carlos
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Unimog
Plunge:	-90 degrees	**Drilling Method:**	Solid Stem Auger
Weather:	Sunny and Warm	**Exploration Diameter:**	6 in. in. O.D.

BORING LOG B-7

Hammer Type - Drop: 140 lb. Auto - 30 in.

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 33.21021° N
Longitude: -117.29439° W
Approximate Ground Surface Elevation (ft.): 366
Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
365			**Artificial Fill (af)** **Silty SAND (SM)**: fine to coarse grained, pale olive (5 Y 6/3), dry to moist, medium dense, low plasticity fines	1											R-Value
360	5		becomes fine grained mottled with dark gray and 1/2" chunks of claystone	2		BC=7 9 16	18"								

Elevation scale: 365, 360, 355, 350, 345, 340, 335. Depth scale: 5, 10, 15, 20, 25, 30.

The boring was terminated at approximately 6.5 ft. below ground surface. The exploration was backfilled with soil cuttings on April 17, 2015.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling or after completion.

GENERAL NOTES:
The exploration elevation is approximate and was estimated from the Preliminary Civil Development Plan by SDG&E dated February 27, 2015.

Date Begin - End:	4/17/2015	Drilling Company:	Pacific Drilling	BORING LOG B-8
Logged By:	J. Co	Drill Crew:	Gordy/Carlos	
Hor.-Vert. Datum:	Not Available	Drilling Equipment:	Unimog	Hammer Type - Drop: 140 lb. Auto - 30 in.
Plunge:	-90 degrees	Drilling Method:	Solid Stem Auger	
Weather:	Sunny and Warm	Exploration Diameter:	6 in. in. O.D.	

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 33.20979° N
Longitude: -117.29447° W
Approximate Ground Surface Elevation (ft.): 367
Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
365			**Artificial Fill (af)** **Clayey SAND (SC)**: fine to medium grained, olive gray (5 Y 5/2) mottled with very dark gray to light gray, dry to moist, loose, low plasticity fines												
	5			1		BC=3 3 6	18"								
360															
			Sandy CLAY (CL): fine to medium-grained, pale olive (5 Y 6/4), moist, hard												
	10			2		BC=9 12 15	18"		15.0	114.4		68			
355															
			Santiago Formation (Tsa) **SANDSTONE: excavates as** **Silty SAND (SM)**: fine to medium-grained, light yellowish brown (2.5 Y 6/4), moist, very dense, low plasticity fines	3											
	15		becomes greenish gray (10Y 6/1) mottled with yellowish brown (10 YR 5/8)	4		BC=15 23 28	16"								
350			The boring was terminated at approximately 16.5 ft. below ground surface. The exploration was backfilled with bentonite on April 17, 2015.												
	20														
345															
	25														
340															
	30														
335															

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling or after completion.

GENERAL NOTES:
The exploration elevation is approximate and was estimated from the Preliminary Civil Development Plan by SDG&E dated February 27, 2015.

KLEINFELDER Bright People. Right Solutions.	PROJECT NO.: 20154777	BORING LOG B-8	FIGURE
	DRAWN BY: JC		A-17
	CHECKED BY: SR	SDG&E OCEAN RANCH SUBSTATION PACIFIC COAST BUSINESS PARK OCEANSIDE, CA	
	DATE: 5/28/2015		
	REVISED: 6/1/2015		PAGE: 1 of 1

Date Begin - End:	4/17/2015	**Drilling Company:**	Pacific Drilling		**BORING LOG B-9**
Logged By:	J. Co	**Drill Crew:**	Gordy/Carlos		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Unimog	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Solid Stem Auger		
Weather:	Sunny and Warm	**Exploration Diameter:**	6 in. in. O.D.		

FIELD EXPLORATION — Latitude: 33.21129° N; Longitude: -117.29375° W; Approximate Ground Surface Elevation (ft.): 368; Surface Condition: Bare Earth and Grass

LABORATORY RESULTS

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
365			**Artificial Fill (af)** **Clayey SAND (SC)**: fine to medium grained, light olive gray (5 Y, 6/2), dry to moist, loose, medium plasticity fines	1											
	5		**Santiago Formation (Tsa)** **CALICHE**: pale yellow to strong brown, dry, very dense, highly cemented rock	2		BC=35 26 26	18"		13.2	112.1					
360			**SANDSTONE: excavates as** **Clayey SAND (SC)**: fine to medium grained, light olive gray (5 Y 6/2), dry to moist, very dense, low plasticity fines												

Elevation scale: 365, 360, 355, 350, 345, 340, 335. Depth scale: 5, 10, 15, 20, 25, 30.

The boring was terminated at approximately 6.5 ft. below ground surface. The exploration was backfilled with soil cuttings on April 17, 2015.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling or after completion.

GENERAL NOTES:
The exploration elevation is approximate and was estimated from the Preliminary Civil Development Plan by SDG&E dated February 27, 2015.

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PROJECT NO.: 20154777	BORING LOG B-9	FIGURE
DRAWN BY: JC		
CHECKED BY: SR	SDG&E OCEAN RANCH SUBSTATION PACIFIC COAST BUSINESS PARK OCEANSIDE, CA	A-18
DATE: 5/28/2015		
REVISED: 6/1/2015		PAGE: 1 of 1

Date Begin - End:	4/17/2015	**Drilling Company:**	Pacific Drilling		**BORING LOG B-10**
Logged By:	J. Co	**Drill Crew:**	Gordy/Carlos		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Unimog	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Solid Stem Auger		
Weather:	Sunny and Warm	**Exploration Diameter:**	6 in. in. O.D.		

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 33.21114° N
Longitude: -117.29319° W
Approximate Ground Surface Elevation (ft.): 374
Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
			Artificial Fill (af) **Clayey SAND (SC)**: fine to medium grained, light olive gray (5 Y, 6/2) with chunks of dark gray, dry to moist, loose, low plasticity fines	1											R-Value
370	5		medium dense to dense, medium plasticity fines	2		BC=7 10 22	18"		9.1	112.9		19			

Elevation scale: 370, 365, 360, 355, 350, 345, 340. Depth scale: 5, 10, 15, 20, 25, 30.

The boring was terminated at approximately 6.5 ft. below ground surface. The exploration was backfilled with soil cuttings on April 17, 2015.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling or after completion.
GENERAL NOTES:
The exploration elevation is approximate and was estimated from the Preliminary Civil Development Plan by SDG&E dated February 27, 2015.

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PROJECT NO.: 20154777	BORING LOG B-10	FIGURE
DRAWN BY: JC		A-19
CHECKED BY: SR	SDG&E OCEAN RANCH SUBSTATION PACIFIC COAST BUSINESS PARK OCEANSIDE, CA	
DATE: 5/28/2015		
REVISED: 6/1/2015		PAGE: 1 of 1

APPENDIX A-1
PREVIOUS FIELD INVESTIGATION BORING LOGS AND TEST PITS (2012)

Date Begin - End:	4/26/12 - 4/27/12	**Drill Company:**	Scott's Drilling
Logged By:	E. Koprulu	**Drill Crew:**	
Hor.-Vert. Datum:	NAD83 - NAD83	**Drill Equipment:**	CME-55
Angle from Vert.:	0 degrees	**Exploration Method:**	Hollow Stem Auger
Weather:	Sunny	**Auger Diameter:**	8 inches

BORING LOG B-3 (2012)

Hammer Type - Drop: 140 lb. Automatic - 30"

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 33.21081° N
Longitude: 117.29389° W
Approximate Surface Elevation (ft): 367.0

Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. blows/6 in	Recovery	USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
365			**Artificial Fill** **Clayey SAND (SC)**: fine to coarse grained, non-plastic fines, gray, moist												
360	5														
	10		**Sandy CLAY (CL)**: fine to medium grained, medium plasticity fines, gray to brown, moist, very hard	1		BC=17 32 44									
355	15														
350															
	20		Fine to coarse grained, low plasticity fines, gray, moist, very hard	2		BC=13 27 40									
345	25														
340															
	30		Fine to medium grained, medium plasticity fines, grayish brown, moist, very hard, decrease in grain size	3		BC=20 30 50/5"									
335															

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PROJECT NO.	124202
DRAWN BY:	EK
CHECKED BY:	DH/SR
DATE:	5/7/2012
REVISED:	6/2/2015

BORING LOG B-3 (2012)

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CALIFORNIA

PLATE
A-5

Date Begin - End:	4/26/12 - 4/27/12	**Drill Company:**	Scott's Drilling	**BORING LOG B-3 (2012)**	
Logged By:	E. Koprulu	**Drill Crew:**			
Hor.-Vert. Datum:	NAD83 - NAD83	**Drill Equipment:**	CME-55	**Hammer Type - Drop:**	140 lb. Automatic - 30"
Angle from Vert.:	0 degrees	**Exploration Method:**	Hollow Stem Auger		
Weather:	Sunny	**Auger Diameter:**	8 inches		

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 33.21081° N
Longitude: 117.29389° W
Approximate Surface Elevation (ft): 367.0

Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. blows/6 in	Recovery	USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
330			**Sandy CLAY (CL)**: fine to medium grained, medium plasticity fines, gray to brown, moist, very hard *(continued)*												
325	40		Fine to coarse grained, low plasticity fines, moist, very hard, intermixed color from light gray - dark brown to reddish brown, some scattered sand lenses	4		BC=13 18 24									
320	45														
315	50		Fine to medium grained, medium plasticity fines, moist, very hard, intermixed color from light gray to reddish brown, some brown lenses of sand	5		BC=21 25 35									
			Santiago Formation (Tsa)												
310	55														
305	60		**CLAYSTONE** excavates as **Sandy CLAY (CL):** fine grained, medium plasticity fines, gray, moist, very hard												
300	65														

Date Begin - End:	4/26/12 - 4/27/12	Drill Company:	Scott's Drilling	BORING LOG B-3 (2012)	
Logged By:	E. Koprulu	Drill Crew:			
Hor.-Vert. Datum:	NAD83 - NAD83	Drill Equipment:	CME-55	Hammer Type - Drop:	140 lb. Automatic - 30"
Angle from Vert.:	0 degrees	Exploration Method:	Hollow Stem Auger		
Weather:	Sunny	Auger Diameter:	8 inches		

FIELD EXPLORATION								LABORATORY RESULTS								
Approximate Elevation (feet)	Depth (feet)	Graphical Log	Latitude: 33.21081° N Longitude: 117.29389° W Approximate Surface Elevation (ft): 367.0 Surface Condition: Bare Earth and Grass	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. blows/6 in	Recovery	USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
295			**Santiago Formation (Tsa)** **CLAYSTONE** excavates as **Sandy CLAY (CL):** fine grained, medium plasticity fines, gray, moist, very hard, iron-oxide staining *(continued)*	6		BC=28 45 50/4"									
	75		The boring was terminated at approximately 71.5 feet below ground surface. The Boring was backfilled with bentonite on April 27, 2012.												
290															
	80														
285															
	85														
280															
	90														
275															
	95														
270															
	100														
265															

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling.
GENERAL NOTES:
The boring location and elevation are approximate and were estimated by BHA, Inc.
A Garmin etrex GPS unit was used to locate the boring with an accuracy of 5 to 10 feet.

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PROJECT NO.	124202	BORING LOG B-3 (2012)	PLATE
DRAWN BY:	EK		A-7
CHECKED BY:	DH/SR	SDG&E OCEAN RANCH SUBSTATION PACIFIC COAST BUSINESS PARK OCEANSIDE, CALIFORNIA	
DATE:	5/7/2012		
REVISED:	6/2/2015		PAGE: 3 of 3

Date Begin - End:	4/24/12	**Drill Company:**	Scott's Drilling	**BORING LOG B-4 (2012)**	
Logged By:	E. Koprulu	**Drill Crew:**			
Hor.-Vert. Datum:	NAD83 - NAD83	**Drill Equipment:**	CME-55	**Hammer Type - Drop:**	140 lb. Automatic - 30"
Angle from Vert.:	0 degrees	**Exploration Method:**	Hollow Stem Auger		
Weather:	Sunny	**Auger Diameter:**	8 inches		

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 33.21102° N
Longitude: 117.29288° W
Approximate Surface Elevation (ft): 374.0

Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. blows/6 in	Recovery	USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
			Artificial Fill **Silty SAND (SM)**: fine to coarse grained, non-plastic fines, gray, moist, dense	1											
			Trace Clay	2		BC=9 20 28									
370			Increase in Clay content												
	5		**Clayey SAND (SC)**: fine to coarse grained, non-plastic fines, dark gray, moist, dense	3		BC=14 26 40									
365															
	10		Fine to coarse grained, low plasticity fines, dark gray, moist, very dense, some lenses of dark brown Lean Clay	4		BC=12 31 42									
360															
	15		**Sandy CLAY (CL)**: fine to medium grained, low plasticity fines, moist, very hard, intermixed color from light gray to light tan, some lenses of dark brown Lean Clay	5		BC=18 32 42									
355															
	20		Fine grained, medium plasticity fines, light yellowish brown to light gray, moist, very hard, increase in clay content, decrease in sand content, lenses of Sand	6		BC=18 35 50/5.5"									
350															
	25		Fine to coarse grained, low plasticity fines, gray to brown, trace organic smell odor, moist, very hard, lenses of Sand throughout, dark brown to black lenses of old Top Soil	7		BC=16 35 42									
345															
	30		Fine grained, medium plasticity fines, gray to dark brown, trace organic smell odor, moist, very hard, black lenses of old Top Soil	8		BC=12 31 48									
340															

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PROJECT NO.	124202
DRAWN BY:	EK
CHECKED BY:	DH/SR
DATE:	5/7/2012
REVISED:	6/2/2015

BORING LOG B-4 (2012)

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CALIFORNIA

PLATE

A-8

Date Begin - End:	4/24/12	**Drill Company:**	Scott's Drilling	**BORING LOG B-4 (2012)**	
Logged By:	E. Koprulu	**Drill Crew:**			
Hor.-Vert. Datum:	NAD83 - NAD83	**Drill Equipment:**	CME-55	**Hammer Type - Drop:**	140 lb. Automatic - 30"
Angle from Vert.:	0 degrees	**Exploration Method:**	Hollow Stem Auger		
Weather:	Sunny	**Auger Diameter:**	8 inches		

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 33.21102° N
Longitude: 117.29288° W
Approximate Surface Elevation (ft): 374.0

Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. blows/6 in	Recovery	USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
				9		BC=20 40 50/5"									
			Silty SAND (SM): fine grained, non-plastic fines, gray, moist, very dense												
335															
	40		**Clayey SAND (SC)**: fine grained, low plasticity fines, white to light brown, moist, very dense, caliche	10		BC=17 42 50									
330															
	45		**Sandy CLAY (CL)**: fine grained, medium plasticity fines, dark gray to black, moist, very hard	11		BC=19 38 50									
325															
	50		Fine grained, low plasticity fines, dark gray, moist, very hard, increase in Sand content, reddish brown and gray sand lenses	12		BC=15 29 46									
320															
	55		Fine to medium grained, low plasticity fines, gray, moist, hard, black colored CL-CH at shoe of sampler	13		BC=12 26 28									
315															
	60		**Lean to Fat CLAY (CL-CH)**: fine grained, medium plasticity fines, dark gray to black, moist, hard	14		BC=16 22 34									
310															
	65		Fine grained, medium plasticity fines, dark gray to black, moist, very hard, increase in sand content	15		BC=19 30 40									
305			<u>**Young Colluvial Deposits (Qyc)**</u>												

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PROJECT NO.	124202	BORING LOG B-4 (2012)	PLATE
DRAWN BY:	EK		A-9
CHECKED BY:	DH/SR	SDG&E OCEAN RANCH SUBSTATION PACIFIC COAST BUSINESS PARK OCEANSIDE, CALIFORNIA	
DATE:	5/7/2012		
REVISED:	6/2/2015		PAGE: 2 of 3

Date Begin - End:	4/24/12	**Drill Company:**	Scott's Drilling		**BORING LOG B-4 (2012)**
Logged By:	E. Koprulu	**Drill Crew:**			
Hor.-Vert. Datum:	NAD83 - NAD83	**Drill Equipment:**	CME-55	**Hammer Type - Drop:**	140 lb. Automatic - 30"
Angle from Vert.:	0 degrees	**Exploration Method:**	Hollow Stem Auger		
Weather:	Sunny	**Auger Diameter:**	8 inches		

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 33.21102° N
Longitude: 117.29288° W
Approximate Surface Elevation (ft): 374.0

Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. blows/6 in	Recovery	USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
			Young Colluvial Deposits (Qyc) **Fat CLAY (CH)**: fine grained, high plasticity fines, black, moist, very hard *(continued)*	16		BC=15 32 40									
300	75		Fine grained, high plasticity fines, black, moist, very hard	17		BC=18 37 50									CONSOL
295	80		**Santiago Formation (Tsa)** **CLAYSTONE** excavates as **Sandy CLAY (CL):** fine to medium grained, low plasticity fines, gray, moist, very hard	18		BC=39 50/4"									
290	85		The boring was terminated at approximately 81 feet below ground surface. Boring was backfilled with bentonite on April 24, 2012.												
285	90														
280	95														
275	100														
270															

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling.
GENERAL NOTES:
The boring location and elevation are approximate and were estimated by BHA, Inc.
A Garmin etrex GPS unit was used to locate the boring with an accuracy of 5 to 10 feet.

gINT FILE: C:\users\mpalmer\desktop\124202_sdge Ocean Ranch.gpj C:KLF_STANDARD_GINT_LIBRARY_BETA.GLB [KLF_BORING/TEST PIT LOG]

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PROJECT NO.	124202	BORING LOG B-4 (2012)	PLATE
DRAWN BY:	EK		A-10
CHECKED BY:	DH/SR	SDG&E OCEAN RANCH SUBSTATION PACIFIC COAST BUSINESS PARK OCEANSIDE, CALIFORNIA	
DATE:	5/7/2012		
REVISED:	6/2/2015		PAGE: 3 of 3

Date Begin - End:	4/24/12 - 4/25/12	**Drill Company:**	Scott's Drilling	**BORING LOG B-5 (2012)**
Logged By:	E. Koprulu	**Drill Crew:**		
Hor.-Vert. Datum:	NAD83 - NAD83	**Drill Equipment:**	CME-55	**Hammer Type - Drop:** 140 lb. Automatic - 30"
Angle from Vert.:	0 degrees	**Exploration Method:**	Hollow Stem Auger	
Weather:	Sunny	**Auger Diameter:**	8 inches	

FIELD EXPLORATION | LABORATORY RESULTS

Latitude: 33.21074° N
Longitude: 117.29347° W
Approximate Surface Elevation (ft): 372.0

Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. blows/6 in	Recovery	USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
370			**Artificial Fill** **Silty SAND (SM)**: fine to coarse grained, non-plastic fines, gray, moist, dense												
365	5		Fine to coarse grained, non-plastic fines, gray, moist, dense, increase in grain size	1		BC=15 24 29									
360	10		**Clayey SAND (SC)**: fine to coarse grained, non-plastic fines, gray to dark gray, moist, very dense	2		BC=18 28 38									
355	15														
350	20		Fine grained, low plasticity fines, gray to dark gray, moist, medium dense, increase in Clay content	3		BC=10 12 13									
345	25														
340	30		**Sandy CLAY (CL)**: fine grained, low plasticity fines, light brown to light gray, moist, firm	4		BC=8 11 13									

Date Begin - End:	4/24/12 - 4/25/12	Drill Company:	Scott's Drilling	BORING LOG B-5 (2012)
Logged By:	E. Koprulu	Drill Crew:		
Hor.-Vert. Datum:	NAD83 - NAD83	Drill Equipment:	CME-55	Hammer Type - Drop: 140 lb. Automatic - 30"
Angle from Vert.:	0 degrees	Exploration Method:	Hollow Stem Auger	
Weather:	Sunny	Auger Diameter:	8 inches	

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 33.21074° N
Longitude: 117.29347° W
Approximate Surface Elevation (ft): 372.0

Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. blows/6 in	Recovery	USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
335															
	40		Fine to medium grained, low plasticity fines, light gray to reddish brown, moist, hard, trace caliche, 3-inch thick lense of Sand	5		BC=10 15 21									
330															
	45														
325															
	50		**CALICHE**: dense, entire sample Caliche	6		BC=23 19 15									
320															
	55														
315															
	60		Fine to coarse grained, low plasticity fines, light gray to brown, moist, hard, some rootlets	7		BC=8 13 15									
310															
	65														
305			<u>**Young Colluvial Deposits (Qyc)**</u> **Fat CLAY (CH)**: high plasticity fines, black, organic odor, moist, hard												

Date Begin - End:	4/24/12 - 4/25/12	**Drill Company:**	Scott's Drilling	**BORING LOG B-5 (2012)**	
Logged By:	E. Koprulu	**Drill Crew:**			
Hor.-Vert. Datum:	NAD83 - NAD83	**Drill Equipment:**	CME-55	**Hammer Type - Drop:**	140 lb. Automatic - 30"
Angle from Vert.:	0 degrees	**Exploration Method:**	Hollow Stem Auger		
Weather:	Sunny	**Auger Diameter:**	8 inches		

FIELD EXPLORATION								LABORATORY RESULTS								
Approximate Elevation (feet)	Depth (feet)	Graphical Log	Latitude: 33.21074° N Longitude: 117.29347° W Approximate Surface Elevation (ft): 372.0 Surface Condition: Bare Earth and Grass	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. blows/6 in	Recovery	USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
				8		BC=15 50/3"									
300			**Santiago Formation (Tsa)** **CLAYSTONE** excavates as **Sandy CLAY (CL):** fine grained, medium plasticity fines, gray, moist, very hard, strongly cemented												
	75		The boring was terminated at approximately 71 feet below ground surface. The Boring was backfilled with bentonite on April 25, 2012.												
295															
	80														
290															
	85														
285															
	90														
280															
	95														
275															
	100														
270															

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling.

GENERAL NOTES:
The boring location and elevation are approximate and were estimated by BHA, Inc.
A Garmin etrex GPS unit was used to locate the boring with an accuracy of 5 to 10 feet.

gINT FILE: C:\users\mpalmer\desktop\124202_sdge Ocean Ranch.gpj C:KLF_STANDARD_GINT_LIBRARY_BETA.GLB [KLF_BORING/TEST PIT LOG]

Date Begin - End:	4/26/12	**Drill Company:**	Scott's Drilling		**BORING LOG B-6 (2012)**
Logged By:	E. Koprulu	**Drill Crew:**			
Hor.-Vert. Datum:	NAD83 - NAD83	**Drill Equipment:**	CME-55	**Hammer Type - Drop:**	140 lb. Automatic - 30"
Angle from Vert.:	0 degrees	**Exploration Method:**	Hollow Stem Auger		
Weather:	Sunny	**Auger Diameter:**	8 inches		

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 33.21047° N
Longitude: 117.29423° W
Approximate Surface Elevation (ft): 366.0

Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. blows/6 in	Recovery	USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
365			**Artificial Fill** **Clayey SAND (SC)**: fine to coarse grained, non-plastic fines, gray, moist, dense												
360	5		Fine to coarse grained, non-plastic fines, gray, moist, very dense	1		BC=16 24 42									
355	10		Coarse grained, non-plastic fines, gray, moist, very dense, decrease in fines content, predominantly coarse grained sand	2		BC=16 37 45									
350	15														
345	20		Coarse grained, non-plastic fines, gray, moist, very dense	3		BC=16 25 39									
340	25		**Sandy CLAY (CL)**: fine to coarse grained, low plasticity fines, grayish brown, moist, very hard	4		BC=20 30 38									
335	30		Fine grained, low plasticity fines, light brown, moist, very hard, gray colored Sand lenses throughout	5		BC=23 47 50									

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PROJECT NO.	124202	BORING LOG B-6 (2012)	PLATE
DRAWN BY:	EK		
CHECKED BY:	DH/SR	SDG&E OCEAN RANCH SUBSTATION PACIFIC COAST BUSINESS PARK OCEANSIDE, CALIFORNIA	A-14
DATE:	5/7/2012		
REVISED:	6/12/2015		PAGE: 1 of 3

Date Begin - End:	4/26/12	**Drill Company:**	Scott's Drilling	**BORING LOG B-6 (2012)**
Logged By:	E. Koprulu	**Drill Crew:**		
Hor.-Vert. Datum:	NAD83 - NAD83	**Drill Equipment:**	CME-55	**Hammer Type - Drop:** 140 lb. Automatic - 30"
Angle from Vert.:	0 degrees	**Exploration Method:**	Hollow Stem Auger	
Weather:	Sunny	**Auger Diameter:**	8 inches	

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 33.21047° N
Longitude: 117.29423° W
Approximate Surface Elevation (ft): 366.0

Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. blows/6 in	Recovery	USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
330			**Sandy CLAY (CL)**: fine to coarse grained, low plasticity fines, grayish brown, moist, very hard *(continued)*												
325	40		Fine grained, low plasticity fines, light brown to white, moist, very hard, abundant caliche	6		BC=8 15 19									
			Pieces of debris (metal pieces) observed in soil cuttings												
320	45		**Fat CLAY (CH)**: high plasticity fines, dark brown to black, trace organic odor, moist, hard, some reddish brown to gray colored Sand lenses, some rootlets	7		BC=8 11 18									
315	50		**Sandy CLAY (CL)**: fine grained, medium plasticity fines, grayish brown, moist, hard	8		BC=13 25 35									
310	55		Soil cuttings indicate black colored Clay with strong organic smell from approximately 50 to 58 feet												
305	60		Fine grained, low plasticity fines, grayish brown, moist, very hard	9		BC=17 18 28									
300	65		Becomes firm to hard	10		BC=6 10 14									
			Fat CLAY (CH): trace fine grained, high plasticity fines, black, organic smell odor, moist, firm to hard												

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PROJECT NO.	124202
DRAWN BY:	EK
CHECKED BY:	DH/SR
DATE:	5/7/2012
REVISED:	6/12/2015

BORING LOG B-6 (2012)

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CALIFORNIA

PLATE

A-15

Date Begin - End: 4/26/12	**Drill Company:** Scott's Drilling		**BORING LOG B-6 (2012)**
Logged By: E. Koprulu	**Drill Crew:**		
Hor.-Vert. Datum: NAD83 - NAD83	**Drill Equipment:** CME-55	**Hammer Type - Drop:** 140 lb. Automatic - 30"	
Angle from Vert.: 0 degrees	**Exploration Method:** Hollow Stem Auger		
Weather: Sunny	**Auger Diameter:** 8 inches		

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 33.21047° N
Longitude: 117.29423° W
Approximate Surface Elevation (ft): 366.0
Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. blows/6 in	Recovery	USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
295			**Fat CLAY (CH)**: trace fine grained, high plasticity fines, black, organic smell odor, moist, firm to hard *(continued)*												
290	75		**Santiago Formation (Tsa)** **CLAYSTONE** excavates as **Sandy CLAY (CL):** fine grained, medium plasticity fines, brown, moist, very hard	11		BC=16 24 31									CONSOL
285	80		Low plasticity fines, gray, moist, iron-oxide staining	12		BC=18 50/5"									
280	85														
275	90														
270	95														
265	100														

The boring was terminated at approximately 81 feet below ground surface. Boring was backfilled with bentonite on April 26, 2012.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling.
GENERAL NOTES:
The boring location and elevation are approximate and were estimated by BHA, Inc.
A Garmin etrex GPS unit was used to locate the boring with an accuracy of 5 to 10 feet.

Date Begin - End:	4/23/12	**Excavation Co.:**	Cut N Core
Logged By:	E. Koprulu	**Excavation Crew:**	
Hor.-Vert. Datum:	NAD83 - NAD83	**Excavation Equip.:**	CAT 430E Backhoe
Angle from Vert.:	0 degrees	**Excav. Dimensions:**	36 inches
Weather:	Sunny		

TEST PIT LOG TP-4

Approximate Elevation (feet)	Depth (feet)	Graphical Log	FIELD EXPLORATION Latitude: 33.21125° N Longitude: 117.29421° W Approximate Surface Elevation (ft): 368.0 Surface Condition: Bare Earth and Grass	Sample Number	Sample Type	USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
			Artificial Fill **Clayey SAND (SC)**: fine to coarse grained, low plasticity fines, light brown, moist, dense, chunks of clay throughout	1									
365	5		**Santiago Formation** **T(sa) SANDSTONE:** Excavates as **Clayey SAND (SC)**: fine to coarse grained, low plasticity fines, gray, moist, dense	2									

360 10 355 15 350 20 345 25 340 30 335

The test pit was terminated at approximately 6 feet below ground surface. Test Pit was backfilled with excavated material on April 23, 2012.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during excavation.
GENERAL NOTES:
The test pit location and elevation are approximate and were estimated by BHA, Inc.
A Garmin etrex GPS unit was used to locate the test pit with an accuracy of 5 to 10 feet.
There was no shoring used for the test pit exploration.

TP-4

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DATE:	5/7/2012
REVISED:	

TEST PIT LOG TP-4

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PACIFIC COAST BUSINESS PARK
OCEANSIDE, CALIFORNIA

PLATE
A-20

Date Begin - End:	4/23/12	**Excavation Co.:**	Cut N Core	**TEST PIT LOG TP-5**
Logged By:	E. Koprulu	**Excavation Crew:**		
Hor.-Vert. Datum:	NAD83 - NAD83	**Excavation Equip.:**	CAT 430E Backhoe	
Angle from Vert.:	0 degrees	**Excav. Dimensions:**	36 inches	
Weather:	Sunny			

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 33.21126° N
Longitude: 117.29373° W
Approximate Surface Elevation (ft): 368.0

Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Description	Sample Number	Sample Type	USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
			Artificial Fill **Sandy CLAY (CL)**: fine to coarse grained, low plasticity fines, light brown, moist, dense, chunks of clay throughout	1									
365	5		**Santiago Formation** **T(sa) SANDSTONE:** Excavates as **Silty SAND (SM)**: fine to coarse grained, low plasticity fines, gray, moist, dense, pockets of dark gray Clay, concreteion observed at approximately 5.5 feet	2									

Elevation scale: 365, 360, 355, 350, 345, 340, 335. Depth scale: 5, 10, 15, 20, 25, 30.

The test pit was terminated at approximately 6 feet below ground surface. Test Pit was backfilled with excavated material on April 23, 2012.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during excavation.
GENERAL NOTES:
The test pit location and elevation are approximate and were estimated by BHA, Inc.
A Garmin etrex GPS unit was used to locate the test pit with an accuracy of 5 to 10 feet.
There was no shoring used for the test pit exploration.

TP-5

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PROJECT NO. 124202	TEST PIT LOG TP-5		PLATE
DRAWN BY: EK			
CHECKED BY: DH	SDG&E OCEAN RANCH SUBSTATION PACIFIC COAST BUSINESS PARK OCEANSIDE, CALIFORNIA		A-21
DATE: 5/7/2012			
REVISED:			PAGE: 1 of 1

TEST PIT LOG TP-6

Date Begin - End:	4/23/12	**Excavation Co.:**	Cut N Core
Logged By:	E. Koprulu	**Excavation Crew:**	
Hor.-Vert. Datum:	NAD83 - NAD83	**Excavation Equip.:**	CAT 430E Backhoe
Angle from Vert.:	0 degrees	**Excav. Dimensions:**	36 inches
Weather:	Sunny		

Latitude: 33.21125° N
Longitude: 117.29333° W
Approximate Surface Elevation (ft): 374.0

Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	FIELD EXPLORATION	Sample Number	Sample Type	USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
			Artificial Fill **Clayey SAND (SC)**: trace gravel, fine to coarse grained, non-plastic fines, light brown, moist, dense	1									
370	5		**Silty SAND (SM)**: fine to coarse grained, non-plastic fines, gray, moist, dense, weakly cemented chunks mixed	2									
365	10												
360	15												
355	20												
350	25												
345	30												
340													

The test pit was terminated at approximately 9.5 feet below ground surface. Test Pit was backfilled with excavated material on April 23, 2012.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during excavation.
GENERAL NOTES:
The test pit location and elevation are approximate and were estimated by BHA, Inc.
A Garmin etrex GPS unit was used to locate the test pit with an accuracy of 5 to 10 feet.
There was no shoring used for the test pit exploration.

TP-6

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PROJECT NO.	124202	TEST PIT LOG TP-6	PLATE
DRAWN BY:	EK		
CHECKED BY:	DH	SDG&E OCEAN RANCH SUBSTATION PACIFIC COAST BUSINESS PARK OCEANSIDE, CALIFORNIA	A-22
DATE:	5/7/2012		
REVISED:			PAGE: 1 of 1

Date Begin - End:	4/23/12	**Excavation Co.:**	Cut N Core
Logged By:	E. Koprulu	**Excavation Crew:**	
Hor.-Vert. Datum:	NAD83 - NAD83	**Excavation Equip.:**	CAT 430E Backhoe
Angle from Vert.:	0 degrees	**Excav. Dimensions:**	36 inches
Weather:	Sunny		

TEST PIT LOG TP-7

FIELD EXPLORATION | LABORATORY RESULTS

Latitude: 32.21111° N
Longitude: 117.29319° W
Approximate Surface Elevation (ft): 373.0

Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Description	Sample Number	Sample Type	USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
			Artificial Fill	1									
			Clayey SAND (SC): fine to coarse grained, non-plastic fines, light brownish gray, moist, dense	2									
370			**Silty SAND (SM)**: fine to medium grained, non-plastic fines, light gray, moist, dense										
			Silty SAND (SM): coarse grained, non-plastic fines, gray, moist, dense	3									
	5		**Clayey SAND (SC)**: fine to coarse grained, non-plastic fines, gray, moist, dense	4									
365													

The test pit was terminated at approximately 8 feet below ground surface. Test Pit was backfilled with excavated material on April 23, 2012.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during excavation.
GENERAL NOTES:
The test pit location and elevation are approximate and were estimated by BHA, Inc.
A Garmin etrex GPS unit was used to locate the test pit with an accuracy of 5 to 10 feet.
There was no shoring used for the test pit exploration.

Elevation scale: 360, 355, 350, 345, 340 — Depth scale: 10, 15, 20, 25, 30

TP-7

gINT FILE: U:\gint\projects\2012\124202_sdge Ocean Ranch.gpj C:KLF_STANDARD_GINT_LIBRARY_BETA.GLB [KLF_BORING/TEST PIT LOG]

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TEST PIT LOG TP-7

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CALIFORNIA

PLATE

A-23

APPENDIX B

LABORATORY TEST RESULTS

APPENDIX B
LABORATORY TEST RESULTS

GENERAL

Laboratory tests were performed on selected samples as an aid in classifying the soils and to evaluate physical properties of the soils that may affect foundation design and construction procedures. The tests were performed in general conformance with the current ASTM or California Department of Transportation (Caltrans) standards. A description of the laboratory-testing program is presented below.

CLASSIFICATION

Soils were visually and texturally classified in accordance with the Unified Soil Classification System (USCS) in general accordance with ASTM D 2488. Soil classifications are indicated on the boring logs in Appendix A.

LABORATORY MOISTURE AND DENSITY DETERMINATIONS

Natural moisture content and dry density tests were performed on selected intact samples collected and moisture content was performed on selected disturbed samples. Moisture content was evaluated in general accordance with ASTM Test Method D 2216; dry unit weight was evaluated using procedures similar to ASTM Test Method D 2937. This data is included on the boring logs in Appendix A.

GRADATION ANALYSIS

Sieve and hydrometer analyses were performed on samples from the site to evaluate the gradation characteristics of the soil and to aid in its classification. The tests were performed in general accordance with ASTM Test Methods D6913 and ASTM D422. The results of the sieve analyses are shown in Figures B1 and B2.

WASH SIEVE

The percent passing the No. 200 sieve of selected soil samples was performed by wash sieving in accordance with ASTM Standard Test Method D1140. The results of the tests are presented on the boring logs in Appendix A.

DIRECT SHEAR TEST

Three-point direct shear tests were performed on selected soil samples to evaluate the shear strength of representative site soils encountered. The soil samples were tested in a saturated state at three different normal pressures in general accordance with ASTM Test Method D 3080. The test results are presented in Figures B3 through B5.

ATTERBERG LIMITS

Atterberg limit testing was performed on soil samples to assist in classification. Testing was performed in general accordance with ASTM D4318. Results are presented on Figure B-6.

R-VALUE TESTS

Two resistance values (R-value) test were performed on a bulk soil samples obtained within the proposed site to evaluate pavement support characteristics of the near-surface onsite soils. R-value tests were performed in accordance with ASTM Standard Test Method D4829. The test results are presented as Figures B-7and B-8.

MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT

The maximum dry density and optimum moisture content of a representative soil sample was evaluated in general accordance with ASTM Test Method D1557. The test result is summarized on Figure B-9

CORROSION TESTING

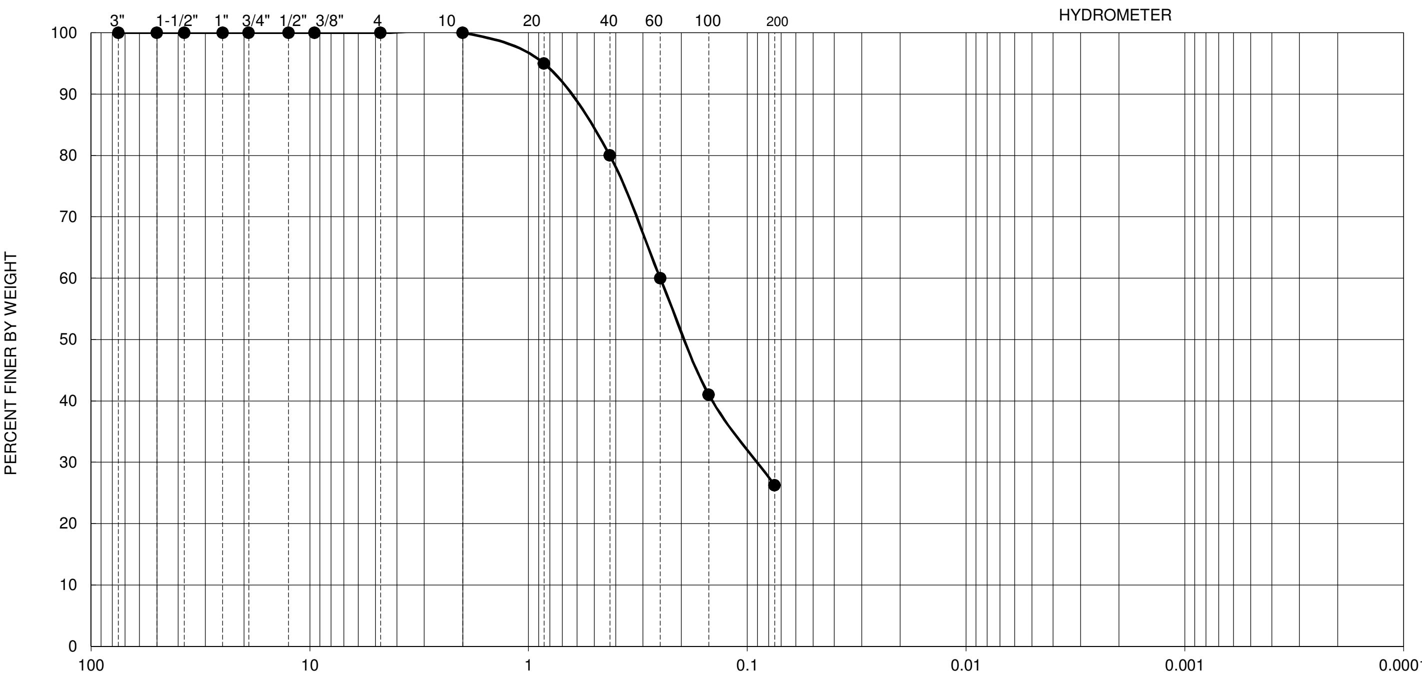
The sulfate and chloride contents, pH, and resistivity of selected samples were evaluated in general accordance with California Test 643. Our boring logs and these test results should be reviewed by a qualified corrosion engineer to evaluate the general soil stratigraphy corrosion potential with respect to construction materials to evaluate whether further testing is warranted. The results of the preliminary corrosive screening are presented on Figures B-10 through B-12 and summarized in Table B1 below.

Table B1
Preliminary Corrosion Test Results

BORING / SAMPLE NO.	DEPTH (FEET)	MINIMUM RESISTIVITY (OHM-CM)	PH	SULFATE CONTENT (PPM)	CHLORIDE CONTENT (PPM)
B-3 / 1	0.5 to 5	480	8.7	210	160
B-4 / 1	0.5 to 5	870	8.9	50	50
B-5 / 1	0.5 to 5	550	8.3	70	160

Date Tested: 5/4/2015

USCS	GRAVEL		SAND			FINES	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Boring No.	Sample No.	Depth (ft)	Passing 200 (%)	USCS Classification
B3	2	2.5-4	26.3	SC

Sample Description	Light Yellow Brown Clayey SAND

	Sieve Size		% Passing
Sieve Analysis	3"	75 mm	100
	2"	50 mm	100
	1.5"	37.5 mm	100
	1"	25 mm	100
	3/4"	19 mm	100
	1/2"	12.5 mm	100
	3/8"	9.5 mm	100
	No. 4	4.75 mm	100
	No. 10	2.0 mm	100
	No. 20	0.85 mm	95
	No. 40	0.425 mm	80
	No. 60	0.25 mm	60
	No 100	0.15 mm	41
	No 200	.075 mm	26.3

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 6913

KLEINFELDER
Bright People. Right Solutions.

Tested by:	Uly P.	Ck by:	TG
Project No.	20154777	Date:	12-Jun-15

GRADATION TEST RESULTS

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CA

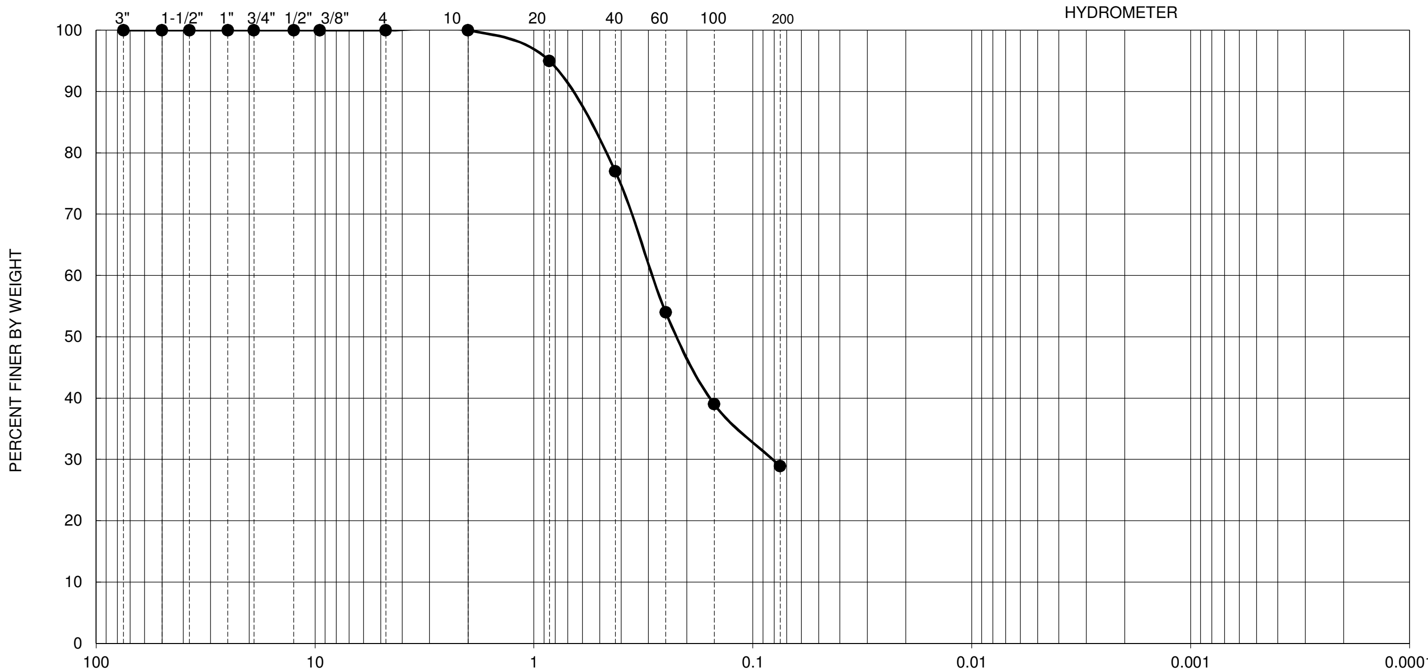
FIGURE

B-1

Date Tested: 5/4/2015

USCS

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Boring No.	Sample No.	Depth (ft)	Passing 200 (%)	USCS Classification
B4	4	10-11.5	28.9	SM

Sample Description	Pale Yellow Silty SAND

	Sieve Size		% Passing
Sieve Analysis	3"	75 mm	100
	2"	50 mm	100
	1.5"	37.5 mm	100
	1"	25 mm	100
	3/4"	19 mm	100
	1/2"	12.5 mm	100
	3/8"	9.5 mm	100
	No. 4	4.75 mm	100
	No. 10	2.0 mm	100
	No. 20	0.85 mm	95
	No. 40	0.425 mm	77
	No. 60	0.25 mm	54
	No 100	0.15 mm	39
	No 200	.075 mm	28.9

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 6913

KLEINFELDER
Bright People. Right Solutions.

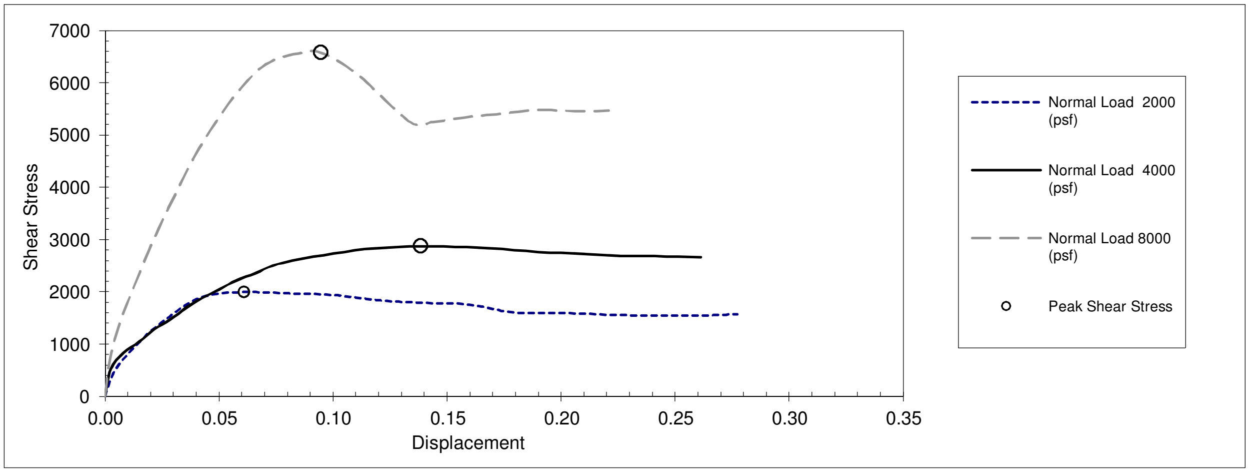
Tested by:	Uly P.	Ck by:	TG
Project No.	20154777	Date:	12-Jun-15

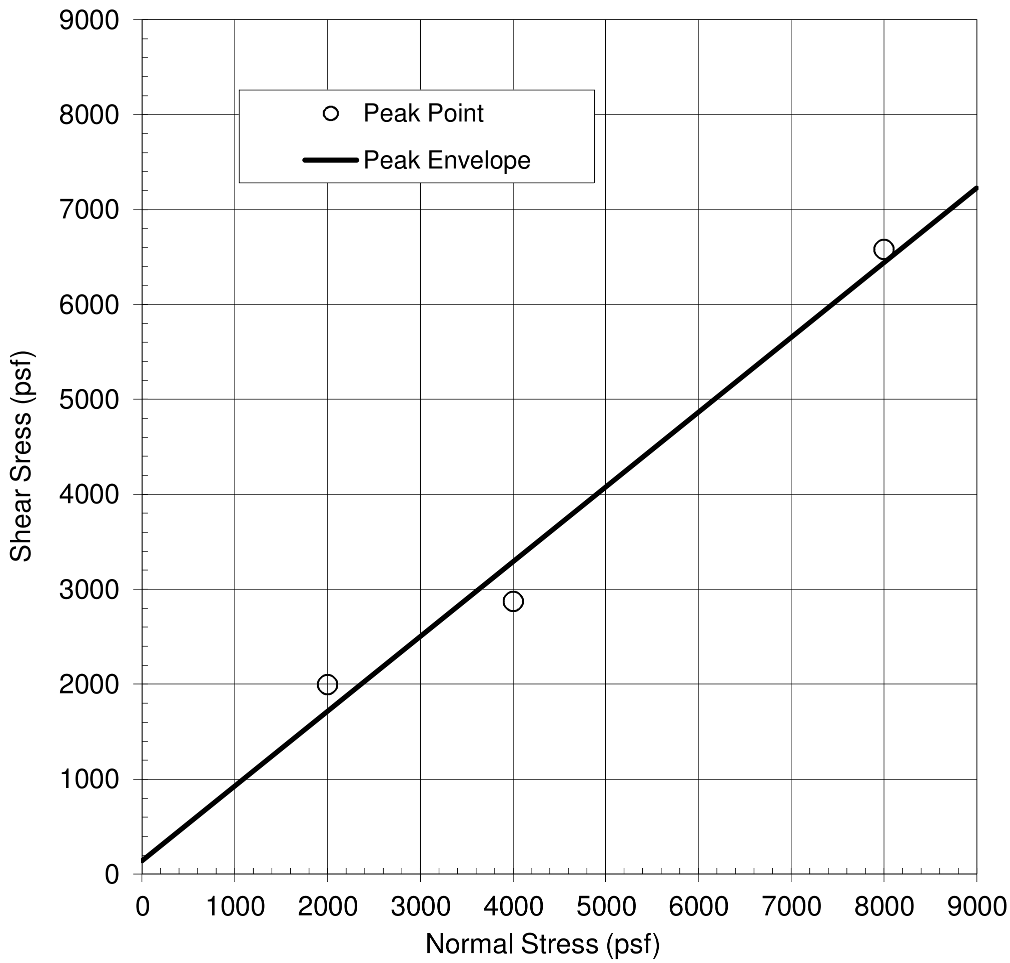
GRADATION TEST RESULTS

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CA

FIGURE

B-2



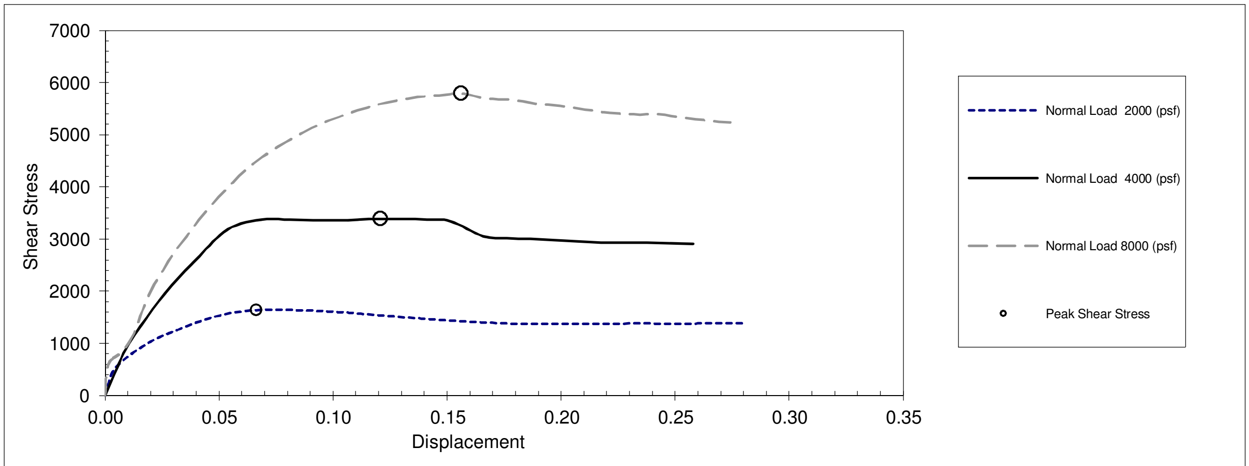


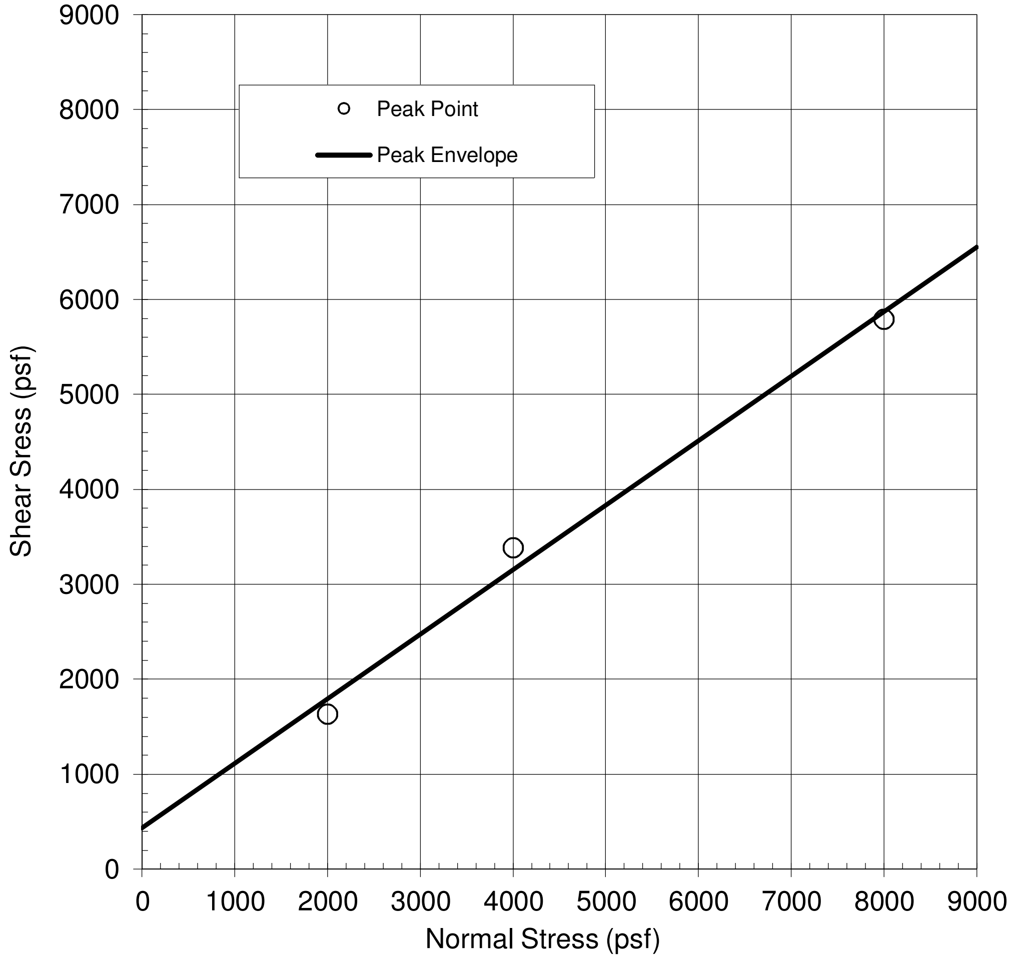
Strain Rate = 0.0118 inch/min
Date Tested: 4/29/2015

				Interpreted Shear Strength			
				Peak			
Boring No.	Sample No.	Depth	UCSC	Cohesion (psf)	Friction Angle (deg)		
B-2	2	2.5'-4'	SM	140	38.2		

Sample description: Light Yellowish Brown Silty SAND

KLEINFELDER Bright People. Right Solutions.		Direct Shear Test Results (ASTM D 3080)	FIGURE
Tested by: Uly P.	Ck by: TG	SDG&E OCEAN RANCH SUBSTATION PACIFIC COAST BUSINESS PARK OCEANSIDE, CA	B-3
Project # 20154777	12-Jun-15		





Strain Rate = 0.0118 inch/min
Date Tested: 4/30/2015

				Interpreted Shear Strength			
				Peak			
Boring No.	Sample No.	Depth	UCSC	Cohesion (psf)	Friction Angle (deg)		
B-4	2	2.5'-5'	SC	435	34.2		

Sample description: Olive Gray Clayey SAND

KLEINFELDER
Bright People. Right Solutions.

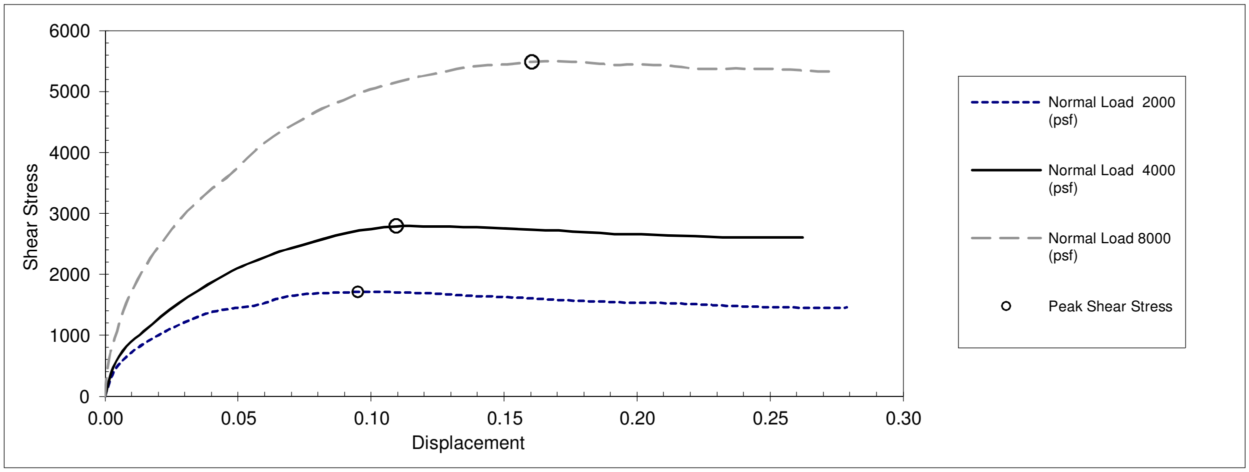
Tested by:	Uly P.	Ck by: TG
Project #	20154777	12-Jun-15

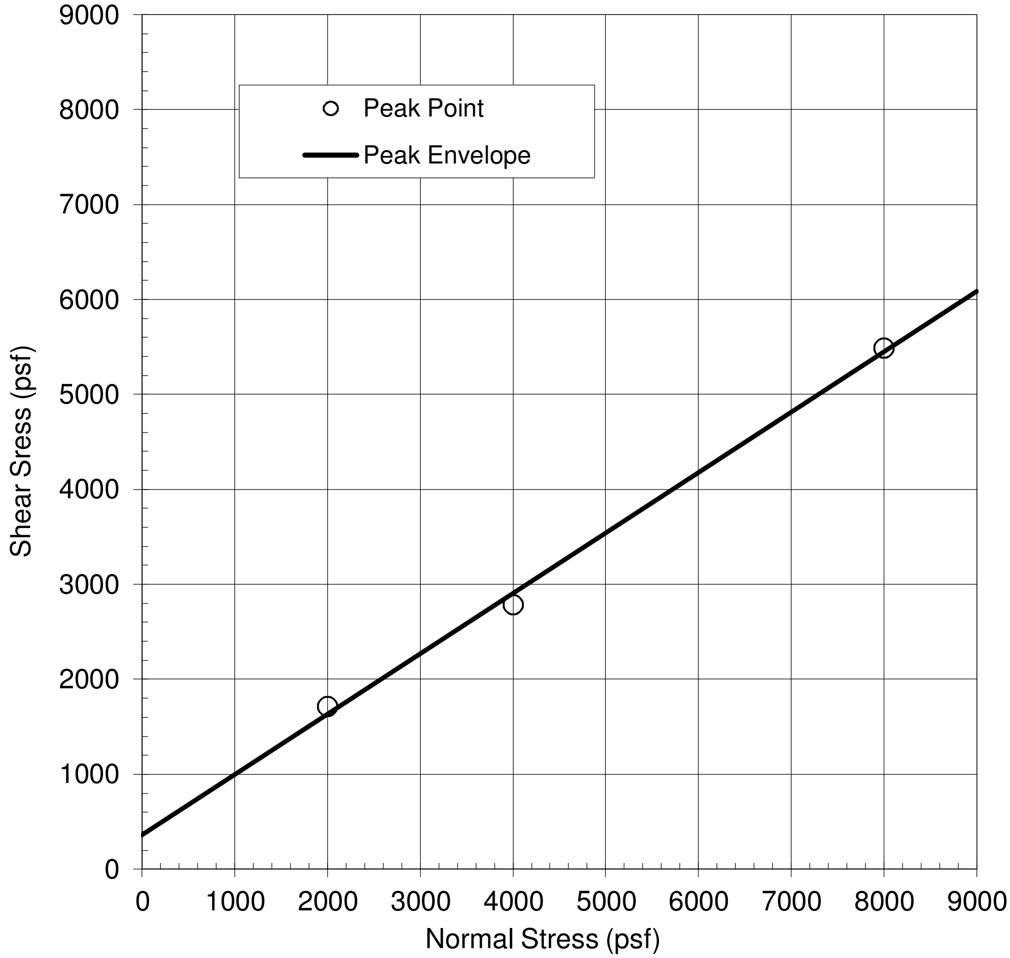
Direct Shear Test Results (ASTM D 3080)

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CA

FIGURE

B-4





Strain Rate = 0.0118 inch/min
Date Tested: 5/4/2015

				Interpreted Shear Strength			
				Peak			
Boring No.	Sample No.	Depth	UCSC	Cohesion (psf)	Friction Angle (deg)		
B-5	2	2.5'-4'	SM	362	32.4		

Sample description: Light Olive Gray Silty SAND

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Bright People. Right Solutions.

Tested by:	Uly P.	Ck by: TG
Project #	20154777	12-Jun-15

Direct Shear Test Results (ASTM D 3080)

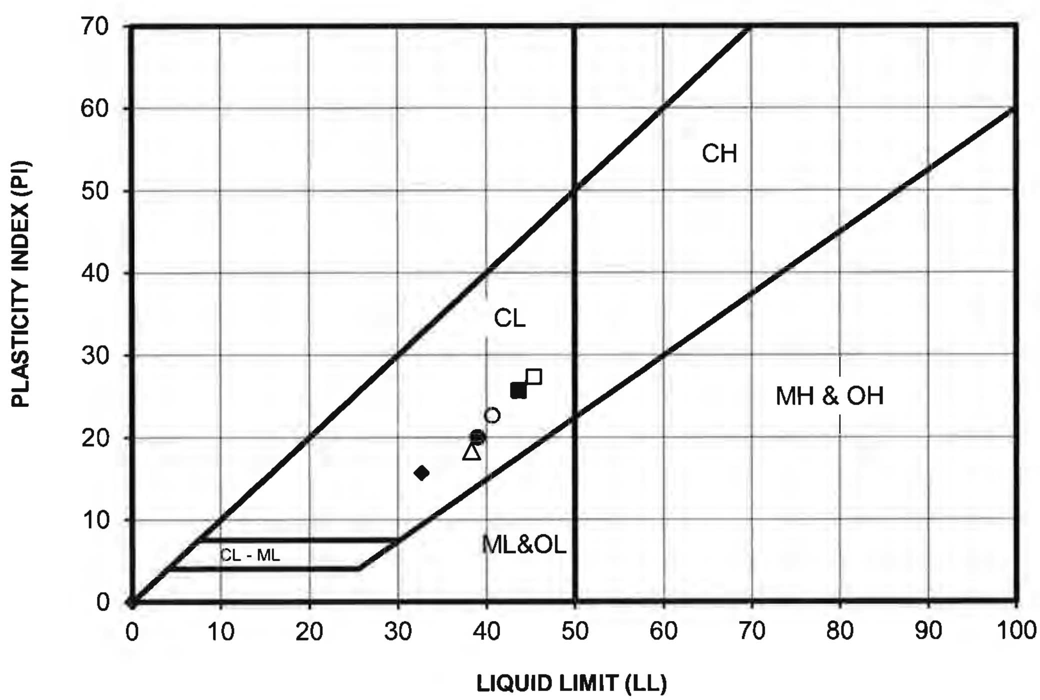
SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CA

FIGURE

B-5

Date Tested : 5/4/2015 & 5/13/2015

SYMBOL	SAMPLE NAME	DEPTH (ft)	LL	PL	PI	USCS CLASSIFICATION (Minus No. 40 Sieve Fraction)	USCS (Entire Sample)
●	B-1-4	10-11.5'	39	19	20	CL	CL
■	B-3-1	0.5-5'	44	18	26	CL	SC
◆	B-4-2	2.5-4'	33	17	16	CL	SC
○	B-4-8	30-31.5'	41	18	23	CL	CL
□	B-4-15	65-66.5'	45	18	27	CL	CL
△	B-6-5	15-16.5'	38	20	18	CL	CL
+							
◇							



PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 4318

KLEINFELDER
Bright People. Right Solutions.

Tested by	Uly P.	Ck by:	TG
PROJECT NO: 20154777		12-Jun-15	

ATTERBERG LIMITS TEST RESULTS

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CA

FIGURE

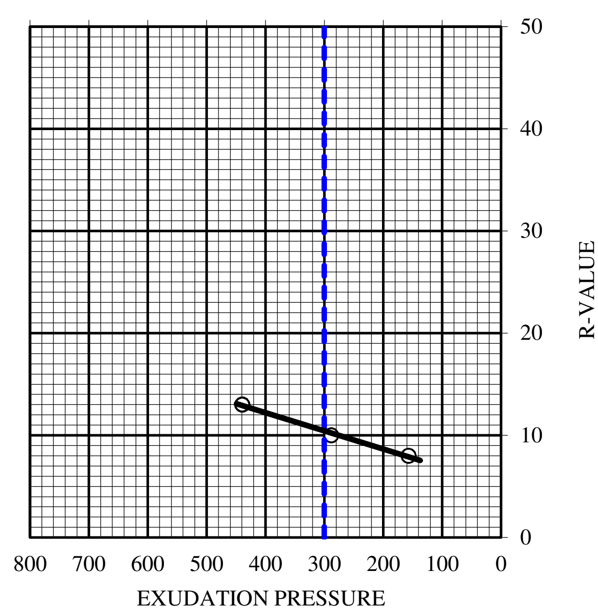
B-6

Boring No.	Sample No.	Depth	Description	Date Tested
B7	1	0.5-5'	Pale Olive Clayey SAND	5/6/2015

TEST SPECIMEN				
MOLD NO.	2	1	9	
FOOT PRESSURE, psi	**80**	**60**	**50**	
INITIAL MOISTURE, %	13.1	13.1	13.1	
"AS-IS" WEIGHT, g	1200	1200	1200	
DRY WEIGHT, g	1060.9	1060.9	1060.9	
WATER ADDED, ml	**40**	**52**	**64**	
COMPACTION MOISTURE, %	16.9	18.0	19.1	
HEIGHT OF BRIQUETTE, in.	**2.58**	**2.6**	**2.62**	
WEIGHT BRIQUETTE/MOLD,	**3213**	**3203.4**	**3216.4**	
WEIGHT OF MOLD, g	**2109.2**	**2103.4**	**2114.5**	
WEIGHT OF BRIQUETTE, g	1103.8	1100	1101.9	
DRY DENSITY, pcf	111.0	108.7	107.1	
STABILOMETER, 1000 lbs	**55**	**61**	**64**	
2000lbs	**134**	**139**	**144**	
DISPLACEMENT, in	**3.59**	**3.66**	**3.84**	
EXUDATION LOAD, lbs	**5515**	**3621**	**1972**	
EXUDATION PRESSURE, psi	439.1	288.3	157.0	
R-VALUE	12	9	7	
CORRECTED R-VALUE	13	10	8	
DIAL READING, END	0.0311	0.0302	0.0404	
DIAL READING, START	0.0300	0.0300	0.0400	
DIFFERENCE	0.0011	0.0002	0.0004	
EXPANSION PRESSURE, PSF	48.0	8.7	17.5	

INITIAL MOISTURE	
WET WEIGHT, g	433.8
DRY WEIGHT, g	383.5
WEIGHT OF WATER	
WEIGHT OF SAMPLE	
MOISTURE CONTENT %	13.1

R-VALUE:	**11**
Location:	



Limitations: Pursuant to applicable codes, the results presented in this report are for the exclusive use of the client and the registered design professional in responsible charge. The results apply only to the samples tested. If changes to the specification were made and not communicated to Kleinfelder, Kleinfelder assumes no responsibility for pass/fail statements (meets/did not meet), if provided. This report may not be reproduced, except in full, without written approval of Kleinfelder.

KLEINFELDER
Bright People. Right Solutions.

Tested By:	Uly P.	Ck by:	TG
Job Number:	20154777	DATE:	12-Jun-15

R-Value (ASTM D2844)

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CA

FIGURE

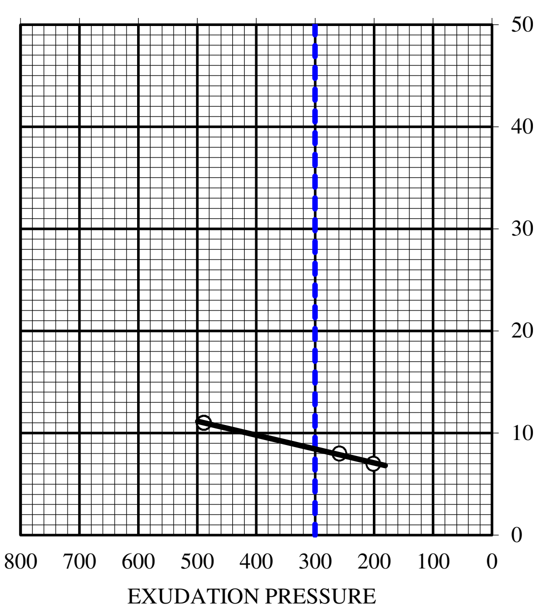
B-7

Boring No.	Sample No.	Depth	Description	Date Tested
B10	1	0.5-5'	Light Olive Gray Clayey SAND	5/6/2015

TEST SPECIMEN				
MOLD NO.	6	3	8	
FOOT PRESSURE, psi	**80**	**60**	**50**	
INITIAL MOISTURE, %	14.5	14.5	14.5	
"AS-IS" WEIGHT, g	1200	1200	1200	
DRY WEIGHT, g	1048.0	1048.0	1048.0	
WATER ADDED, ml	**30**	**45**	**58**	
COMPACTION MOISTURE, %	17.4	18.8	20.0	
HEIGHT OF BRIQUETTE, in.	**2.5**	**2.55**	**2.6**	
WEIGHT BRIQUETTE/MOLD,	**3170.7**	**3176.5**	**3174.6**	
WEIGHT OF MOLD, g	**2101**	**2105.4**	**2112.6**	
WEIGHT OF BRIQUETTE, g	1069.7	1071.1	1062	
DRY DENSITY, pcf	110.6	107.2	103.2	
STABILOMETER, 1000 lbs	**57**	**61**	**66**	
2000lbs	**136**	**142**	**145**	
DISPLACEMENT, in	**3.5**	**3.74**	**3.92**	
EXUDATION LOAD, lbs	**6142**	**3253**	**2529**	
EXUDATION PRESSURE, psi	489.0	259.0	201.4	
R-VALUE	11	8	6	
CORRECTED R-VALUE	11	8	7	
DIAL READING, END	0.0478	0.0285	0.0476	
DIAL READING, START	0.0475	0.0285	0.0482	
DIFFERENCE	0.0003	0.0000	-0.0006	
EXPANSION PRESSURE, PSF	13.1	0.0	0.0	

INITIAL MOISTURE	
WET WEIGHT, g	506.0
DRY WEIGHT, g	441.9
WEIGHT OF WATER	
WEIGHT OF SAMPLE	
MOISTURE CONTENT %	14.5

R-VALUE:	**9**
Location:	



KLEINFELDER
Bright People. Right Solutions.

R-Value (ASTM D2844)

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CA

FIGURE **B-8**

Tested By:	Uly P.	Ck by:	TG
Job Number:	20154777	DATE:	12-Jun-15

KLEINFELDER
Bright People. Right Solutions.

5761 Copley Drive, Suite 100
San Diego, CA 92111
Phone: (858) 223-8500 Fax: (858) 277-1035

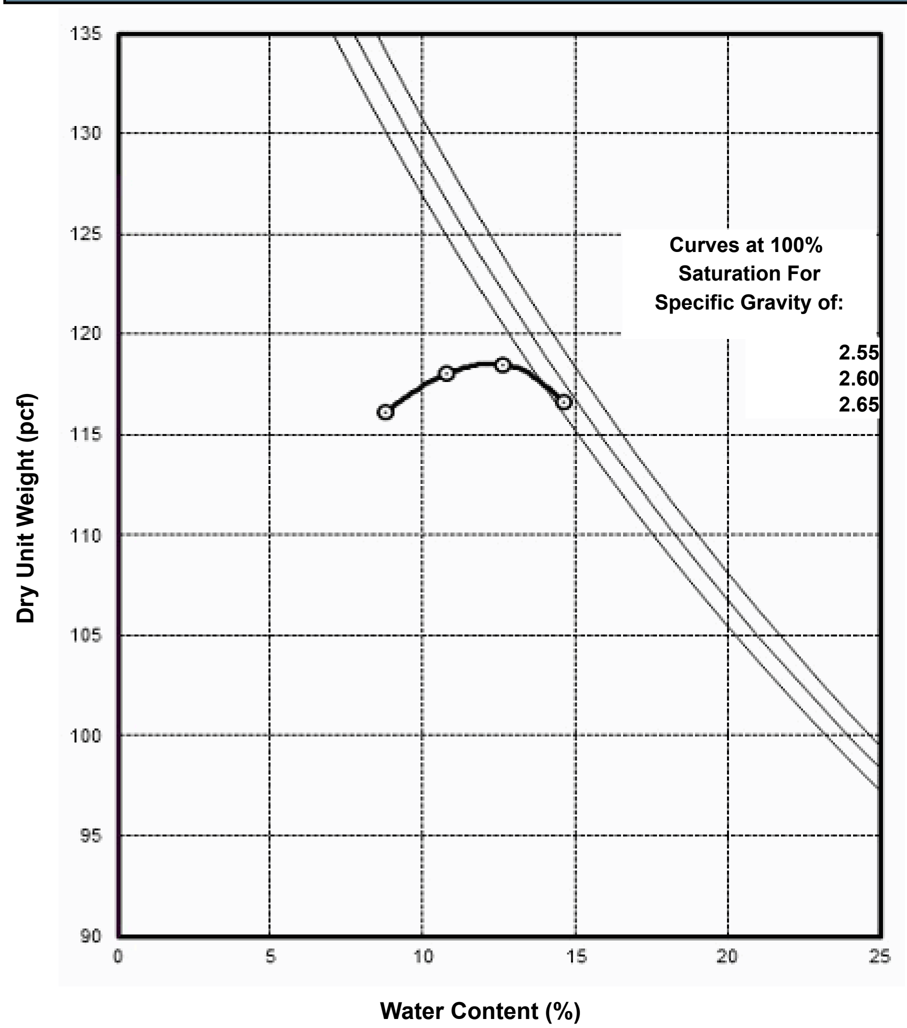
Laboratory Compaction Characteristics of Soil Using Modified Effort ASTM D 1557

Report To:

Richard Brady & Associates, Inc.
Osborn, Linda
3710 Ruffin Road
San Diego, CA 92123

Report Date: 5/14/2015
Project No.: 20154777.003A
Project: SDG&E - San Mateo Sub 12kV Breaker Proj
Task: 03-000L Lab Testing

TEST RESULTS



Sample No.: SD_20154777.B5.1
Date Sampled: 4/16/2015
Sample Location:
B-5 Sample 1 at 0.5'-5'

Material Description:
light olive brown clayey sand

Compaction Test Method:
ASTM D 1557 Method A
Maximum Dry Unit Weight (pcf): 118.5
Optimum Water Content (%): 12.3

Remarks:

Reviewed on 5/14/2015 by: [signature]
Ulysses Panuncialman
Laboratory Manager

FIGURE B-9

L A B O R A T O R Y   R E P O R T

Telephone (619) 425-1993   Fax 425-7917   Established 1928

C L A R K S O N L A B O R A T O R Y A N D S U P P L Y I N C.
350 Trousdale Dr. Chula Vista, Ca. 91910 www.clarksonlab.com
A N A L Y T I C A L A N D C O N S U L T I N G C H E M I S T S

Date: May 12, 2015
Purchase Order Number: PROJ#20154777
Sales Order Number: 26878
Account Number: KLE
To:

Kleinfelder Inc.
550 West C Street Ste 1200
San Diego, CA 92101
Attention: Uly Panuncialman

Laboratory Number: SO5666-1   Customers Phone: 831-4600
Fax: 831-4619
Sample Designation:

One soil sample received on 05/04/15 at 3:42pm
marked as:
Project: SDG&E Ocean Ranch Substation
Project #: 20154777
Boring #: B3
Sample #: 1
Depth: 0.5-5'
Date Sampled: 04/15/15.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 8.7

Water Added (ml)	Resistivity (ohm-cm)
10	1800
5	990
5	550
5	480
5	480
5	520
5	550

24 years to perforation for a 16 gauge metal culvert.
29 years to perforation for a 14 gauge metal culvert.
41 years to perforation for a 12 gauge metal culvert.
52 years to perforation for a 10 gauge metal culvert.
63 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417   0.021%

Water Soluble Chloride Calif. Test 422   0.016%

Laura Torres
LT/ram

FIGURE B-10

L A B O R A T O R Y   R E P O R T

Telephone (619) 425-1993   Fax 425-7917   Established 1928

C L A R K S O N L A B O R A T O R Y A N D S U P P L Y I N C.
350 Trousdale Dr. Chula Vista, Ca. 91910 www.clarksonlab.com
A N A L Y T I C A L A N D C O N S U L T I N G C H E M I S T S

Date: May 12, 2015
Purchase Order Number: PROJ#20154777
Sales Order Number: 26878
Account Number: KLE
To:
--
Kleinfelder Inc.
550 West C Street Ste 1200
San Diego, CA 92101
Attention: Uly Panuncialman

Laboratory Number: SO5666-2   Customers Phone: 831-4600
Fax: 831-4619
Sample Designation:
--
One soil sample received on 05/04/15 at 3:42pm
marked as:
Project: SDG&E Ocean Ranch Substation
Project #: 20154777
Boring #: B4
Sample #: 1
Depth: 0.5-5'
Date Sampled: 04/15/15.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 8.9

Water Added (ml)	Resistivity (ohm-cm)
10	2200
5	1400
5	870
5	880
5	910
5	920

29 years to perforation for a 16 gauge metal culvert.
38 years to perforation for a 14 gauge metal culvert.
52 years to perforation for a 12 gauge metal culvert.
66 years to perforation for a 10 gauge metal culvert.
81 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417 0.005%

Water Soluble Chloride Calif. Test 422 0.005%

Laura Torres
LT/ram

FIGURE B-11

L A B O R A T O R Y   R E P O R T

Telephone (619) 425-1993   Fax 425-7917   Established 1928

C L A R K S O N   L A B O R A T O R Y   A N D   S U P P L Y   I N C.
350 Trousdale Dr. Chula Vista, Ca. 91910 www.clarksonlab.com
A N A L Y T I C A L   A N D   C O N S U L T I N G   C H E M I S T S

Date: May 12, 2015
Purchase Order Number: PROJ#20154777
Sales Order Number: 26878
Account Number: KLE
To:

Kleinfelder Inc.
550 West C Street Ste 1200
San Diego, CA 92101
Attention: Uly Panuncialman

Laboratory Number: SO5666-3   Customers Phone: 831-4600
Fax: 831-4619
Sample Designation:

One soil sample received on 05/04/15 at 3:42pm
marked as:
Project: SDG&E Ocean Ranch Substation
Project #: 20154777
Boring #: B5
Sample #: 1
Depth: 0.5-5'
Date Sampled: 04/15/15.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 8.3

Water Added (ml)	Resistivity (ohm-cm)
10	2000
5	1100
5	720
5	580
5	550
5	570
5	590

24 years to perforation for a 16 gauge metal culvert.
31 years to perforation for a 14 gauge metal culvert.
43 years to perforation for a 12 gauge metal culvert.
55 years to perforation for a 10 gauge metal culvert.
67 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417 0.007%

Water Soluble Chloride Calif. Test 422 0.016%

Laura Torres
LT/ram

FIGURE B-12

APPENDIX C

SUGGESTED GUIDELINES FOR EARTHWORK CONSTRUCTION

APPENDIX C
SUGGESTED GUIDELINES FOR EARTHWORK CONSTRUCTION

GENERAL

Scope - The work done under theses specifications shall include site clearing, removal of unsuitable material, excavation, preparation of natural soils, placement and compaction of on-site and imported fill material.

Contractor's Responsibility - The Contractor shall attentively examine the site in such a manner that he can correlate existing surface conditions with those presented in the geotechnical evaluation report. He shall satisfy himself that the quality and quantity of exposed materials and subsurface soil or rock deposits have been satisfactorily represented by the Geotechnical Engineer's report and project drawings. Any discrepancy of prior knowledge to the Contractor to that is revealed through his evaluations shall be made known to the Owner. It is the Contractor's responsibility to review the report prior to construction. The selection of equipment for use on the project and the order of the work shall similarly be the Contractor's responsibility. The Contractor shall be responsible for providing equipment capable of completing the requirements included in the following sections.

Geotechnical Engineer - The work covered by these specifications shall be observed and tested by Kleinfelder, the Geotechnical Engineer, who shall be hired by the Owner. The Geotechnical Engineer will be present during the site preparation and grading to observe the work and to perform the tests necessary to evaluate material quality and compaction. The Geotechnical Engineer shall submit a report to the Owner, including a tabulation of tests performed. The costs of re-testing unsuitable work installed by the Contractors shall be deducted by the Owner from the payments to the Contractor.

Standard Specifications - Where referred to in these specifications, "Standard Specifications" shall mean the State of California Standard Specifications for Public Works Construction, with Regional Supplement Amendments for San Diego County, 2000 Edition.

Compaction Test Method - Where referred to herein, relative compaction shall mean the in-place dry density of soil expressed as a percentage of the maximum dry density of the same material, as determined by the ASTM D 1557 Compaction Test Procedure. Optimum moisture content shall mean the moisture content at the maximum dry density determined above.

SITE PREPARATION

Clearing - Areas to be graded shall be cleared and grubbed of all vegetation and debris. These materials shall be removed from the site by the Contractor.

Stripping - Surface soils containing roots and organic matter shall be stripped from areas to be graded and stockpiled or discarded as directed by the Owner. In general, the depth of stripping of the topsoil will be approximately 6 to 12 inches within the landscaped areas. Deeper stripping, where required to remove weak soils or accumulations of organic matter, shall be performed when determined necessary by the Geotechnical Engineer. Stripped material shall be removed from the site or stockpiled at a location designated by the Owner.

Removal of Existing Fill - Existing fill soils, trash and debris in the areas to be graded shall be removed prior to the placing of any compacted fill. Portions of any existing fills that are suitable for use in new compacted fill may be stockpiled for future use. All organic materials, topsoil, expansive soils, oversized rock or other unsuitable material shall be removed from the site by the Contractor or disposed of at a location on-site, if so designated by the Owner.

Ground Surface - The ground surface exposed by stripping shall be scarified to a depth of 6 inches, moisture conditioned to the proper moisture content for compaction and compacted as required for compacted fill. Ground surface preparation shall be approved by the Geotechnical Engineer prior to placing fill.

EXCAVATION

General - Excavations shall be made to the lines and grades indicated on the plans. The data presented in the Geotechnical Engineer's report is for information only and the Contractor shall make his own interpretation with regard to the methods and equipment necessary to perform the excavation and to obtain material suitable for fill.

Materials - Soils which are removed and are unsuitable for fill shall be placed in nonstructural areas of the project, or in deeper fills at locations designated by the Geotechnical Engineer.

All oversize rocks and boulders that cannot be incorporated in the work shall be removed from the site by the Contractor.

Treatment of Exposed Surface - The ground surface exposed by excavation shall be scarified to a depth of 6 inches, moisture conditioned to the proper moisture content for compaction and compacted as required for compacted fill. Compaction shall be approved by the Geotechnical Engineer prior to placing fill.

COMPACTED FILL

Materials - Fill material shall consist of suitable on-site or imported soil. All materials used for structural fill shall be reasonably free of organic material, have an Expansion Index of 50 or less, 100% passing the 3 inch sieve and less than 30 percent passing the #200 sieve.

Placement - All fill materials shall be placed in layers of 8 inches or less in loose thickness and uniformly moisture conditioned. Each lift should then be compacted with a sheepsfoot roller or other approved compaction equipment to at least 90 percent relative compaction in areas under structures, utilities, roadways and parking areas. No fill material shall be placed, spread or rolled while it is frozen or thawing, or during unfavorable weather conditions.

Compaction Equipment - The Contractor shall provide and use sufficient equipment of a type and weight suitable for the conditions encountered in the field. The equipment shall be capable of obtaining the required compaction in all areas.

Recompaction - When, in the judgment of the Geotechnical Engineer, sufficient compactive effort has not been used, or where the field density tests indicate that the required compaction or moisture content has not been obtained, or if pumping or other indications of instability are noted, the fill shall be reworked and recompacted as needed to obtain a stable fill at the required density and moisture content before additional fill is placed.

Responsibility - The Contractor shall be responsible for the maintenance and protection of all embankments and fills made during the contract period and shall bear the expense of replacing any portion which has become displaced due to carelessness, negligent work or failure to take proper precautions.

UTILITY TRENCH BEDDING AND BACKFILL

Material - Pipe bedding shall be defined as all material within 4 inches of the perimeter and 12 inches over the top of the pipe. Material for use as bedding shall be clean sand, gravel, crushed aggregate or native free draining material, having a Sand Equivalent of not less than 30.

Backfill should be classified as all material within the remainder of the trench. Backfill shall meet the requirements set forth in Section 4.2.7 for compacted fill.

Placement and Compaction - Pipe bedding shall be placed in layers not exceeding 8 inches in loose thickness, conditioned to the proper moisture content for compaction and compacted to at least 90 percent relative compaction. All other trench backfill shall be placed and compacted in accordance with Section 306-1.3.2 of the Standard Specifications for Mechanically Compacted Backfill. Backfill shall be compacted as required for adjacent fill. If not specified, backfill shall be compacted to at least 90 percent relative compaction in areas under structures, utilities, roadways, parking areas and concrete flatwork.

SUBSURFACE DRAINAGE

General - Subsurface drainage shall be constructed as shown on the plans. Drainage pipe shall meet the requirements set forth in the Standard Specifications.

Materials - Permeable drain rock used for subdrainage shall meet the following gradation requirements:

SIEVE SIZE	PERCENTAGE PASSING
3"	100
1-1/2"	90 - 100
3/4"	50 - 80
No. 4	24 - 40
No. 100	0 - 4
No. 200	0 - 2

Geotextile Fabric - Filter fabric shall be placed between the permeable drain rock and native soils. Filter cloth shall have an equivalent opening size greater than the No. 100 sieve and a grab strength not less than 100 pounds. Samples of filter fabric shall be submitted to the Geotechnical Engineer for approval before the material is brought to the site.

Placement and Compaction - Drain rock shall be placed in layers not exceeding 8 inches in loose thickness and compacted as required for adjacent fill, but in no case, to be less than 85 percent relative compaction. Placement of geotextile fabric shall be in accordance with the manufacturer's specifications and shall be checked by the Geotechnical Engineer.

AGGREGATE BASE BENEATH CONCRETE SLABS

Materials - Aggregate base beneath concrete slabs shall consist of clean free-draining sand, gravel or crushed rock conforming to the following gradation requirements:

SIEVE SIZE	PERCENT PASSING
1"	100
3/8"	30 – 100
No. 20	0 – 10

Placement - Aggregate base shall be compacted and kept moist until placement of concrete. Compaction shall be by suitable vibrating compactors. Aggregate base shall be placed in layers not exceeding 8 inches in loose thickness. Each layer shall be compacted by at least four passes of the compaction equipment or until 95 percent relative compaction has been obtained.

APPENDIX D

ASFE INSERT

Important Information about Your

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical-engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical-Engineering Report Is Based on a Unique Set of Project-Specific Factors

Geotechnical engineers consider many unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk-management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical-engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical-engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical-engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, droughts, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical-engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical-engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical-engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold-prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold-prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical-engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold-prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely, on Your GBA-Member Geotechncial Engineer for Additional Assistance

Membership in the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk confrontaton techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your GBA-member geotechnical engineer for more information.

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