APPENDIX E – GEOTECHNICAL REPORT, PROPOSED MINERAL EXTRACTION FACILITY

Geotechnical Report

Proposed Mineral Extraction Facility
409 W. McDonald Road
Calipatria, California

Prepared for:

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August 25, 2020

Mr. Jurg Heuberger
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Preliminary Geotechnical Report
Proposed Mineral Extraction Facility
409 W. McDonald Road
Calipatria, California
LCI Report No. LE19154

Dear Mr. Heuberger:

This preliminary geotechnical report is provided for design and construction of the proposed mineral extraction facility at the Hudson Ranch No. 1 geothermal power plant located at 409 W. McDonald Road northwest of Calipatria, California. Our geotechnical exploration was conducted in response to your request for our services. The enclosed report describes our soil engineering site evaluation and presents our professional opinions regarding geotechnical conditions at the site to be considered in the design and construction of the project.

Based on the geotechnical conditions encountered at the points of exploration, the project site appears suitable for the proposed construction provided the professional opinions contained in this report are considered in the design and construction of this project. The site is not located within published geohazard areas other than high seismic ground motions and liquefaction risks. The nearest know earthquake fault is located 5 miles south-west. Prior studies in this area have detected CO_2 gas pockets at 50 to 100 feet below ground surface. Deep foundations should not be extended into the gas pockets.

We appreciate the opportunity to provide our findings and professional opinions regarding geotechnical conditions at the site. Please provide our office with a set of the foundation plans and civil plans for review to insure that the geotechnical site constraints have been included in the design documents. If you have any questions or comments regarding our findings, please call our office at (760) 370-3000.

Respectfully Submitted,
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TABLE OF CONTENTS

Page

Appendices

APPENDIX A: Vicinity and Site Maps
APPENDIX B: Cone Penetration Test (CPT) Logs and Key to CPT Interpretations
APPENDIX C: Laboratory Test Results
APPENDIX D. Drilled Pier Compression Capacity Chart
APPENDIX E: Liquefaction Analysis
APPENDIX F: Utility Trench Backfill

EXECUTIVE SUMMARY

This executive summary presents ***selected*** elements of our findings and professional opinions. This summary ***may not*** present all details needed for the proper application of our findings and professional opinions. Our findings, professional opinions, and application options are ***best related through reading the full report***, and are best evaluated with the active participation of the engineer of record who developed them. The findings of this study are summarized below:

- Clay soils (CL) of medium to high expansion (EI = 70 to 100) predominate the near surface soils at the project site.

- Replacement of the upper 3.0 feet of clays with imported non-expansive granular fill can be used to mitigate the expansion forces and eliminate the need for special foundation designs for the administration area buildings, warehouses and other structures with thin slab-on-grade foundations. Design and construction of site improvements (concrete flatwork, curbs, housekeeping slabs, etc.) should include provisions to mitigate clay soil movement. Additionally, the weak clay subgrade soil requires thickened structural sections for pavements.

- The risk of liquefaction induced settlement is very low. Liquefaction may occur in isolated silt and sand layers encountered at various depths between 8 and 50 feet below ground surface. Potential liquefaction induced settlements of less than ¼ inch have been estimated for the project site. There is a very low risk of ground rupture and/or sand boil formation should liquefaction occur.

- The native soil is severely corrosive to metals and contains sufficient sulfates and chlorides to require special concrete mixes (6.5 sack cement factor with a 0.45 maximum water cement ratio and Type V cement) and protection of embedded steel components (5-inch minimum concrete cover) when concrete is placed in contact with native soil. Polypropylene vapor retarders (10 to 15 mil) should be used below all slabs on grade to reduce corrosion potential of steel reinforcement

- All reinforcing bars, anchor bolts and hold down bolts shall have a minimum concrete cover of 5.0 inches unless epoxy coated (ASTM D3963/A934). Hold-down straps at the foundation perimeter and pressurized water lines below or within the foundations are not allowed.

- In order to reduce settlement in the mineral extraction plant structures to generally accepted limits, existing soft, compressible clays may be strengthened by soil improvement (soil mixing or replacement with sand/cement) or by use of deep foundation systems like auger cast or driven piles. Pile lengths should be less than 50 feet to avoid penetrating CO_2 gas pockets below the site. Structural mats may also be used to limit movement between groups of process vessels or equipment. These options are discussed in the report.

- The mineral extraction plant site is located adjacent to CO_2 gas mud pots and above a naturally occurring CO_2 gas reservoir. The reservoir is generally located at depths greater than 50 feet. The measured gas pressure obtained from previous investigation at the adjacent geothermal plant site was approximately 15 to 25 psi.

- Pavement structural sections should be designed for clay subgrade soils (R-Value = 5) and an appropriate Traffic Index (TI) selected by the civil designer.

- Groundwater is expected to be encountered at about 8 to 9 feet below ground surface at the project site.

Section 1
INTRODUCTION

1.1 Project Description

This report presents the findings of our geotechnical exploration and soil testing for the proposed mineral extraction facility at the Hudson Ranch No.1 geothermal power plant located at 409 W. McDonald Road northwest of Calipatria, California (See Vicinity Map, Plate A-1). The proposed mineral extraction facility will likely consist of a clarifier, thickener, filter and reactor vessels, pipe racks, lab and administration buildings, warehouse, electrolysis block, chilled water plant, cooling towers, and various ancillary structures. No site plan was available for the proposed development at the time that this report was prepared.

The process, warehouse, laboratory, and administration buildings are planned to consist of single story structures with slab-on-grade floors and steel-frame construction. Expected footing loads are estimated at 1 to 2 kips per lineal foot with column loading of 10 to 50 kips for the small structures. Process tanks may range in diameter from 8 to 32 feet (1,000 psf to 2,500 psf loading). The clarifier tank diameter will be approximately 125 feet with a maximum load of 2,000 psf.

Site development will include initial site grading, deep ground improvement to control tank settlements, deep foundations for heavily loaded pipe supports or process structures, building support pad construction, underground utility installation, electrical grounding grid placement, roadway construction and concrete flatwork placement.

1.2 Purpose and Scope of Work

The purpose of this geotechnical study was to investigate the subsurface soil at selected locations within the site for evaluation of physical/engineering properties and liquefaction potential during seismic events. Professional opinions were developed from field and laboratory test data and are provided in this report regarding geotechnical conditions at this site and the effect on design and construction.

The scope of our services consisted of the following:

- Field exploration and in-situ testing of the site soils at selected locations and depths.
- Laboratory testing for physical and/or chemical properties of selected samples.
- Review of the available literature and publications pertaining to local geology, faulting, and seismicity.
- Engineering analysis and evaluation of the data collected.
- Preparation of this report presenting our findings and professional opinions regarding the geotechnical aspects of project design and construction.

This report addresses the following geotechnical parameters:

- Subsurface soil and groundwater conditions
- Site geology, regional faulting and seismicity, and site seismic design criteria
- Liquefaction potential and its mitigation
- Expansive soil and methods of mitigation
- Aggressive soil conditions to metals and concrete

Professional opinions with regard to the above parameters are provided for the following:

- Site grading, earthwork and embankment construction
- Building pad and foundation subgrade preparation
- Allowable soil bearing pressures and expected settlements
- Deep foundation alternatives
- Soil improvement alternatives
- Concrete slabs-on-grade
- Lateral earth pressures
- Excavation conditions and buried utility installations
- Mitigation of the potential effects of salt concentrations in native soil to concrete mixes and steel reinforcement
- Seismic design parameters
- Pavement structural sections

Our scope of work for this report did not include an evaluation of the site for the presence of environmentally hazardous materials or conditions, storm water infiltration, groundwater mounding, landscape suitability of the soil, or CO_2 gas reservoirs below the site.

1.3 Authorization

Mr. Derek Benson, Chief Operating Officer of Energy Source Minerals, LLC, provided authorization by written agreement to proceed with our work on September 3, 2019. The Notice to Proceed was received in July 2020. We conducted our work in general accordance with our written proposal dated July 25, 2019.

Section 2
METHODS OF INVESTIGATION

2.1 Field Exploration

Subsurface exploration was performed on July 20, 2020 using Kehoe Testing and Engineering, Inc. of Huntington Beach, California to advance three (3) electric cone penetrometer (CPT) soundings to approximate depths of 50 feet below existing ground surface. The soundings were made at the locations shown on the Site and Exploration Plan (Plate A-2). The approximate sounding locations were established in the field and plotted on the site map by sighting to discernible site features. Shallow (5-foot deep) mechanical auger borings (6-inch diameter) were made in the future laydown yard to the west in order to obtain near surface soil samples for laboratory analysis.

CPT soundings provide a continuous profile of the soil stratigraphy with readings every 2.5cm (1 inch) in depth. Direct sampling for visual and physical confirmation of soil properties has been used by our firm to establish direct correlations with CPT exploration in this geographical region.

The CPT exploration was conducted by hydraulically advancing an instrumented Hogentogler 15cm^2 conical probe into the ground at a rate of 2cm per second using a 30-ton truck as a reaction mass. An electronic data acquisition system recorded a nearly continuous log of the resistance of the soil against the cone tip (Qc) and soil friction against the cone sleeve (Fs) as the probe was advanced. Empirical relationships (Robertson and Campanella, 1989) were then applied to the data to give a continuous profile of the soil stratigraphy. Interpretation of CPT data provides correlations for SPT blow count, phi (ϕ) angle (soil friction angle), undrained shear strength (S_u) of clays and over-consolidation ratio (OCR). These correlations may then be used to evaluate vertical and lateral soil bearing capacities and consolidation characteristics of the subsurface soil.

Interpretive logs of the CPT soundings and logs of the test borings were produced after review of field and laboratory test data and are presented on Plates B-1 through B-5 in Appendix B of this report. Keys to the interpretation of CPT soundings and Logs of Test Borings and are presented on Plates B-6 and B-7. The stratification lines shown on the subsurface logs represent the approximate boundaries between the various strata. However, the transition from one stratum to another may be gradual over some range of depth.

2.2 Laboratory Testing

Laboratory tests were conducted on selected bulk (auger cuttings) obtained from the soil borings to aid in classification and evaluation of selected engineering properties of the site soils. The tests were conducted in general conformance to the procedures of the American Society for Testing and Materials (ASTM) or other standardized methods as referenced below. The laboratory testing program consisted of the following tests:

- Plasticity Index (ASTM D4318)
- Moisture-Density Relationship (ASTM D1557)
- Chemical Analyses (soluble sulfates & chlorides, pH, and resistivity) (Caltrans Methods)

The laboratory test results are presented on the subsurface logs (Appendix B) and in Appendix C.

Engineering parameters of soil strength, compressibility and relative density utilized for developing design criteria provided within this report were either extrapolated from correlations with the subsurface CPT data or from data obtained from the field and laboratory testing program.

Section 3
DISCUSSION

3.1 Site Conditions

The project site is located approximately 3.0 miles west of English Road on the west side of Hudson Ranch No. 1 geothermal plant on McDonald Road northwest of Calipatria, California. The proposed mineral extraction facility project site is planned to be located on the existing equipment/material laydown yard located at the west and south sides of the Hudson Ranch No. 1 geothermal plant. The laydown yard area contains pipes, steel vertical tanks, containers, equipment and materials for the Hudson Ranch geothermal plant. The Mineral Extraction Demonstration Building is located at the mid-east side of the proposed mineral extraction project site.

The project area is located adjacent to the Salton Sea (located approximately ½-mile west), an inland lake with no outlet. Agricultural wastewater and periodic storm water runoff supply the majority of the water sustaining the lake.

Adjacent properties are flat-lying and are approximately at the same elevation with this site. The Hudson Ranch 1 Geothermal Plant forms the eastern boundary of the site. McDonald Road abuts the north side of the project site. Abandoned shallow duck ponds lies to the southeast side of the project site. Several carbon dioxide (CO_2) gas driven mud volcanoes are sited at the vacant parcel located southwest of the site. Vacant land located adjacent to the west side is planned to be used as the new open laydown yard.

The project site lies at an elevation of approximately 220 feet below mean sea level (MSL) (El. 780 local datum) in the Imperial Valley region of the California low desert. The surrounding properties lie on terrain which is flat (planar), part of a large agricultural valley, which was previously an ancient lake bed covered with fresh water to an elevation of 43± feet above MSL. Annual rainfall in this arid region is less than 3 inches per year with four months of average summertime temperatures above 100 ^{o}F. Winter temperatures are mild, seldom reaching freezing.

3.2 Geologic Setting

The project site is located in the Salton Trough region of the Colorado Desert physiographic province of southeastern California. The Salton Trough is a topographic and geologic structural depression resulting extending from the San Gorgonio Pass to the Gulf of California (Norris & Webb, 1990). The Salton Trough is bounded on the northeast by the San Andreas fault and Chocolate Mountains and the southwest by the Peninsular Range and faults of the San Jacinto Fault Zone. The Salton Trough represents the northward extension of the Gulf of California, containing both marine and non-marine sediments deposited since the Miocene Epoch (Morton, 1977). Tectonic activity that formed the trough continues at a high rate as evidenced by deformed young sedimentary deposits and high levels of seismicity. Figure 1 shows the location of the site in relation to regional faults and physiographic features.

The Imperial Valley is directly underlain by lacustrine deposits, which consist of interbedded lenticular and tabular silt, sand, and clay. The Late Pleistocene to Holocene (present) lake deposits are probably less than 100 feet thick and derived from periodic flooding of the Colorado River which intermittently formed a fresh water lake (Lake Cahuilla). Older deposits consist of Miocene to Pleistocene non-marine and marine sediments deposited during intrusions of the Gulf of California. Basement rock consisting of Mesozoic granite and Paleozoic metamorphic rocks are estimated to exist at depths between 15,000 - 20,000 feet.

3.3 Subsurface Soil

The UC Davis California Soil Resource Lab "SoilWeb Earth" computer application (UC Davis, 2020) for Google Earth indicates that surficial deposits at the project site consist predominantly of silty clay loams overlying fine sands of the Imperial soil group (see Plate A-3). These loams are formed in sediment and alluvium of mixed origin (Colorado River overflows and fresh-water lake-bed sediments).

Subsurface soils encountered during the field exploration conducted on July 20, 2020, consist of approximately 18 to 23 feet of near surface clays (CL-CH). A 1 to 2 feet thick layer of loose to medium dense sandy silt (ML) layer was encountered from 18 to 24 feet below ground surface. Stiff clays to clayey silt soils (CL-ML) were encountered at a depth of 20 to 48 feet below ground surface. Very loose to loose sandy/clayey silts (ML) were encountered at 48 to 50 feet below ground surface the maximum depth of exploration.

The project site is known to have pockets of CO_2 gas between a depth of 50 and 100 feet below ground surface. Gas pressure within this depth was measured at 15 to 24 psi at the Hudson Ranch 1 Geothermal Plant site. Svensen and others (2007) indicate that a sandstone CO_2 reservoir underlies the site at a depth of 150 to 200 meters. The subsurface logs (Plates B-1 through B-5) depicts the stratigraphic relationships of the various soil types.

The native surface clays likely exhibit moderate to high swell potential (Expansion Index, EI = 70 to 110) when correlated to Plasticity Index tests (ASTM D4318) performed on the native soils. The clay is expansive when wetted and can shrink with moisture loss (drying). Development of building foundations and concrete flatwork should include provisions for mitigating potential swelling forces and reduction in soil strength, which can occur from saturation of the soil.

Typical measures considered to remediate expansive soil include:

- Capping silt/clay soil with a non-expansive sand layer of sufficient thickness (3.0 feet minimum) to reduce the effects of soil shrink/swell.
- Moisture conditioning subgrade soils to a minimum of 5% above optimum moisture (ASTM D1557) within the drying zone of surface soils.
- Design of foundations that are resistant to shrink/swell forces of silt/clay soil.
- A combination of the methods described above

3.4 Groundwater

Groundwater was not noted in the CPT soundings, but is typically encountered at approximately 8 to 9 feet below ground surface in the vicinity of the project site. The silts encountered at 18 to 24 feet below ground surface are the water bearing strata.

There is uncertainty in the accuracy of short-term water level measurements, particularly in fine-grained soil. Groundwater levels may fluctuate with precipitation, irrigation of adjacent properties, site landscape watering, drainage, and site grading. The referenced groundwater level should not be interpreted to represent an accurate or permanent condition. Our work scope did not include a groundwater surface mounding study resulting from applied landscape water.

3.5 Faulting

The project site is located in the seismically active Imperial Valley of southern California with numerous mapped faults of the San Andreas Fault System traversing the region. The San Andreas Fault System is comprised of the San Andreas, San Jacinto, and Elsinore Fault Zones in southern California. The Imperial fault represents a transition from the more continuous San Andreas fault to a more nearly echelon pattern characteristic of the faults under the Gulf of California (USGS, 1990). We have performed a computer-aided search of known faults or seismic zones that lie within a 45 mile (72 kilometer) radius of the project site (Table 1).

A fault map illustrating known active faults relative to the site is presented on Figure 1, *Regional Fault Map*. Figure 2 shows the project site in relation to local faults. The criterion for fault classification adopted by the California Geological Survey defines Earthquake Fault Zones along Holocene-active or pre-Holocene faults (CGS, 2019b). Earthquake Fault Zones are regulatory zones that address the hazard of surface fault rupture. A Holocene-active fault is one that has ruptured during Holocene time (within the last 11,700 years). A pre-Holocene fault is a fault that has not ruptured in the last 11,700 years. Pre-Holocene faults may still be capable of surface rupture in the future, but are not regulated by the Alquist-Priolo Act (AP). Review of the current Earthquake Fault Zone maps (CGS, 2019a) indicates that the nearest zoned fault is the Elmore Ranch fault located approximately 5.0 miles southwest of the project site and San Andreas fault located approximately 13.2 miles northwest of the project site.

The project site lies 1.3 miles east of the Brawley Seismic Zone (BSZ), a pull-apart basin between the southern terminus of the San Andreas fault and the northern trace of the Imperial fault. The BSZ is composed of numerous cross-cutting high angle normal faults. The BSZ extends northward beyond the termination of the mapped Imperial/Brawley faults to beneath the Salton Sea, where it terminates upon intersecting the San Andreas fault near Bombay Beach. The Brawley Seismic Zone was the source of the 1981 5.9M_W Westmorland earthquake sequence that involved activity on at least seven distinct fault planes within the zone. An earthquake swarm with eleven (11) earthquakes above magnitude 4.0 (the largest being 5.5$M_{w)}$ occurred approximately 2 miles northwest of Brawley, California between August 26-28, 2012. Although there was no evidence of surface rupture associated with this event, numerous structures in Brawley were damaged.

The faults in the Brawley Seismic Zone are considered to be short enough that earthquakes much larger than 6-6.5M_W are unlikely. The California Geological Survey considers the Brawley Seismic Zone to have a maximum magnitude of 6.4Mw, with a very short 24-year average return interval, and a geologic slip rate of 25 mm/year (CDMG, 1996).

3.6 General Ground Motion Analysis

The project site is considered likely to be subjected to moderate to strong ground motion from earthquakes in the region. Ground motions are dependent primarily on the earthquake magnitude and distance to the seismogenic (rupture) zone. Acceleration magnitudes also are dependent upon attenuation by rock and soil deposits, direction of rupture and type of fault; therefore, ground motions may vary considerably in the same general area.

<u>2019 CBC General Ground Motion Parameters:</u> The California Building Code (CBC) requires that a site-specific ground motion hazard analysis be performed in accordance with ASCE 7-16 Section 11.4.8 for structures on Site Class D and E sites with S_1 greater than or equal to 0.2 and Site Class E sites with S_s greater than or equal to 1.0. **This project site has been classified as Site Class D and has a S_1 value of 0.6, which would require a site-specific ground motion hazard analysis**. However, ASCE 7-16 Section 11.4.8 provides three exceptions which permit the use of conservative values of design parameters for certain conditions for Site Class D and E sites in lieu of a site specific hazard analysis. The exceptions are:

- Exception 1: Structures on Site Class E sites with S_s greater than or equal to 1.0, provided the site coefficient F_a is taken as equal to that of Site Class C.
- Exception 2: Structures on Site Class D sites with S_1 greater than or equal to 0.2, provided the value of the seismic response coefficient C_s is determined by Equations 12.8-2 for values of $T \leq 1.5T_S$ and taken as equal to 1.5 times the value computed in accordance with either Equation 12.8-3 for $T_L \geq T > 1.5T_S$ or Equation 12.8-4 for $T > T_L$.
- Exception 3: Structures on Site Class E sites with S_1 greater than or equal to 0.2, provided that T is less than or equal to T_S and the equivalent static force procedure is used for design.

The project structural engineer should confirm that an exception applies to the project. If none of the exceptions apply, our office should be consulted to perform a site-specific ground motion hazard analysis.

The 2019 CBC general ground motion parameters are based on the Risk-Targeted Maximum Considered Earthquake (MCE_R). The Structural Engineers Association of California (SEAOC) and Office of Statewide Health Planning and Development (OSHPD) Seismic Design Maps Web Application (SEAOC, 2020) was used to obtain the site coefficients and adjusted maximum considered earthquake spectral response acceleration parameters. Design spectral response acceleration parameters are defined as the earthquake ground motions that are two-thirds (2/3) of the corresponding MCE_R ground motions. The Maximum Considered Earthquake Geometric Mean (MCE_G) peak ground acceleration adjusted for soil site class effects (PGA_M) value to be used for liquefaction and seismic settlement analysis in accordance with 2019 CBC Section 1803.5.12 ($PGA_M = F_{PGA}$*PGA) is estimated at 0.55g for the project site. **Design earthquake ground motion parameters are provided in Table 2.**

3.7 Seismic and Other Hazards

- **Groundshaking.** The primary seismic hazard at the project site is the potential for strong groundshaking during earthquakes along the Elmore, Imperial, Brawley, and San Andreas Faults and the Brawley Seismic Zone.
- **Surface Rupture.** The California Geological Survey (2019b) has established Earthquake Fault Zones in accordance with the 1972 Alquist-Priolo Earthquake Fault Zone Act. The Earthquake Fault Zones consists of boundary zones surrounding well defined, active faults or fault segments. The project site does not lie within an A-P Earthquake Fault Zone; therefore, surface fault rupture is considered to be low at the project site.

- **Liquefaction and lateral spreading.** Liquefaction is a potential design consideration because of underlying saturated sandy substrata. Although the Imperial Valley has not yet been evaluated for seismic hazards by the California Geological Survey seismic hazards zonation program, liquefaction is well documented in the Imperial Valley after strong seismic events (McCrink, et al, 2011 and Rymer et al, 2011). The potential for liquefaction at the site is discussed in more detail in Section 3.8. Liquefaction induced lateral spreading is not expected to occur at this site due to the planar topography.

<u>Other Potential Geologic Hazards.</u>

- **Landsliding.** The hazard of landsliding is unlikely due to the regional planar topography. No ancient landslides are shown on geologic maps, aerial photographs and topographic maps of the region and no indications of landslides were observed during our site investigation.
- **Volcanic hazards.** The site is located in proximity to a known volcanically active area (Obsidian Butte and Red Hill). Obsidian Butte and Red Hill are small remnants of volcanic domes located approximately 1.25 and 4 miles southwest of the project site, respectively. The domes erupted about 1,800 to 2,500 years ago (Wright et al, 2015). The subsurface brine fluids around the domes have a high heat flow and are currently being utilized to produce geothermal energy.
- **Tsunamis and seiches.** The site lies within 1 mile of the Salton Sea, so the threat of seiches or other seismically-induced flooding is considered possible. The County of Imperial has established -220 MSL as the minimum height for foundation of all structures unless protected from Salton Sea flood stage by a continuous berm with top elevation of -220 MSL. This minimum height may be modified with time as the Salton Sea level is declining.
- **Flooding.** Based on our review of FEMA (2008) FIRM Panel 060250725C which encompasses the project site, the project site is located in Flood Zone X, an area determined to be outside the 0.2% annual chance (500-year) floodplain. The County of Imperial has established -220 MSL as the minimum height for foundation of all structures unless protected from Salton Sea flood stage by a continuous berm with top elevation of -220 MSL.

- **Collapsible soils.** Collapsible soil generally consists of dry, loose, low-density material that have the potential collapse and compact (decrease in volume) when subjected to the addition of water or excessive loading. Soils found to be most susceptible to collapse include loess (fine grained wind-blown soils), young alluvium fan deposits in semi-arid to arid climates, debris flow deposits and residual soil deposits. Due to the cohesive nature of the subsurface soils and shallow groundwater, the potential for hydro-collapse of the subsurface soils at this project site is considered very low.
- **Expansive soils.** In general, much of the near surface soils in the Imperial Valley consist of silty clays and clays which are moderate to highly expansive. The expansive soil conditions are discussed in more detail in Section 3.3.
- **Underground Carbon Dioxide Gas.** The site lies near a large reservoir of carbon dioxide gas as evidenced by nearby (adjacent southwest vacant property) open craters with bubbling gas and mud pot domes (mud volcanoes). Pockets of CO_2 gas between a depth of 50 and 100 feet below ground surface were encountered in previously geotechnical exploration performed for the Hudson Ranch 1 Geothermal Plant site with a measured gas pressure within this depth of at 15 to 25 psi. Svensen and others (2007) indicate that a sandstone CO_2 reservoir underlies the site at a depth of 150 to 200 meters.

3.8 Liquefaction

Liquefaction occurs when granular soils below the water table are subjected to vibratory motions, such as those produced by earthquakes. With strong ground shaking, the pore water pressure increases as the soil tends to reduce in volume. If the increase in pore water pressure is sufficient to reduce the vertical effective stress (suspending the soil particles in water), the soil strength decreases and the soil behaves as a liquid (similar to quicksand). Liquefaction can produce excessive settlement, ground rupture, lateral spreading, or failure of shallow bearing foundations.

Four conditions are generally required for liquefaction to occur:

(1) the soil must be saturated (relatively shallow groundwater);
(2) the soil must be loosely packed (low to medium relative density);
(3) the soil must be relatively cohesionless (not clayey); and
(4) groundshaking of sufficient intensity must occur to function as a trigger mechanism.

All of these conditions exist to some degree at this site.

Methods of Analysis: The computer program CLiq (Version 2.2.0.32, Geologismiki, 2017) was utilized for liquefaction assessment at the project site. The estimated settlements have been adjusted for transition zones between layers and the post liquefaction volumetric strain has been weighed with depth (Robertson, 2014 and Cetin et al., 2009). Computer printouts of the liquefaction analyses are provided in Appendix E.

The liquefaction potential at the project site was evaluated using the 1997 NCEER Liquefaction Workshop and the Idriss and Boulanger (2008) methods. The 1997 NCEER methods utilize CPT cone readings from site exploration and earthquake magnitude/PGA estimates from the seismic hazard analysis. The resistance to liquefaction is plotted on a chart of cyclic shear stress ratio (CSR) versus a corrected tip pressures $Q_{tn,cs}$. The analysis was performed using a PGA_M value of 0.55g was used in the analysis with a 8-foot groundwater depth and a threshold factor of safety (FS) of 1.3.

The fines content of the liquefiable sands and silts increases their liquefaction resistance in that more ground motion cycles are required to fully develop the increased pore pressures. The CPT tip pressures (Qc) were adjusted to an equivalent clean sand pressure ($Q_{tn,cs}$) in accordance with NCEER (1998).

The soils encountered at the points of exploration included saturated silts and silty sands that could liquefy during a Maximum Considered Earthquake. Liquefaction can occur within several thin isolated sandy silty layers between depths of 8 to 49 feet. The likely triggering mechanism for liquefaction appears to be strong groundshaking associated with the rupture of the San Andreas Fault, Elmore Fault and Brawley Seismic Zone. The analysis is summarized in the table below.

Table 3. Summary of Liquefaction Analysis

Boring Location	Depth To First Liquefiable Zone (ft)	Potential Induced Settlement (in)
CPT-1	15	Less than ¼”
CPT-2	8	Less than ¼”
CPT-3	20.5	Less than ¼”

Liquefaction Induced Settlements: ***Based on empirical relationships, total induced settlements are estimated to be less than ¼ inch should liquefaction occur.*** Differential settlement is estimated at be two-thirds of the total potential settlement in accordance with California Special Publication 117. Accordingly, there is a potential for ⅙ inch of liquefaction induced differential settlement at the project site. The differential settlement based on seismic settlements is estimated at 1 inch over a distance of 100 feet. Foundations should be designed for a maximum deflection of L/720.

Because of the depth of the liquefiable layer, the 8 to 15 feet thick non-liquefiable clay layer will likely act as a bridge over the liquefiable layer resulting in a fairly uniform ground surface settlement; therefore, wide area subsidence of the soil overburden would be the expected effect of liquefaction rather than bearing capacity failure of the proposed structures.

Liquefaction Induced Ground Failure: Based on research from Ishihara (1985) and Youd and Garris (1995) small ground fissure or sand boil formation is unlikely because of the thickness of the overlying unliquefiable soil. Sand boils are conical piles of sand derived from the upward flow of groundwater caused by excess porewater pressures created during strong ground shaking. Sand boils are not inherently damaging by themselves, but are an indication that liquefaction occurred at depth (Jones, 2003). Liquefaction induced lateral spreading is not expected to occur at this site due to the planar topography. According to Youd (2005), if the liquefiable layer lies at a depth greater that about twice the height of a free face, lateral spread is not likely to develop. No slopes or free faces occur at this site.

Mitigation: Based on an estimate of less than ¼ inch of liquefaction induced settlements, no ground improvement or deep foundations are required to mitigate liquefaction settlement at this project site.

Section 4
DESIGN CRITERIA

4.1 Site Preparation

Clearing and Grubbing: All surface improvements, debris or vegetation including grass, trees, and weeds on the site at the time of construction should be removed from the construction area. Root balls should be completely excavated. Organic strippings should be stockpiled and not used as engineered fill. All trash, construction debris, concrete slabs, old pavement, landfill, contaminated soil, and buried obstructions such as old foundations and utility lines exposed during rough grading should be traced to the limits of the foreign material by the grading contractor and removed under our supervision. Any excavations resulting from site clearing should be sloped to a bowl shape to the lowest depth of disturbance and backfilled under the observation of the geotechnical engineer's representative.

Mass Grading: The surface soils are loose with 2 to 4 inches of "fluff" on the surface, as indicated by wheel load depressions. Prior to placing any fills, the surface 12 inches of soil should be uniformly moisture conditioned by discing and wetting to a minimum of optimum plus 2 to 8% and compacted to a minimum of 90% of ASTM D1557 maximum density. Onsite native clays placed as engineered fill should be uniformly moisture conditioned by discing and wetting or drying to optimum plus 2 to 8% and compacted in 6 inch maximum lifts to a minimum of 90% relative compaction. Clods shall be reduced by discing to a maximum dimension of 1.0 inch prior to being placed as fill.

Building Pad Preparation: The existing surface soil within building pads for offices, maintenance shops, laboratory, production packaging, storage and other light building foundation areas should be removed to 36 inches below the building pad elevation or existing grade (whichever is lower) extending five feet beyond all exterior wall/column lines (including adjacent concreted areas). Exposed subgrade should be scarified to a depth of 8 inches, uniformly moisture conditioned to 2 to 8% above optimum moisture content and recompacted to a minimum of 90% of the maximum density determined in accordance with ASTM D1557 methods.

It is possible that wet soils will pump under equipment loads. Light earthmoving and compaction equipment should be planned for compacting soil at depth.

An engineered building support pad consisting a minimum of 3.0 feet of granular soil, placed in maximum 8-inch lifts (loose), compacted to a minimum of 95% of ASTM D1557 maximum density at 2% below to 4% above optimum moisture, should be placed below the administration complex buildings and warehouse slabs. If soft conditions are encountered at the bottom of the excavation and subgrade compaction is not achievable, a layer of geotextile stabilization/separation fabric such as Mirafi 600X or equivalent should be placed directly on the bottom of the excavation after fine grading of the subgrade soils. The geotextile stabilization/separation fabric should be placed in accordance to the manufacturer's recommendations.

Imported fill soil shall be non-expansive and should meet the USCS classifications of ML (non-plastic), SM, SP-SM, or SW-SM with a maximum rock size of 3 inches and no less than 5% passing the No. 200 sieve. The geotechnical engineer should approve imported fill soil sources before hauling material to the site. Imported fill should be placed in lifts no greater than 8 inches in loose thickness and compacted to a minimum of 95% of ASTM D1557 maximum dry density at optimum moisture ±2%.

Mat Foundation Subgrade Preparation (Lightly Loaded Structures): The existing surface soil within mat foundations areas should be removed to 12 inches below the mat foundation elevation or existing grade (whichever is lower) extending five feet beyond the mat foundation. Exposed subgrade should be inspected by the geotechnical engineer and if found to be loose, shall be scarified to a depth of 8 inches, uniformly moisture conditioned to 2 to 8% above optimum and recompacted to at least 90% of the maximum density determined in accordance with ASTM D1557 methods.

An engineered support pad consisting of 12 inches of Class 2 aggregate base shall be placed below mat foundations. The aggregate base shall be compacted to a minimum of 95% of ASTM D1557 maximum density at 2% below to 4% above optimum moisture.

Reinforced Structural Fill: Structures that are not sensitive to settlements, not heavy loaded, or that can be economically replaced or repaired such as small tanks, pumps and vessels, can be supported on shallow foundations on reinforced structural fill. Also, some heavy loaded structures that are settlement tolerant may be supported by mat foundations placed on reinforced structural fill (see Section 4.2 Shallow Foundations, Structural Mats and Settlements).

The performance of structural fill with respect to resisting liquefaction failure mechanisms, and reducing some of the static differential settlements can be enhanced by reinforced the structural fill with geogrid fabrics. Geogrids are polymer grid structures that come in rolls (much like wire mesh). When placed in horizontal layers within the compacted structural fill mass, the geogrids provide tensile properties.

Geotextile fabric and geogrid reinforced structural fill will enhance spreading of foundation loads and resist soil rupture resulting in the following benefits:

- Reduced static and differential settlement.
- Reduced transient loads to the compressible clay soils.
- Reduced rupture potential of surface soils, thus allowing higher foundation loadings.

Effectiveness of the geogrids to achieve the above results is dependent on its projection beyond the loaded foundation to create a reinforced mass larger than the loaded area. It is especially effective where several loaded areas or individual spread footings are underlain by the continuously reinforced mass projecting beyond the extremities of the loaded areas.

Excavation for Reinforced Fill: The native soils should be excavated from the designated foundation areas extending 5.0 feet beyond all exterior foundation lines to 3.0 feet below the planned bottom of foundation level. Exposed subgrade should be inspected by the geotechnical engineer and if found to be loose, shall be scarified to a depth of 8 inches, uniformly moisture conditioned to 2 to 8% above optimum and recompacted to a minimum of 90% of the maximum density determined in accordance with ASTM D1557 methods. A 6 oz. non-woven separation fabric equivalent to Mirafi 160N or equialent should be placed over the subgrade prior to placing the reinforced structural fill.

If soft conditions are encountered at the bottom of the excavation and subgrade compaction is not achievable, a geotextile separation fabric and geogrid layer should be placed over the graded smooth surface prior to placing the reinforced structural fill. The geotextile shall a 6 oz. non-woven fabric equivalent to Mirafi 160N or equivalent. Geogrids shall be either Tensar TriAx 5 or Greenbook Type S2 biaxial geogrid (ex. Tenax MS330 or equivalent). The geotextile stabilization/separation fabric and the geogrid should be placed in accordance to the manufacturer's recommendations.

Reinforced Structural Fill: Structural fill should consist of crushed Caltrans Class 2 aggregate base. The first lift of aggregate base should be end dumped and spread in a 1.0 foot thick uniform layer, uniformly moisture conditioned to ±2% of optimum moisture and compacted to a minimum of 90% of ASTM D1557 maximum density. After completion of compacting, a geogrid reinforcing mesh (Tensar TriAx 5 or Greenbook Type S2 biaxial geogrid (ex. Tenax MS330 or equivalent)). should be placed over the first layer of base material lapped at sides/ends (1.0 foot minimum) in conformance to the manufacturer's installation instructions.

A second 1.0 foot thick layer of aggregate base should be end dumped and spread uniformly over the geogrid mesh. This layer may be placed in two lifts, uniformly moisture conditioned to ±2% of optimum moisture and compacted to a minimum of 95% of ASTM D1557 maximum density. After compacting the second layer a geogrid mesh should be placed over the aggregate base material and two final 0.5 foot thick aggregate base layers placed and compacted to a minimum of 95% of ASTM D1557 maximum density. The completed reinforced structural fill should be a minimum of 3 feet thick.

Following completion of concrete placement for the mat foundation, the remaining excavation area against the foundation should be backfilled with aggregate base in 0.5 foot maximum lifts and compacted to a minimum of 95%.

Concrete Hardscape Areas: In areas other than the basin backfill which are to receive housekeeping slabs or area concrete slabs, the ground surface should be presaturated (20% minimum moisture content) to a minimum depth of 24 inches and then scarified to 8 inches, moisture conditioned to a minimum of 5% over optimum, and recompacted to a minimum of 90% of ASTM D1557 maximum density just prior to concrete placement.

Observation and Density Testing: All site preparation and fill placement should be continuously observed and tested by a representative of a qualified geotechnical engineering firm. Full-time observation services during the excavation and scarification process is necessary to detect undesirable materials or conditions and soft areas that may be encountered in the construction area. The geotechnical firm that provides observation and testing during construction shall assume the responsibility of "*geotechnical engineer of record*" and, as such, shall perform additional tests and investigation as necessary to satisfy themselves as to the site conditions and the geotechnical parameters for site development.

Auxiliary Structures Foundation Preparation: Auxiliary structures such as free standing or retaining walls should have footings extended to a minimum of 30 inches below grade. The existing soil beneath the structure foundation prepared in the manner described for the building pad except the preparation needed only to extend 24 inches below and beyond the footing.

4.2 Shallow Foundations, Structural Mats and Settlements

Spread footings: Shallow spread footings and continuous wall footings are suitable to support the structures planned for offices, control rooms and warehouses. Footings shall be founded on 3.0 feet of engineered granular fill as described in Section 4.1. The foundations may be designed using an allowable soil bearing pressure of 2,000 psf. The allowable soil pressure may be increased by one-third for short term loads induced by winds or seismic events.

Resistance to horizontal loads will be developed by passive earth pressure on the sides of footings and frictional resistance developed along the bases of footings and concrete slabs. Passive resistance to lateral earth pressure may be calculated using an equivalent fluid pressure of 300 pcf (for imported sands) to resist lateral loadings. The top one foot of embedment should not be considered in computing passive resistance unless the adjacent area is confined by a slab or pavement. An allowable friction coefficient of 0.35 (for imported sands) may also be used at the base of the footings to resist lateral loading.

Foundation movement under the estimated static (non-seismic) loadings and static site conditions are estimated to not exceed ¾ inch with differential movement of about two-thirds of total movement for the loading assumptions stated above when the subgrade preparation guidelines given above are followed. Seismically induced liquefaction settlement may be on the order of less than ¾ inch.

Structural Mat Foundations for Lightly Loaded Structures: Mat foundations for lightly loaded structures like pumps, small tanks, generators, etc., may be designed using an allowable soil bearing pressure of 1,500 psf when the foundation is supported on 12 inches of compacted Class 2 aggregate base (95% of ASTM D1557 maximum density to ±2% of optimum moisture). The native soils supporting the concrete structural mat and compacted aggregate base shall be moisture conditioned and recompacted as specified in Section 4.1 of this report.

The allowable soil pressure may be increased by one-third for short term loads induced by winds or seismic events. Design criteria for these mat foundations are provided below.

<u>Flat Plate Structural Mats</u>: The structural mat should have a double mat of steel and a minimum thickness of 12 inches. Structural mats may be designed for a modulus of subgrade reaction (Ks) of 100 pci when placed on 12 inches of compacted Class 2 aggregate base.

Settlement estimates (in inches) for lightly loaded structures (1,000 and 1,500 psf) for different mat dimensions and 12 inches of compacted aggregate base follow:

Table 4: Settlement Estimates (inches)

Load, psf	**Size of Mat (ft.)**						
	6 x 8	**8 x 11**	**10 x10**	**10 x 15**	**15 x 25**	**20 x 20**	**25 x 50**
1,000	0.8	1.0	1.1	1.3	1.9	2.0	2.8
1,500	1.1	1.4	1.5	1.8	2.6	2.7	3.8

Differential movements of about two-thirds of total movement are expected for the lightly loaded structures (1,500 psf).

<u>Structural Mat Foundations for Heavy Structures:</u> Heavily loaded structures that are settlement tolerant may be supported on structural concrete mat foundations. The mat shall be founded on the reinforced structural fill which has been properly prepared and compacted as described in Section 4.1 of this report.

Structural mat foundations placed over reinforced structural fill may be designed using an allowable soil bearing pressure of 4,000 psf. The allowable soil pressure may be increased by one-third for short term loads induced by winds or seismic events.

<u>Flat Plate Structural Mats:</u> Structural mats may be designed for a modulus of subgrade reaction (Ks) of 300 pci when placed on 3.0 feet of Class 2 aggregate base material (reinforced structural fill). The structural fill supported pad shall be moisture conditioned and compacted as specified in Section 4.1 of this report.

Resistance to horizontal loads will be developed by passive earth pressure on the sides of footings and frictional resistance developed along the bases of footings. Passive resistance to lateral earth pressure may be calculated using an equivalent fluid pressure of 350 pcf (for aggregate base) to resist lateral loadings. The top one foot of embedment should not be considered in computing passive resistance unless the adjacent area is confined by a slab or pavement. An allowable friction coefficient of 0.40 may also be used at the base of the mats with aggregate base subgrade to resist lateral loading.

Settlement estimates (in inches) developed for different footing and mat dimensions supported on 3.0 feet of reinforced structural fill and loaded from 1,000 to 4,000 psf follow:

Table 5: Settlement Estimates (inches)

Load, psf	Size of Footing or Mat (ft.)							
	10 x 10	**12 x 25**	**20 x 20**	**25 x 30**	**30 x 35**	**50 x 50**	**50 x 75**	**60 x 120**
1,000	1.1	1.7	1.9	2.4	2.7	3.3	3.5	3.8
2,000	1.9	2.9	3.3	4.1	4.6	5.7	6.1	6.5
3,000	2.6	3.9	4.5	5.5	6.1	---	---	---
4,000	3.1	4.8	5.5	6.7	---	---	---	---

4.3 Flexible Tank Foundations and Settlements

<u>Tank Engineered Pad Preparation:</u> The existing soils underlying the proposed tank area should be removed to a depth of 36 inches below ground surface or a minimum of 24 inches below the bottom of the ring wall foundation (whichever is lower), extending to a minimum of 5 feet beyond the perimeter of the tank. Exposed subgrade should be scarified to a depth of 8 inches, uniformly moisture conditioned to 2 to 8% above optimum moisture content and recompacted to a minimum of 90% of the maximum density determined in accordance with ASTM D1557 methods.

If soft conditions are encountered at the bottom of the excavation and subgrade compaction is not achievable, the native soil at the sub-excavation and footing excavation level should be overlain by a woven geotextile stabilizing fabric (Mirafi HP 370 or equivalent). The area should then be brought to finish grade with engineered fill consisting of the following components:

- 36 inches of reinforced crushed aggregate base
- 8 inches of crushed rock (1" x No. 4)
- 4 inches of oiled sand

The fill may be crowned about 40% of the total center settlement to allow for differential settlement between the tank perimeter and center. If compaction of sub-excavation level is achievable, the 36 inches of aggregate base shall be placed in 8-inch maximum loose lifts and compacted to a minimum 95% of ASTM D1557 maximum density within 2% of optimum moisture.

If bottom of excavation subgrade compaction is not achievable and the geotextile stabilizing fabric is utilized, the first 12-inch layer of aggregate base placed over the geotextile fabric shall be compacted to a minimum of 90%. The remaining engineered aggregate base fill should be placed in 8-inch maximum loose lifts and compacted to a minimum 95% of ASTM D1557 maximum density within 2% of optimum moisture. The crushed rock tank underlayment should meet the gradation requirements of ASTM C33, Size 57 (1" x No. 4 rock).

Steel Tank Foundation: Flexible steel tanks, which can withstand large settlements, generally require minimal foundations, allowing settlement to occur and using flexible connections to inlet/outlet piping. The tank should have a perimeter ring wall foundation which supports the tank wall and roof.

The interior footings and the ringwall may be proportioned for a net load (in addition to the uniform tank liquid load) for dead load of roof weight (plus sustained live load). This soil pressure can be increased by one third for transient and seismic loads. The minimum depth of the ring wall footing should be 24 inches below the finished ground surface. The minimum footing width should be 12 inches.

Estimated Settlements: The subsurface clays are moist and overconsolidated in their natural state. Imposed foundations loads can consolidate the soils by reducing the void ratio through pore water expulsion. The amount of vertical settlement that occurs as a result of soil compression varies with applied loads, foundation shape and width. The clays will consolidate fairly slowly because of its low permeability.

Flexible connections such a "Flex-Tend" expansion joints should be used to connect exterior piping with the tank. The tank should be preloaded and monitored for settlement prior to making piping connections. It may be necessary to readjust piping connections after the loading sequence.

Estimated settlements were calculated using the consolidation and field data test data for the clay strata and Schmertman's analysis for the granular strata using the CPT data correlations. The soils to a depth of the diameter of the tanks (80, 100 and 120 feet) may be significantly stressed to contribute to the overall settlement. The estimated settlement for the different proposed diameter tanks with an imposed pressure load of 1,500 and 2,000 psf are as follow:

Table 6: Settlement Estimates (inches)

Diameter (ft)	**Load (psf)**	**Settlement Estimates (in)**
80	1,500	5.2
	2,000	6.5
100	1,500	5.5
	2,000	6.8
120	1,500	5.7
	2,000	7.0

Soil Improvements and Underlayment: If estimated settlements are excessive even for the flexible steel tanks and connections supported by the engineered fill, the existing soils underlying the clarifier tank should be improved by soil mixing or soil replacement (sand/cement) with 48 inch diameter shafts. The minimum surface area replacement ratio shall be 20 percent.

Table 7: Estimated Settlement – Flexible Steel Tanks Overlaying Soil Mixed Columns

Diameter (ft)	Treatment Depth (ft)	Load (psf)	Settlement Estimates (in)
80	20	1,500	2.0
	25	1,500	1.1
	30	1,500	0.4
	20	2,000	3.1
	25	2,000	2.0
	30	2,000	1.2
100	20	1,500	2.1
	25	1,500	1.1
	30	1,500	0.4
	20	2,000	3.1
	25	2,000	2.1
	30	2,000	1.2
120	20	1,500	2.1
	25	1,500	1.1
	30	1,500	0.4
	20	2,000	3.2
	25	2,000	2.1
	30	2,000	1.2

Following soil mixing, the area should be brought to finish grade with engineered fill consisting of the following components:

- 36 inches of reinforced crushed aggregate base
- 8 inches of crushed rock (1” x No. 4)
- 4 inches of oiled sand

The fill may be crowned about 40% of the total center settlement to allow for differential settlement between the tank perimeter and center.

Estimated Tank Settlements: Tank settlements with soil mixing improvement below the tank are shown in Table 6 and 7 of this report. Flexible connections should be used at inlet/outlet pipes. The clays will consolidate fairly slowly because of their low permeability. "Flex-Tend" piping joints are a common flexible connector. The tank should be preloaded and monitored for settlement prior to making piping connections. It may be necessary to readjust piping connections after the loading sequence.

4.4 Soil Mixing (Rigid Mats)

The use of soil improvement like soil mixing with cement or soil replacement (sand/cement) may be used to reduce settlement to tolerable limits. The highly plastic native clays were found to not mix well with conventional soil mixing augers (Hudson Ranch 1 Plant site) and imported sands may be required for soil-cement mixing.

Structural mat foundations placed over the improved soil are anticipated to be used to support the various structural elements of the plant. Mats overlaying soil mixed columns should be underlain by 3.0 feet of crushed aggregate base (Caltrans Class 2, 1-½" or ¾" grading).

The existing soils should be improved by soil mixing or soil replacement (sand/cement) with 48 inch diameter shafts. The minimum surface area replacement ratio shall be 20 percent. The deep soil mixing serves to reduce settlement by replacing the compressible clay soils below the structures with very stiff soil-cement columns, creating a stiffer composite soil matrix. Soil-cement design should be provided by a licensed specialty contractor. Soil improvement treatment depth may reduce settlements according to Tables No. 8 and 9:

Table 8: Estimated Settlements (1,500 psf Mat Loading)
Mats Overlaying Soil Mixed Columns

Treatment Depth (ft)	Foundation Size (ft)	Load (psf)	Settlement Estimates (in)
20	30x35	1,500	1.6
25	30x35	1,500	0.9
30	30x35	1,500	0.3
20	50x50	1,500	1.9
25	50x50	1,500	1.1
30	50x50	1,500	0.4

Table 9: Estimated Settlements (2,500 psf Mat Loading)
Mats Overlaying Soil Mixed Columns

Treatment Depth (ft)	Foundation Size (ft)	Load (psf)	Settlement Estimates (in)
20	30x35	2,500	3.2
25	30x35	2,500	2.4
30	30x35	2,500	1.7
20	50x50	2,500	3.7
25	50x50	2,500	2.8
30	50x50	2,500	1.9

It is unlikely that significant differential settlement will occur on foundations supported by improved soil. Soil-cement design should be provided by a licensed specialty contractor. Soil-cement design should be provided by a licensed specialty contractor.

4.5 Auger Cast Piles

Auger cast piles (cast-in-place grout with steel cage reinforcement) has been used successfully to provide deep foundations for heavily loaded and critical elements of industrial plants. Estimated capacities of 24 and 30-inch diameter auger cast pile are provided below.

Vertical Capacity: Vertical capacity for 24 and 30-inch diameter shafts are presented in Plate D-1. Capacities for other shaft sizes can be determined in direct proportion to shaft diameters. End bearing and skin friction parameters have been used to determine the allowable shaft capacity. The allowable capacities include a factor of safety of 2.5. Resistance to uplift may be considered equivalent to 50 percent of the allowable downward vertical capacity.

The allowable vertical compression capacities may be increased by 33 percent to accommodate temporary loads from wind or seismic forces. The allowable vertical shaft capacities are based on the supporting capacity of the soil. The structural capacity of the piles should be verified by the structural engineer.

Lateral Capacity: The lateral capacity for 24 and 30 inch diameter shafts are given in the Table 8. The allowable horizontal deflection at the shaft head has been assumed to be one-half inch (0.50 inch).

Table 10: Lateral Capacities – Auger Cast Piles

Shaft Diameter (in.)	**24**		**30**	
Head Condition	Free	Fixed	Free	Fixed
Allowable Head Deflection (in.)	0.5	0.5	0.5	0.5
Length (ft.)	**30**	**30**	**30**	**30**
Lateral Capacity (kips)	22.3	46.0	31.6	63.3
Maximum Moment (foot-kips)	110.8	-290.0	187.5	-479.2
@Depth from Pier Head (ft.)	9.5	0	11.2	0
Length (ft.)	**40**	**40**	**40**	**40**
Lateral Capacity (kips)	22.4	46.1	31.7	66.0
Maximum Moment (foot-kips)	-111.7	-290.8	188.3	-500.0
@Depth from Pier Head (ft.)	9.5	0	11.4	0
Length (ft.)	**45**	**45**	**45**	**45**
Lateral Capacity (kips)	22.4	46.1	31.7	66.0
Maximum Moment (foot-kips)	-111.7	-290.8	188.3	-500.0
@Depth from Pier Head (ft.)	9.5	0	11.4	0

The geotechnical engineer should observe the auger cast pile drilling and electronic logs to evaluate each pile on a case-by-case basis.

Settlement: Total settlements of less than ¼ inch are anticipated for single auger cast piles designed according to the preceding recommendations.

Axial Load Group Effect: If pile spacing is a least 2.5 pile diameters center-to-center, no reduction in axial load capacity is considered necessary for a group effect.

Lateral Load Group Effect: Group action should be considered when the pile/pier spacing in the direction of loading is less than 6 to 8 pile diameters. Reduction in lateral loading for pile/pier group action can be evaluated by reducing the effective Modulus of Soil Reaction in the direction of loading by a reduction factor R, as follow:

Table 11: Lateral Load Reduction Factors for Group Action

Pile Spacing in Direction of Loading D=Pile Diameter	Reduction Factor, R
8D	1.00
6D	0.80
4D	0.50
3D	0.40

Soil Parameters: Soil parameters of the subsurface soil for determining deep foundation capacities are presented in Table No. 10.

Table 12: Soil Strength Parameters for Deep Foundations

Layer Type	Depth (ft)	Unit Weight (pcf)	Friction Angle (deg)	Cohesion (ksf)	Strain Factor, E50 o Dr (%)	Lateral Soil Modulus, k (pci)
CL-CH	0 to 20	125	---	0.70	1.25	120
ML	20 to 22	120	24°	0.50	0.85	300
CL	22 to 48	125	---	0.90	1.00	200
ML	48 to 50	120	24°	0.90	0.85	300

Soil parameters for short drilled pier foundation design (T-Poles) are provided below:

Cohesion = 700 psf (Includes F.S. = 2.0)
Soil Unit Weight = 125 pcf
Phi Angle, Ø = 0
Native Soil Modulus of Soil Reaction, K = 50 pci
Allowable Tip Bearing Capacity = 2,000 psf
Allowable Vertical Skin Friction per foot of depth = 200 psf/ft
Allowable Negative Skin Friction (Tension) per foot of depth = 280 psf/ft
Depth to Groundwater = 9.0 ft. (Historic Level)

4.6 Driven Piles

The use of driven steel pipes had been used successfully for elevated pipe rack supports. Special provisions for corrosion protection due to the corrosive nature of the subsurface soils will be required. Steel driven pipe for the elevated pipe rack supports have been preliminary sized as 10-in diameter with a ½" thick wall. Axial and lateral loads were applied at 2 feet above ground surface. Estimated axial and lateral capacities of a 10-in diameter driven steel pipe are provided in Table 13.

Table 13: Allowable Capacities of Driven Steel Pipe

Pile Type:	Driven 10-in Diameter Steel Pipe		
Pile Length (ft):	**32 feet**	**42 feet**	**47 feet**
Specified Tip Depth (ft):	**30 feet**	**40 feet**	**45 feet**
Height Above Ground (ft):	**2 feet**	**2 feet**	**2 feet**
Pipe Pile Size:	10”	10”	10”
Allowable Axial Capacity (kips) – FS=2.5:	25.1	34.5	39.5
Allowable Lateral Load – Free Head Condition (kips):	2.3	2.4	2.5
Top Deflection (in) – Free Head Condition	0.50	0.50	0.50
Maximum Moment from Lateral Load, Free Head Condition (ft-kips):	8.3	8.4	9.2
Depth of Maximum Moment(from Top of Post), Free Head (ft):	4.8	4.8	4.8

Recommendations for other steel shapes and sizes can be made available upon request.

Vertical Capacity: Point bearing and skin friction parameters have been used to determine the allowable shaft capacity. The allowable capacities include a factor of safety of 2.5. The allowable vertical compression capacities may be increased by 33 percent to accommodate temporary loads derived from wind or seismic forces. The allowable vertical shaft capacities are based on the supporting capacity of the soil. Resistance to uplift may be considered equivalent to 50 percent of the allowable downward vertical capacity.

Lateral Capacity: The allowable lateral load was assumed to be applied at the top of the pile. The allowable horizontal deflection at the shaft head has been assumed to be one-half inch (0.50 inch).

Settlement: Total settlements of less than ¼ inch are anticipated for single piles designed according to the preceding recommendations. If pile spacing is a least 2.5 pile diameters center-to-center, no reduction in axial load capacity is considered necessary for a group effect.

Pile Driving: Complete documentation of the proposed hammer should be submitted to the geotechnical engineer for approval prior to mobilization. Driving records should be maintained on each pile. The numbers of blows required to drive a pile each foot should be recorded. Driving energy necessary to insure development of full design capacity shall be established after each selection of the pile driver.

The geotechnical engineer should observe pile driving and evaluate each pile on a case-by-case basis. Pre-drilling of pilot holes for piles to a depth of half the pile depth will be allowed without reduction in pile capacity.

4.7 Concrete Mixes and Corrosivity

Selected chemical analyses for corrosivity were conducted on bulk samples of the near surface soil from the project site (Plate C-2). The native soils were found to have S2 (severe) levels of sulfate ion concentration (6,426 to 7,014ppm). Sulfate ions in high concentrations can attack the cementitious material in concrete, causing weakening of the cement matrix and eventual deterioration by raveling. The following table provides American Concrete Institute (ACI) recommended cement types, water-cement ratio and minimum compressive strengths for concrete in contact with soils:

Table 14. Concrete Mix Design Criteria due to Soluble Sulfate Exposure

Sulfate Exposure Class	Water-soluble Sulfate (SO_4) in soil, ppm	Cement Type	Maximum Water-Cement Ratio by weight	Minimum Strength f'c (psi)
S0	0-1,000	–	–	–
S1	1,000-2,000	II	0.50	4,000
S2	2,000-20,000	V	0.45	4,500
S3	Over 20,000	V (plus Pozzolon)	0.45	4,500

Note: From ACI 318-14 Table 19.3.1.1 and Table 19.3.2.1

A minimum of 6.5 sacks per cubic yard of concrete (4,500 psi) of Type V Portland Cement with a maximum water/cement ratio of 0.45 (by weight) should be used for concrete placed in contact with native soil on this project (sitework including sidewalks, housekeeping slabs and foundations). Admixtures may be required to allow placement of this low water/cement ratio concrete. Thorough concrete consolidation and hard trowel finishes should be used due to the aggressive soil exposure.

The native soil has very severe levels of chloride ion concentration (>18,000ppm). Chloride ions can cause corrosion of reinforcing steel, anchor bolts and other buried metallic conduits. Resistivity determinations on the soil indicate very severe potential for metal loss because of electrochemical corrosion processes. Mitigation of the corrosion of steel can be achieved by using steel pipes coated with epoxy corrosion inhibitors, asphaltic and epoxy coatings, cathodic protection or by encapsulating the portion of the pipe lying above groundwater with a minimum of 4 inches of densely consolidated concrete. ***No metallic water pipes or conduits should be placed below foundations.***

Foundation designs shall provide a minimum concrete cover of five (5) inches around steel reinforcing or embedded components (anchor bolts, etc.) exposed to native soil. If the 5-inch concrete edge distance cannot be achieved, all embedded steel components (anchor bolts, etc.) shall be epoxy coated for corrosion protection (in accordance with ASTM D3963/A934) or a corrosion inhibitor and a permanent waterproofing membrane shall be placed along the exterior face of the exterior footings. Additionally, the concrete should be thoroughly vibrated at footings during placement to decrease the permeability of the concrete.

Typical corrosion protection for steel pipe piles used for pipe rack supports has consisted of a 12” by 36” deep collar at the top of the pipe pile. This is accomplished by predrilling a 36” diameter hole to 36” deep at each pile location and filling with concrete following pile driving.

Landmark does not practice corrosion engineering. We recommend that a qualified corrosion engineer evaluate the corrosion potential on metal construction materials and concrete at the site to obtain final design recommendations.

4.8 Embankment Construction and General Site Fill

Site preparation and embankment construction: All areas to receive new fill for the embankments should be stripped of all vegetation. The surface 12 inches of native soil shall be uniformly moisture conditioned to 2 to 8% above optimum moisture by discing and compacted in 6-inch maximum lifts to a minimum of 90% of ASTM D1557 maximum density.

The embankment slopes may be constructed no steeper than 3:1 (unless lined with concrete or HDPE/PVC sheeting) with a minimum crown width of 15 feet. Embankments should be overbuilt by 6 inches and subsequently cut to the plan line and grade to remove loose material along the slope faces.

Native cohesive soil from the site or adjacent land areas is anticipated to be used as general and embankment fill and as pond liner material. The fill soils should consist of cohesive silty clay (CL) or clay (CH). The clay soils are considered adequate for engineered fill. The general and embankment fill should be pulverized/disced to less than 1.0 inch maximum clod size, uniformly moisture conditioned to 2 to 8% over optimum, placed in 6 inch maximum lifts and compacted to a minimum of 90% of ASTM D1557 maximum density.

4.9 Excavations

All site excavations should conform to CalOSHA requirements for Type B soil. The contractor is solely responsible for the safety of workers entering trenches. Temporary excavations with depths of 4 feet or less may be cut nearly vertical for short duration. Excavations deeper than 4 feet will require shoring or slope inclinations in conformance to CAL/OSHA regulations for Type B soil. Surcharge loads of stockpiled soil or construction materials should be set back from the top of the slope a minimum distance equal to the height of the slope. All permanent slopes should not be steeper than 3:1 to reduce wind and rain erosion. Protected slopes with ground cover may be as steep as 2:1. However, maintenance with motorized equipment may not be possible at this inclination.

4.10 Utility Trench Backfill

Utility Trench Backfill: Prior to placement of utility bedding, the exposed subgrade at the bottom of trench excavations should be examined for soft, loose, or unstable soil. Loose materials at trench bottoms resulting from excavation disturbance should be removed to firm material. If extensive soft or unstable areas are encountered, these areas should be over-excavated to a depth of at least 2 feet or to a firm base and be replaced with additional bedding material.

Backfill Materials: Pipe zone backfill (i.e., material beneath and in the immediate vicinity of the pipe) should consist of a 4 to 8 inch bed of ⅜-inch crushed rock, sand/cement slurry (3 sack cement factor), and/or crusher fines (sand) extending to a minimum of 12 inches above the top of pipe. If crushed rock is used for pipe zone backfill for utilities, the crushed rock material should be completed surrounded by a 6 oz. non-woven filter fabric such as Mirafi 160N or equivalent. The filter fabric shall cover the trench bottom, sidewalls and over the top of the crushed rock. The filter fabric is recommended to inhibit the migration of fine material into void spaces in the crushed rock which may create the potential for sinkholes or depressions to develop at the ground surface.

Pipe bedding should be in accordance with pipe manufacturer's recommendations. Recommendations provided above for pipe zone backfill are minimum requirements only. More stringent material specifications may be required to fulfill local codes and/or bedding requirements for specific types of pipes. On-site soil free of debris, vegetation, and other deleterious matter may be suitable for use as utility trench backfill above pipezone, but may be difficult to uniformly maintain at specified moistures and compact to the specified densities. Native backfill should only be placed and compacted after encapsulating buried pipes with suitable bedding and pipe envelope material.

Compaction Criteria: Mechanical compaction is recommended; ponding or jetting should not be allowed, especially in areas supporting structural loads or beneath concrete slabs supported-on-grade, pavements, or other improvements. All trench backfill should be placed and compacted in accordance with recommendations provided above for engineered fill.

The pipe zone material (crusher fines, sand) shall be compacted to a minimum of 95% of ASTM D1557 maximum density. Pipe deflection should be checked to not exceed 2% of pipe diameter. Native clay/silt soils may be used to backfill the remainder of the trench. Soils used for trench backfill shall be placed in maximum 6 inch lifts (loose), compacted to a minimum of 90% of ASTM D1557 maximum density at a minimum of 4% above optimum moisture.

Imported granular material is acceptable for backfill of utility trenches. Granular trench backfill used in building pad areas should be plugged with a solid (no clods or voids) 2-foot width of native clay soils at each end of the building foundation to prevent landscape water migration into the trench below the building.

Backfill soil of utility trenches within paved areas should be uniformly moisture conditioned to a minimum of 4% above optimum moisture, placed in layers not more than 6 inches in thickness and mechanically compacted to a minimum of 90% of the ASTM D1557 maximum dry density, except that the top 12 inches shall be compacted to 95% (if granular trench backfill).

4.11 Seismic Design

This site is located in the seismically active southern California area and the site structures are subject to strong ground shaking due to potential fault movements along the San Andreas and Elmore Faults and the Brawley Seismic Zone. Engineered design and earthquake-resistant construction are the common solutions to increase safety and development of seismic areas. Designs should comply with the latest edition of the CBC for Site Class D using the seismic coefficients given in Section 3.6 and Table 2 of this report.

4.12 Laydown Yard

The new laydown yard should consist of a minimum of 8.0 inches of Caltrans Class 2 aggregate base placed over 12 inches of moisture conditioned native clay soil (minimum of 2% above optimum moisture) compacted to a minimum of 90% of the maximum dry density determined by ASTM D1557. Alternately, the access roads may consist of 6.0 inches of aggregate base placed over 9 inches of lime treated soil compacted to a minimum of 90%. Preliminary estimates of lime content required to stabilize the clay soils is 6% hydrated lime by weight of soil.

4.13 Pavements

Pavements should be designed according to the 2020 Caltrans Highway Design Manual or other acceptable methods. Traffic indices were not provided by the project engineer or owner; therefore, we have provided structural sections for several traffic indices for comparative evaluation. The public agency or design engineer should decide the appropriate traffic index for the site. Maintenance of proper drainage is necessary to prolong the service life of the pavements. Based on the current Caltrans method, an estimated R-value of 5 for the subgrade soil and assumed traffic indices, the following table provides our estimates for asphaltic concrete (AC) and Portland Cement Concrete (PCC) pavement sections.

Table 15. Pavement Structural Sections

R-Value of Subgrade Soil - 5 (estimated) Design Method - Caltrans 2020

Traffic Index	Flexible Pavements		Rigid (PCC) Pavements	
	Asphaltic Concrete Thickness (in.)	Aggregate Base Thickness (in.)	Concrete Thickness (in.)	Aggregate Base Thickness (in.)
4.0	3.0	6.5	5.0	6.0
5.0	3.0	10.0	5.5	6.0
6.0	4.0	11.5	6.0	8.0
6.5	4.0	14.0	7.0	8.0
8.0	5.0	17.5	8.0	11.0
10.0	5.0	23.5	9.0	13.0
11.0	6.0	26.0	10.0	15.0

Notes:

1) Asphaltic concrete shall be Caltrans, Type A HMA (Hot Mix Asphalt), ¾ inch maximum (½ inch maximum for parking areas), with PG70-10 asphalt concrete, compacted to a minimum of 95% of the Hveem density (CAL 308) or a minimum of 92% of the Maximum Theoretical Density (ASTM D2041).
2) Aggregate base shall conform to Caltrans Class 2 (¾ in. maximum), compacted to a minimum of 95% of ASTM D1557 maximum dry density.
3) Place pavements on 12 inches of moisture conditioned (minimum 2% above optimum if clays) native clay soil compacted to a minimum of 90% of the maximum dry density determined by ASTM D1557. Prewetting of subgrade soils (to 3.5 feet) may be required depending on moisture of subgrade at time of aggregate base placement.
4) Portland cement concrete for pavements should have Type V cement, a minimum compressive strength of 4,500 psi at 28 days, and a maximum water-cement ratio of 0.45.

5) Typical Street Classifications (Imperial County).

Parking Areas:	TI = 4.0
Cul-de-Sacs:	TI = 5.0
Local Streets:	TI = 6.0
Minor Collectors:	TI = 6.5 (trash truck areas)
Major Collectors:	TI = 8.0
Minor Arterial:	TI = 10.0
Primary Arterial:	TI = 11.0

Section 5
LIMITATIONS AND ADDITIONAL SERVICES

5.1 Limitations

The findings and professional opinions within this report are based on current information regarding the proposed mineral extraction facility at the Hudson Ranch No.1 geothermal power plant located at 409 W. McDonald Road northwest of Calipatria, California. The conclusions and professional opinions of this report are invalid if:

- Structural loads change from those stated or the structures are relocated.
- The Additional Services section of this report is not followed.
- This report is used for adjacent or other property.
- Changes of grade or groundwater occur between the issuance of this report and construction other than those anticipated in this report.
- Any other change that materially alters the project from that proposed at the time this report was prepared.

This report was prepared according to the generally accepted *geotechnical engineering standards of practice* that existed in Imperial County at the time the report was prepared. No express or implied warranties are made in connection with our services.

Findings and professional opinions in this report are based on selected points of field exploration, geologic literature, limited laboratory testing, and our understanding of the proposed project. Our analysis of data and professional opinions presented herein are based on the assumption that soil conditions do not vary significantly from those found at specific exploratory locations. Variations in soil conditions can exist between and beyond the exploration points or groundwater elevations may change. The nature and extend of such variations may not become evident until, during or after construction. If variations are detected, we should immediately be notified as these conditions may require additional studies, consultation, and possible design revisions.

Environmental or hazardous materials evaluations were not performed by Landmark for this project. Landmark 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.

The client has responsibility to see that all parties to the project including designer, contractor, and subcontractor are made aware of this entire report within a reasonable time from its issuance. This report should be considered invalid for periods after two years from the date of report issuance without a review of the validity of the findings and professional opinions by our firm, because of potential changes in the Geotechnical Engineering Standards of Practice. This report is based upon government regulations in effect at the time of preparation of this report. Future changes or modifications to these regulations may require modification of this report. Land or facility use, on and off-site conditions, regulations, design criteria, procedures, or other factors may change over time, which may require additional work. Any party other than the client who wishes to use this report shall notify Landmark of such intended use. Based on the intended use of the report, Landmark 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 Landmark from any liability resulting from the use of this report by any unauthorized party and client agrees to defend, indemnify, and hold Landmark harmless from any claim or liability associated with such unauthorized use or non-compliance.

This report contains information that may be useful in the preparation of contract specifications. However, the report is not worded is such a manner that we recommend its use as a construction specification document without proper modification. The use of information contained in this report for bidding purposes should be done at the contractor's option and risk.

5.2 Plan Review

Landmark Consultants, Inc. should be retained during development of design and construction documents to check that the geotechnical professional opinions are appropriate for the proposed project and that the geotechnical professional opinions are properly interpreted and incorporated into the documents. Landmark should have the opportunity to review the final design plans and specifications for the project prior to the issuance of such for bidding.

Governmental agencies may require review of the plans by the geotechnical engineer of record for compliance to the geotechnical report.

5.3 Additional Services

We recommend that Landmark Consultant be retained to provide the tests and observations services during construction. *The geotechnical engineering firm providing such tests and observations shall become the geotechnical engineer of record and assume responsibility for the project.*

Landmark Consultants, Inc. professional opinions for this site are, to a high degree, dependent upon appropriate quality control of subgrade preparation, fill placement, and foundation construction. Accordingly, the findings and professional opinions in this report are made contingent upon the opportunity for Landmark Consultants to observe grading operations and foundation excavations for the proposed construction.

If parties other than Landmark Consultants, Inc. are engaged to provide observation and testing services during construction, such parties must be notified that they will be required to assume complete responsibility as the geotechnical engineer of record for the geotechnical phase of the project by concurring with the professional opinions in this report and/or by providing alternative professional guidance.

Additional information concerning the scope and cost of these services can be obtained from our office.

Section 6
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TABLES

Table 1
Summary of Characteristics of Closest Known Active Faults

Fault Name	Approximate Distance (miles)	Approximate Distance (km)	Maximum Moment Magnitude (Mw)	Fault Length (km)	Slip Rate (mm/yr)
Elmore Ranch	5.0	8.0	6.6	29 ± 3	1 ± 0.5
Hot Springs *	12.4	19.8			
San Andreas - Coachella	13.2	21.0	7.2	96 ± 10	25 ± 5
Imperial	18.3	29.4	7	62 ± 6	20 ± 5
Brawley *	18.6	29.7			
Superstition Hills	18.8	30.1	6.6	23 ± 2	4 ± 2
Superstition Mountain	22.5	36.0	6.6	24 ± 2	5 ± 3
San Jacinto - Borrego	27.0	43.1	6.6	29 ± 3	4 ± 2
Rico *	28.9	46.2			
Painted Gorge Wash*	29.6	47.4			
San Jacinto - Anza	31.5	50.4	7.2	91 ± 9	12 ± 6
Yuha Well *	33.9	54.3			
Unnamed 1*	34.0	54.4			
Shell Beds	34.4	55.1			
Vista de Anza*	35.6	57.0			
Yuha*	35.8	57.3			
Unnamed 2*	36.6	58.5			
San Jacinto - Coyote Creek	37.3	59.7	6.8	41 ± 4	4 ± 2
Ocotillo*	37.8	60.4			
Laguna Salada	38.0	60.8	7	67 ± 7	3.5 ± 1.5
Elsinore - Coyote Mountain	38.9	62.2	6.8	39 ± 4	4 ± 2
Borrego (Mexico)*	45.0	72.0			

* Note: Faults not included in CGS database.

Table 2a
2019 California Building Code (CBC) and ASCE 7-16 Seismic Parameters

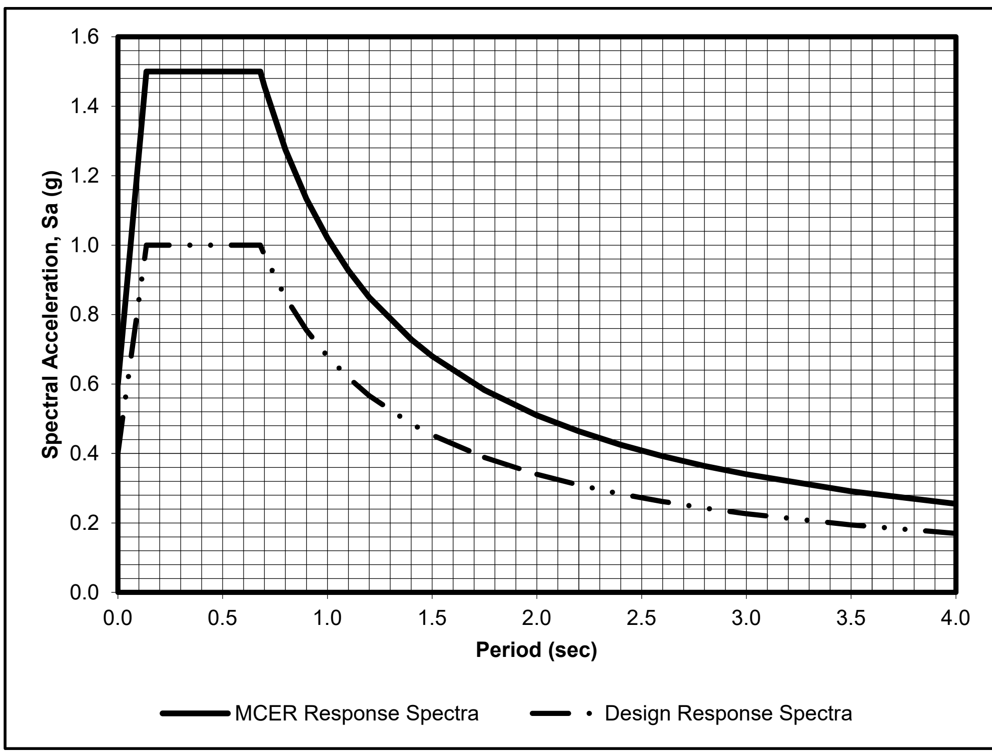
			ASCE 7-16 Reference
Soil Site Class:	**D**		Table 20.3-1
Latitude:	33.2048	N	
Longitude:	-115.5790	W	
Risk Category:	II		
Seismic Design Category:	D		

Maximum Considered Earthquake (MCE) Ground Motion

Mapped MCE_R Short Period Spectral Response	$\mathbf{S_s}$	1.500 g	CBC Figure 1613.3.1(1)	
Mapped MCE_R 1 second Spectral Response	$\mathbf{S_1}$	0.600 g	CBC Figure 1613.3.1(2)	
Short Period (0.2 s) Site Coefficient	$\mathbf{F_a}$	1.00	CBC Table 1613.3.3(1)	
Long Period (1.0 s) Site Coefficient	$\mathbf{F_v}$	1.70	CBC Table 1613.3.3(2)	
MCE_R Spectral Response Acceleration Parameter (0.2 s)	$\mathbf{S_{MS}}$	1.500 g	$= F_a * S_s$	CBC Equation 16-37
MCE_R Spectral Response Acceleration Parameter (1.0 s)	$\mathbf{S_{M1}}$	1.020 g	$= F_v * S_1$	CBC Equation 16-38

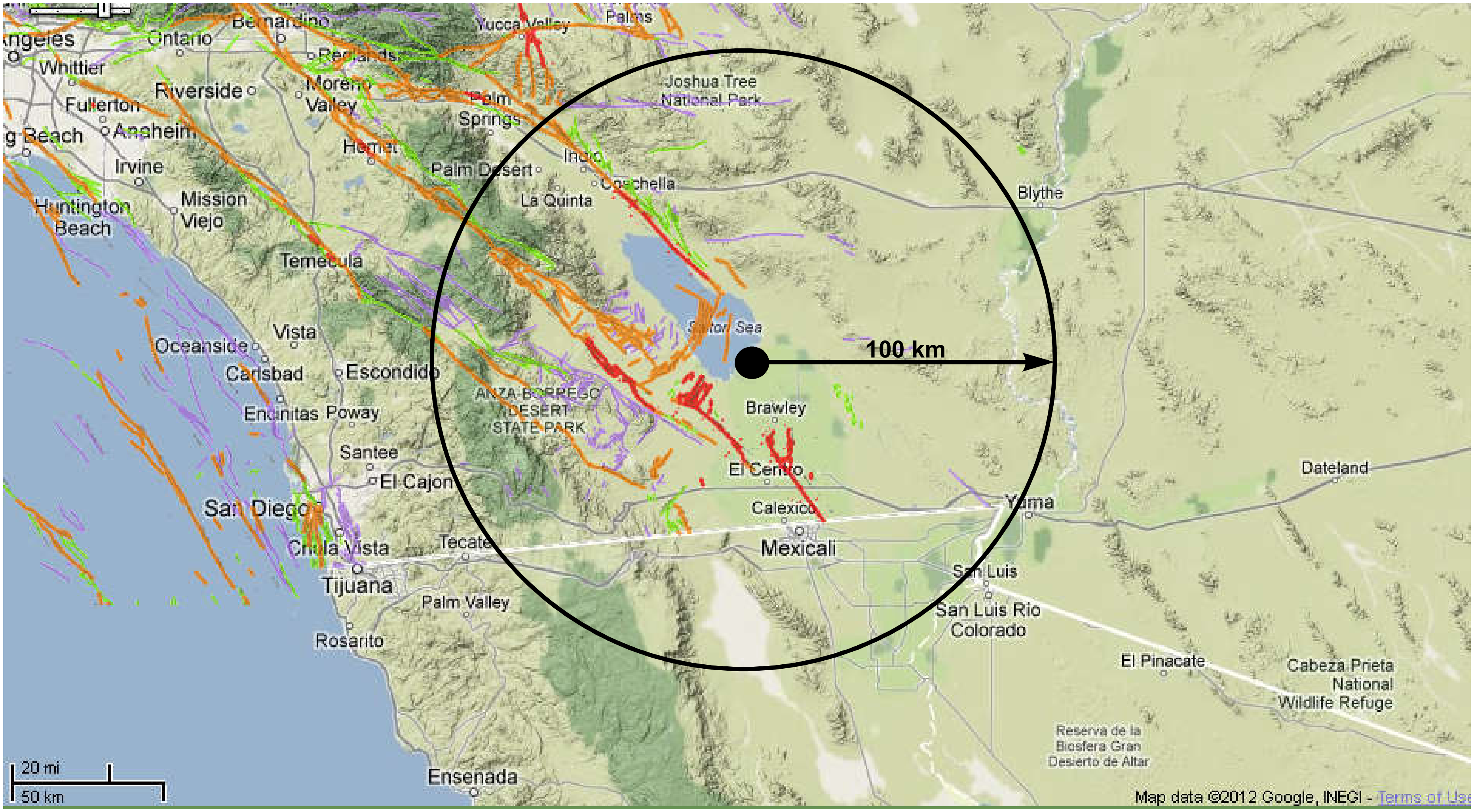
Design Earthquake Ground Motion

Design Spectral Response Acceleration Parameter (0.2 s)	$\mathbf{S_{DS}}$	1.000 g	$= 2/3*S_{MS}$	CBC Equation 16-39
Design Spectral Response Acceleration Parameter (1.0 s)	$\mathbf{S_{D1}}$	0.680 g	$= 2/3*S_{M1}$	CBC Equation 16-40
Risk Coefficient at Short Periods (less than 0.2 s)	$\mathbf{C_{RS}}$	0.945		ASCE Figure 22-17
Risk Coefficient at Long Periods (greater than 1.0 s)	$\mathbf{C_{R1}}$	0.917		ASCE Figure 22-18
	$\mathbf{T_L}$	8.00 sec		ASCE Figure 22-12
	$\mathbf{T_O}$	0.14 sec	$=0.2*S_{D1}/S_{DS}$	
	$\mathbf{T_S}$	0.68 sec	$=S_{D1}/S_{DS}$	
Peak Ground Acceleration	$\mathbf{PGA_M}$	0.55 g		ASCE Equation 11.8-1



Period T (sec)	Sa (g)	MCE_R Sa (g)
0.00	0.40	0.60
0.14	1.00	1.50
0.68	1.00	1.50
0.70	0.97	1.46
0.80	0.85	1.28
0.90	0.76	1.13
1.00	0.68	1.02
1.10	0.62	0.93
1.20	0.57	0.85
1.20	0.57	0.85
1.40	0.49	0.73
1.50	0.45	0.68
1.75	0.39	0.58
2.00	0.34	0.51
2.20	0.31	0.46
2.40	0.28	0.43
2.60	0.26	0.39
2.80	0.24	0.36
3.00	0.23	0.34
3.50	0.19	0.29
4.00	0.17	0.26

FIGURES



Source: California Geological Survey 2010 Fault Activity Map of California
http://www.quake.ca.gov/gmaps/FAM/faultactivitymap.html#

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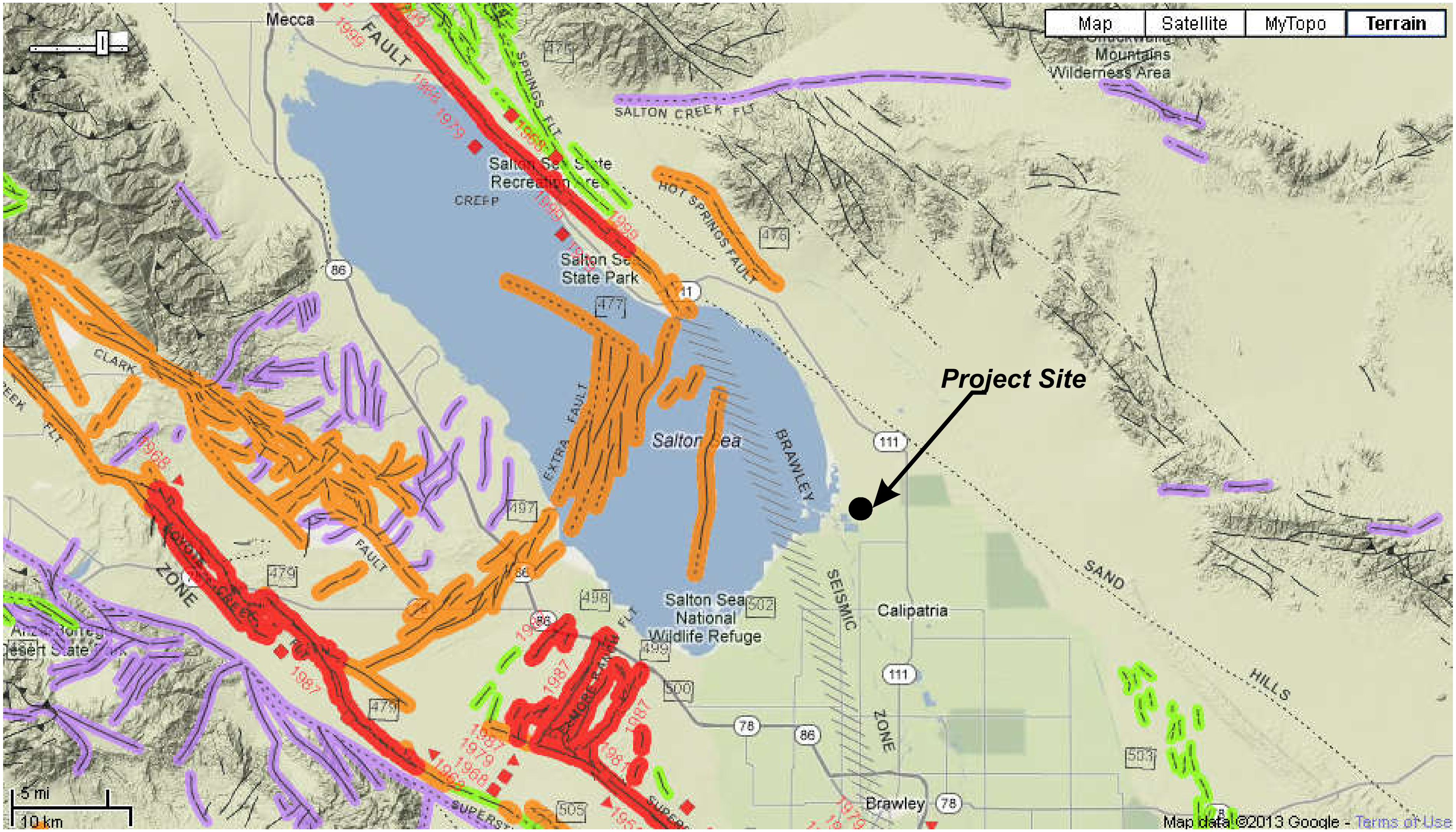
Regional Fault Map

Figure 1



Source: California Geological Survey 2010 Fault Activity Map of California
http://www.quake.ca.gov/gmaps/FAM/faultactivitymap.html#

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Project No.: LE19154

Map of Local Faults

Figure 2

EXPLANATION

Fault traces on land are indicated by solid lines where well located, by dashed lines where approximately located or inferred, and by dotted lines where concealed by younger rocks or by lakes or bays. Fault traces are queried where continuation or existence is uncertain. Concealed faults in the Great Valley are based on maps of selected subsurface horizons, so locations shown are approximate and may indicate structural trend only. All offshore faults based on seismic reflection profile records are shown as solid lines where well defined, dashed where inferred, queried where uncertain.

FAULT CLASSIFICATION COLOR CODE
(Indicating Recency of Movement)

Fault along which historic (last 200 years) displacement has occurred and is associated with one or more of the following:

(a) a recorded earthquake with surface rupture. (Also included are some well-defined surface breaks caused by ground shaking during earthquakes, e.g. extensive ground breakage, not on the White Wolf fault, caused by the Arvin-Tehachapi earthquake of 1952). The date of the associated earthquake is indicated. Where repeated surface ruptures on the same fault have occurred, only the date of the latest movement may be indicated, especially if earlier reports are not well documented as to location of ground breaks.

(b) fault creep slippage - slow ground displacement usually without accompanying earthquakes.

(c) displaced survey lines.

1906 ▶ ◀ 1906 / 1838 ▷ ◁ 1838 — A triangle to the right or left of the date indicates termination point of observed surface displacement. Solid red triangle indicates known location of rupture termination point. Open black triangle indicates uncertain or estimated location of rupture termination point.

▶ 1951 ◀ — Date bracketed by triangles indicates local fault break.

1992 — No triangle by date indicates an intermediate point along fault break.

CREEP — Fault that exhibits fault creep slippage. Hachures indicate linear extent of fault creep. Annotation (creep with leader) indicates representative locations where fault creep has been observed and recorded.

1969 / 1968 ■ ■ 1968 — Square on fault indicates where fault creep slippage has occured that has been triggered by an earthquake on some other fault. Date of causative earthquake indicated. Squares to right and left of date indicate terminal points between which triggered creep slippage has occurred (creep either continuous or intermittent between these end points).

Holocene fault displacement (during past 11,700 years) without historic record. Geomorphic evidence for Holocene faulting includes sag ponds, scarps showing little erosion, or the following features in Holocene age deposits: offset stream courses, linear scarps, shutter ridges, and triangular faceted spurs. Recency of faulting offshore is based on the interpreted age of the youngest strata displaced by faulting.

Late Quaternary fault displacement (during past 700,000 years). Geomorphic evidence similar to that described for Holocene faults except features are less distinct. Faulting may be younger, but lack of younger overlying deposits precludes more accurate age classification.

Quaternary fault (age undifferentiated). Most faults of this category show evidence of displacement sometime during the past 1.6 million years; possible exceptions are faults which displace rocks of undifferentiated Plio-Pleistocene age. Unnumbered Quaternary faults were based on Fault Map of California, 1975. See Bulletin 201, Appendix D for source data.

Pre-Quaternary fault (older that 1.6 million years) or fault without recognized Quaternary displacement. Some faults are shown in this category because the source of mapping used was of reconnaissnce nature, or was not done with the object of dating fault displacements. Faults in this category are not necessarily inactive.

ADDITIONAL FAULT SYMBOLS

Bar and ball on downthrown side (relative or apparent).

Arrows along fault indicate relative or apparent direction of lateral movement.

Arrow on fault indicates direction of dip.

Low angle fault (barbs on upper plate). Fault surface generally dips less than 45° but locally may have been subsequently steepened. On offshore faults, barbs simply indicate a reverse fault regardless of steepness of dip.

OTHER SYMBOLS

491 — Numbers refer to annotations listed in the appendices of the accompanying report. Annotations include fault name, age of fault displacement, and pertinent references including Earthquake Fault Zone maps where a fault has been zoned by the Alquist-Priolo Earthquake Fault Zoning Act. This Act requires the State Geologist to delineate zones to encompass faults with Holocene displacement.

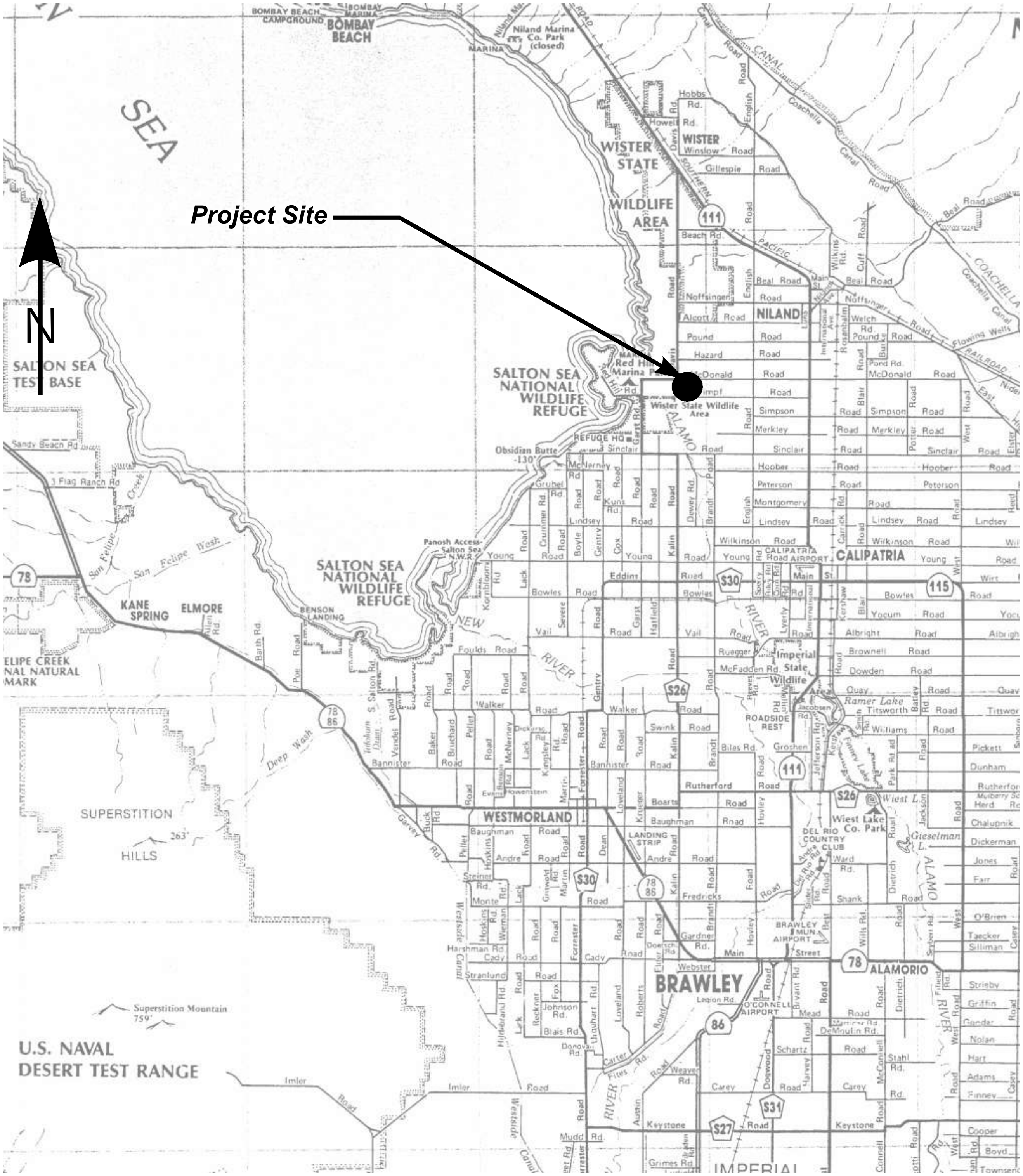
Structural discontinuity (offshore) separating differing Neogene structural domains. May indicate discontinuities between basement rocks.

Brawley Seismic Zone, a linear zone of seismicity locally up to 10 km wide associated with the releasing step between the Imperial and San Andreas faults.

Geologic Time Scale			Years Before Present (Approx.)	Fault Symbol	Recency of Movement	DESCRIPTION ON LAND	DESCRIPTION OFFSHORE
Quaternary	Late Quaternary	Historic	200			Displacement during historic time (e.g. San Andreas fault 1906). Includes areas of known fault creep.	
		Holocene	11,700		? ? ?	Displacement during Holocene time.	Fault offsets seafloor sediments or strata of Holocene age.
		Pleistocene	700,000		? ?	Faults showing evidence of displacement during late Quaternary time.	Fault cuts strata of Late Pleistocene age.
	Early Quaternary		1,600,000*		?	Undivided Quaternary faults - most faults in this category show evidence of displacement during the last 1,600,000 years; possible exceptions are faults which displace rocks of undifferentiated Plio-Pleistocene age.	Fault cuts strata of Quaternary age.
Pre-Quaternary			4.5 billion (Age of Earth)			Faults without recognized Quaternary displacement or showing evidence of no displacement during Quaternary time. Not necessarily inactive.	Fault cuts strata of Pliocene or older age.

* Quaternary now recognized as extending to 2.6 Ma (Walker and Geissman, 2009). Quaternary faults in this map were established using the previous 1.6 Ma criterion.

APPENDIX A



LANDMARK
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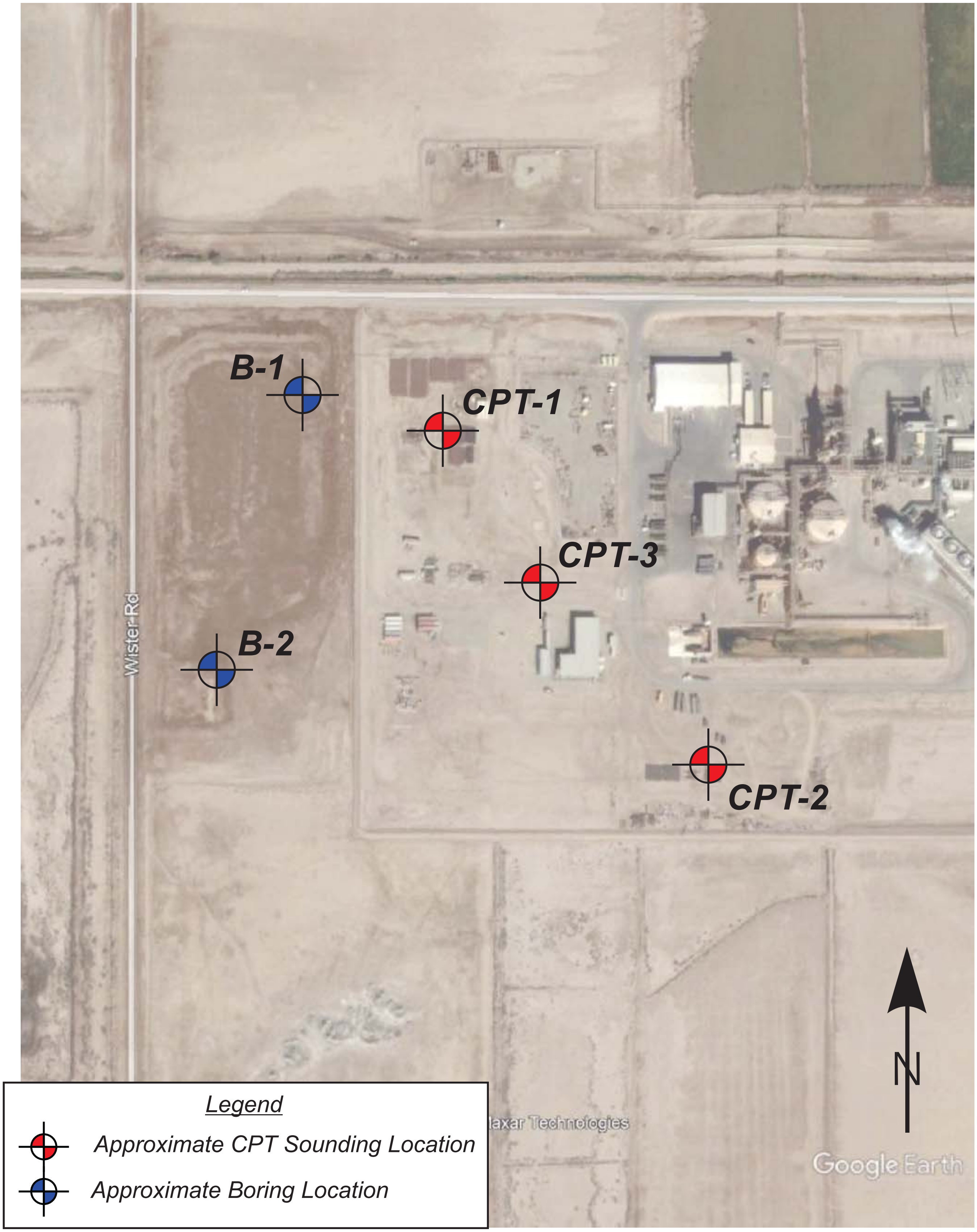
Vicinity Map

Plate A-1



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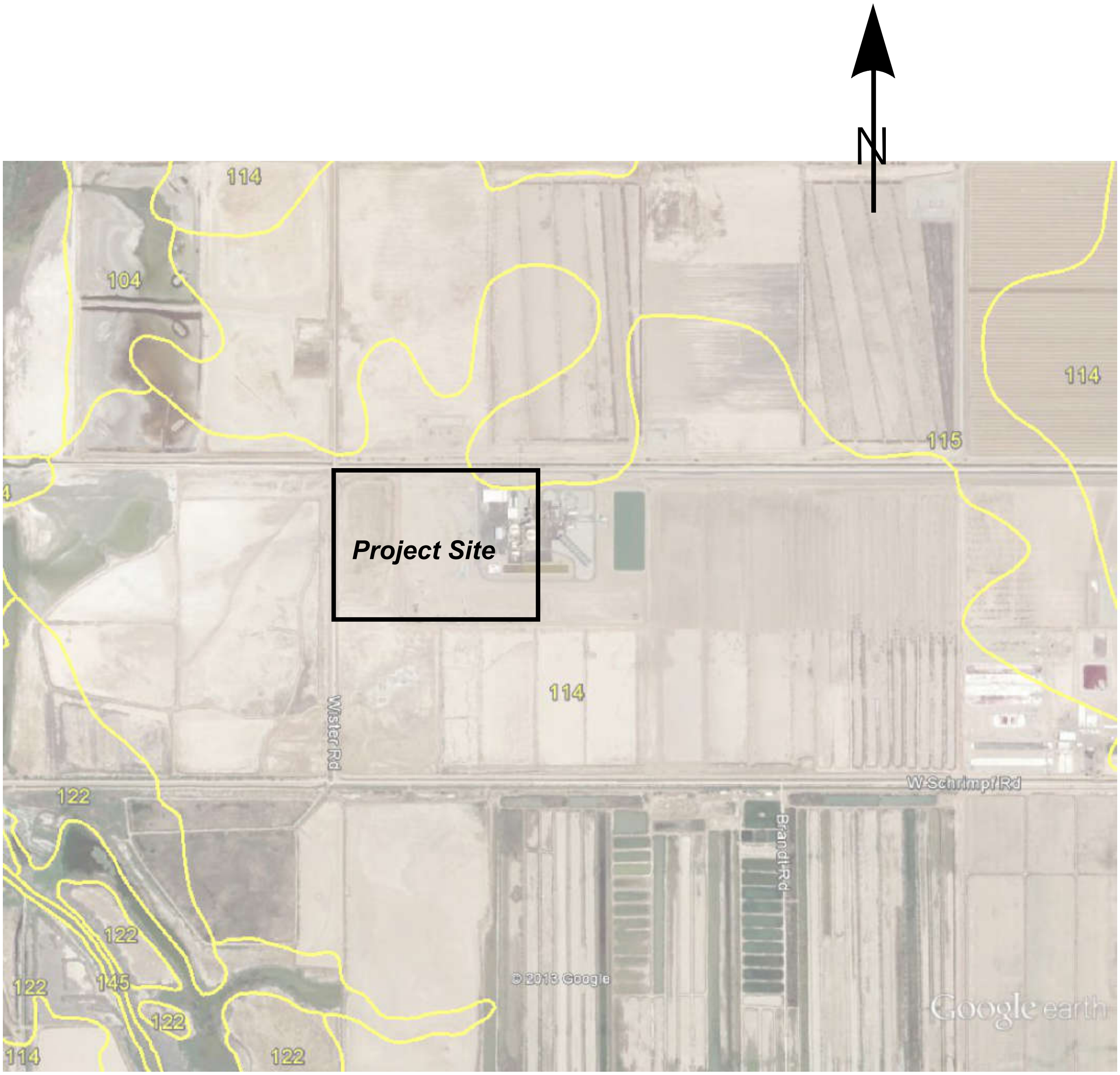
Site and Exploration Plan

Plate
A-2



Geo-Engineers and Geologists

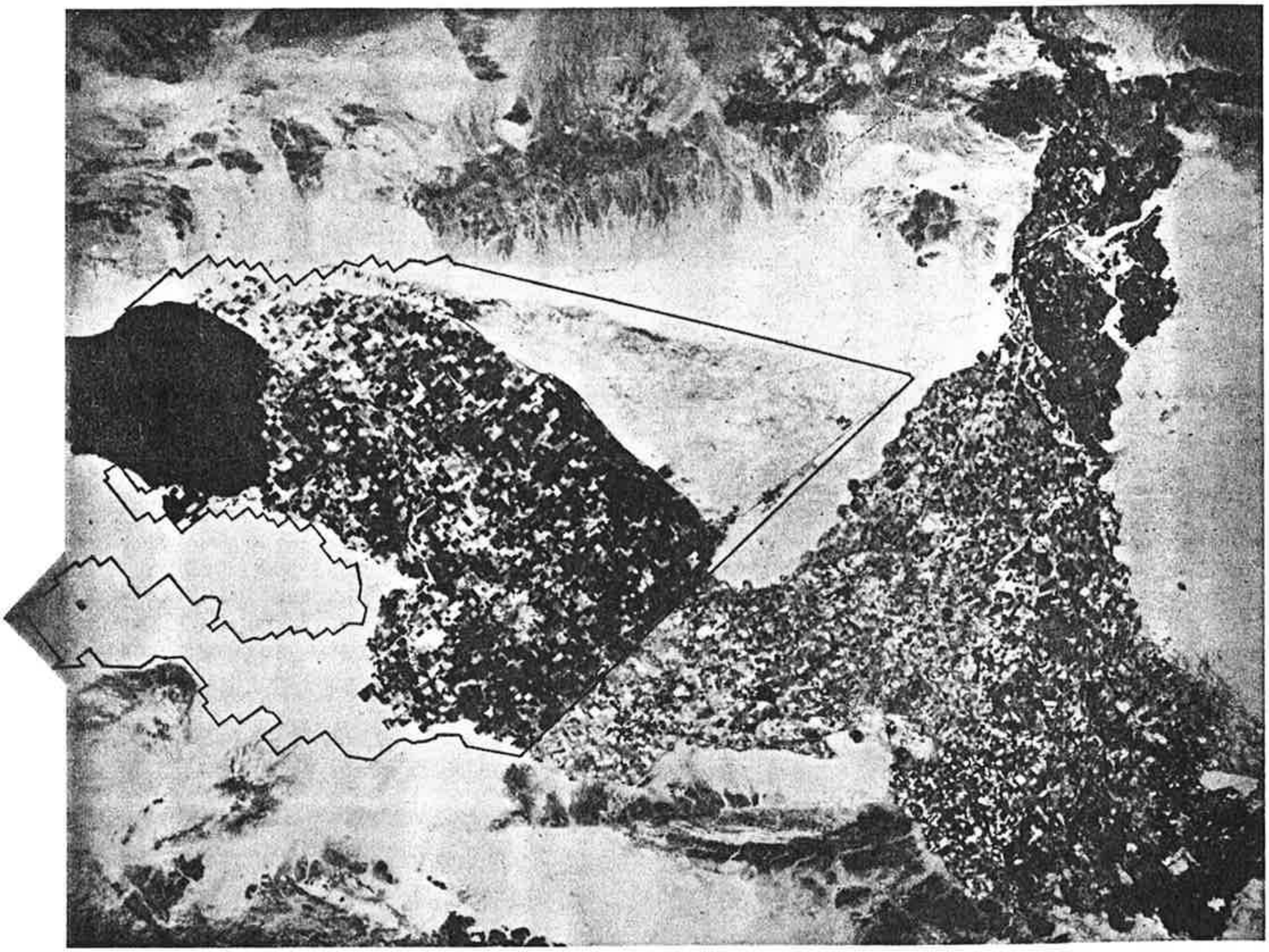
Project No.: LE19154

Soil Survey Map

Plate A-3

Soil Survey of

IMPERIAL COUNTY CALIFORNIA IMPERIAL VALLEY AREA



United States Department of Agriculture Soil Conservation Service

in cooperation with

University of California Agricultural Experiment Station

and

Imperial Irrigation District

TABLE 11.--ENGINEERING INDEX PROPERTIES

[The symbol > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
100 Antho	0-13	Loamy fine sand	SM	A-2	0	100	100	75-85	10-30	---	NP
	13-60	Sandy loam, fine sandy loam.	SM	A-2, A-4	0	90-100	75-95	50-60	15-40	---	NP
101*:											
Antho	0-8	Loamy fine sand	SM	A-2	0	100	100	75-85	10-30	---	NP
	8-60	Sandy loam, fine sandy loam.	SM	A-2, A-4	0	90-100	75-95	50-60	15-40	---	NP
Superstition	0-6	Fine sand	SM	A-2	0	100	95-100	70-85	15-25	---	NP
	6-60	Loamy fine sand, fine sand, sand.	SM	A-2	0	100	95-100	70-85	15-25	---	NP
102*. Badland											
103 Carsitas	0-10	Gravelly sand	SP, SP-SM	A-1, A-2	0-5	60-90	50-85	30-55	0-10	---	NP
	10-60	Gravelly sand, gravelly coarse sand, sand.	SP, SP-SM	A-1	0-5	60-90	50-85	25-50	0-10	---	NP
104* Fluvaquents											
105 Glenbar	0-13	Clay loam	CL	A-6	0	100	100	90-100	70-95	35-45	15-30
	13-60	Clay loam, silty clay loam.	CL	A-6	0	100	100	90-100	70-95	35-45	15-30
106 Glenbar	0-13	Clay loam	CL	A-6, A-7	0	100	100	90-100	70-95	35-45	15-25
	13-60	Clay loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	70-95	35-45	15-25
107* Glenbar	0-13	Loam	ML, CL-ML, CL	A-4	0	100	100	100	70-80	20-30	NP-10
	13-60	Clay loam, silty clay loam.	CL	A-6, A-7	0	100	100	95-100	75-95	35-45	15-30
108 Holtville	0-14	Loam	ML	A-4	0	100	100	85-100	55-95	25-35	NP-10
	14-22	Clay, silty clay	CL, CH	A-7	0	100	100	95-100	85-95	40-65	20-35
	22-60	Silt loam, very fine sandy loam.	ML	A-4	0	100	100	95-100	65-85	25-35	NP-10
109 Holtville	0-17	Silty clay	CL, CH	A-7	0	100	100	95-100	85-95	40-65	20-35
	17-24	Clay, silty clay	CL, CH	A-7	0	100	100	95-100	85-95	40-65	20-35
	24-35	Silt loam, very fine sandy loam.	ML	A-4	0	100	100	95-100	65-85	25-35	NP-10
	35-60	Loamy very fine sand, loamy fine sand.	SM, ML	A-2, A-4	0	100	100	75-100	20-55	---	NP
110 Holtville	0-17	Silty clay	CH, CL	A-7	0	100	100	95-100	85-95	40-65	20-35
	17-24	Clay, silty clay	CH, CL	A-7	0	100	100	95-100	85-95	40-65	20-35
	24-35	Silt loam, very fine sandy loam.	ML	A-4	0	100	100	95-100	55-85	25-35	NP-10
	35-60	Loamy very fine sand, loamy fine sand.	SM, ML	A-2, A-4	0	100	100	75-100	20-55	---	NP

See footnote at end of table.

TABLE 11.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
111*:											
Holtville---------	0-10	Silty clay loam	CL, CH	A-7	0	100	100	95-100	85-95	40-65	20-35
	10-22	Clay, silty clay	CL, CH	A-7	0	100	100	95-100	85-95	40-65	20-35
	22-60	Silt loam, very fine sandy loam.	ML	A-4	0	100	100	95-100	65-85	25-35	NP-10
Imperial----------	0-12	Silty clay loam	CL	A-7	0	100	100	100	85-95	40-50	10-20
	12-60	Silty clay loam, silty clay, clay.	CH	A-7	0	100	100	100	85-95	50-70	25-45
112---------------- Imperial	0-12	Silty clay------	CH	A-7	0	100	100	100	85-95	50-70	25-45
	12-60	Silty clay loam, silty clay, clay.	CH	A-7	0	100	100	100	85-95	50-70	25-45
113---------------- Imperial	0-12	Silty clay------	CH	A-7	0	100	100	100	85-95	50-70	25-45
	12-60	Silty clay, clay, silty clay loam.	CH	A-7	0	100	100	100	85-95	50-70	25-45
114---------------- Imperial	0-12	Silty clay------	CH	A-7	0	100	100	100	85-95	50-70	25-45
	12-60	Silty clay loam, silty clay, clay.	CH	A-7	0	100	100	100	85-95	50-70	25-45
115*:											
Imperial----------	0-12	Silty clay loam	CL	A-7	0	100	100	100	85-95	40-50	10-20
	12-60	Silty clay loam, silty clay, clay.	CH	A-7	0	100	100	100	85-95	50-70	25-45
Glenbar-----------	0-13	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	70-95	35-45	15-25
	13-60	Clay loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	70-95	35-45	15-25
116*:											
Imperial----------	0-13	Silty clay loam	CL	A-7	0	100	100	100	85-95	40-50	10-20
	13-60	Silty clay loam, silty clay, clay.	CH	A-7	0	100	100	100	85-95	50-70	25-45
Glenbar-----------	0-13	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	70-95	35-45	15-25
	13-60	Clay loam, silty clay loam.	CL	A-6	0	100	100	90-100	70-95	35-45	15-30
117, 118----------- Indio	0-12	Loam------------	ML	A-4	0	95-100	95-100	85-100	75-90	20-30	NP-5
	12-72	Stratified loamy very fine sand to silt loam.	ML	A-4	0	95-100	95-100	85-100	75-90	20-30	NP-5
119*:											
Indio-------------	0-12	Loam------------	ML	A-4	0	95-100	95-100	85-100	75-90	20-30	NP-5
	12-72	Stratified loamy very fine sand to silt loam.	ML	A-4	0	95-100	95-100	85-100	75-90	20-30	NP-5
Vint--------------	0-10	Loamy fine sand	SM	A-2	0	95-100	95-100	70-80	25-35	---	NP
	10-60	Loamy sand, loamy fine sand.	SM	A-2	0	95-100	95-100	70-80	20-30	---	NP
120*--------------- Laveen	0-12	Loam------------	ML, CL-ML	A-4	0	100	95-100	75-85	55-65	20-30	NP-10
	12-60	Loam, very fine sandy loam.	ML, CL-ML	A-4	0	95-100	85-95	70-80	55-65	15-25	NP-10

See footnote at end of table.

TABLE 11.--ENGINEERING INDEX PROPERTIES--Continued

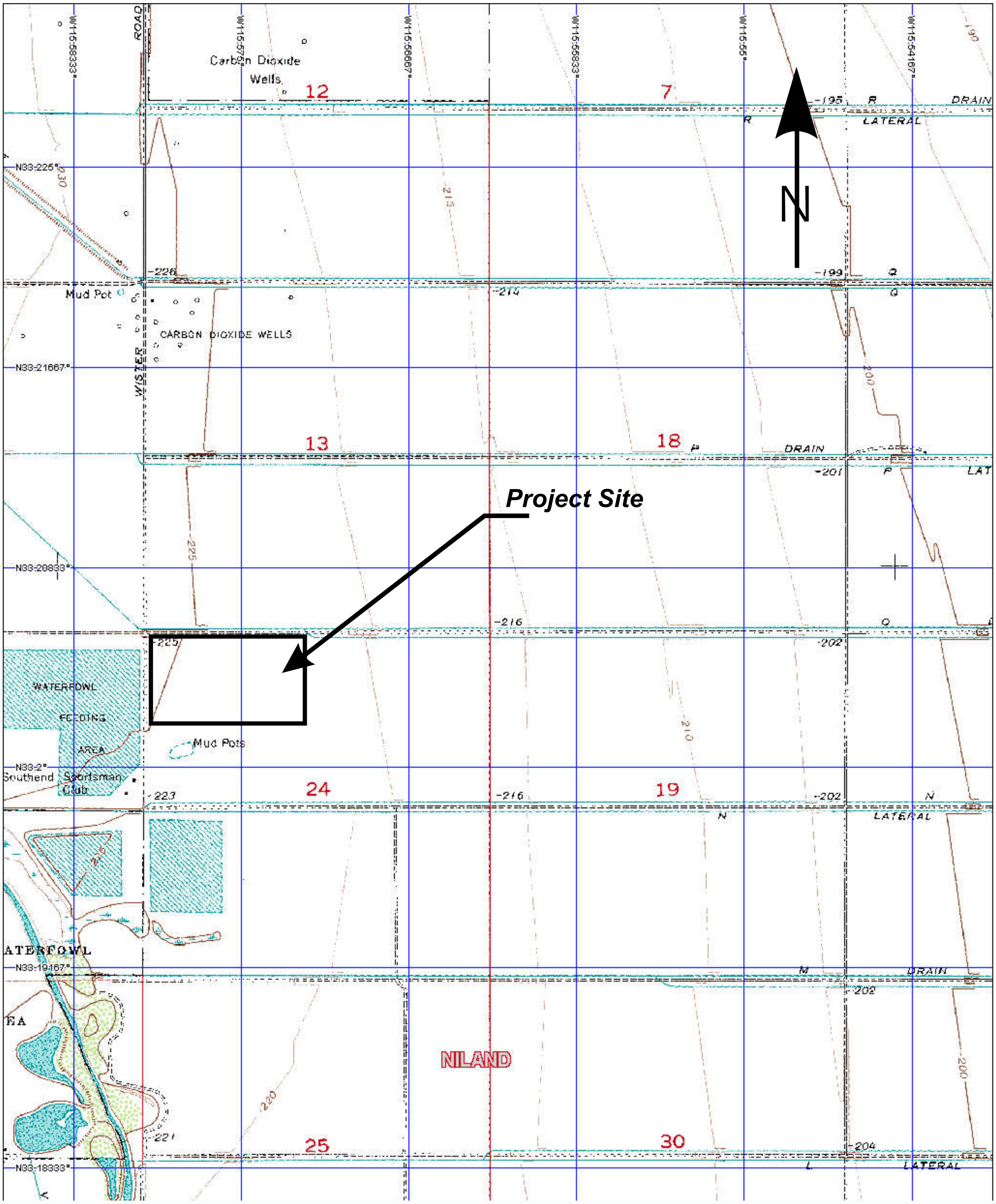
Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
121----------------- Meloland	0-12	Fine sand-------	SM, SP-SM	A-2, A-3	0	95-100	90-100	75-100	5-30	---	NP
	12-26	Stratified loamy fine sand to silt loam.	ML	A-4	0	100	100	90-100	50-65	25-35	NP-10
	26-71	Clay, silty clay, silty clay loam.	CL, CH	A-7	0	100	100	95-100	85-95	40-65	20-40
122----------------- Meloland	0-12	Very fine sandy loam.	ML	A-4	0	95-100	95-100	95-100	55-85	25-35	NP-10
	12-26	Stratified loamy fine sand to silt loam.	ML	A-4	0	100	100	90-100	50-70	25-35	NP-10
	26-71	Clay, silty clay, silty clay loam.	CH, CL	A-7	0	100	100	95-100	85-95	40-65	20-40
123*:											
Meloland----------	0-12	Loam-------------	ML	A-4	0	95-100	95-100	95-100	55-85	25-35	NP-10
	12-26	Stratified loamy fine sand to silt loam.	ML	A-4	0	100	100	90-100	50-70	25-35	NP-10
	26-38	Clay, silty clay, silty clay loam.	CH, CL	A-7	0	100	100	95-100	85-95	40-65	20-40
	38-60	Stratified silt loam to loamy fine sand.	SM, ML	A-4	0	100	100	75-100	35-55	25-35	NP-10
Holtville---------	0-12	Loam-------------	ML	A-4	0	100	100	85-100	55-95	25-35	NP-10
	12-24	Clay, silty clay	CH, CL	A-7	0	100	100	95-100	85-95	40-65	20-35
	24-36	Silt loam, very fine sandy loam.	ML	A-4	0	100	100	95-100	55-85	25-35	NP-10
	36-60	Loamy very fine sand, loamy fine sand.	SM, ML	A-2, A-4	0	100	100	75-100	20-55	---	NP
124, 125----------- Niland	0-23	Gravelly sand---	SM, SP-SM	A-2, A-3	0	90-100	70-95	50-65	5-25	---	NP
	23-60	Silty clay, clay, clay loam.	CL, CH	A-7	0	100	100	85-100	80-95	40-65	20-40
126----------------- Niland	0-23	Fine sand-------	SM, SP-SM	A-2, A-3	0	90-100	90-100	50-65	5-25	---	NP
	23-60	Silty clay------	CL, CH	A-7	0	100	100	85-100	80-95	40-65	20-40
127----------------- Niland	0-23	Loamy fine sand	SM	A-2	0	90-100	90-100	50-65	15-30	---	NP
	23-60	Silty clay------	CL, CH	A-7	0	100	100	85-100	80-95	40-65	20-40
128*:											
Niland------------	0-23	Gravelly sand---	SM, SP-SM	A-2, A-3	0	90-100	70-95	50-65	5-25	---	NP
	23-60	Silty clay, clay, clay loam.	CL, CH	A-7	0	100	100	85-100	80-100	40-65	20-40
Imperial----------	0-12	Silty clay------	CH	A-7	0	100	100	100	85-95	50-70	25-45
	12-60	Silty clay loam, silty clay, clay.	CH	A-7	0	100	100	100	85-95	50-70	25-45
129*: Pits											
130, 131----------- Rositas	0-27	Sand------------	SP-SM	A-3, A-1, A-2	0	100	80-100	40-70	5-15	---	NP
	27-60	Sand, fine sand, loamy sand.	SM, SP-SM	A-3, A-2, A-1	0	100	80-100	40-85	5-30	---	NP

See footnote at end of table.

TABLE 11.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag-ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas-ticity index
	In				Pct					Pct	
132, 133, 134, 135-Rositas	0-9	Fine sand	SM	A-3, A-2	0	100	80-100	50-80	10-25	---	NP
	9-60	Sand, fine sand, loamy sand.	SM, SP-SM	A-3, A-2, A-1	0	100	80-100	40-85	5-30	---	NP
136 Rositas	0-4	Loamy fine sand	SM	A-1, A-2	0	100	80-100	40-85	10-35	---	NP
	4-60	Sand, fine sand, loamy sand.	SM, SP-SM	A-3, A-2, A-1	0	100	80-100	40-85	5-30	---	NP
137 Rositas	0-12	Silt loam	ML	A-4	0	100	100	90-100	70-90	20-30	NP-5
	12-60	Sand, fine sand, loamy sand.	SM, SP-SM	A-3, A-2, A-1	0	100	80-100	40-85	5-30	---	NP
138*:											
Rositas	0-4	Loamy fine sand	SM	A-1, A-2	0	100	80-100	40-85	10-35	---	NP
	4-60	Sand, fine sand, loamy sand.	SM, SP-SM	A-3, A-2, A-1	0	100	80-100	40-85	5-30	---	NP
Superstition	0-6	Loamy fine sand	SM	A-2	0	100	95-100	70-85	15-25	---	NP
	6-60	Loamy fine sand, fine sand, sand.	SM	A-2	0	100	95-100	70-85	15-25	---	NP
139 Superstition	0-6	Loamy fine sand	SM	A-2	0	100	95-100	70-85	15-25	---	NP
	6-60	Loamy fine sand, fine sand, sand.	SM	A-2	0	100	95-100	70-85	15-25	---	NP
140*:											
Torriorthents											
Rock outcrop											
141*:											
Torriorthents											
Orthids											
142 Vint	0-10	Loamy very fine sand.	SM, ML	A-4	0	100	100	85-95	40-65	15-25	NP-5
	10-60	Loamy fine sand	SM	A-2	0	95-100	95-100	70-80	20-30	---	NP
143 Vint	0-12	Fine sandy loam	ML, CL-ML, SM, SM-SC	A-4	0	100	100	75-85	45-55	15-25	NP-5
	12-60	Loamy sand, loamy fine sand.	SM	A-2	0	95-100	95-100	70-80	20-30	---	NP
144*:											
Vint	0-10	Very fine sandy loam.	SM, ML	A-4	0	100	100	85-95	40-65	15-25	NP-5
	10-40	Loamy fine sand	SM	A-2	0	95-100	95-100	70-80	20-30	---	NP
	40-60	Silty clay	CL, CH	A-7	0	100	100	95-100	85-95	40-65	20-35
Indio	0-12	Very fine sandy loam.	ML	A-4	0	95-100	95-100	85-100	75-90	20-30	NP-5
	12-40	Stratified loamy very fine sand to silt loam.	ML	A-4	0	95-100	95-100	85-100	75-90	20-30	NP-5
	40-72	Silty clay	CL, CH	A-7	0	100	100	95-100	85-95	40-65	20-35

* See description of the map unit for composition and behavior characteristics of the map unit.



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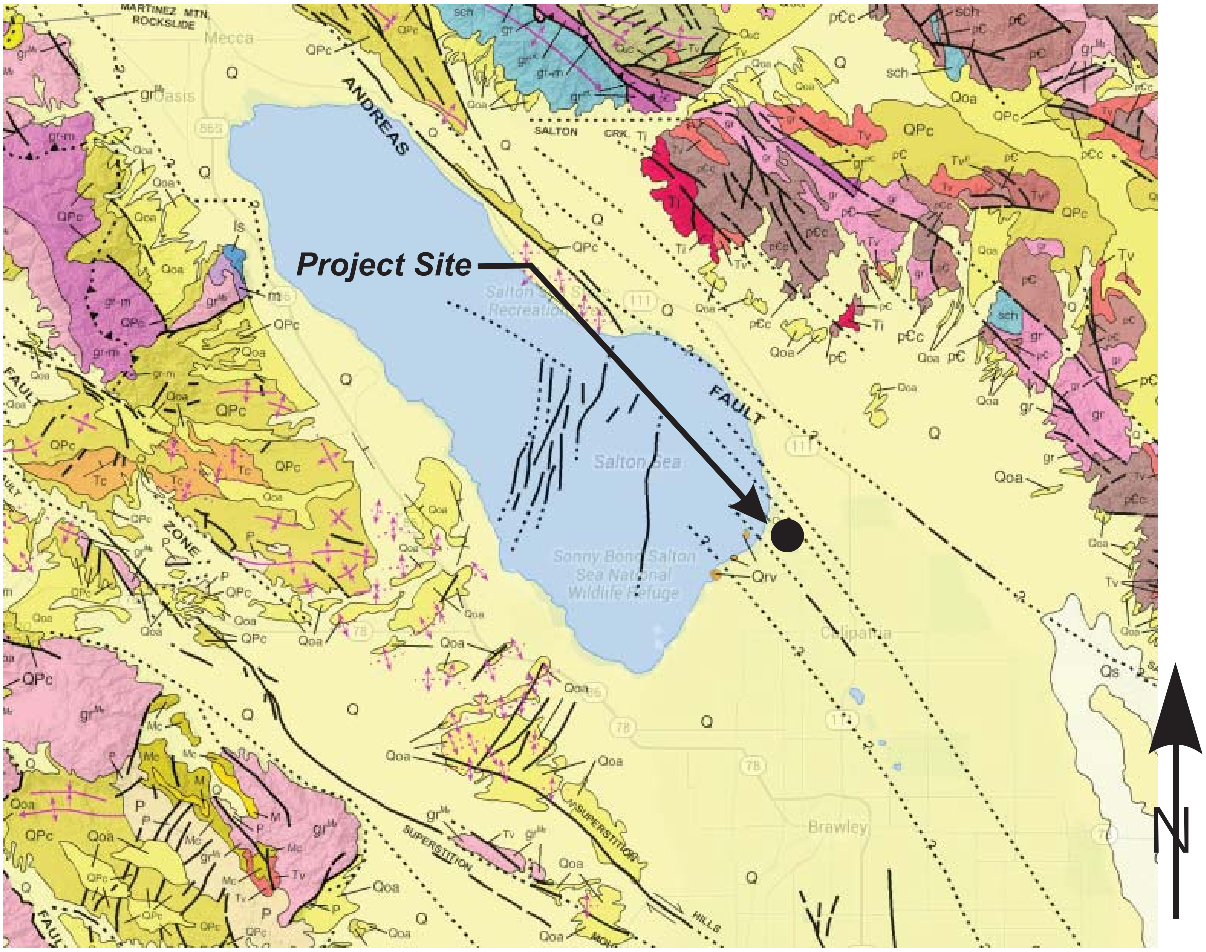
Topographic Map

Plate A-4



GEOLOGIC LEGEND

Quaternary Deposits
- Qs
- Q
- Qls
- Qg
- Qoa
- QPc

Quaternary Volcanic Rocks
- Qrv, Qrv
- Qv, Qv

Tertiary Sedimentary Rocks
- Tc
- P
- M, Mc
- Oc, Ocv
- E, Ec
- Ep

Tertiary Volcanic Rocks
- Tv, Tv
- Ti

Tertiary Plutonic Rocks
- gr

Mesozoic Sedimentary and Metasedimentary Rocks
- TK
- K
- Ku
- Kl
- KJf, KJf, KJf
- J
- T̶R
- sch
- ls

Mesozoic Mixed Rocks
- gr-m

Mesozoic Metavolcanic Rocks
- Mzv
- mv

Mesozoic Plutonic Rocks
- gr
- um
- gb
- gr

Paleozoic Sedimentary and Metasedimentary Rocks
- Pz
- Pm
- C
- D
- SO
- Є

Paleozoic Mixed Rocks
- m

Paleozoic Metavolcanic Rocks
- Pzv

Paleozoic Plutonic Rocks
- gr

Pre-Cambrian Rocks
- pЄ
- pЄc
- gr

SYMBOLS

Geologic boundary

Fault traces - solid where well located, dashed where approximately located or inferred, dotted where concealed, and queried where continuation or existence is uncertain. Ball and bar on downthrown side (relative or apparent). Arrows indicate direction of lateral movement (relative or apparent).

Thrust fault (barbs on upper plate).

Regional strike and dip of stratified rocks.

Regional strike and dip of stratified rocks (overturned).

Anticlinal fold.

Synclinal fold.

Monoclinal fold.

Site Location
Lat N33.2048 Long: W-115.5790

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Project No.: LE19154

Regional Geologic Map

Plate A-5

APPENDIX B

CLIENT: Energy Source
PROJECT: Minerals Processing Facility - Calipatria, CA
LOCATION: See Site and Boring Location Plan

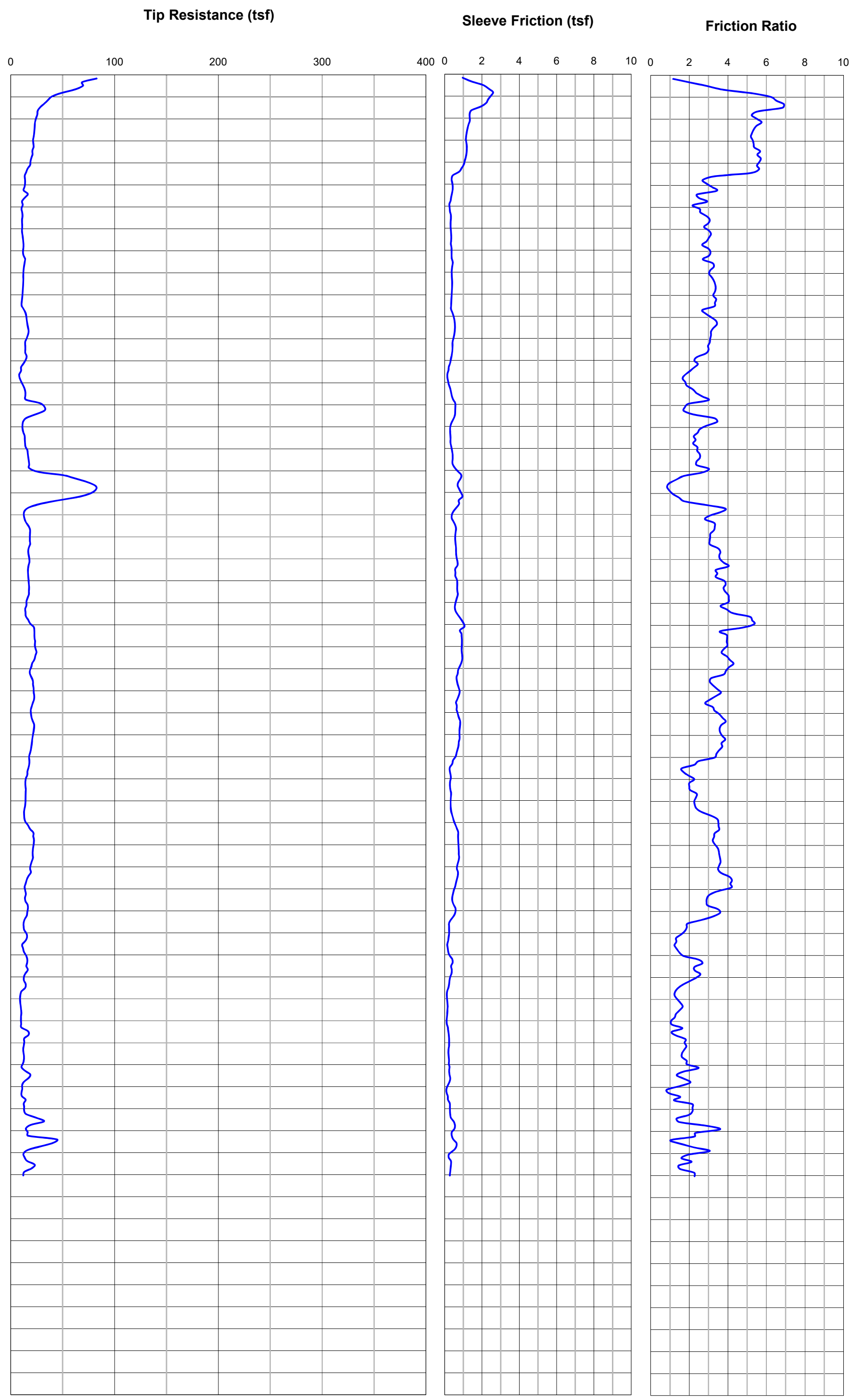
CONE PENETROMETER: Kehoe Testing & Engineering Truck Mounted Electric Cone with 30 ton reaction weight
DATE: 7/20/2020

CONE SOUNDING DATA CPT-1

INTERPRETED SOIL PROFILE
From Robertson and Campanella (1989

GROUND ELEVATION +/-

DEPTH	Soil Type	USCS	Consistency
	Clayey Silt to Silty Clay	ML/CL	hard
	Clay	CL/CH	very stiff
	Clay	" "	very stiff
	Clay	" "	very stiff
	Clay	" "	stiff
5	Clayey Silt to Silty Clay	ML/CL	stiff
	Silty Clay to Clay	CL	stiff
	Silty Clay to Clay	" "	stiff
	Silty Clay to Clay	" "	stiff
	Silty Clay to Clay	" "	stiff
10	Silty Clay to Clay	" "	stiff
	Clayey Silt to Silty Clay	ML/CL	stiff
	Clayey Silt to Silty Clay	" "	stiff
	Clayey Silt to Silty Clay	" "	stiff
	Clayey Silt to Silty Clay	" "	stiff
15	Clayey Silt to Silty Clay	" "	very stiff
	Clayey Silt to Silty Clay	" "	stiff
	Clayey Silt to Silty Clay	" "	very stiff
	Sand to Silty Sand	SP/SM	medium dense
	Sandy Silt to Clayey Silt	ML	loose
20	Clayey Silt to Silty Clay	ML/CL	stiff
	Clayey Silt to Silty Clay	" "	stiff
	Silty Clay to Clay	CL	stiff
	Silty Clay to Clay	" "	stiff
	Clay	CL/CH	stiff
25	Silty Clay to Clay	CL	very stiff
	Silty Clay to Clay	" "	very stiff
	Clayey Silt to Silty Clay	ML/CL	very stiff
	Clayey Silt to Silty Clay	" "	very stiff
	Clayey Silt to Silty Clay	" "	very stiff
30	Clayey Silt to Silty Clay	" "	very stiff
	Clayey Silt to Silty Clay	" "	stiff
	Clayey Silt to Silty Clay	" "	stiff
	Clayey Silt to Silty Clay	" "	stiff
	Clayey Silt to Silty Clay	" "	very stiff
35	Clayey Silt to Silty Clay	" "	very stiff
	Silty Clay to Clay	CL	stiff
	Clayey Silt to Silty Clay	ML/CL	stiff
	Clayey Silt to Silty Clay	" "	stiff
	Sandy Silt to Clayey Silt	ML	very loose
40	Clayey Silt to Silty Clay	ML/CL	stiff
	Clayey Silt to Silty Clay	" "	stiff
	Clayey Silt to Silty Clay	" "	firm
	Sandy Silt to Clayey Silt	ML	very loose
	Clayey Silt to Silty Clay	ML/CL	stiff
45	Clayey Silt to Silty Clay	" "	stiff
	Clayey Silt to Silty Clay	" "	stiff
	Clayey Silt to Silty Clay	" "	very stiff
	Sandy Silt to Clayey Silt	ML	loose
	Sandy Silt to Clayey Silt	" "	very loose
50			
55			



END OF SOUNDING AT 50 ft.

Project No.
LE19154

LANDMARK
Geo-Engineers and Geologists

PLATE
B-1

LANDMARK CONSULTANTS, INC.
CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: Minerals Processing Facility - Calipatria, CA **Project No:** LE19154 **Date:** 7/20/2020

CONE SOUNDING: CPT-1
Est. GWT (ft): 8
Phi Correlation: **0** 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	**Nk:** Phi (deg.)	**17** Su (tsf)	OCR
0.15	0.5	73.71	2.06	Silty Sand to Sandy Silt	SM/ML	very dense	115	16	139.3	30	125	46		
0.30	1.0	50.28	5.10	Silty Clay to Clay	CL	hard	125	29		60			2.96	>10
0.45	1.5	32.03	6.75	Clay	CL/CH	very stiff	125	26		80			1.88	>10
0.60	2.0	25.30	5.43	Clay	CL/CH	very stiff	125	20		80			1.48	>10
0.75	2.5	23.16	5.53	Clay	CL/CH	very stiff	125	19		85			1.35	>10
0.93	3.0	22.05	5.25	Clay	CL/CH	very stiff	125	18		85			1.29	>10
1.08	3.5	21.52	5.46	Clay	CL/CH	very stiff	125	17		85			1.25	>10
1.23	4.0	19.94	5.62	Clay	CL/CH	very stiff	125	16		90			1.16	>10
1.38	4.5	16.51	5.47	Clay	CL/CH	stiff	125	13		95			0.96	>10
1.53	5.0	13.67	2.96	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		80			0.79	>10
1.68	5.5	13.95	2.88	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		80			0.80	>10
1.83	6.0	10.92	2.55	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		85			0.62	>10
1.98	6.5	11.04	2.84	Silty Clay to Clay	CL	stiff	125	6		90			0.63	>10
2.13	7.0	10.92	2.92	Silty Clay to Clay	CL	stiff	125	6		90			0.62	>10
2.28	7.5	11.54	3.01	Silty Clay to Clay	CL	stiff	125	7		90			0.65	>10
2.45	8.0	12.06	2.92	Silty Clay to Clay	CL	stiff	125	7		85			0.68	>10
2.60	8.5	13.18	2.97	Silty Clay to Clay	CL	stiff	125	8		85			0.75	>10
2.75	9.0	12.41	3.13	Silty Clay to Clay	CL	stiff	125	7		90			0.70	>10
2.90	9.5	12.01	3.27	Silty Clay to Clay	CL	stiff	125	7		95			0.68	>10
3.05	10.0	11.57	3.31	Silty Clay to Clay	CL	stiff	125	7		95			0.65	>10
3.20	10.5	10.60	3.34	Silty Clay to Clay	CL	stiff	125	6		100			0.59	9.00
3.35	11.0	13.94	2.88	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		85			0.79	>10
3.50	11.5	15.99	3.35	Silty Clay to Clay	CL	stiff	125	9		85			0.91	>10
3.65	12.0	16.40	3.11	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		85			0.93	>10
3.80	12.5	13.94	3.01	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		90			0.78	>10
3.95	13.0	14.53	2.52	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		85			0.82	>10
4.13	13.5	10.69	2.23	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		95			0.59	>10
4.28	14.0	8.93	1.74	Clayey Silt to Silty Clay	ML/CL	firm	120	4		100			0.49	6.88
4.43	14.5	13.09	2.14	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		90			0.73	>10
4.58	15.0	18.97	2.55	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		80			1.08	>10
4.73	15.5	29.93	1.92	Sandy Silt to Clayey Silt	ML	medium dense	115	9	34.7	60	41	34		
4.88	16.0	12.52	3.06	Silty Clay to Clay	CL	stiff	125	7		100			0.69	7.70
5.03	16.5	12.97	2.33	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		95			0.72	>10
5.18	17.0	14.64	2.34	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		90			0.82	>10
5.33	17.5	16.90	2.49	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		85			0.95	>10
5.48	18.0	20.59	2.70	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		85			1.17	>10
5.65	18.5	63.66	1.34	Silty Sand to Sandy Silt	SM/ML	medium dense	115	14	69.7	35	62	37		
5.80	19.0	80.09	0.99	Sand to Silty Sand	SP/SM	medium dense	115	15	87.0	25	68	38		
5.95	19.5	45.01	2.01	Sandy Silt to Clayey Silt	ML	medium dense	115	13	48.5	50	51	35		
6.10	20.0	14.03	3.51	Silty Clay to Clay	CL	stiff	125	8		100			0.78	7.27
6.25	20.5	15.02	3.14	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.83	>10
6.40	21.0	18.51	3.15	Clayey Silt to Silty Clay	ML/CL	very stiff	120	7		95			1.04	>10
6.55	21.5	18.15	3.20	Clayey Silt to Silty Clay	ML/CL	very stiff	120	7		100			1.02	>10
6.70	22.0	17.28	3.59	Silty Clay to Clay	CL	stiff	125	10		100			0.96	9.59
6.85	22.5	17.23	3.73	Silty Clay to Clay	CL	stiff	125	10		100			0.96	9.19
7.00	23.0	16.87	3.54	Silty Clay to Clay	CL	stiff	125	10		100			0.94	8.41
7.18	23.5	17.48	3.84	Silty Clay to Clay	CL	stiff	125	10		100			0.97	8.70
7.33	24.0	16.22	4.03	Silty Clay to Clay	CL	stiff	125	9		100			0.90	7.41
7.48	24.5	14.41	3.94	Silty Clay to Clay	CL	stiff	125	8		100			0.79	5.88
7.63	25.0	16.61	5.26	Clay	CL/CH	stiff	125	13		100			0.92	5.65
7.78	25.5	22.55	4.10	Silty Clay to Clay	CL	very stiff	125	13		100			1.27	>10
7.93	26.0	23.15	3.96	Silty Clay to Clay	CL	very stiff	125	13		100			1.30	>10
8.08	26.5	23.78	3.88	Silty Clay to Clay	CL	very stiff	125	14		100			1.34	>10
8.23	27.0	19.71	4.08	Silty Clay to Clay	CL	very stiff	125	11		100			1.10	8.85
8.38	27.5	19.97	3.33	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.11	>10
8.53	28.0	21.84	3.44	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.22	>10
8.68	28.5	22.14	3.08	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.24	>10
8.85	29.0	19.71	3.36	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.09	>10
9.00	29.5	21.17	3.76	Silty Clay to Clay	CL	very stiff	125	12		100			1.18	9.00
9.15	30.0	21.93	3.63	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.22	>10
9.30	30.5	20.35	3.75	Silty Clay to Clay	CL	very stiff	125	12		100			1.13	8.00
9.45	31.0	18.51	3.42	Clayey Silt to Silty Clay	ML/CL	very stiff	120	7		100			1.02	9.39
9.60	31.5	17.60	2.12	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.97	8.27
9.75	32.0	15.49	1.97	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.84	6.43
9.90	32.5	14.23	2.02	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.77	5.42
10.05	33.0	14.26	2.33	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.77	5.31
10.20	33.5	13.47	2.41	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.72	4.78
10.38	34.0	13.35	3.34	Silty Clay to Clay	CL	stiff	125	8		100			0.71	3.50
10.53	34.5	19.03	3.46	Silty Clay to Clay	CL	very stiff	125	11		100			1.05	6.00
10.68	35.0	22.10	3.27	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.22	>10
10.83	35.5	21.29	3.52	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.18	>10
10.98	36.0	20.24	3.59	Silty Clay to Clay	CL	very stiff	125	12		100			1.11	6.21
11.13	36.5	17.63	3.86	Silty Clay to Clay	CL	stiff	125	10		100			0.96	4.89
11.28	37.0	13.91	3.94	Silty Clay to Clay	CL	stiff	125	8		100			0.74	3.35
11.43	37.5	14.14	2.96	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.75	4.47
11.58	38.0	16.22	3.35	Silty Clay to Clay	CL	stiff	125	9		100			0.87	4.00
11.73	38.5	13.76	2.59	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.73	4.09

LANDMARK CONSULTANTS, INC.
CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: Minerals Processing Facility - Calipatria, CA **Project No:** LE19154 **Date:** 7/20/2020

CONE SOUNDING: CPT-1
Est. GWT (ft): 8
Phi Correlation: **0** 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	**Nk:** Phi (deg.)	**17** Su (tsf)	OCR
11.88	39.0	13.53	1.74	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.71	3.91
12.05	39.5	13.56	1.29	Sandy Silt to Clayey Silt	ML	very loose	115	4	11.1	100	8	29		
12.20	40.0	13.03	1.52	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.68	3.58
12.35	40.5	15.58	2.48	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.83	4.68
12.50	41.0	14.41	2.40	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.76	4.09
12.65	41.5	13.68	1.68	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.72	3.66
12.80	42.0	9.49	1.29	Clayey Silt to Silty Clay	ML/CL	firm	120	4		100			0.47	2.13
12.95	42.5	9.49	1.57	Clayey Silt to Silty Clay	ML/CL	firm	120	4		100			0.47	2.06
13.10	43.0	9.99	1.20	Clayey Silt to Silty Clay	ML/CL	firm	120	4		100			0.50	2.20
13.25	43.5	12.27	1.28	Sandy Silt to Clayey Silt	ML	very loose	115	4	9.7	100	3	28		
13.40	44.0	14.41	1.62	Sandy Silt to Clayey Silt	ML	very loose	115	4	11.3	100	8	29		
13.58	44.5	12.27	1.73	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.63	2.91
13.73	45.0	12.36	1.79	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.63	2.91
13.88	45.5	14.32	1.85	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.75	3.58
14.03	46.0	13.65	1.77	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.71	3.28
14.18	46.5	10.69	1.10	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		100			0.53	2.27
14.33	47.0	13.18	1.92	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.68	3.07
14.48	47.5	23.75	1.60	Sandy Silt to Clayey Silt	ML	loose	115	7	18.0	95	22	31		
14.63	48.0	16.66	2.93	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.88	4.18
14.78	48.5	33.85	1.62	Sandy Silt to Clayey Silt	ML	loose	115	10	25.5	80	32	32		
14.93	49.0	18.65	2.42	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			1.00	4.89
15.10	49.5	17.39	1.72	Sandy Silt to Clayey Silt	ML	very loose	115	5	13.0	100	12	30		
15.25	50.0	15.14	2.01	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.79	3.43

CLIENT: Energy Source
PROJECT: Minerals Processing Facility - Calipatria, CA

CONE PENETROMETER: Kehoe Testing & Engineering Truck Mounted Electric Cone with 30 ton reaction weight

LOCATION: See Site and Boring Location Plan

DATE: 7/20/2020

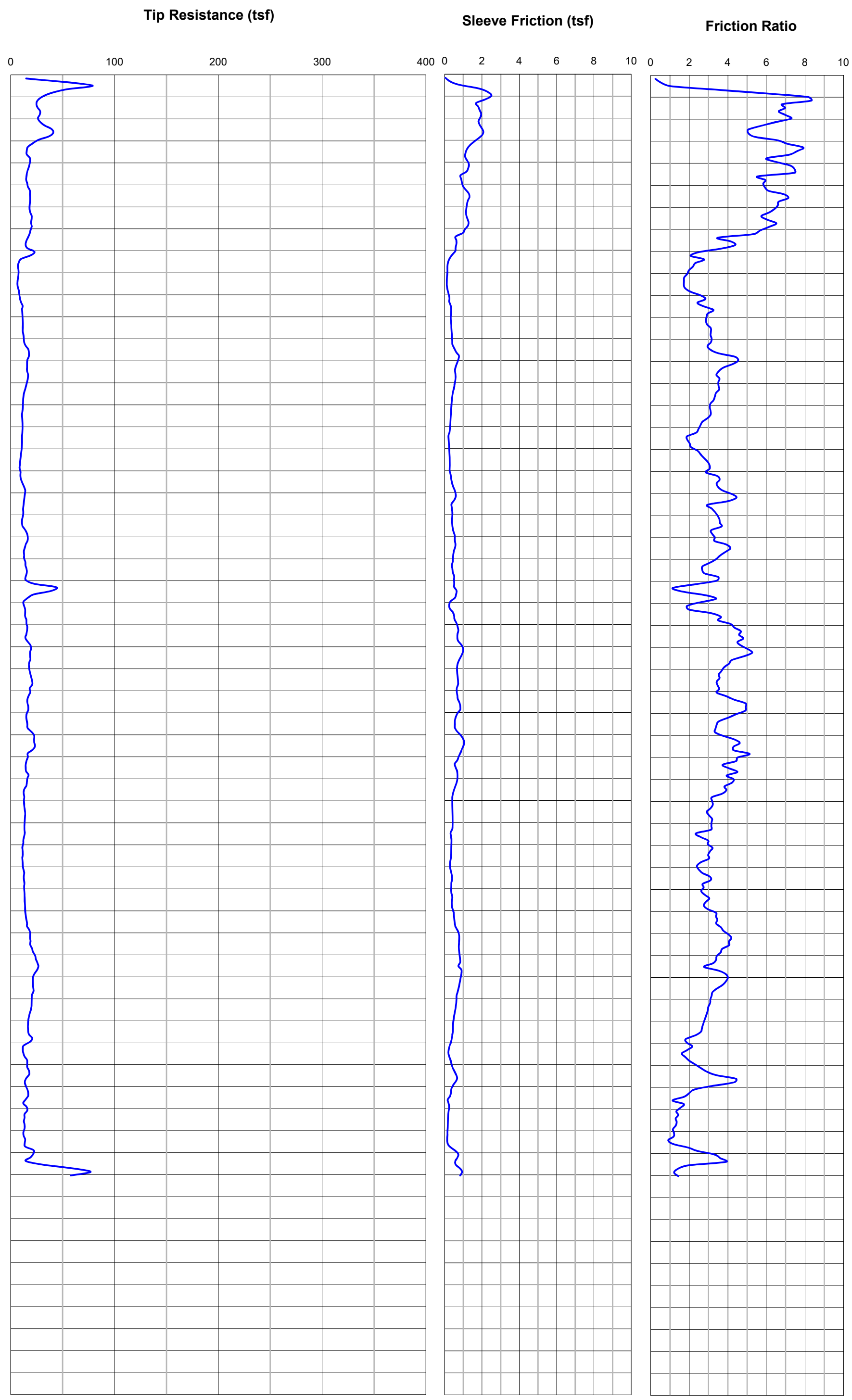
CONE SOUNDING DATA CPT-2

DEPTH

INTERPRETED SOIL PROFILE
From Robertson and Campanella (1989

GROUND ELEVATION +/-

Clayey Silt to Silty Clay	ML/CL	hard
Clay	CL/CH	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	stiff
Clay	" "	very stiff
Clay	" "	very stiff
Silty Clay to Clay	CL	stiff
Clayey Silt to Silty Clay	ML/CL	stiff
Silty Clay to Clay	CL	firm
Silty Clay to Clay	" "	stiff
Silty Clay to Clay	" "	stiff
Silty Clay to Clay	" "	stiff
Silty Clay to Clay	" "	stiff
Silty Clay to Clay	" "	stiff
Silty Clay to Clay	" "	stiff
Clayey Silt to Silty Clay	ML/CL	stiff
Silty Clay to Clay	CL	firm
Silty Clay to Clay	" "	stiff
Silty Clay to Clay	" "	stiff
Silty Clay to Clay	" "	stiff
Silty Clay to Clay	" "	stiff
Clayey Silt to Silty Clay	ML/CL	stiff
Sandy Silt to Clayey Silt	ML	loose
Clayey Silt to Silty Clay	ML/CL	stiff
Clay	CL/CH	stiff
Clay	" "	very stiff
Clayey Silt to Silty Clay	ML/CL	very stiff
Clay	CL/CH	stiff
Silty Clay to Clay	CL	stiff
Clay	CL/CH	very stiff
Clay	" "	stiff
Silty Clay to Clay	CL	stiff
Silty Clay to Clay	" "	stiff
Clayey Silt to Silty Clay	ML/CL	stiff
Silty Clay to Clay	CL	stiff
Clayey Silt to Silty Clay	ML/CL	stiff
Clayey Silt to Silty Clay	" "	stiff
Silty Clay to Clay	CL	stiff
Silty Clay to Clay	" "	very stiff
Clayey Silt to Silty Clay	ML/CL	very stiff
Clayey Silt to Silty Clay	" "	very stiff
Clayey Silt to Silty Clay	" "	very stiff
Clayey Silt to Silty Clay	" "	stiff
Clayey Silt to Silty Clay	" "	stiff
Silty Clay to Clay	CL	stiff
Sandy Silt to Clayey Silt	ML	very loose
Sandy Silt to Clayey Silt	" "	very loose
Sandy Silt to Clayey Silt	" "	very loose
Sandy Silt to Clayey Silt	" "	loose



END OF SOUNDING AT 50 ft.

Project No.
LE19154

LANDMARK
Geo-Engineers and Geologists

PLATE
B-2

LANDMARK CONSULTANTS, INC.
CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: Minerals Processing Facility - Calipatria, CA **Project No:** LE19154 **Date:** 7/20/2020

CONE SOUNDING: CPT-2
Est. GWT (ft): 8
Phi Correlation: **0** 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	**Nk:** Phi (deg.)	**17** Su (tsf)	OCR
0.15	0.5	48.85	0.60	Sand to Silty Sand	SP/SM	very dense	115	9	92.3	20	113	44		
0.30	1.0	41.20	5.85	Clay	CL/CH	hard	125	33		70			2.42	>10
0.45	1.5	25.51	7.37	Clay	CL/CH	very stiff	125	20		90			1.50	>10
0.60	2.0	27.45	6.97	Clay	CL/CH	very stiff	125	22		85			1.61	>10
0.75	2.5	33.35	5.74	Clay	CL/CH	very stiff	125	27		75			1.95	>10
0.93	3.0	34.91	5.66	Clay	CL/CH	hard	125	28		70			2.04	>10
1.08	3.5	17.60	7.54	Clay	CL/CH	very stiff	125	14		100			1.02	>10
1.23	4.0	17.45	6.56	Clay	CL/CH	very stiff	125	14		100			1.01	>10
1.38	4.5	16.81	7.39	Clay	CL/CH	stiff	125	13		100			0.97	>10
1.53	5.0	15.29	5.78	Clay	CL/CH	stiff	125	12		100			0.88	>10
1.68	5.5	17.99	6.53	Clay	CL/CH	very stiff	125	14		95			1.04	>10
1.83	6.0	18.30	6.55	Clay	CL/CH	very stiff	125	15		95			1.06	>10
1.98	6.5	19.59	5.97	Clay	CL/CH	very stiff	125	16		90			1.13	>10
2.13	7.0	19.62	6.11	Clay	CL/CH	very stiff	125	16		90			1.13	>10
2.28	7.5	16.63	4.32	Clay	CL/CH	stiff	125	13		85			0.95	>10
2.45	8.0	17.69	3.51	Silty Clay to Clay	CL	very stiff	125	10		80			1.01	>10
2.60	8.5	12.33	2.39	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		80			0.70	>10
2.75	9.0	7.26	2.02	Silty Clay to Clay	CL	firm	125	4		100			0.40	5.42
2.90	9.5	6.71	1.73	Silty Clay to Clay	CL	firm	125	4		100			0.36	4.57
3.05	10.0	7.70	2.16	Silty Clay to Clay	CL	firm	125	4		100			0.42	5.42
3.20	10.5	10.07	2.67	Silty Clay to Clay	CL	stiff	125	6		95			0.56	8.14
3.35	11.0	11.10	3.03	Silty Clay to Clay	CL	stiff	125	6		100			0.62	9.39
3.50	11.5	11.63	2.97	Silty Clay to Clay	CL	stiff	125	7		95			0.65	9.79
3.65	12.0	12.09	3.13	Silty Clay to Clay	CL	stiff	125	7		100			0.68	>10
3.80	12.5	14.61	3.05	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		90			0.82	>10
3.95	13.0	16.95	4.14	Silty Clay to Clay	CL	stiff	125	10		95			0.96	>10
4.13	13.5	15.67	3.84	Silty Clay to Clay	CL	stiff	125	9		95			0.88	>10
4.28	14.0	16.34	3.49	Silty Clay to Clay	CL	stiff	125	9		95			0.92	>10
4.43	14.5	13.94	3.48	Silty Clay to Clay	CL	stiff	125	8		100			0.78	>10
4.58	15.0	12.04	3.23	Silty Clay to Clay	CL	stiff	125	7		100			0.67	7.56
4.73	15.5	11.30	3.09	Silty Clay to Clay	CL	stiff	125	6		100			0.62	6.54
4.88	16.0	11.20	2.67	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		100			0.62	8.70
5.03	16.5	11.01	2.05	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		100			0.60	8.14
5.18	17.0	10.66	2.18	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		100			0.58	7.27
5.33	17.5	9.49	2.76	Silty Clay to Clay	CL	stiff	125	5		100			0.51	4.28
5.48	18.0	8.90	2.99	Silty Clay to Clay	CL	firm	125	5		100			0.48	3.74
5.65	18.5	10.07	3.48	Silty Clay to Clay	CL	stiff	125	6		100			0.55	4.37
5.80	19.0	13.35	3.80	Silty Clay to Clay	CL	stiff	125	8		100			0.74	6.76
5.95	19.5	12.82	3.79	Silty Clay to Clay	CL	stiff	125	7		100			0.71	6.21
6.10	20.0	11.95	3.32	Silty Clay to Clay	CL	stiff	125	7		100			0.65	5.31
6.25	20.5	11.04	3.61	Silty Clay to Clay	CL	stiff	125	6		100			0.60	4.57
6.40	21.0	15.20	3.22	Silty Clay to Clay	CL	stiff	125	9		100			0.84	7.56
6.55	21.5	14.79	3.79	Silty Clay to Clay	CL	stiff	125	8		100			0.82	6.88
6.70	22.0	12.80	3.63	Silty Clay to Clay	CL	stiff	125	7		100			0.70	5.31
6.85	22.5	14.53	2.81	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.80	9.00
7.00	23.0	14.82	3.24	Silty Clay to Clay	CL	stiff	125	8		100			0.82	6.43
7.18	23.5	35.05	1.69	Sandy Silt to Clayey Silt	ML	medium dense	115	10	34.8	60	41	34		
7.33	24.0	16.75	2.92	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.93	>10
7.48	24.5	13.43	2.33	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.73	6.88
7.63	25.0	14.64	3.76	Silty Clay to Clay	CL	stiff	125	8		100			0.80	5.76
7.78	25.5	15.52	4.53	Clay	CL/CH	stiff	125	12		100			0.85	4.78
7.93	26.0	16.34	4.66	Clay	CL/CH	stiff	125	13		100			0.90	5.00
8.08	26.5	18.91	4.83	Clay	CL/CH	very stiff	125	15		100			1.05	6.21
8.23	27.0	17.75	3.85	Silty Clay to Clay	CL	stiff	125	10		100			0.98	7.13
8.38	27.5	19.74	3.51	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.10	>10
8.53	28.0	19.27	3.48	Silty Clay to Clay	CL	very stiff	125	11		100			1.07	7.85
8.68	28.5	16.46	4.39	Clay	CL/CH	stiff	125	13		100			0.90	4.47
8.85	29.0	16.37	4.76	Clay	CL/CH	stiff	125	13		100			0.90	4.37
9.00	29.5	15.46	3.64	Silty Clay to Clay	CL	stiff	125	9		100			0.84	5.00
9.15	30.0	19.50	3.49	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.08	>10
9.30	30.5	22.81	4.42	Silty Clay to Clay	CL	very stiff	125	13		100			1.27	9.59
9.45	31.0	18.04	4.65	Clay	CL/CH	stiff	125	14		100			0.99	4.68
9.60	31.5	14.70	4.07	Clay	CL/CH	stiff	125	12		100			0.79	3.43
9.75	32.0	15.93	4.24	Clay	CL/CH	stiff	125	13		100			0.87	3.74
9.90	32.5	14.49	3.98	Clay	CL/CH	stiff	125	12		100			0.78	3.21
10.05	33.0	12.71	3.35	Silty Clay to Clay	CL	stiff	125	7		100			0.67	3.28
10.20	33.5	13.26	3.08	Silty Clay to Clay	CL	stiff	125	8		100			0.71	3.43
10.38	34.0	13.62	3.12	Silty Clay to Clay	CL	stiff	125	8		100			0.73	3.43
10.53	34.5	13.30	2.87	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.71	4.28
10.68	35.0	12.36	2.84	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.65	3.74
10.83	35.5	11.39	3.08	Silty Clay to Clay	CL	stiff	125	7		100			0.59	2.57
10.98	36.0	11.33	2.67	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.59	3.28
11.13	36.5	12.56	2.84	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.66	3.66
11.28	37.0	13.00	2.69	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.68	3.83
11.43	37.5	13.32	2.90	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.70	3.91
11.58	38.0	13.85	3.03	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.73	4.09
11.73	38.5	15.02	3.41	Silty Clay to Clay	CL	stiff	125	9		100			0.80	3.43

LANDMARK CONSULTANTS, INC.
CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: Minerals Processing Facility - Calipatria, CA **Project No:** LE19154 **Date:** 7/20/2020

CONE SOUNDING: CPT-2
Est. GWT (ft): 8
Phi Correlation: **0** 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	**Nk:** Phi (deg.)	**17** Su (tsf)	OCR
11.88	39.0	17.48	3.81	Silty Clay to Clay	CL	stiff	125	10		100			0.94	4.28
12.05	39.5	18.77	4.10	Silty Clay to Clay	CL	very stiff	125	11		100			1.02	4.68
12.20	40.0	21.70	3.59	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.19	8.14
12.35	40.5	25.45	3.13	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		100			1.41	>10
12.50	41.0	23.31	3.80	Silty Clay to Clay	CL	very stiff	125	13		100			1.28	6.43
12.65	41.5	21.44	3.69	Silty Clay to Clay	CL	very stiff	125	12		100			1.17	5.42
12.80	42.0	20.82	3.15	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.14	7.00
12.95	42.5	19.85	3.01	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.08	6.32
13.10	43.0	17.57	2.84	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.94	5.10
13.25	43.5	16.66	2.65	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.89	4.57
13.40	44.0	18.92	2.00	Sandy Silt to Clayey Silt	ML	very loose	115	5	14.6	100	16	30		
13.58	44.5	12.01	1.89	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.61	2.73
13.73	45.0	14.91	2.03	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.78	3.66
13.88	45.5	17.07	2.97	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.91	4.47
14.03	46.0	14.26	3.97	Clay	CL/CH	stiff	125	11		100			0.74	2.06
14.18	46.5	16.43	1.99	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.87	4.09
14.33	47.0	14.34	1.43	Sandy Silt to Clayey Silt	ML	very loose	115	4	10.8	100	7	29		
14.48	47.5	13.06	1.35	Sandy Silt to Clayey Silt	ML	very loose	115	4	9.8	100	4	29		
14.63	48.0	12.91	1.22	Sandy Silt to Clayey Silt	ML	very loose	115	4	9.7	100	3	28		
14.78	48.5	13.28	1.07	Sandy Silt to Clayey Silt	ML	very loose	115	4	9.9	100	4	29		
14.93	49.0	19.21	2.55	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.03	5.00
15.10	49.5	21.38	3.15	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.16	5.88
15.25	50.0	64.39	1.34	Silty Sand to Sandy Silt	SM/ML	medium dense	115	14	47.4	55	50	35		

CLIENT: Energy Source
PROJECT: Minerals Processing Facility - Calipatria, CA
LOCATION: See Site and Boring Location Plan

CONE PENETROMETER: Kehoe Testing & Engineering Truck Mounted Electric Cone with 30 ton reaction weight
DATE: 7/20/2020

CONE SOUNDING DATA CPT-3

DEPTH

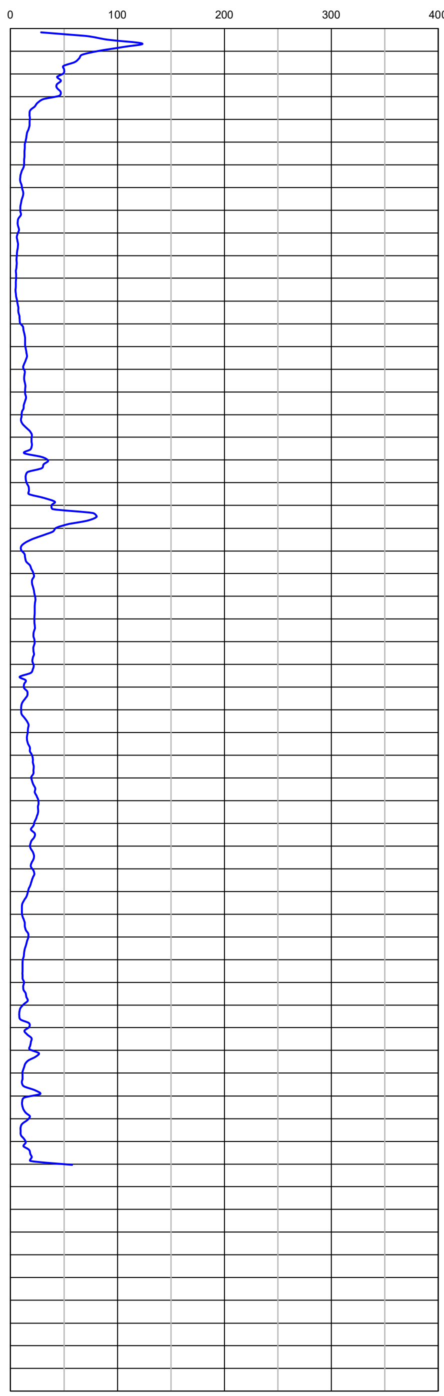
INTERPRETED SOIL PROFILE
From Robertson and Campanella (1989

GROUND ELEVATION +/-

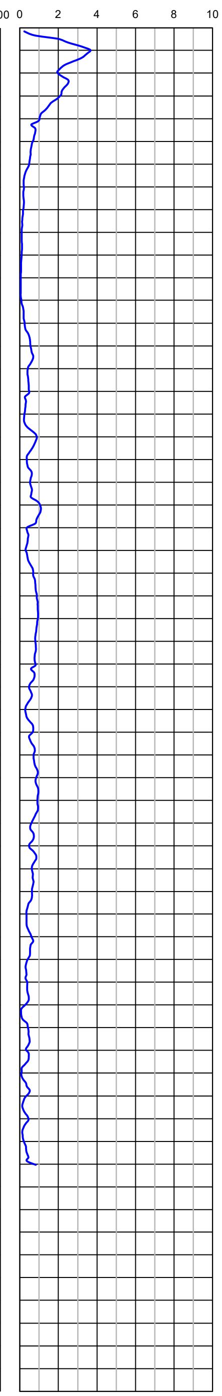
Silty Sand to Sandy Silt	SM/ML	very dense
Silty Clay to Clay	CL	hard
Clay	CL/CH	hard
Clay	" "	very stiff
Clay	" "	stiff
Clay	" "	stiff
Clayey Silt to Silty Clay	ML/CL	stiff
Clayey Silt to Silty Clay	" "	stiff
Clayey Silt to Silty Clay	" "	firm
Silty Clay to Clay	CL	firm
Sensitive fine grained	ML	firm
Sensitive fine grained	" "	firm
Silty Clay to Clay	CL	firm
Silty Clay to Clay	" "	stiff
Clay	CL/CH	stiff
Silty Clay to Clay	CL	stiff
Clayey Silt to Silty Clay	ML/CL	stiff
Clayey Silt to Silty Clay	" "	stiff
Clayey Silt to Silty Clay	" "	very stiff
Clayey Silt to Silty Clay	" "	very stiff
Clayey Silt to Silty Clay	" "	very stiff
Silty Sand to Sandy Silt	SM/ML	medium dense
Clayey Silt to Silty Clay	ML/CL	very stiff
Clayey Silt to Silty Clay	" "	stiff
Silty Clay to Clay	CL	very stiff
Silty Clay to Clay	" "	very stiff
Silty Clay to Clay	" "	very stiff
Silty Clay to Clay	" "	very stiff
Clay	CL/CH	stiff
Silty Clay to Clay	CL	stiff
Silty Clay to Clay	" "	stiff
Silty Clay to Clay	" "	stiff
Silty Clay to Clay	" "	very stiff
Silty Clay to Clay	" "	very stiff
Clayey Silt to Silty Clay	ML/CL	very stiff
Clayey Silt to Silty Clay	" "	very stiff
Clayey Silt to Silty Clay	" "	very stiff
Silty Clay to Clay	CL	very stiff
Clay	CL/CH	stiff
Clayey Silt to Silty Clay	ML/CL	stiff
Clay	CL/CH	stiff
Silty Clay to Clay	CL	stiff
Clayey Silt to Silty Clay	ML/CL	stiff
Clayey Silt to Silty Clay	" "	stiff
Clayey Silt to Silty Clay	" "	stiff
Sandy Silt to Clayey Silt	ML	very loose
Clayey Silt to Silty Clay	ML/CL	stiff
Clayey Silt to Silty Clay	" "	stiff
Clayey Silt to Silty Clay	" "	stiff
Sandy Silt to Clayey Silt	ML	loose

Depth scale: 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55

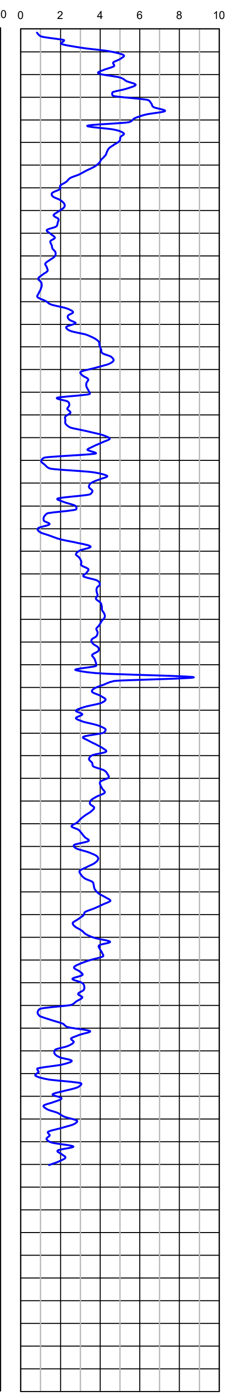
Tip Resistance (tsf)



Sleeve Friction (tsf)



Friction Ratio



END OF SOUNDING AT 50 ft.

Project No.
LE19154

LANDMARK
Geo-Engineers and Geologists

PLATE
B-3

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: Minerals Processing Facility - Calipatria, CA **Project No:** LE19154 **Date:** 7/20/2020

CONE SOUNDING: CPT-3

Est. GWT (ft): 8

Phi Correlation: **0** 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	**Nk:** Phi (deg.)	**17** Su (tsf)	OCR
0.15	0.5	63.22	1.34	Silty Sand to Sandy Silt	SM/ML	very dense	115	14	119.5	25	121	45		
0.30	1.0	103.50	3.18	Sandy Silt to Clayey Silt	ML	very dense	115	30	195.7	35	119	45		
0.45	1.5	63.74	4.96	Overconsolidated Soil	??	very dense	120	64	120.5	55	97	42		
0.60	2.0	49.78	4.26	Clayey Silt to Silty Clay	ML/CL	hard	120	20		55			2.92	>10
0.75	2.5	44.64	5.37	Clay	CL/CH	hard	125	36		65			2.62	>10
0.93	3.0	45.37	4.88	Silty Clay to Clay	CL	hard	125	26		60			2.66	>10
1.08	3.5	25.98	6.55	Clay	CL/CH	very stiff	125	21		85			1.52	>10
1.23	4.0	18.05	6.43	Clay	CL/CH	very stiff	125	14		95			1.05	>10
1.38	4.5	17.53	4.50	Clay	CL/CH	very stiff	125	14		85			1.02	>10
1.53	5.0	14.92	5.07	Clay	CL/CH	stiff	125	12		95			0.86	>10
1.68	5.5	13.25	4.44	Clay	CL/CH	stiff	125	11		95			0.76	>10
1.83	6.0	12.73	3.91	Clay	CL/CH	stiff	125	10		90			0.73	>10
1.98	6.5	9.89	2.92	Silty Clay to Clay	CL	stiff	125	6		95			0.56	>10
2.13	7.0	10.06	2.09	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		85			0.57	>10
2.28	7.5	11.27	1.74	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		75			0.64	>10
2.45	8.0	9.39	2.09	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		85			0.52	>10
2.60	8.5	7.93	1.80	Clayey Silt to Silty Clay	ML/CL	firm	120	3		90			0.44	9.79
2.75	9.0	7.26	1.54	Clayey Silt to Silty Clay	ML/CL	firm	120	3		90			0.40	7.70
2.90	9.5	6.49	1.59	Silty Clay to Clay	CL	firm	125	4		100			0.35	4.47
3.05	10.0	6.29	1.70	Silty Clay to Clay	CL	firm	125	4		100			0.34	4.00
3.20	10.5	5.65	1.34	Sensitive fine grained	ML	firm	120	3		100			0.30	5.21
3.35	11.0	5.18	1.10	Sensitive fine grained	ML	firm	120	3		100			0.27	4.28
3.50	11.5	4.94	1.03	Sensitive fine grained	ML	firm	120	2		100			0.26	3.83
3.65	12.0	5.44	1.00	Sensitive fine grained	ML	firm	120	3		100			0.29	4.28
3.80	12.5	7.11	2.17	Silty Clay to Clay	CL	firm	125	4		100			0.38	4.00
3.95	13.0	8.57	2.53	Silty Clay to Clay	CL	firm	125	5		100			0.47	5.21
4.13	13.5	12.26	2.68	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		95			0.68	>10
4.28	14.0	13.65	3.87	Silty Clay to Clay	CL	stiff	125	8		100			0.76	>10
4.43	14.5	14.89	4.24	Clay	CL/CH	stiff	125	12		100			0.84	9.00
4.58	15.0	12.99	4.27	Clay	CL/CH	stiff	125	10		100			0.72	6.76
4.73	15.5	13.05	3.18	Silty Clay to Clay	CL	stiff	125	7		100			0.73	8.70
4.88	16.0	13.70	3.37	Silty Clay to Clay	CL	stiff	125	8		100			0.76	9.19
5.03	16.5	13.54	2.22	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		90			0.75	>10
5.18	17.0	11.00	2.37	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		100			0.60	8.00
5.33	17.5	11.67	2.35	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.64	8.70
5.48	18.0	19.13	3.98	Silty Clay to Clay	CL	very stiff	125	11		95			1.08	>10
5.65	18.5	19.38	3.71	Silty Clay to Clay	CL	very stiff	125	11		95			1.09	>10
5.80	19.0	25.71	2.00	Sandy Silt to Clayey Silt	ML	loose	115	7	27.9	70	35	33		
5.95	19.5	25.60	2.11	Sandy Silt to Clayey Silt	ML	loose	115	7	27.5	70	34	33		
6.10	20.0	14.57	3.93	Silty Clay to Clay	CL	stiff	125	8		100			0.81	7.85
6.25	20.5	17.23	3.50	Silty Clay to Clay	CL	stiff	125	10		100			0.96	>10
6.40	21.0	37.03	2.27	Sandy Silt to Clayey Silt	ML	medium dense	115	11	38.8	60	45	34		
6.55	21.5	65.68	1.77	Silty Sand to Sandy Silt	SM/ML	medium dense	115	15	68.3	40	61	37		
6.70	22.0	57.05	1.17	Silty Sand to Sandy Silt	SM/ML	medium dense	115	13	58.9	40	57	36		
6.85	22.5	30.51	1.47	Sandy Silt to Clayey Silt	ML	loose	115	9	31.3	60	38	33		
7.00	23.0	11.32	3.14	Silty Clay to Clay	CL	stiff	125	6		100			0.61	4.37
7.18	23.5	13.72	2.93	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.75	8.00
7.33	24.0	19.48	3.26	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.09	>10
7.48	24.5	20.86	3.66	Silty Clay to Clay	CL	very stiff	125	12		100			1.17	>10
7.63	25.0	21.94	3.85	Silty Clay to Clay	CL	very stiff	125	13		100			1.23	>10
7.78	25.5	22.99	3.97	Silty Clay to Clay	CL	very stiff	125	13		100			1.29	>10
7.93	26.0	22.58	4.18	Silty Clay to Clay	CL	very stiff	125	13		100			1.27	>10
8.08	26.5	22.40	3.93	Silty Clay to Clay	CL	very stiff	125	13		100			1.26	>10
8.23	27.0	22.08	3.67	Silty Clay to Clay	CL	very stiff	125	13		100			1.24	>10
8.38	27.5	21.59	3.80	Silty Clay to Clay	CL	very stiff	125	12		100			1.21	>10
8.53	28.0	21.00	3.75	Silty Clay to Clay	CL	very stiff	125	12		100			1.17	9.79
8.68	28.5	16.09	5.17	Clay	CL/CH	stiff	125	13		100			0.88	4.47
8.85	29.0	13.28	4.24	Clay	CL/CH	stiff	125	11		100			0.72	3.35
9.00	29.5	14.86	3.96	Silty Clay to Clay	CL	stiff	125	8		100			0.81	4.89
9.15	30.0	10.35	3.34	Silty Clay to Clay	CL	stiff	125	6		100			0.54	2.82
9.30	30.5	12.96	3.03	Silty Clay to Clay	CL	stiff	125	7		100			0.69	3.74
9.45	31.0	16.44	4.11	Silty Clay to Clay	CL	stiff	125	9		100			0.90	5.42
9.60	31.5	15.80	3.45	Silty Clay to Clay	CL	stiff	125	9		100			0.86	5.00
9.75	32.0	18.78	4.00	Silty Clay to Clay	CL	very stiff	125	11		100			1.03	6.43
9.90	32.5	21.19	3.57	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.18	>10
10.05	33.0	20.83	4.33	Silty Clay to Clay	CL	very stiff	125	12		100			1.15	7.41
10.20	33.5	21.59	4.05	Silty Clay to Clay	CL	very stiff	125	12		100			1.20	7.70
10.38	34.0	24.28	3.88	Silty Clay to Clay	CL	very stiff	125	14		100			1.35	9.39
10.53	34.5	25.92	3.58	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		100			1.45	>10
10.68	35.0	23.93	3.05	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		100			1.33	>10
10.83	35.5	21.06	2.85	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.16	9.79
10.98	36.0	20.19	3.12	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.11	8.70
11.13	36.5	20.78	3.48	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.14	9.00
11.28	37.0	20.01	3.33	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.10	8.14
11.43	37.5	20.89	3.29	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.15	8.70
11.58	38.0	17.17	3.77	Silty Clay to Clay	CL	stiff	125	10		100			0.93	4.37
11.73	38.5	12.93	4.30	Clay	CL/CH	stiff	125	10		100			0.68	2.27

LANDMARK CONSULTANTS, INC.
CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: Minerals Processing Facility - Calipatria, CA **Project No:** LE19154 **Date:** 7/20/2020

CONE SOUNDING: CPT-3
Est. GWT (ft): 8
Phi Correlation: **0** 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	**Nk:** Phi (deg.)	**17** Su (tsf)	OCR
11.88	39.0	10.74	3.38	Silty Clay to Clay	CL	stiff	125	6		100			0.55	2.13
12.05	39.5	12.93	2.75	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.68	3.58
12.20	40.0	15.86	3.36	Silty Clay to Clay	CL	stiff	125	9		100			0.85	3.66
12.35	40.5	14.48	4.14	Clay	CL/CH	stiff	125	12		100			0.77	2.57
12.50	41.0	12.26	3.90	Clay	CL/CH	stiff	125	10		100			0.63	2.00
12.65	41.5	11.20	2.87	Silty Clay to Clay	CL	stiff	125	6		100			0.57	2.13
12.80	42.0	11.73	2.93	Silty Clay to Clay	CL	stiff	125	7		100			0.60	2.20
12.95	42.5	12.76	3.09	Silty Clay to Clay	CL	stiff	125	7		100			0.66	2.49
13.10	43.0	14.39	2.81	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.76	3.74
13.25	43.5	8.57	0.95	Sensitive fine grained	ML	firm	120	4		100			0.41	2.00
13.40	44.0	14.74	2.01	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.78	3.83
13.58	44.5	15.97	3.00	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.85	4.28
13.73	45.0	18.55	2.26	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			1.00	5.42
13.88	45.5	22.21	2.08	Sandy Silt to Clayey Silt	ML	loose	115	6	17.1	100	20	31		
14.03	46.0	12.49	1.27	Sandy Silt to Clayey Silt	ML	very loose	115	4	9.6	100	3	28		
14.18	46.5	10.97	1.74	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		100			0.55	2.27
14.33	47.0	19.01	2.20	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.02	5.31
14.48	47.5	11.26	1.41	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.57	2.34
14.63	48.0	16.00	2.30	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.84	3.91
14.78	48.5	9.98	2.04	Clayey Silt to Silty Clay	ML/CL	firm	120	4		100			0.49	1.92
14.93	49.0	12.17	1.45	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.62	2.49
15.10	49.5	15.97	2.19	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.84	3.74
15.25	50.0	32.11	1.87	Sandy Silt to Clayey Silt	ML	loose	115	9	23.8	90	30	32		

LOG OF BORING NO. B-1

SHEET 1 OF 1

DEPTH	FIELD: SAMPLE	FIELD: USCS CLASS.	FIELD: BLOW COUNT	FIELD: POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	LABORATORY: DRY DENSITY (pcf)	LABORATORY: MOISTURE CONTENT (% dry wt.)	LABORATORY: OTHER TESTS
0–5	X				SILTY CLAY (CL): Brown, very moist, medium stiff to stiff, medium plasticity.		27.3	LL=35% PI=19%
5								
10								
15								
20								
25								
30								

DATE DRILLED: 7/20/2020
TOTAL DEPTH: 5 Feet
DEPTH TO WATER: N/A

LOGGED BY: J. Avalos
TYPE OF BIT: 6” Auger
DIAMETER: 6 in.

SURFACE ELEVATION: Approximately -225'
HAMMER WT.:
DROP:

PROJECT No. LE9154

LANDMARK Geo-Engineers and Geologists

PLATE B-4

LOG OF BORING NO. B-2

DEPTH	SAMPLE	USCS CLASS.	BLOW COUNT	POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	DRY DENSITY (pcf)	MOISTURE CONTENT (% dry wt.)	OTHER TESTS
0–5					SILTY CLAY (CL): Brown, very moist, medium stiff to stiff, medium plasticity.		23.1	LL=39% PI=21%
5								
10								
15								
20								
25								
30								

DATE DRILLED: 7/20/2020 TOTAL DEPTH: 5 Feet DEPTH TO WATER: N/A

LOGGED BY: J. Avalos TYPE OF BIT: 6” Auger DIAMETER: 6 in.

SURFACE ELEVATION: Approximately -225' HAMMER WT.: DROP:

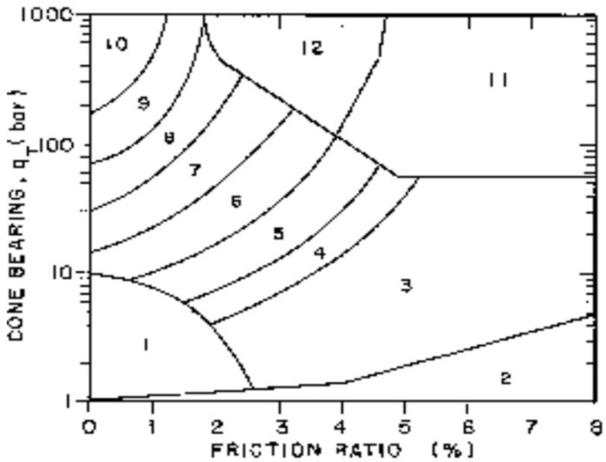
PROJECT No. LE9154

LANDMARK Geo-Engineers and Geologists

PLATE B-5

Simplified Soil Classification Chart

After Robertson & Campanella (1989)



Geotechnical Parameters from CPT Data:

Equivalent SPT N(60) blow count = Qc/(Qc/N Ratio)

N1(60) = Cn*N(60) Normalized SPT blow count

Cn = 1/(p'o)^0.5 < 1.6 max. from Liao & Whitman (1986)

p'o = effective overburden pressure (tsf) using unit densities given below and estimated groundwater table.

Dr = Relative density (%) from Jamiolkowski et. al. (1986) relationship = -98 +68*log(Qc/p'o^0.5) where Qc, p'o in tonne/sqm

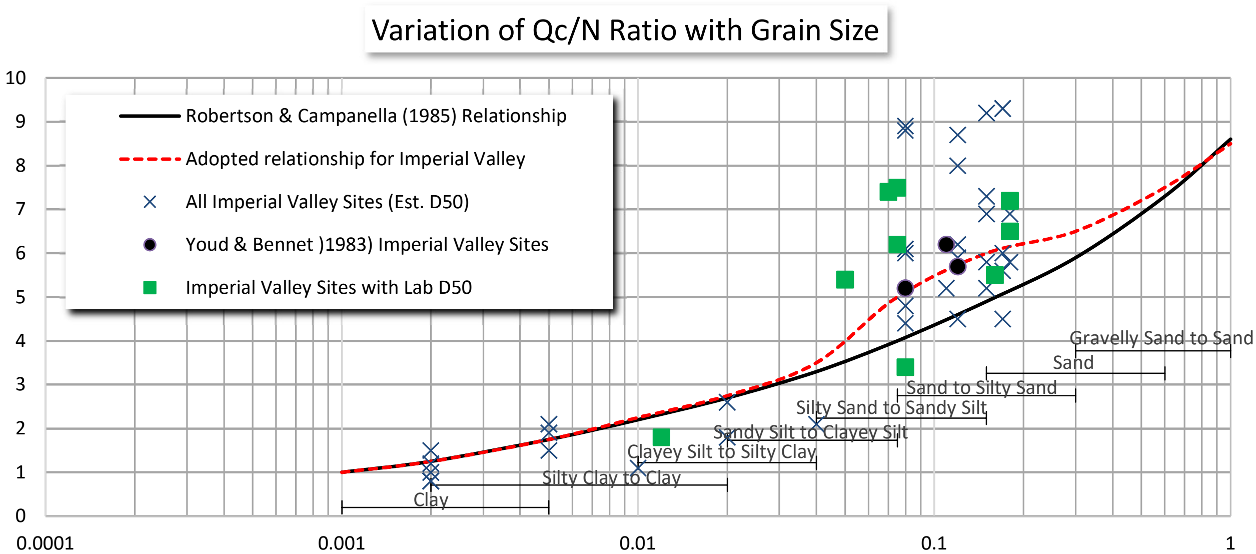
Note: 1 tonne/sqm = 0.1024 tsf, 1 bar =1.0443 tsf

Phi = Friction Angle estimated from either:

1. Roberton & Campanella (1983) chart:
   Phi = 5.3 + 24*(log(Qc/p'o))+3(log(Qc/p'o))^2
2. Peck, Hansen & Thornburn (1974) N-Phi Correlation
3. Schmertman (1978) chart [Phi = 28+0.14*Dr for fine uniform sands]

Su = undrained shear strength (tsf) = (Qc-p'o)/Nk where Nk varies from 10 to 22, 17 for OC clays

OCR = Overconsolidation Ratio estimated from Schmertman (1978) chart using Su/p'o ratio and estimated normal consolidated Su/p'o



Note: Assumed Properties and Adopted Qc/N Ratio based on correlations from Imperial Valley, California soils

Table of Soil Types and Assumed Properties

Zone	Soil Classification	UCS	Density (pcf)	R&C Qc/N	Adopted Qc/N	Est. PI	Fines (%)	D50 (mm)
1	Sensitive fine grained	ML	120	2	2	NP-15	65-100	0.02
2	Organic Material	OL/OH	120	1	1	--	--	--
3	Clay	CL/CH	125	1	1.25	25-40+	90-100	0.002
4	Silty Clay to Clay	CL	125	1.5	2	15-40	90-100	0.01
5	Clayey Silt to Silty Clay	ML/CL	120	2	2.75	25-May	90-100	0.02
6	Sandy Silt to Clayey Silt	ML	115	2.5	3.5	NP-10	65-100	0.04
7	Silty Sand to Sandy Silt	SM/ML	115	3	5	NP	35-75	0.075
8	Sand to Silty Sand	SP/SM	115	4	6	NP	May-35	0.15
9	Sand	SP	110	5	6.5	NP	0-5	0.3
10	Gravelly Sand to Sand	SW	115	6	7.5	NP	0-5	0.6
11	Overconsolidated Soil	--	120	1	1	NP	90-100	0.01
12	Sand to Clayey Sand	SP/SC	115	2	2	NP-5	--	---

Su (tsf)	Consistency
0-0.13	very soft
0.13-.25	soft
0.25-0.5	firm
0.5-1.0	stiff
1.0-2.0	very stiff
>2.0	hard
Dr (%)	**Relative Density**
0-15	very loose
15-35	loose
35-65	medium dense
65-85	dense
>85	very dense

LANDMARK Geo-Engineers and Geologists

Project No: LE19154

Key to CPT Interpretation of Logs

Plate B-6

DEFINITION OF TERMS

PRIMARY DIVISIONS			SYMBOLS	SECONDARY DIVISIONS
Coarse grained soils More than half of material is larger that No. 200 sieve	Gravels	Clean gravels (less than 5% fines)	GW	Well graded gravels, gravel-sand mixtures, little or no fines
	More than half of coarse fraction is larger than No. 4 sieve		GP	Poorly graded gravels, or gravel-sand mixtures, little or no fines
		Gravel with fines	GM	Silty gravels, gravel-sand-silt mixtures, non-plastic fines
			GC	Clayey gravels, gravel-sand-clay mixtures, plastic fines
	Sands	Clean sands (less than 5% fines)	SW	Well graded sands, gravelly sands, little or no fines
	More than half of coarse fraction is smaller than No. 4 sieve		SP	Poorly graded sands or gravelly sands, little or no fines
		Sands with fines	SM	Silty sands, sand-silt mixtures, non-plastic fines
			SC	Clayey sands, sand-clay mixtures, plastic fines
Fine grained soils More than half of material is smaller than No. 200 sieve	Silts and clays		ML	Inorganic silts, clayey silts with slight plasticity
	Liquid limit is less than 50%		CL	Inorganic clays of low to medium plasticity, gravely, sandy, or lean clays
			OL	Organic silts and organic clays of low plasticity
	Silts and clays		MH	Inorganic silts, micaceous or diatomaceous silty soils, elastic silts
	Liquid limit is more than 50%		CH	Inorganic clays of high plasticity, fat clays
			OH	Organic clays of medium to high plasticity, organic silts
Highly organic soils			PT	Peat and other highly organic soils

GRAIN SIZES

Silts and Clays	Sand			Gravel		Cobbles	Boulders
	Fine	Medium	Coarse	Fine	Coarse		

200 40 10 4 3/4" 3" 12"

US Standard Series Sieve — Clear Square Openings

Sands, Gravels, etc.	Blows/ft. *
Very Loose	0-4
Loose	4-10
Medium Dense	10-30
Dense	30-50
Very Dense	Over 50

Clays & Plastic Silts	Strength **	Blows/ft. *
Very Soft	0-0.25	0-2
Soft	0.25-0.5	2-4
Firm	0.5-1.0	4-8
Stiff	1.0-2.0	8-16
Very Stiff	2.0-4.0	16-32
Hard	Over 4.0	Over 32

* Number of blows of 140 lb. hammer falling 30 inches to drive a 2 inch O.D. (1 3/8 in. I.D.) split spoon (ASTM D1586).

** Unconfined compressive strength in tons/s.f. as determined by laboratory testing or approximated by the Standard Penetration Test (ASTM D1586), Pocket Penetrometer, Torvane, or visual observation.

Type of Samples:

Ring Sample — Standard Penetration Test — Shelby Tube — Bulk (Bag) Sample

Drilling Notes:

1. Sampling and Blow Counts
   Ring Sampler - Number of blows per foot of a 140 lb. hammer falling 30 inches.
   Standard Penetration Test - Number of blows per foot.
   Shelby Tube - Three (3) inch nominal diameter tube hydraulically pushed.
2. P. P. = Pocket Penetrometer (tons/s.f.).
3. NR = No recovery.
4. GWT = Ground Water Table observed @ specified time.

APPENDIX C

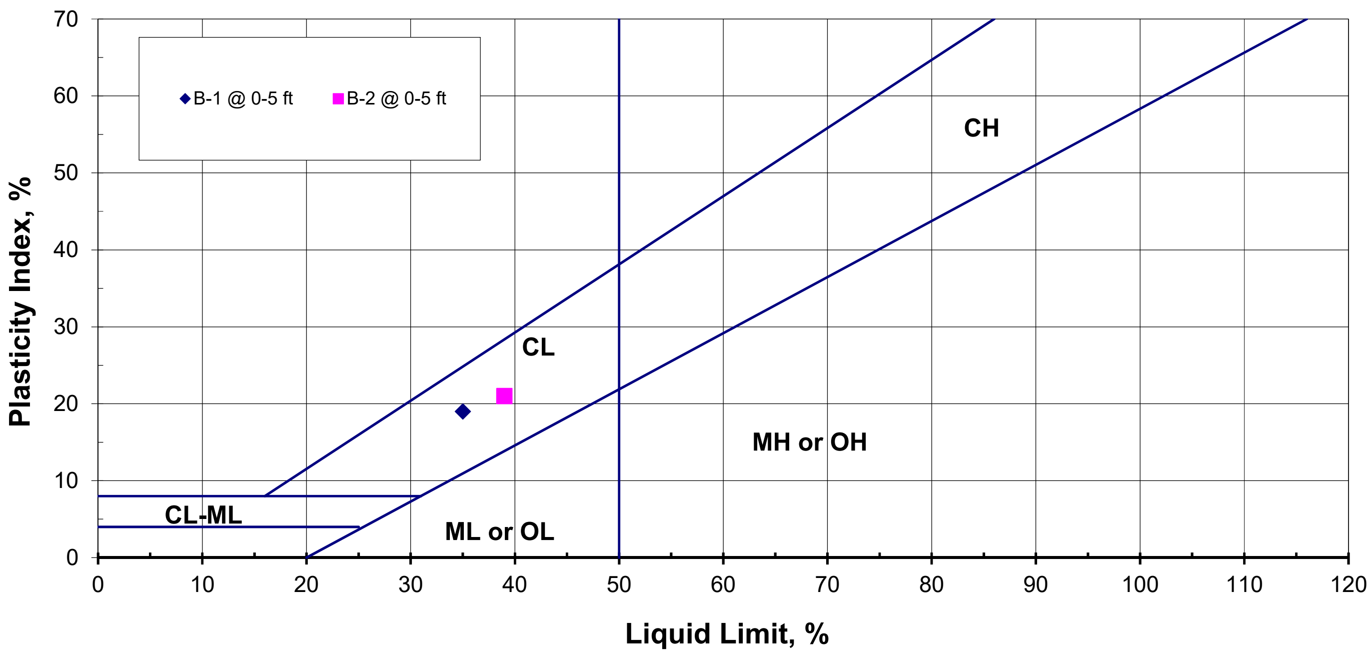
LANDMARK CONSULTANTS, INC.

CLIENT: Energy Source
PROJECT: Hudson Ranch Mineral Processing Facility
JOB No.: LE19154
DATE: 07/23/20

ATTERBERG LIMITS (ASTM D4318)

Sample Location	Sample Depth (ft)	Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)	USCS Classification
B-1	0-5	35	16	19	CL
B-2	0-5	39	18	21	CL

PLASTICITY CHART



LANDMARK
Geo-Engineers and Geologists

Project No.: LE19154

Atterberg Limits
Test Results

Plate
C-1

LANDMARK CONSULTANTS, INC.

CLIENT: Energy Source
PROJECT: Hudson Ranch Mineral Processing Facility
JOB No.: LE19154
DATE: 07/27/20

CHEMICAL ANALYSIS

Boring:	B-1	B-2	**Caltrans**
Sample Depth, ft:	0-5	0-5	**Method**
pH:	8.2	8.7	**643**
Electrical Conductivity (mmhos):	8.24	10.1	**424**
Resistivity (ohm-cm):	20	23	**643**
Chloride (Cl), ppm:	>18,000	>18,000	**422**
Sulfate (SO4), ppm:	6,426	7,014	**417**

General Guidelines for Soil Corrosivity

Material Affected	Chemical Agent	Range of Values	Degree of Corrosivity
Concrete	Soluble Sulfates (ppm)	0 - 1,000	Low
		1,000 - 2,000	Moderate
		2,000 - 20,000	Severe
		> 20,000	Very Severe
Normal Grade Steel	Soluble Chlorides (ppm)	0 - 200	Low
		200 - 700	Moderate
		700 - 1,500	Severe
		> 1,500	Very Severe
Normal Grade Steel	Resistivity (ohm-cm)	1 - 1,000	Very Severe
		1,000 - 2,000	Severe
		2,000 - 10,000	Moderate
		> 10,000	Low

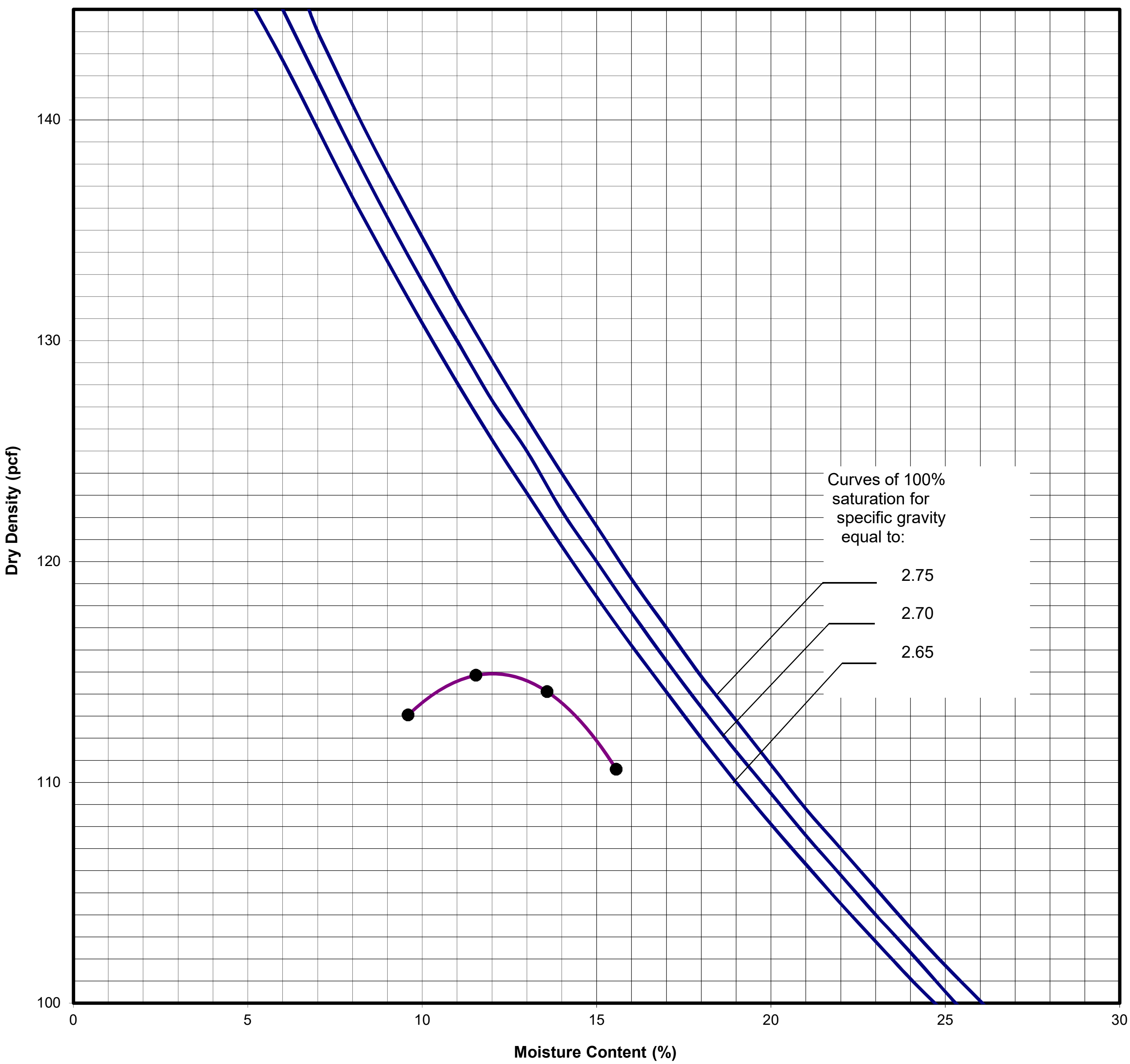
LANDMARK
Geo-Engineers and Geologists

Project No.: LE19154

Selected Chemical Test Results

Plate C-2

Client: Energy Source	**Soil Description:** Silty Clay (CL)
Project: H.R Mineral Processing Facility	**Sample Location:** B-1 @ 0-5'
Project No.: LE19154	**Test Method:** ASTM D-1557-A
Date: 7/28/2020	**Maximum Dry Density (pcf):** **114.9**
Lab. No.: EC20-396	**Optimum Moisture Content (%):** **12.0**



LANDMARK
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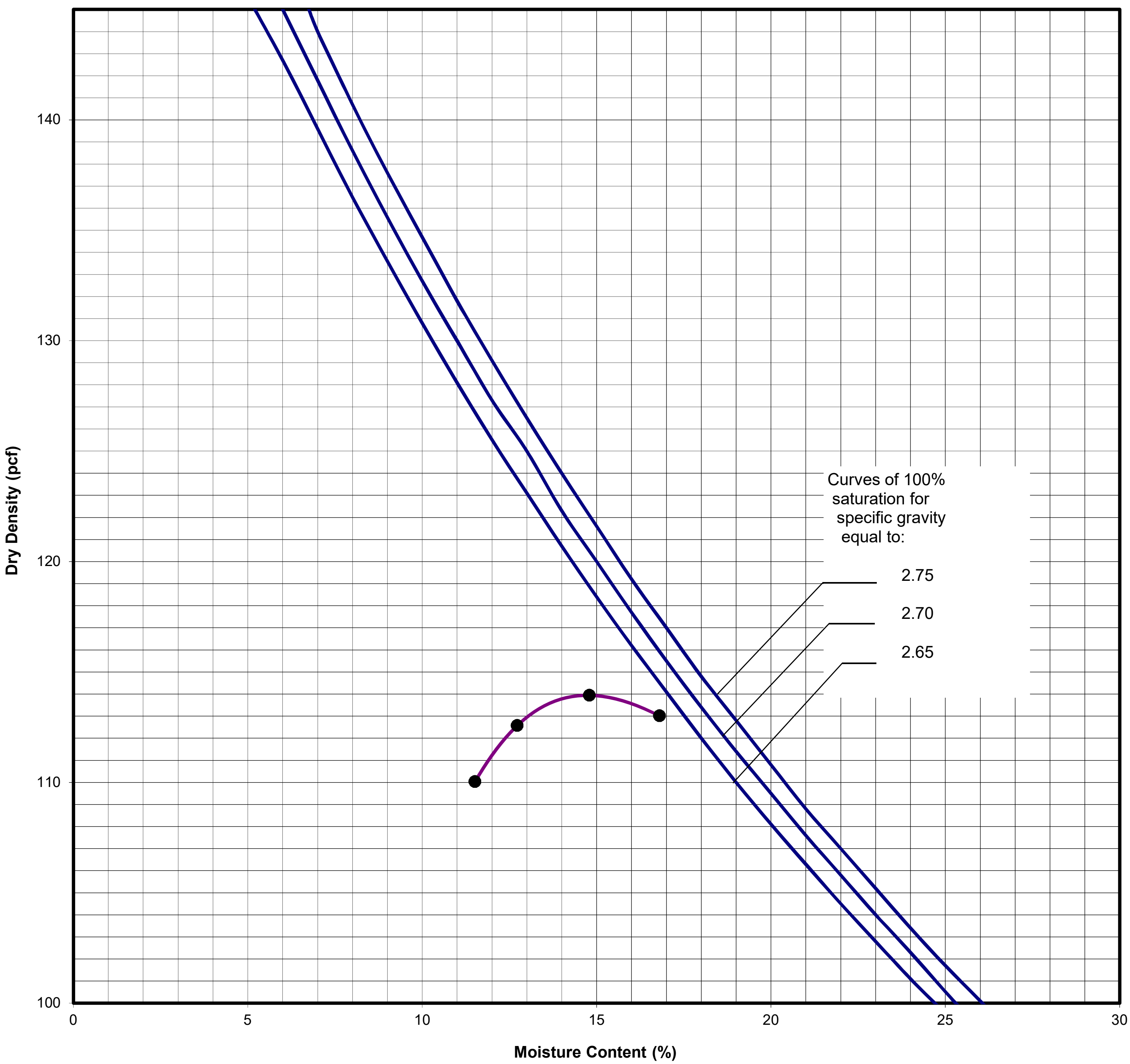
Project No.: LE19154

Moisture Density Relationship

Plate C-3

Client:	Energy Source	**Soil Description:**	Silty Clay (CL)
Project:	H.R Mineral Processing Facility	**Sample Location:**	B-2 @ 0-5'
Project No.:	LE19154	**Test Method:**	ASTM D-1557-A
Date:	7/28/2020	**Maximum Dry Density (pcf):**	**113.9**
Lab. No.:	EC20-397	**Optimum Moisture Content (%):**	**14.7**



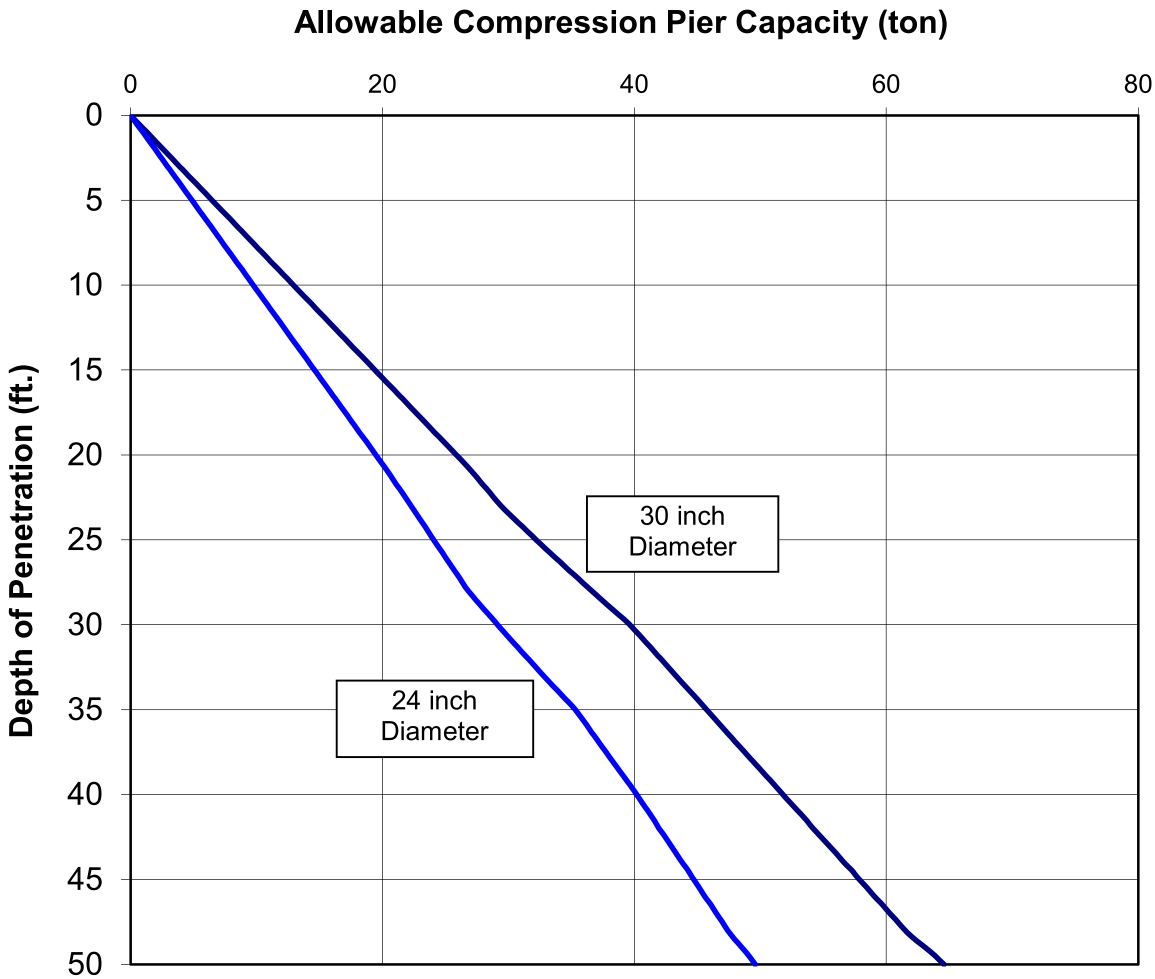
LANDMARK Geo-Engineers and Geologists

Project No.: LE19154

Moisture Density Relationship

Plate C-4

APPENDIX D



Notes:

1. Compression load capacity are based on skin friction and end-bearing capacity. The structural capacity of the piers should be checked.
2. The indicated capacities are for sustained (dead plus live) vertical compression load, and include a factor of safety of at least 2.5.
3. For temporary wind or seismic load, the above values may be increased by one-third.
4. Capacities of other pier sizes are in direct proportion to the pile diameter.
5. Pier capacity in tension should be taken as 50% of the compression capacity.

LANDMARK Geo-Engineers and Geologists **Project No.: LE19154**	**Drilled Pier Compression Capacity Chart Energy Source Mineral Extraction Facility Calipatria, CA**	**Plate D-1**

APPENDIX E

Landmark Consultants, Inc.
780 N. 4th Street
El Centro, CA 92243

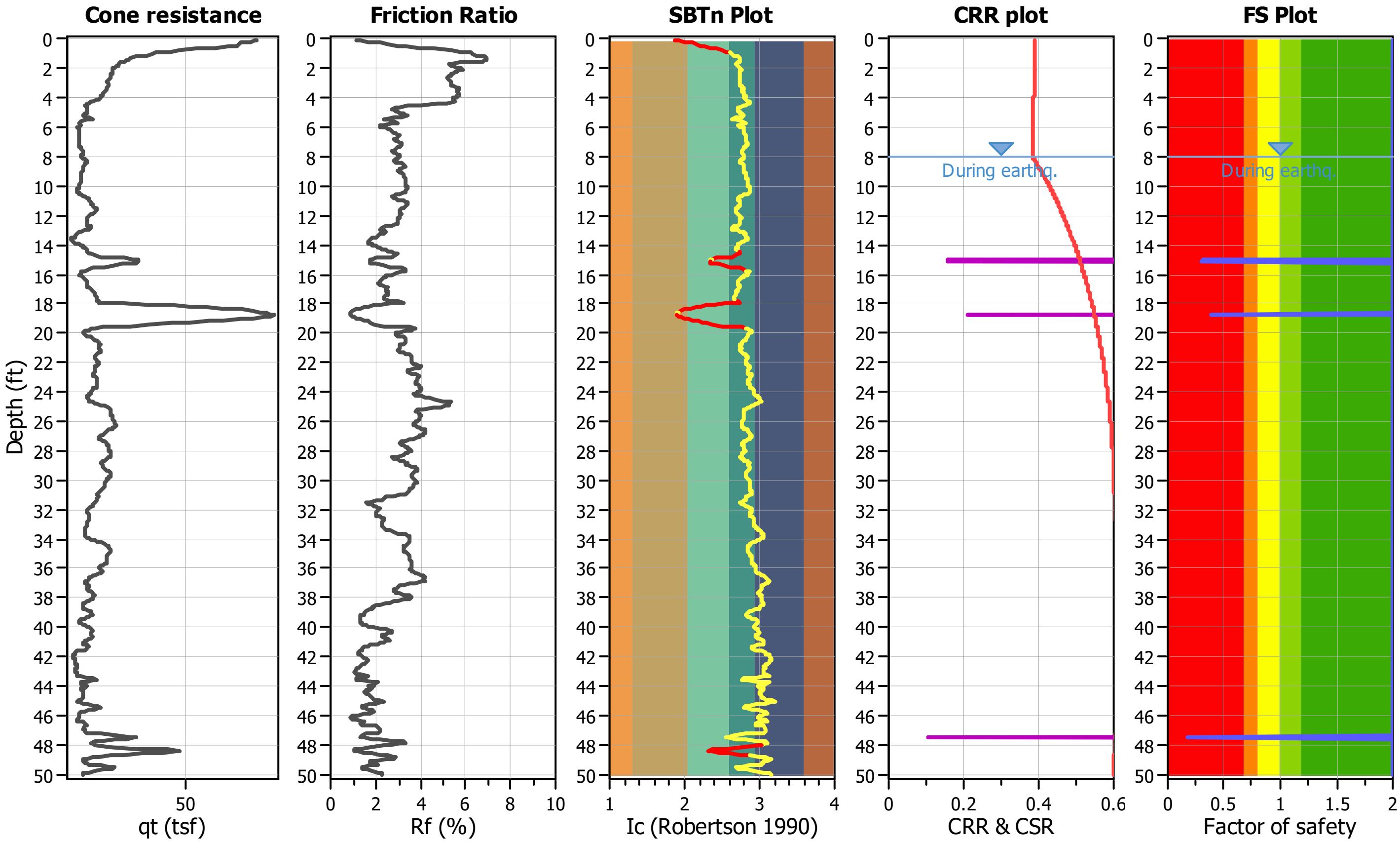
LIQUEFACTION ANALYSIS REPORT

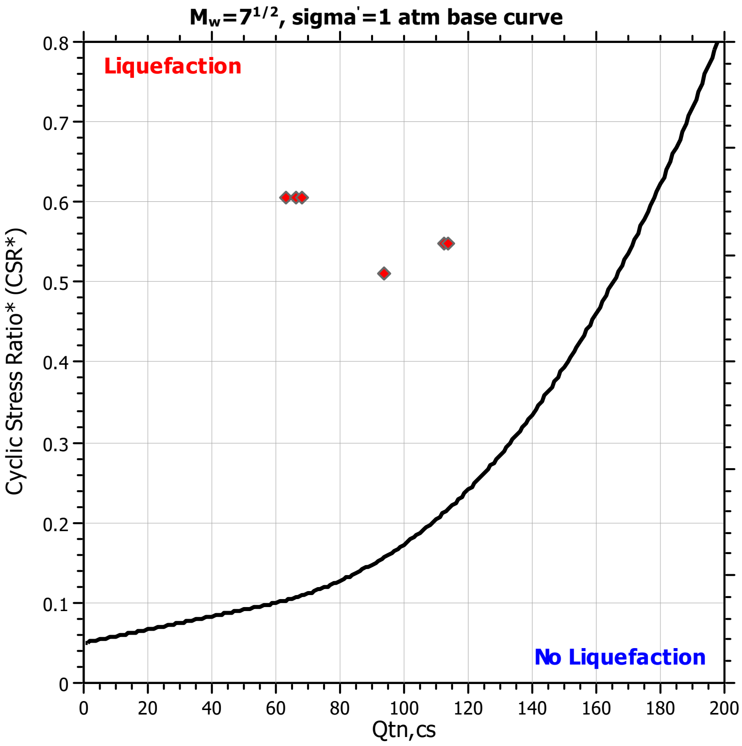
Project title : Mineral Processing Facility **Location : Calipatria, CA**

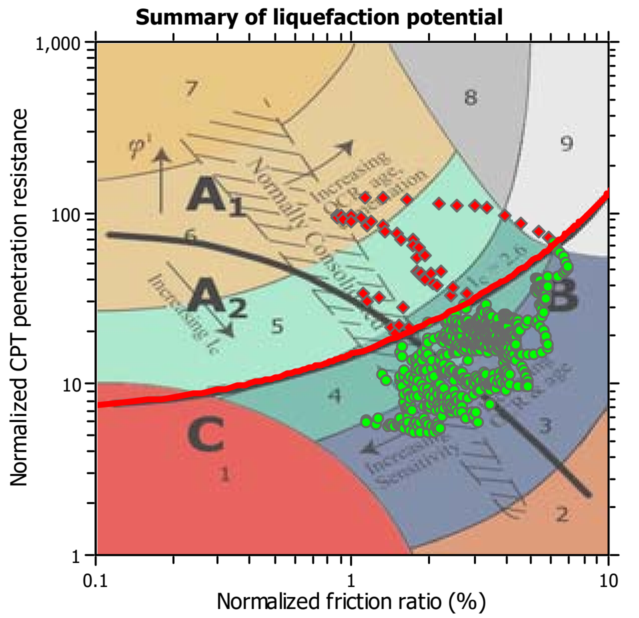
CPT file : CPT-01

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	8.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	8.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.55	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

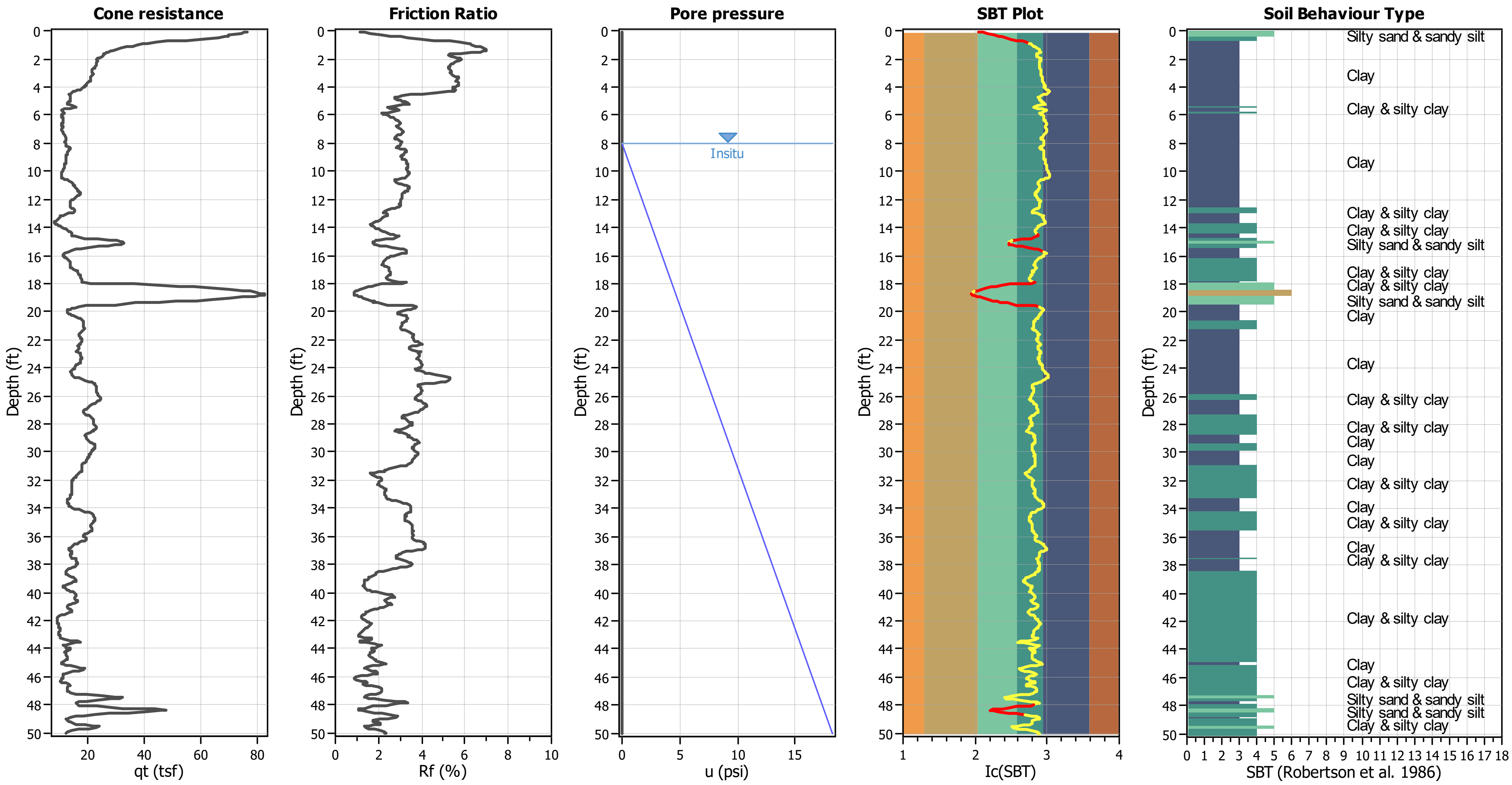






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



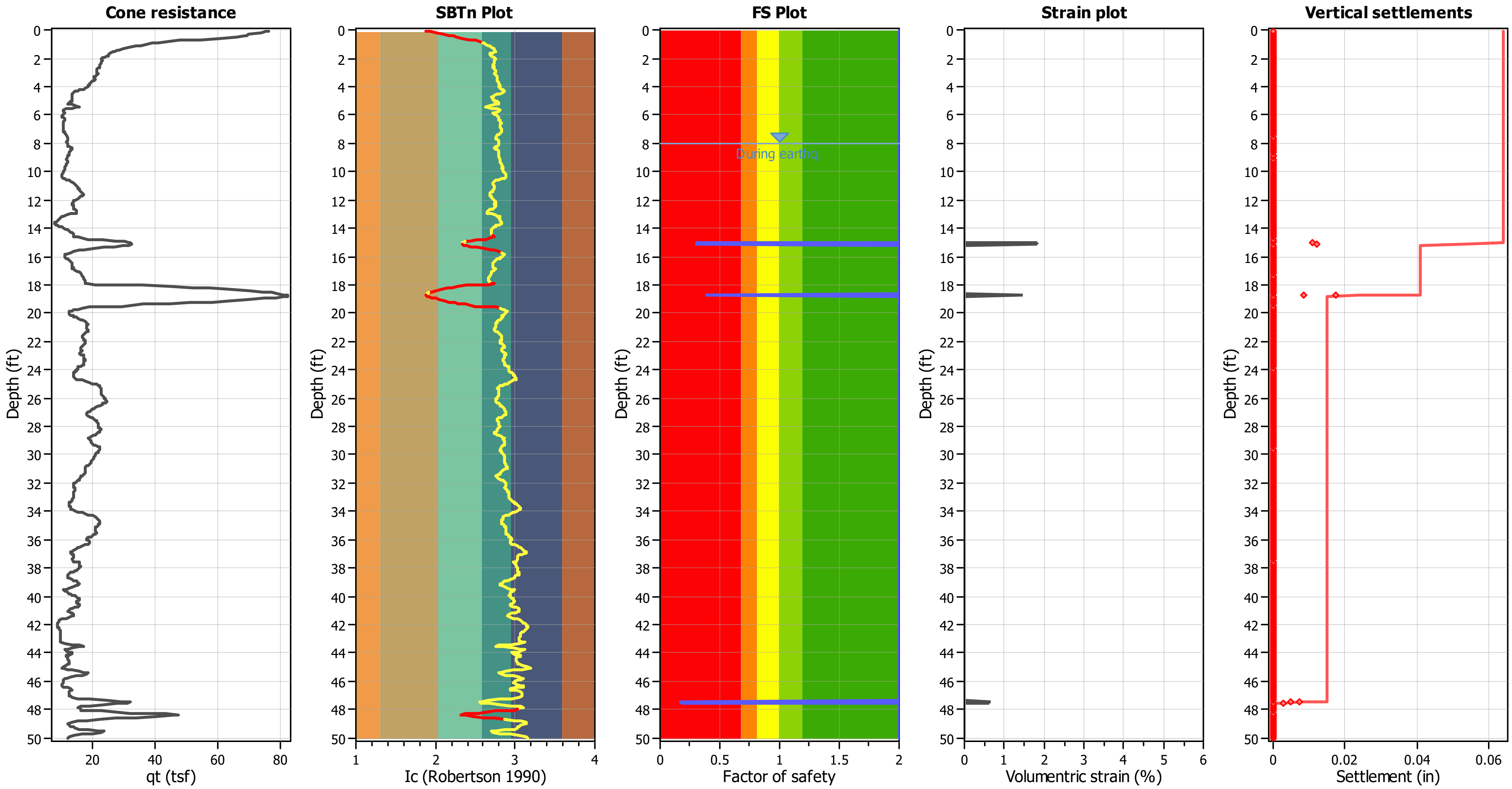
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	8.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	8.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

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

Estimation of post-earthquake settlements



Abbreviations

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

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

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
8.05	87.73	2.00	0.00	0.86	0.00	8.09	87.77	2.00	0.00	0.86	0.00
8.17	87.81	2.00	0.00	0.86	0.00	8.20	87.79	2.00	0.00	0.86	0.00
8.29	88.67	2.00	0.00	0.86	0.00	8.37	90.30	2.00	0.00	0.86	0.00
8.42	92.41	2.00	0.00	0.86	0.00	8.47	93.66	2.00	0.00	0.86	0.00
8.54	93.96	2.00	0.00	0.86	0.00	8.64	93.57	2.00	0.00	0.85	0.00
8.68	92.38	2.00	0.00	0.85	0.00	8.81	91.15	2.00	0.00	0.85	0.00
8.85	89.79	2.00	0.00	0.85	0.00	8.90	88.87	2.00	0.00	0.85	0.00
8.96	88.26	2.00	0.00	0.85	0.00	8.99	88.34	2.00	0.00	0.85	0.00
9.10	88.91	2.00	0.00	0.85	0.00	9.14	89.70	2.00	0.00	0.85	0.00
9.19	90.37	2.00	0.00	0.84	0.00	9.29	90.95	2.00	0.00	0.84	0.00
9.33	91.32	2.00	0.00	0.84	0.00	9.43	91.47	2.00	0.00	0.84	0.00
9.47	91.45	2.00	0.00	0.84	0.00	9.52	91.37	2.00	0.00	0.84	0.00
9.58	91.16	2.00	0.00	0.84	0.00	9.69	90.90	2.00	0.00	0.84	0.00
9.73	90.63	2.00	0.00	0.84	0.00	9.78	89.94	2.00	0.00	0.83	0.00
9.92	89.43	2.00	0.00	0.83	0.00	10.02	88.98	2.00	0.00	0.83	0.00
10.08	88.97	2.00	0.00	0.83	0.00	10.12	88.76	2.00	0.00	0.83	0.00
10.17	88.18	2.00	0.00	0.83	0.00	10.27	87.51	2.00	0.00	0.83	0.00
10.33	86.92	2.00	0.00	0.82	0.00	10.38	86.72	2.00	0.00	0.82	0.00
10.44	86.72	2.00	0.00	0.82	0.00	10.53	86.29	2.00	0.00	0.82	0.00
10.58	85.36	2.00	0.00	0.82	0.00	10.64	85.38	2.00	0.00	0.82	0.00
10.70	87.35	2.00	0.00	0.82	0.00	10.80	90.21	2.00	0.00	0.82	0.00
10.85	93.13	2.00	0.00	0.82	0.00	10.92	95.16	2.00	0.00	0.81	0.00
10.97	98.11	2.00	0.00	0.81	0.00	11.05	100.21	2.00	0.00	0.81	0.00
11.15	102.11	2.00	0.00	0.81	0.00	11.21	102.80	2.00	0.00	0.81	0.00
11.26	103.51	2.00	0.00	0.81	0.00	11.30	103.75	2.00	0.00	0.81	0.00
11.40	103.67	2.00	0.00	0.81	0.00	11.45	103.28	2.00	0.00	0.81	0.00
11.50	102.92	2.00	0.00	0.81	0.00	11.56	102.65	2.00	0.00	0.80	0.00
11.67	102.13	2.00	0.00	0.80	0.00	11.71	101.64	2.00	0.00	0.80	0.00
11.77	100.67	2.00	0.00	0.80	0.00	11.84	99.34	2.00	0.00	0.80	0.00
11.89	97.08	2.00	0.00	0.80	0.00	12.03	95.22	2.00	0.00	0.80	0.00
12.08	93.87	2.00	0.00	0.80	0.00	12.13	93.27	2.00	0.00	0.79	0.00
12.20	92.66	2.00	0.00	0.79	0.00	12.23	92.28	2.00	0.00	0.79	0.00
12.33	92.34	2.00	0.00	0.79	0.00	12.38	92.53	2.00	0.00	0.79	0.00
12.49	92.52	2.00	0.00	0.79	0.00	12.55	91.88	2.00	0.00	0.79	0.00
12.60	90.77	2.00	0.00	0.79	0.00	12.64	89.36	2.00	0.00	0.79	0.00
12.69	87.84	2.00	0.00	0.78	0.00	12.76	86.27	2.00	0.00	0.78	0.00
12.81	83.94	2.00	0.00	0.78	0.00	12.91	82.40	2.00	0.00	0.78	0.00
12.95	81.22	2.00	0.00	0.78	0.00	13.01	80.89	2.00	0.00	0.78	0.00
13.07	79.10	2.00	0.00	0.78	0.00	13.17	76.46	2.00	0.00	0.78	0.00
13.22	73.49	2.00	0.00	0.78	0.00	13.26	70.84	2.00	0.00	0.78	0.00
13.33	68.84	2.00	0.00	0.77	0.00	13.48	66.77	2.00	0.00	0.77	0.00
13.53	64.17	2.00	0.00	0.77	0.00	13.58	61.80	2.00	0.00	0.77	0.00
13.65	60.11	2.00	0.00	0.77	0.00	13.70	59.86	2.00	0.00	0.77	0.00
13.75	59.83	2.00	0.00	0.77	0.00	13.80	60.41	2.00	0.00	0.77	0.00
13.86	62.24	2.00	0.00	0.77	0.00	13.93	64.18	2.00	0.00	0.76	0.00
13.98	66.81	2.00	0.00	0.76	0.00	14.07	68.84	2.00	0.00	0.76	0.00
14.11	72.16	2.00	0.00	0.76	0.00	14.21	74.85	2.00	0.00	0.76	0.00
14.25	78.08	2.00	0.00	0.76	0.00	14.34	80.07	2.00	0.00	0.76	0.00

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

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
14.38	82.81	2.00	0.00	0.76	0.00	14.46	84.85	2.00	0.00	0.75	0.00
14.51	87.38	2.00	0.00	0.75	0.00	14.60	89.81	2.00	0.00	0.75	0.00
14.64	94.48	2.00	0.00	0.75	0.00	14.79	95.95	2.00	0.00	0.75	0.00
14.82	96.01	2.00	0.00	0.75	0.00	14.89	94.16	2.00	0.00	0.75	0.00
14.95	93.83	2.00	0.00	0.75	0.00	14.99	93.84	2.00	0.00	0.75	0.00
15.04	93.96	0.31	1.83	0.75	0.01	15.10	93.61	0.31	1.84	0.74	0.01
15.22	93.37	2.00	0.00	0.74	0.00	15.26	93.48	2.00	0.00	0.74	0.00
15.31	94.57	2.00	0.00	0.74	0.00	15.36	96.03	2.00	0.00	0.74	0.00
15.48	97.17	2.00	0.00	0.74	0.00	15.53	98.21	2.00	0.00	0.74	0.00
15.57	97.95	2.00	0.00	0.74	0.00	15.63	95.97	2.00	0.00	0.74	0.00
15.74	92.59	2.00	0.00	0.73	0.00	15.79	88.66	2.00	0.00	0.73	0.00
15.84	85.65	2.00	0.00	0.73	0.00	15.90	82.45	2.00	0.00	0.73	0.00
16.00	79.56	2.00	0.00	0.73	0.00	16.06	77.73	2.00	0.00	0.73	0.00
16.10	77.23	2.00	0.00	0.73	0.00	16.14	77.11	2.00	0.00	0.73	0.00
16.24	76.76	2.00	0.00	0.72	0.00	16.31	76.53	2.00	0.00	0.72	0.00
16.36	77.02	2.00	0.00	0.72	0.00	16.41	76.48	2.00	0.00	0.72	0.00
16.59	76.12	2.00	0.00	0.72	0.00	16.63	75.55	2.00	0.00	0.72	0.00
16.68	76.41	2.00	0.00	0.72	0.00	16.74	77.48	2.00	0.00	0.72	0.00
16.78	78.87	2.00	0.00	0.72	0.00	16.84	80.74	2.00	0.00	0.71	0.00
16.90	81.88	2.00	0.00	0.71	0.00	16.93	82.95	2.00	0.00	0.71	0.00
17.03	83.92	2.00	0.00	0.71	0.00	17.07	85.31	2.00	0.00	0.71	0.00
17.14	86.30	2.00	0.00	0.71	0.00	17.21	86.84	2.00	0.00	0.71	0.00
17.34	87.11	2.00	0.00	0.71	0.00	17.39	87.14	2.00	0.00	0.71	0.00
17.43	86.41	2.00	0.00	0.70	0.00	17.52	85.30	2.00	0.00	0.70	0.00
17.56	84.40	2.00	0.00	0.70	0.00	17.60	84.64	2.00	0.00	0.70	0.00
17.66	86.15	2.00	0.00	0.70	0.00	17.75	90.42	2.00	0.00	0.70	0.00
17.86	95.80	2.00	0.00	0.70	0.00	17.91	101.68	2.00	0.00	0.70	0.00
17.96	104.21	2.00	0.00	0.70	0.00	18.00	104.62	2.00	0.00	0.69	0.00
18.05	105.13	2.00	0.00	0.69	0.00	18.14	107.01	2.00	0.00	0.69	0.00
18.20	109.02	2.00	0.00	0.69	0.00	18.26	109.23	2.00	0.00	0.69	0.00
18.31	109.67	2.00	0.00	0.69	0.00	18.40	110.22	2.00	0.00	0.69	0.00
18.49	110.33	2.00	0.00	0.69	0.00	18.55	110.29	2.00	0.00	0.69	0.00
18.59	111.20	2.00	0.00	0.68	0.00	18.69	112.43	0.39	1.45	0.68	0.02
18.74	113.75	0.40	1.43	0.68	0.01	18.78	114.72	2.00	0.00	0.68	0.00
18.84	115.67	2.00	0.00	0.68	0.00	18.93	116.12	2.00	0.00	0.68	0.00
18.98	115.36	2.00	0.00	0.68	0.00	19.07	114.14	2.00	0.00	0.68	0.00
19.13	113.52	2.00	0.00	0.68	0.00	19.20	113.71	2.00	0.00	0.67	0.00
19.24	109.52	2.00	0.00	0.67	0.00	19.33	102.29	2.00	0.00	0.67	0.00
19.39	98.56	2.00	0.00	0.67	0.00	19.51	100.99	2.00	0.00	0.67	0.00
19.55	107.05	2.00	0.00	0.67	0.00	19.60	106.16	2.00	0.00	0.67	0.00
19.65	103.58	2.00	0.00	0.67	0.00	19.71	99.41	2.00	0.00	0.67	0.00
19.79	95.35	2.00	0.00	0.66	0.00	19.84	91.38	2.00	0.00	0.66	0.00
19.88	87.75	2.00	0.00	0.66	0.00	19.97	83.96	2.00	0.00	0.66	0.00
20.02	81.80	2.00	0.00	0.66	0.00	20.13	82.70	2.00	0.00	0.66	0.00
20.20	85.27	2.00	0.00	0.66	0.00	20.24	88.30	2.00	0.00	0.66	0.00
20.29	91.48	2.00	0.00	0.66	0.00	20.40	93.81	2.00	0.00	0.65	0.00
20.46	95.76	2.00	0.00	0.65	0.00	20.50	96.81	2.00	0.00	0.65	0.00
20.55	98.00	2.00	0.00	0.65	0.00	20.66	98.50	2.00	0.00	0.65	0.00

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

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
20.72	98.16	2.00	0.00	0.65	0.00	20.77	97.16	2.00	0.00	0.65	0.00
20.81	96.10	2.00	0.00	0.65	0.00	20.91	95.42	2.00	0.00	0.65	0.00
20.96	95.18	2.00	0.00	0.64	0.00	21.02	94.97	2.00	0.00	0.64	0.00
21.08	94.47	2.00	0.00	0.64	0.00	21.18	93.97	2.00	0.00	0.64	0.00
21.21	94.25	2.00	0.00	0.64	0.00	21.30	95.12	2.00	0.00	0.64	0.00
21.35	96.67	2.00	0.00	0.64	0.00	21.44	97.69	2.00	0.00	0.64	0.00
21.48	98.57	2.00	0.00	0.64	0.00	21.56	98.74	2.00	0.00	0.63	0.00
21.61	98.85	2.00	0.00	0.63	0.00	21.66	98.85	2.00	0.00	0.63	0.00
21.76	99.06	2.00	0.00	0.63	0.00	21.82	99.50	2.00	0.00	0.63	0.00
21.88	100.05	2.00	0.00	0.63	0.00	21.92	100.62	2.00	0.00	0.63	0.00
22.03	101.34	2.00	0.00	0.63	0.00	22.09	102.28	2.00	0.00	0.63	0.00
22.14	103.33	2.00	0.00	0.62	0.00	22.19	103.97	2.00	0.00	0.62	0.00
22.29	104.10	2.00	0.00	0.62	0.00	22.36	102.61	2.00	0.00	0.62	0.00
22.40	99.39	2.00	0.00	0.62	0.00	22.45	96.13	2.00	0.00	0.62	0.00
22.55	94.52	2.00	0.00	0.62	0.00	22.61	94.55	2.00	0.00	0.62	0.00
22.67	94.63	2.00	0.00	0.62	0.00	22.71	96.10	2.00	0.00	0.62	0.00
22.81	98.22	2.00	0.00	0.61	0.00	22.85	100.38	2.00	0.00	0.61	0.00
22.94	101.02	2.00	0.00	0.61	0.00	23.00	101.39	2.00	0.00	0.61	0.00
23.07	101.87	2.00	0.00	0.61	0.00	23.16	102.00	2.00	0.00	0.61	0.00
23.21	101.80	2.00	0.00	0.61	0.00	23.29	101.53	2.00	0.00	0.61	0.00
23.33	101.30	2.00	0.00	0.60	0.00	23.40	101.27	2.00	0.00	0.60	0.00
23.44	101.72	2.00	0.00	0.60	0.00	23.52	102.52	2.00	0.00	0.60	0.00
23.56	102.72	2.00	0.00	0.60	0.00	23.65	102.30	2.00	0.00	0.60	0.00
23.69	101.19	2.00	0.00	0.60	0.00	23.77	100.26	2.00	0.00	0.60	0.00
23.82	98.79	2.00	0.00	0.60	0.00	23.93	97.40	2.00	0.00	0.59	0.00
23.98	95.34	2.00	0.00	0.59	0.00	24.06	93.67	2.00	0.00	0.59	0.00
24.11	92.42	2.00	0.00	0.59	0.00	24.19	92.32	2.00	0.00	0.59	0.00
24.22	92.75	2.00	0.00	0.59	0.00	24.29	93.99	2.00	0.00	0.59	0.00
24.39	95.27	2.00	0.00	0.59	0.00	24.43	97.28	2.00	0.00	0.59	0.00
24.52	100.71	2.00	0.00	0.58	0.00	24.60	105.12	2.00	0.00	0.58	0.00
24.66	109.38	2.00	0.00	0.58	0.00	24.70	112.16	2.00	0.00	0.58	0.00
24.75	115.03	2.00	0.00	0.58	0.00	24.84	117.82	2.00	0.00	0.58	0.00
24.89	120.57	2.00	0.00	0.58	0.00	24.97	122.04	2.00	0.00	0.58	0.00
25.03	122.58	2.00	0.00	0.58	0.00	25.09	119.53	2.00	0.00	0.57	0.00
25.15	114.19	2.00	0.00	0.57	0.00	25.20	110.20	2.00	0.00	0.57	0.00
25.29	109.63	2.00	0.00	0.57	0.00	25.36	111.29	2.00	0.00	0.57	0.00
25.41	111.58	2.00	0.00	0.57	0.00	25.46	111.63	2.00	0.00	0.57	0.00
25.54	111.80	2.00	0.00	0.57	0.00	25.60	112.24	2.00	0.00	0.57	0.00
25.66	112.53	2.00	0.00	0.57	0.00	25.72	112.62	2.00	0.00	0.56	0.00
25.81	112.43	2.00	0.00	0.56	0.00	25.86	111.99	2.00	0.00	0.56	0.00
25.93	111.43	2.00	0.00	0.56	0.00	25.99	110.84	2.00	0.00	0.56	0.00
26.08	110.35	2.00	0.00	0.56	0.00	26.13	110.22	2.00	0.00	0.56	0.00
26.21	110.31	2.00	0.00	0.56	0.00	26.26	111.09	2.00	0.00	0.55	0.00
26.35	111.67	2.00	0.00	0.55	0.00	26.38	112.28	2.00	0.00	0.55	0.00
26.48	112.46	2.00	0.00	0.55	0.00	26.52	112.29	2.00	0.00	0.55	0.00
26.60	111.62	2.00	0.00	0.55	0.00	26.67	110.33	2.00	0.00	0.55	0.00
26.74	109.03	2.00	0.00	0.55	0.00	26.79	107.35	2.00	0.00	0.55	0.00
26.88	105.71	2.00	0.00	0.54	0.00	26.92	103.45	2.00	0.00	0.54	0.00

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

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
26.99	101.61	2.00	0.00	0.54	0.00	27.04	100.14	2.00	0.00	0.54	0.00
27.12	99.26	2.00	0.00	0.54	0.00	27.18	97.87	2.00	0.00	0.54	0.00
27.26	95.99	2.00	0.00	0.54	0.00	27.33	94.17	2.00	0.00	0.54	0.00
27.38	93.32	2.00	0.00	0.54	0.00	27.48	93.19	2.00	0.00	0.53	0.00
27.54	93.91	2.00	0.00	0.53	0.00	27.58	94.94	2.00	0.00	0.53	0.00
27.63	96.61	2.00	0.00	0.53	0.00	27.73	97.96	2.00	0.00	0.53	0.00
27.78	99.28	2.00	0.00	0.53	0.00	27.84	100.26	2.00	0.00	0.53	0.00
27.89	101.53	2.00	0.00	0.53	0.00	27.99	102.12	2.00	0.00	0.53	0.00
28.05	101.82	2.00	0.00	0.52	0.00	28.11	100.75	2.00	0.00	0.52	0.00
28.16	99.62	2.00	0.00	0.52	0.00	28.31	97.59	2.00	0.00	0.52	0.00
28.37	94.06	2.00	0.00	0.52	0.00	28.42	90.42	2.00	0.00	0.52	0.00
28.47	88.54	2.00	0.00	0.52	0.00	28.52	89.47	2.00	0.00	0.52	0.00
28.58	91.08	2.00	0.00	0.52	0.00	28.64	92.31	2.00	0.00	0.51	0.00
28.69	92.75	2.00	0.00	0.51	0.00	28.78	92.60	2.00	0.00	0.51	0.00
28.84	92.57	2.00	0.00	0.51	0.00	28.89	93.11	2.00	0.00	0.51	0.00
28.94	94.41	2.00	0.00	0.51	0.00	29.02	96.03	2.00	0.00	0.51	0.00
29.11	97.39	2.00	0.00	0.51	0.00	29.14	98.87	2.00	0.00	0.51	0.00
29.22	100.37	2.00	0.00	0.50	0.00	29.29	101.90	2.00	0.00	0.50	0.00
29.33	102.90	2.00	0.00	0.50	0.00	29.41	102.94	2.00	0.00	0.50	0.00
29.48	102.29	2.00	0.00	0.50	0.00	29.59	101.48	2.00	0.00	0.50	0.00
29.63	100.99	2.00	0.00	0.50	0.00	29.70	100.77	2.00	0.00	0.50	0.00
29.74	100.52	2.00	0.00	0.50	0.00	29.82	100.32	2.00	0.00	0.49	0.00
29.86	100.31	2.00	0.00	0.49	0.00	29.95	100.50	2.00	0.00	0.49	0.00
30.03	100.72	2.00	0.00	0.49	0.00	30.12	100.83	2.00	0.00	0.49	0.00
30.14	100.29	2.00	0.00	0.49	0.00	30.22	99.60	2.00	0.00	0.49	0.00
30.26	98.61	2.00	0.00	0.49	0.00	30.35	97.96	2.00	0.00	0.49	0.00
30.39	96.80	2.00	0.00	0.48	0.00	30.52	95.74	2.00	0.00	0.48	0.00
30.55	94.74	2.00	0.00	0.48	0.00	30.62	94.23	2.00	0.00	0.48	0.00
30.66	93.60	2.00	0.00	0.48	0.00	30.75	92.31	2.00	0.00	0.48	0.00
30.81	90.91	2.00	0.00	0.48	0.00	30.85	89.01	2.00	0.00	0.48	0.00
30.96	87.31	2.00	0.00	0.48	0.00	31.01	84.01	2.00	0.00	0.47	0.00
31.10	80.61	2.00	0.00	0.47	0.00	31.15	76.88	2.00	0.00	0.47	0.00
31.27	74.77	2.00	0.00	0.47	0.00	31.32	73.45	2.00	0.00	0.47	0.00
31.37	72.97	2.00	0.00	0.47	0.00	31.41	69.45	2.00	0.00	0.47	0.00
31.47	65.22	2.00	0.00	0.47	0.00	31.54	61.52	2.00	0.00	0.47	0.00
31.63	62.43	2.00	0.00	0.46	0.00	31.69	64.38	2.00	0.00	0.46	0.00
31.77	65.72	2.00	0.00	0.46	0.00	31.83	66.47	2.00	0.00	0.46	0.00
31.92	67.02	2.00	0.00	0.46	0.00	31.97	66.53	2.00	0.00	0.46	0.00
32.05	65.35	2.00	0.00	0.46	0.00	32.11	63.93	2.00	0.00	0.46	0.00
32.19	63.50	2.00	0.00	0.45	0.00	32.23	63.49	2.00	0.00	0.45	0.00
32.34	63.52	2.00	0.00	0.45	0.00	32.36	63.89	2.00	0.00	0.45	0.00
32.43	64.78	2.00	0.00	0.45	0.00	32.50	66.35	2.00	0.00	0.45	0.00
32.58	67.60	2.00	0.00	0.45	0.00	32.63	68.35	2.00	0.00	0.45	0.00
32.71	68.20	2.00	0.00	0.45	0.00	32.75	67.66	2.00	0.00	0.44	0.00
32.82	67.10	2.00	0.00	0.44	0.00	32.89	66.70	2.00	0.00	0.44	0.00
32.94	66.65	2.00	0.00	0.44	0.00	33.03	66.56	2.00	0.00	0.44	0.00
33.07	66.45	2.00	0.00	0.44	0.00	33.16	66.36	2.00	0.00	0.44	0.00
33.22	66.29	2.00	0.00	0.44	0.00	33.30	66.27	2.00	0.00	0.44	0.00

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

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
33.34	66.67	2.00	0.00	0.43	0.00	33.43	67.44	2.00	0.00	0.43	0.00
33.48	69.47	2.00	0.00	0.43	0.00	33.61	71.37	2.00	0.00	0.43	0.00
33.65	73.38	2.00	0.00	0.43	0.00	33.70	74.71	2.00	0.00	0.43	0.00
33.74	76.03	2.00	0.00	0.43	0.00	33.83	76.99	2.00	0.00	0.43	0.00
33.88	78.06	2.00	0.00	0.43	0.00	33.93	79.99	2.00	0.00	0.43	0.00
34.04	82.44	2.00	0.00	0.42	0.00	34.09	84.91	2.00	0.00	0.42	0.00
34.14	87.14	2.00	0.00	0.42	0.00	34.24	89.76	2.00	0.00	0.42	0.00
34.30	90.64	2.00	0.00	0.42	0.00	34.41	91.53	2.00	0.00	0.42	0.00
34.45	91.04	2.00	0.00	0.42	0.00	34.50	91.74	2.00	0.00	0.42	0.00
34.56	91.63	2.00	0.00	0.41	0.00	34.62	91.83	2.00	0.00	0.41	0.00
34.67	91.91	2.00	0.00	0.41	0.00	34.76	91.78	2.00	0.00	0.41	0.00
34.78	91.75	2.00	0.00	0.41	0.00	34.87	91.96	2.00	0.00	0.41	0.00
34.92	92.44	2.00	0.00	0.41	0.00	35.00	92.85	2.00	0.00	0.41	0.00
35.05	93.11	2.00	0.00	0.41	0.00	35.14	93.15	2.00	0.00	0.40	0.00
35.18	93.18	2.00	0.00	0.40	0.00	35.26	93.23	2.00	0.00	0.40	0.00
35.32	93.32	2.00	0.00	0.40	0.00	35.38	93.35	2.00	0.00	0.40	0.00
35.44	93.43	2.00	0.00	0.40	0.00	35.53	93.65	2.00	0.00	0.40	0.00
35.58	93.61	2.00	0.00	0.40	0.00	35.66	93.07	2.00	0.00	0.40	0.00
35.71	91.65	2.00	0.00	0.39	0.00	35.81	90.23	2.00	0.00	0.39	0.00
35.85	89.01	2.00	0.00	0.39	0.00	35.93	88.33	2.00	0.00	0.39	0.00
35.98	87.78	2.00	0.00	0.39	0.00	36.03	87.97	2.00	0.00	0.39	0.00
36.14	88.93	2.00	0.00	0.39	0.00	36.20	89.99	2.00	0.00	0.39	0.00
36.24	90.37	2.00	0.00	0.39	0.00	36.29	90.09	2.00	0.00	0.38	0.00
36.39	89.58	2.00	0.00	0.38	0.00	36.45	88.86	2.00	0.00	0.38	0.00
36.50	87.81	2.00	0.00	0.38	0.00	36.55	86.38	2.00	0.00	0.38	0.00
36.66	84.88	2.00	0.00	0.38	0.00	36.72	83.25	2.00	0.00	0.38	0.00
36.82	81.90	2.00	0.00	0.38	0.00	36.86	80.52	2.00	0.00	0.38	0.00
36.91	79.23	2.00	0.00	0.37	0.00	36.97	77.73	2.00	0.00	0.37	0.00
37.04	76.37	2.00	0.00	0.37	0.00	37.09	74.94	2.00	0.00	0.37	0.00
37.18	73.34	2.00	0.00	0.37	0.00	37.25	72.32	2.00	0.00	0.37	0.00
37.31	71.19	2.00	0.00	0.37	0.00	37.35	69.83	2.00	0.00	0.37	0.00
37.41	69.33	2.00	0.00	0.37	0.00	37.53	70.14	2.00	0.00	0.36	0.00
37.57	72.39	2.00	0.00	0.36	0.00	37.62	73.97	2.00	0.00	0.36	0.00
37.67	76.06	2.00	0.00	0.36	0.00	37.75	78.23	2.00	0.00	0.36	0.00
37.84	80.16	2.00	0.00	0.36	0.00	37.87	81.25	2.00	0.00	0.36	0.00
37.95	81.44	2.00	0.00	0.36	0.00	38.01	81.09	2.00	0.00	0.36	0.00
38.06	79.36	2.00	0.00	0.35	0.00	38.15	76.35	2.00	0.00	0.35	0.00
38.24	72.54	2.00	0.00	0.35	0.00	38.28	69.06	2.00	0.00	0.35	0.00
38.33	66.07	2.00	0.00	0.35	0.00	38.41	62.91	2.00	0.00	0.35	0.00
38.48	59.65	2.00	0.00	0.35	0.00	38.53	57.02	2.00	0.00	0.35	0.00
38.58	55.79	2.00	0.00	0.35	0.00	38.66	56.05	2.00	0.00	0.34	0.00
38.72	56.29	2.00	0.00	0.34	0.00	38.80	56.16	2.00	0.00	0.34	0.00
38.88	55.66	2.00	0.00	0.34	0.00	38.91	55.86	2.00	0.00	0.34	0.00
38.98	55.87	2.00	0.00	0.34	0.00	39.10	55.39	2.00	0.00	0.34	0.00
39.15	54.26	2.00	0.00	0.34	0.00	39.20	53.12	2.00	0.00	0.34	0.00
39.24	52.16	2.00	0.00	0.33	0.00	39.33	51.42	2.00	0.00	0.33	0.00
39.37	49.95	2.00	0.00	0.33	0.00	39.48	48.06	2.00	0.00	0.33	0.00
39.52	46.85	2.00	0.00	0.33	0.00	39.63	47.13	2.00	0.00	0.33	0.00

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

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
39.67	48.43	2.00	0.00	0.33	0.00	39.78	49.71	2.00	0.00	0.33	0.00
39.82	51.59	2.00	0.00	0.33	0.00	39.87	53.55	2.00	0.00	0.32	0.00
39.92	55.52	2.00	0.00	0.32	0.00	39.97	59.02	2.00	0.00	0.32	0.00
40.05	63.38	2.00	0.00	0.32	0.00	40.14	67.48	2.00	0.00	0.32	0.00
40.19	69.70	2.00	0.00	0.32	0.00	40.25	70.33	2.00	0.00	0.32	0.00
40.31	70.24	2.00	0.00	0.32	0.00	40.36	68.14	2.00	0.00	0.32	0.00
40.45	66.51	2.00	0.00	0.31	0.00	40.52	65.37	2.00	0.00	0.31	0.00
40.58	66.17	2.00	0.00	0.31	0.00	40.62	66.47	2.00	0.00	0.31	0.00
40.73	66.43	2.00	0.00	0.31	0.00	40.76	66.14	2.00	0.00	0.31	0.00
40.84	65.15	2.00	0.00	0.31	0.00	40.90	63.24	2.00	0.00	0.31	0.00
40.97	60.76	2.00	0.00	0.31	0.00	41.03	58.58	2.00	0.00	0.30	0.00
41.11	57.40	2.00	0.00	0.30	0.00	41.15	56.89	2.00	0.00	0.30	0.00
41.22	56.32	2.00	0.00	0.30	0.00	41.28	54.90	2.00	0.00	0.30	0.00
41.37	53.12	2.00	0.00	0.30	0.00	41.42	51.09	2.00	0.00	0.30	0.00
41.51	49.88	2.00	0.00	0.30	0.00	41.55	47.58	2.00	0.00	0.30	0.00
41.64	45.16	2.00	0.00	0.29	0.00	41.69	42.70	2.00	0.00	0.29	0.00
41.82	41.98	2.00	0.00	0.29	0.00	41.85	42.28	2.00	0.00	0.29	0.00
41.91	42.59	2.00	0.00	0.29	0.00	41.95	43.40	2.00	0.00	0.29	0.00
42.05	44.08	2.00	0.00	0.29	0.00	42.09	45.04	2.00	0.00	0.29	0.00
42.17	45.67	2.00	0.00	0.29	0.00	42.22	46.39	2.00	0.00	0.28	0.00
42.30	46.64	2.00	0.00	0.28	0.00	42.35	46.55	2.00	0.00	0.28	0.00
42.41	46.21	2.00	0.00	0.28	0.00	42.47	45.82	2.00	0.00	0.28	0.00
42.52	45.31	2.00	0.00	0.28	0.00	42.62	44.80	2.00	0.00	0.28	0.00
42.68	44.03	2.00	0.00	0.28	0.00	42.74	43.48	2.00	0.00	0.28	0.00
42.79	42.30	2.00	0.00	0.27	0.00	42.90	41.52	2.00	0.00	0.27	0.00
43.01	40.82	2.00	0.00	0.27	0.00	43.05	41.09	2.00	0.00	0.27	0.00
43.10	41.42	2.00	0.00	0.27	0.00	43.16	42.16	2.00	0.00	0.27	0.00
43.21	44.39	2.00	0.00	0.27	0.00	43.27	47.82	2.00	0.00	0.27	0.00
43.32	50.64	2.00	0.00	0.27	0.00	43.41	51.17	2.00	0.00	0.26	0.00
43.46	50.07	2.00	0.00	0.26	0.00	43.53	50.72	2.00	0.00	0.26	0.00
43.59	53.75	2.00	0.00	0.26	0.00	43.68	55.66	2.00	0.00	0.26	0.00
43.73	55.71	2.00	0.00	0.26	0.00	43.79	54.66	2.00	0.00	0.26	0.00
43.86	54.28	2.00	0.00	0.26	0.00	43.95	54.15	2.00	0.00	0.26	0.00
43.97	53.74	2.00	0.00	0.25	0.00	44.03	53.82	2.00	0.00	0.25	0.00
44.12	53.51	2.00	0.00	0.25	0.00	44.17	52.74	2.00	0.00	0.25	0.00
44.27	51.84	2.00	0.00	0.25	0.00	44.31	50.57	2.00	0.00	0.25	0.00
44.39	50.33	2.00	0.00	0.25	0.00	44.43	50.06	2.00	0.00	0.25	0.00
44.53	50.99	2.00	0.00	0.25	0.00	44.57	51.80	2.00	0.00	0.24	0.00
44.65	53.13	2.00	0.00	0.24	0.00	44.73	53.94	2.00	0.00	0.24	0.00
44.78	53.85	2.00	0.00	0.24	0.00	44.83	53.17	2.00	0.00	0.24	0.00
44.90	52.61	2.00	0.00	0.24	0.00	44.97	53.31	2.00	0.00	0.24	0.00
45.05	54.02	2.00	0.00	0.24	0.00	45.10	54.85	2.00	0.00	0.24	0.00
45.19	54.62	2.00	0.00	0.23	0.00	45.23	54.10	2.00	0.00	0.23	0.00
45.28	53.90	2.00	0.00	0.23	0.00	45.36	54.26	2.00	0.00	0.23	0.00
45.41	55.80	2.00	0.00	0.23	0.00	45.52	57.44	2.00	0.00	0.23	0.00
45.57	58.24	2.00	0.00	0.23	0.00	45.63	57.51	2.00	0.00	0.23	0.00
45.67	55.40	2.00	0.00	0.23	0.00	45.78	52.93	2.00	0.00	0.22	0.00
45.84	49.95	2.00	0.00	0.22	0.00	45.89	46.82	2.00	0.00	0.22	0.00

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

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
45.94	43.62	2.00	0.00	0.22	0.00	46.03	40.76	2.00	0.00	0.22	0.00
46.08	39.42	2.00	0.00	0.22	0.00	46.14	38.96	2.00	0.00	0.22	0.00
46.21	39.79	2.00	0.00	0.22	0.00	46.30	42.01	2.00	0.00	0.22	0.00
46.36	44.32	2.00	0.00	0.21	0.00	46.42	46.12	2.00	0.00	0.21	0.00
46.47	47.23	2.00	0.00	0.21	0.00	46.56	47.92	2.00	0.00	0.21	0.00
46.63	49.70	2.00	0.00	0.21	0.00	46.67	52.52	2.00	0.00	0.21	0.00
46.73	55.13	2.00	0.00	0.21	0.00	46.89	56.57	2.00	0.00	0.21	0.00
46.92	56.81	2.00	0.00	0.20	0.00	47.00	56.78	2.00	0.00	0.20	0.00
47.05	57.17	2.00	0.00	0.20	0.00	47.16	57.61	2.00	0.00	0.20	0.00
47.20	58.48	2.00	0.00	0.20	0.00	47.28	59.16	2.00	0.00	0.20	0.00
47.33	61.04	2.00	0.00	0.20	0.00	47.42	63.43	0.17	0.67	0.20	0.01
47.48	66.17	0.18	0.64	0.20	0.00	47.52	68.14	0.18	0.62	0.19	0.00
47.58	70.67	2.00	0.00	0.19	0.00	47.68	72.94	2.00	0.00	0.19	0.00
47.72	74.11	2.00	0.00	0.19	0.00	47.77	73.68	2.00	0.00	0.19	0.00
47.86	72.64	2.00	0.00	0.19	0.00	47.91	70.32	2.00	0.00	0.19	0.00
48.00	67.40	2.00	0.00	0.19	0.00	48.05	64.68	2.00	0.00	0.19	0.00
48.10	64.48	2.00	0.00	0.18	0.00	48.25	64.36	2.00	0.00	0.18	0.00
48.30	65.61	2.00	0.00	0.18	0.00	48.39	67.48	2.00	0.00	0.18	0.00
48.44	70.45	2.00	0.00	0.18	0.00	48.52	73.36	2.00	0.00	0.18	0.00
48.58	76.13	2.00	0.00	0.18	0.00	48.64	76.02	2.00	0.00	0.18	0.00
48.73	74.46	2.00	0.00	0.17	0.00	48.79	72.03	2.00	0.00	0.17	0.00
48.82	68.10	2.00	0.00	0.17	0.00	48.90	63.24	2.00	0.00	0.17	0.00
48.96	57.31	2.00	0.00	0.17	0.00	49.04	53.89	2.00	0.00	0.17	0.00
49.08	51.55	2.00	0.00	0.17	0.00	49.17	52.59	2.00	0.00	0.17	0.00
49.25	55.43	2.00	0.00	0.17	0.00	49.32	58.51	2.00	0.00	0.16	0.00
49.37	60.06	2.00	0.00	0.16	0.00	49.41	60.30	2.00	0.00	0.16	0.00
49.50	59.80	2.00	0.00	0.16	0.00	49.54	58.99	2.00	0.00	0.16	0.00
49.63	58.51	2.00	0.00	0.16	0.00	49.69	58.79	2.00	0.00	0.16	0.00
49.74	58.31	2.00	0.00	0.16	0.00	49.85	57.50	2.00	0.00	0.16	0.00
49.94	56.38	2.00	0.00	0.15	0.00	49.99	55.74	2.00	0.00	0.15	0.00
50.03	55.41	2.00	0.00	0.15	0.00						

Total estimated settlement: 0.06

Abbreviations

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

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LANDMARK Geo-Engineers and Geologists

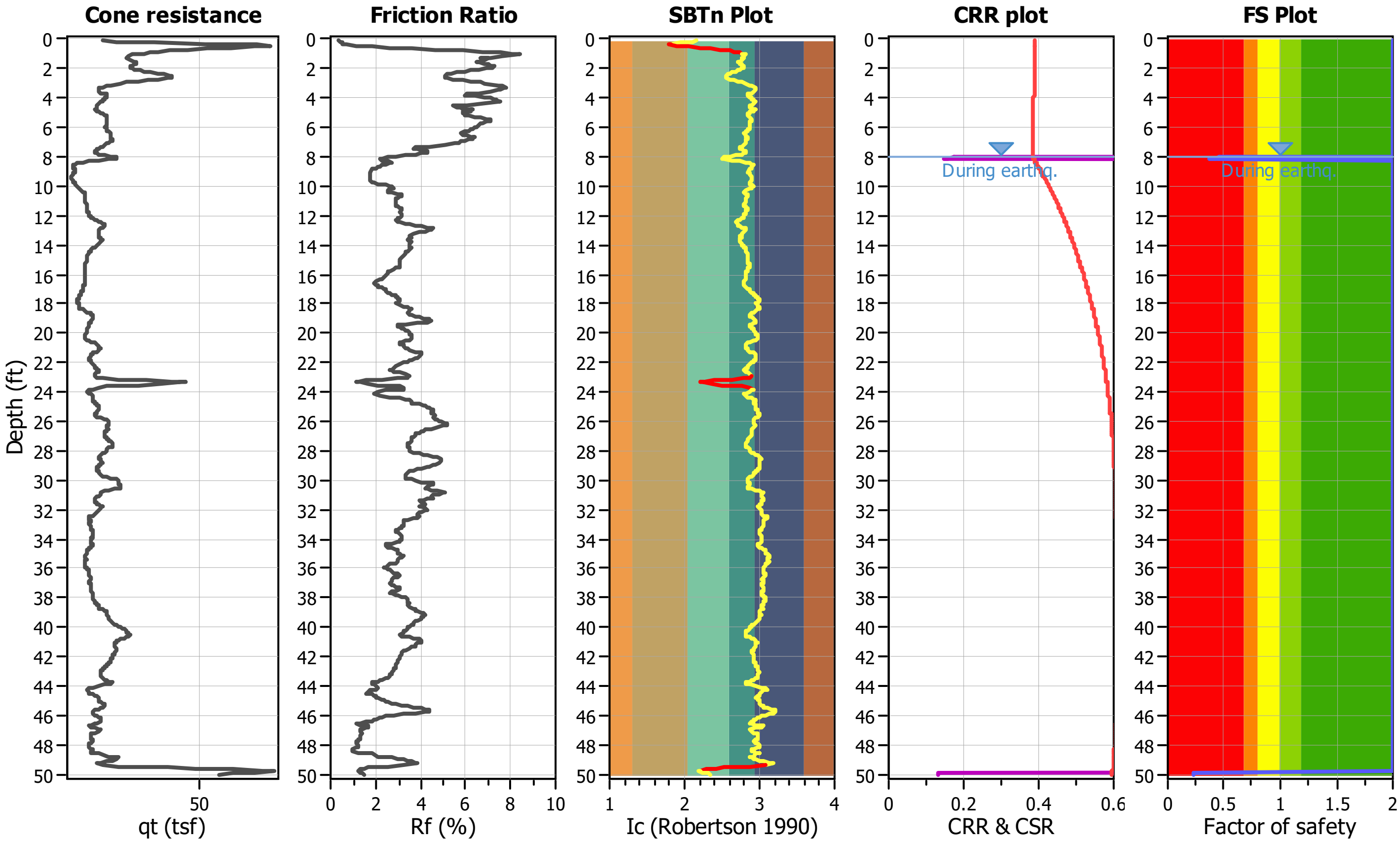
LIQUEFACTION ANALYSIS REPORT

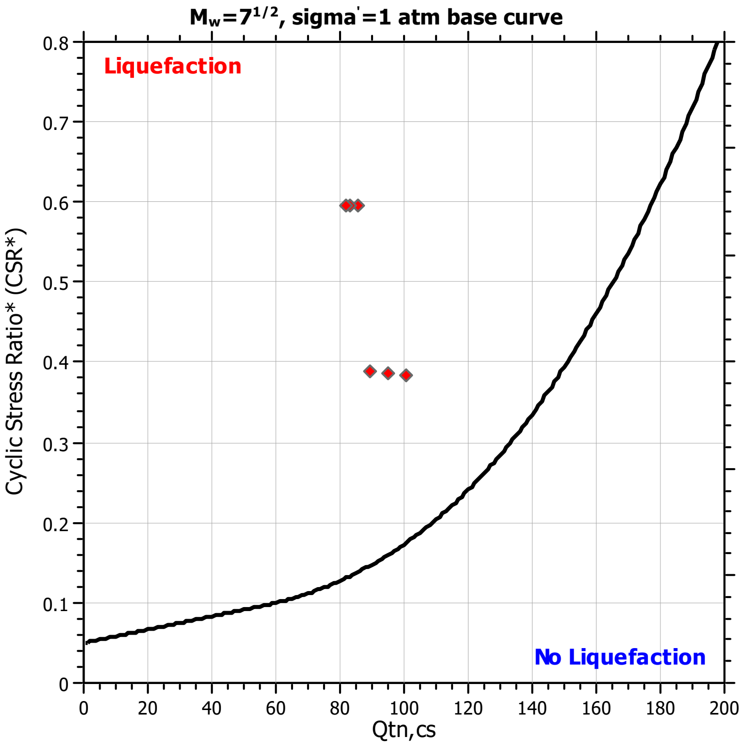
Project title : Mineral Processing Facility **Location : Calipatria, CA**

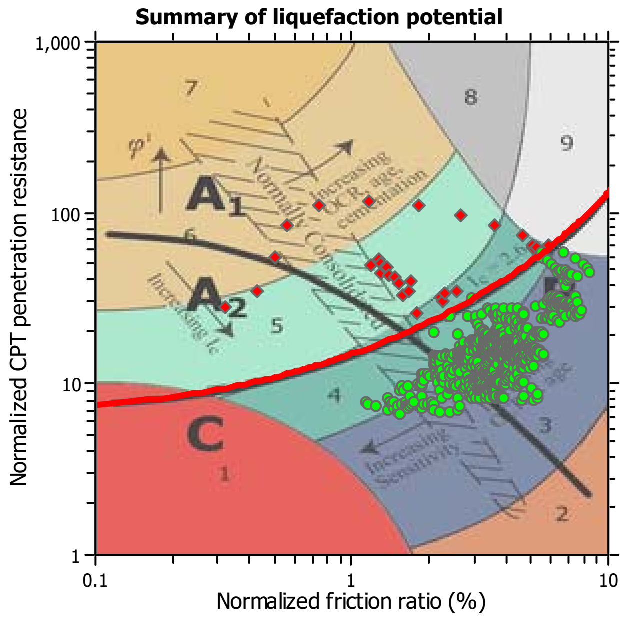
CPT file : CPT-02

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	8.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	8.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.55	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

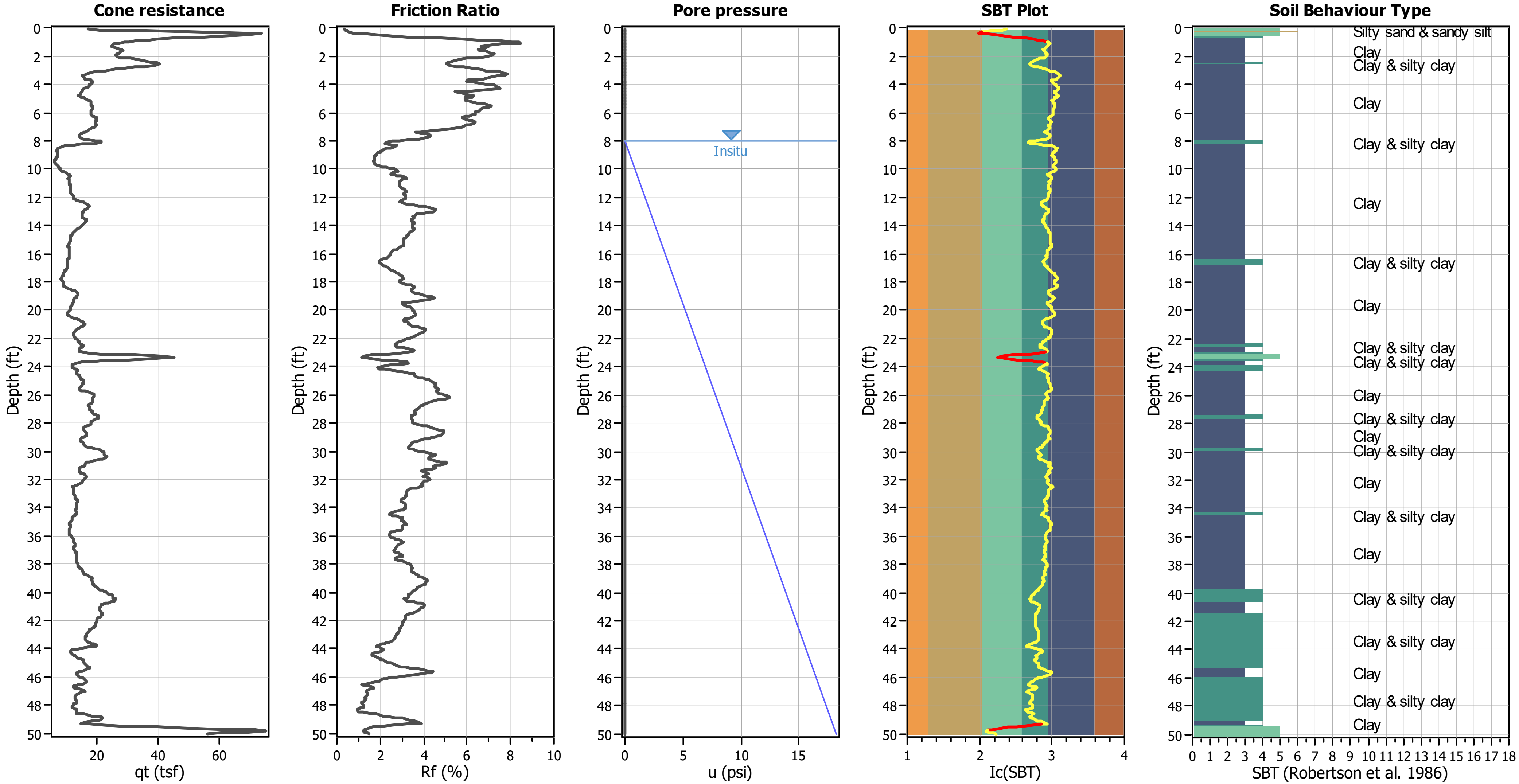






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



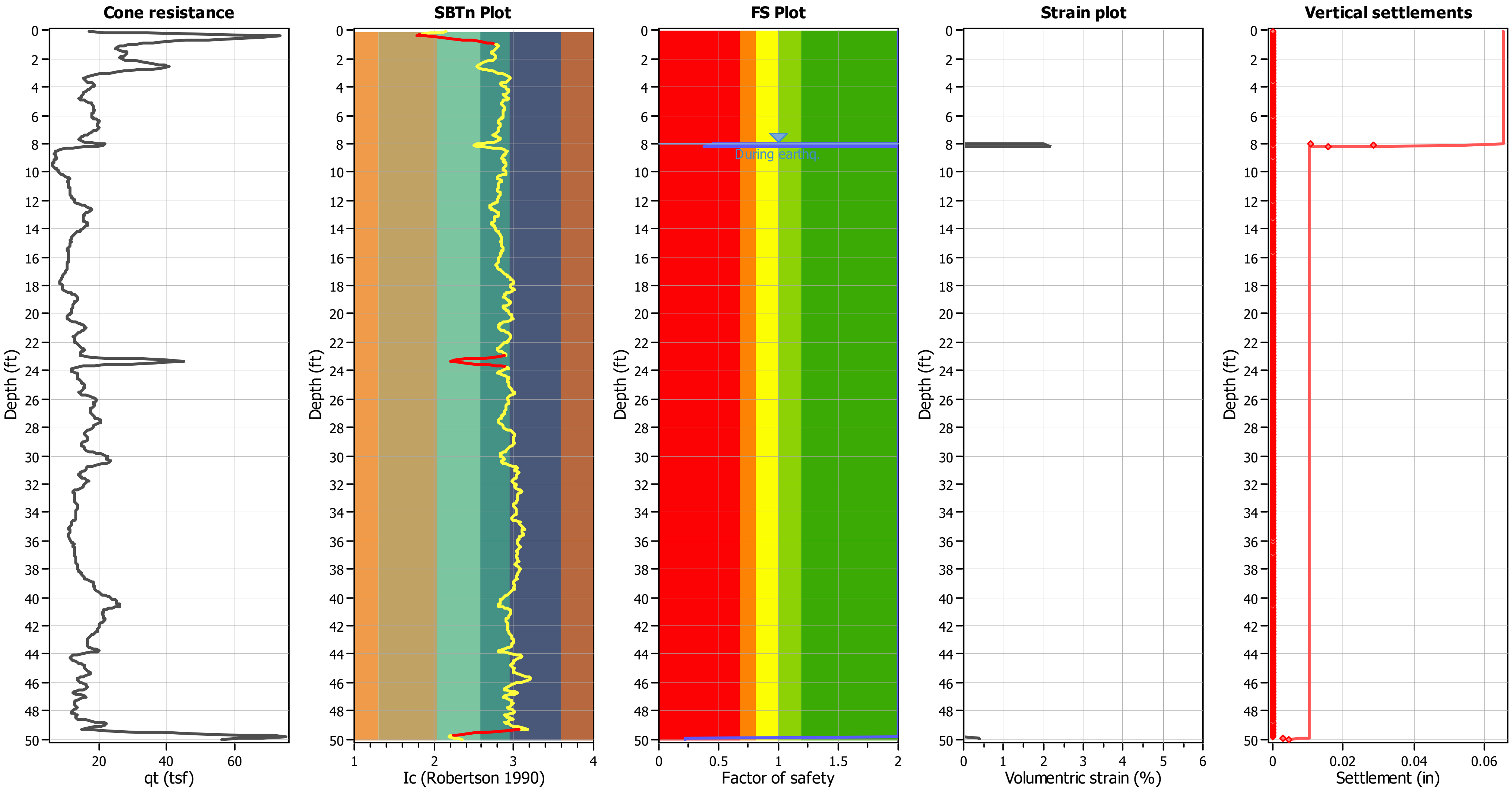
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	8.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	8.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

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

Estimation of post-earthquake settlements



Abbreviations

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

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

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
8.02	100.48	0.45	2.01	0.86	0.01	8.13	94.88	0.41	2.10	0.86	0.03
8.19	89.16	0.38	2.21	0.86	0.02	8.24	84.52	2.00	0.00	0.86	0.00
8.28	81.83	2.00	0.00	0.86	0.00	8.34	78.54	2.00	0.00	0.86	0.00
8.40	73.04	2.00	0.00	0.86	0.00	8.51	68.33	2.00	0.00	0.86	0.00
8.55	63.93	2.00	0.00	0.86	0.00	8.66	62.29	2.00	0.00	0.85	0.00
8.72	61.01	2.00	0.00	0.85	0.00	8.77	60.76	2.00	0.00	0.85	0.00
8.82	60.48	2.00	0.00	0.85	0.00	8.86	59.60	2.00	0.00	0.85	0.00
9.04	58.78	2.00	0.00	0.85	0.00	9.09	58.10	2.00	0.00	0.85	0.00
9.13	57.68	2.00	0.00	0.85	0.00	9.18	57.08	2.00	0.00	0.84	0.00
9.24	56.36	2.00	0.00	0.84	0.00	9.31	55.81	2.00	0.00	0.84	0.00
9.35	55.42	2.00	0.00	0.84	0.00	9.40	54.96	2.00	0.00	0.84	0.00
9.46	54.69	2.00	0.00	0.84	0.00	9.52	55.25	2.00	0.00	0.84	0.00
9.66	56.72	2.00	0.00	0.84	0.00	9.71	59.04	2.00	0.00	0.84	0.00
9.76	61.32	2.00	0.00	0.83	0.00	9.83	63.75	2.00	0.00	0.83	0.00
9.88	66.11	2.00	0.00	0.83	0.00	9.93	68.39	2.00	0.00	0.83	0.00
9.98	70.86	2.00	0.00	0.83	0.00	10.05	73.39	2.00	0.00	0.83	0.00
10.14	75.35	2.00	0.00	0.83	0.00	10.20	75.31	2.00	0.00	0.83	0.00
10.25	75.87	2.00	0.00	0.83	0.00	10.36	77.11	2.00	0.00	0.82	0.00
10.41	79.99	2.00	0.00	0.82	0.00	10.45	82.42	2.00	0.00	0.82	0.00
10.52	84.77	2.00	0.00	0.82	0.00	10.59	86.38	2.00	0.00	0.82	0.00
10.63	86.74	2.00	0.00	0.82	0.00	10.73	85.85	2.00	0.00	0.82	0.00
10.77	84.94	2.00	0.00	0.82	0.00	10.86	84.19	2.00	0.00	0.82	0.00
10.93	84.10	2.00	0.00	0.81	0.00	11.04	83.71	2.00	0.00	0.81	0.00
11.08	83.86	2.00	0.00	0.81	0.00	11.13	83.97	2.00	0.00	0.81	0.00
11.18	84.63	2.00	0.00	0.81	0.00	11.23	85.10	2.00	0.00	0.81	0.00
11.29	85.68	2.00	0.00	0.81	0.00	11.39	86.53	2.00	0.00	0.81	0.00
11.44	87.61	2.00	0.00	0.81	0.00	11.49	88.49	2.00	0.00	0.81	0.00
11.56	88.46	2.00	0.00	0.80	0.00	11.62	88.10	2.00	0.00	0.80	0.00
11.71	88.14	2.00	0.00	0.80	0.00	11.77	89.34	2.00	0.00	0.80	0.00
11.84	90.56	2.00	0.00	0.80	0.00	11.92	91.31	2.00	0.00	0.80	0.00
11.97	91.37	2.00	0.00	0.80	0.00	12.08	91.44	2.00	0.00	0.80	0.00
12.15	91.65	2.00	0.00	0.79	0.00	12.19	92.02	2.00	0.00	0.79	0.00
12.24	92.43	2.00	0.00	0.79	0.00	12.31	93.46	2.00	0.00	0.79	0.00
12.37	96.34	2.00	0.00	0.79	0.00	12.46	100.63	2.00	0.00	0.79	0.00
12.52	105.42	2.00	0.00	0.79	0.00	12.56	110.26	2.00	0.00	0.79	0.00
12.63	114.71	2.00	0.00	0.79	0.00	12.68	119.09	2.00	0.00	0.79	0.00
12.78	121.71	2.00	0.00	0.78	0.00	12.84	122.65	2.00	0.00	0.78	0.00
12.89	121.93	2.00	0.00	0.78	0.00	12.94	120.21	2.00	0.00	0.78	0.00
13.03	118.15	2.00	0.00	0.78	0.00	13.10	115.07	2.00	0.00	0.78	0.00
13.16	111.83	2.00	0.00	0.78	0.00	13.20	107.27	2.00	0.00	0.78	0.00
13.34	105.16	2.00	0.00	0.77	0.00	13.40	104.27	2.00	0.00	0.77	0.00
13.47	105.54	2.00	0.00	0.77	0.00	13.52	105.58	2.00	0.00	0.77	0.00
13.56	105.35	2.00	0.00	0.77	0.00	13.60	105.31	2.00	0.00	0.77	0.00
13.66	105.95	2.00	0.00	0.77	0.00	13.75	106.38	2.00	0.00	0.77	0.00
13.81	106.28	2.00	0.00	0.77	0.00	13.87	105.44	2.00	0.00	0.76	0.00
13.92	104.27	2.00	0.00	0.76	0.00	14.02	103.09	2.00	0.00	0.76	0.00
14.07	101.79	2.00	0.00	0.76	0.00	14.14	100.84	2.00	0.00	0.76	0.00
14.18	99.91	2.00	0.00	0.76	0.00	14.28	98.29	2.00	0.00	0.76	0.00

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

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
14.35	96.35	2.00	0.00	0.76	0.00	14.40	94.54	2.00	0.00	0.76	0.00
14.45	93.27	2.00	0.00	0.76	0.00	14.55	92.18	2.00	0.00	0.75	0.00
14.61	90.99	2.00	0.00	0.75	0.00	14.67	90.05	2.00	0.00	0.75	0.00
14.71	89.10	2.00	0.00	0.75	0.00	14.82	88.31	2.00	0.00	0.75	0.00
14.88	87.66	2.00	0.00	0.75	0.00	14.92	87.17	2.00	0.00	0.75	0.00
14.98	86.59	2.00	0.00	0.75	0.00	15.07	85.99	2.00	0.00	0.74	0.00
15.12	85.53	2.00	0.00	0.74	0.00	15.25	85.17	2.00	0.00	0.74	0.00
15.29	84.88	2.00	0.00	0.74	0.00	15.35	84.43	2.00	0.00	0.74	0.00
15.41	83.74	2.00	0.00	0.74	0.00	15.47	82.98	2.00	0.00	0.74	0.00
15.51	82.22	2.00	0.00	0.74	0.00	15.56	81.01	2.00	0.00	0.74	0.00
15.68	79.90	2.00	0.00	0.73	0.00	15.73	78.88	2.00	0.00	0.73	0.00
15.78	78.31	2.00	0.00	0.73	0.00	15.84	77.29	2.00	0.00	0.73	0.00
15.95	76.41	2.00	0.00	0.73	0.00	16.00	75.82	2.00	0.00	0.73	0.00
16.04	75.50	2.00	0.00	0.73	0.00	16.11	74.97	2.00	0.00	0.73	0.00
16.15	74.37	2.00	0.00	0.73	0.00	16.22	73.93	2.00	0.00	0.73	0.00
16.31	72.60	2.00	0.00	0.72	0.00	16.35	70.03	2.00	0.00	0.72	0.00
16.40	67.51	2.00	0.00	0.72	0.00	16.53	66.31	2.00	0.00	0.72	0.00
16.62	66.89	2.00	0.00	0.72	0.00	16.67	67.75	2.00	0.00	0.72	0.00
16.75	68.29	2.00	0.00	0.72	0.00	16.82	69.38	2.00	0.00	0.71	0.00
16.91	70.53	2.00	0.00	0.71	0.00	17.00	71.70	2.00	0.00	0.71	0.00
17.05	72.05	2.00	0.00	0.71	0.00	17.10	71.99	2.00	0.00	0.71	0.00
17.18	72.10	2.00	0.00	0.71	0.00	17.21	72.52	2.00	0.00	0.71	0.00
17.27	73.15	2.00	0.00	0.71	0.00	17.36	73.81	2.00	0.00	0.71	0.00
17.42	74.46	2.00	0.00	0.70	0.00	17.48	74.85	2.00	0.00	0.70	0.00
17.54	74.85	2.00	0.00	0.70	0.00	17.63	74.63	2.00	0.00	0.70	0.00
17.68	74.30	2.00	0.00	0.70	0.00	17.75	73.88	2.00	0.00	0.70	0.00
17.80	73.49	2.00	0.00	0.70	0.00	17.89	73.27	2.00	0.00	0.70	0.00
17.94	73.51	2.00	0.00	0.70	0.00	18.00	74.38	2.00	0.00	0.69	0.00
18.06	76.26	2.00	0.00	0.69	0.00	18.17	78.14	2.00	0.00	0.69	0.00
18.21	79.76	2.00	0.00	0.69	0.00	18.28	80.89	2.00	0.00	0.69	0.00
18.33	82.39	2.00	0.00	0.69	0.00	18.38	84.17	2.00	0.00	0.69	0.00
18.48	85.83	2.00	0.00	0.69	0.00	18.55	87.11	2.00	0.00	0.69	0.00
18.60	88.48	2.00	0.00	0.68	0.00	18.64	90.53	2.00	0.00	0.68	0.00
18.74	92.55	2.00	0.00	0.68	0.00	18.80	94.72	2.00	0.00	0.68	0.00
18.85	96.63	2.00	0.00	0.68	0.00	18.91	99.05	2.00	0.00	0.68	0.00
19.01	101.20	2.00	0.00	0.68	0.00	19.07	102.85	2.00	0.00	0.68	0.00
19.13	103.31	2.00	0.00	0.68	0.00	19.17	102.47	2.00	0.00	0.68	0.00
19.27	99.61	2.00	0.00	0.67	0.00	19.33	93.74	2.00	0.00	0.67	0.00
19.39	87.54	2.00	0.00	0.67	0.00	19.43	82.91	2.00	0.00	0.67	0.00
19.50	82.33	2.00	0.00	0.67	0.00	19.60	82.80	2.00	0.00	0.67	0.00
19.66	83.30	2.00	0.00	0.67	0.00	19.70	84.01	2.00	0.00	0.67	0.00
19.77	85.28	2.00	0.00	0.66	0.00	19.87	86.37	2.00	0.00	0.66	0.00
19.92	86.84	2.00	0.00	0.66	0.00	19.96	86.35	2.00	0.00	0.66	0.00
20.05	85.69	2.00	0.00	0.66	0.00	20.10	84.95	2.00	0.00	0.66	0.00
20.15	84.60	2.00	0.00	0.66	0.00	20.22	84.43	2.00	0.00	0.66	0.00
20.32	84.41	2.00	0.00	0.66	0.00	20.36	85.04	2.00	0.00	0.65	0.00
20.46	85.82	2.00	0.00	0.65	0.00	20.52	86.27	2.00	0.00	0.65	0.00
20.58	86.31	2.00	0.00	0.65	0.00	20.63	86.45	2.00	0.00	0.65	0.00

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

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
20.67	87.46	2.00	0.00	0.65	0.00	20.76	88.95	2.00	0.00	0.65	0.00
20.82	91.12	2.00	0.00	0.65	0.00	20.87	93.03	2.00	0.00	0.65	0.00
20.98	94.12	2.00	0.00	0.64	0.00	21.02	94.42	2.00	0.00	0.64	0.00
21.07	94.69	2.00	0.00	0.64	0.00	21.18	95.32	2.00	0.00	0.64	0.00
21.23	96.61	2.00	0.00	0.64	0.00	21.29	97.50	2.00	0.00	0.64	0.00
21.34	97.76	2.00	0.00	0.64	0.00	21.43	96.76	2.00	0.00	0.64	0.00
21.49	94.96	2.00	0.00	0.64	0.00	21.60	93.01	2.00	0.00	0.63	0.00
21.65	91.47	2.00	0.00	0.63	0.00	21.75	90.17	2.00	0.00	0.63	0.00
21.81	88.85	2.00	0.00	0.63	0.00	21.86	87.74	2.00	0.00	0.63	0.00
21.91	86.96	2.00	0.00	0.63	0.00	21.97	86.27	2.00	0.00	0.63	0.00
22.02	85.65	2.00	0.00	0.63	0.00	22.13	85.09	2.00	0.00	0.62	0.00
22.18	83.37	2.00	0.00	0.62	0.00	22.27	82.75	2.00	0.00	0.62	0.00
22.34	81.89	2.00	0.00	0.62	0.00	22.40	82.42	2.00	0.00	0.62	0.00
22.44	82.06	2.00	0.00	0.62	0.00	22.49	82.25	2.00	0.00	0.62	0.00
22.53	82.92	2.00	0.00	0.62	0.00	22.60	83.60	2.00	0.00	0.62	0.00
22.64	86.33	2.00	0.00	0.62	0.00	22.78	89.01	2.00	0.00	0.61	0.00
22.84	91.22	2.00	0.00	0.61	0.00	22.89	90.96	2.00	0.00	0.61	0.00
22.93	90.48	2.00	0.00	0.61	0.00	22.99	90.39	2.00	0.00	0.61	0.00
23.03	89.23	2.00	0.00	0.61	0.00	23.12	86.03	2.00	0.00	0.61	0.00
23.17	81.58	2.00	0.00	0.61	0.00	23.26	80.71	2.00	0.00	0.61	0.00
23.31	82.23	2.00	0.00	0.60	0.00	23.37	84.60	2.00	0.00	0.60	0.00
23.43	87.47	2.00	0.00	0.60	0.00	23.52	91.09	2.00	0.00	0.60	0.00
23.57	92.93	2.00	0.00	0.60	0.00	23.64	92.90	2.00	0.00	0.60	0.00
23.70	89.15	2.00	0.00	0.60	0.00	23.79	84.58	2.00	0.00	0.60	0.00
23.84	77.88	2.00	0.00	0.60	0.00	23.89	71.86	2.00	0.00	0.60	0.00
24.01	66.69	2.00	0.00	0.59	0.00	24.05	63.75	2.00	0.00	0.59	0.00
24.10	64.58	2.00	0.00	0.59	0.00	24.15	66.01	2.00	0.00	0.59	0.00
24.22	70.63	2.00	0.00	0.59	0.00	24.32	76.35	2.00	0.00	0.59	0.00
24.41	82.31	2.00	0.00	0.59	0.00	24.48	85.49	2.00	0.00	0.59	0.00
24.54	87.39	2.00	0.00	0.58	0.00	24.59	88.43	2.00	0.00	0.58	0.00
24.63	89.36	2.00	0.00	0.58	0.00	24.74	90.78	2.00	0.00	0.58	0.00
24.80	92.91	2.00	0.00	0.58	0.00	24.85	95.44	2.00	0.00	0.58	0.00
24.89	97.67	2.00	0.00	0.58	0.00	24.95	99.72	2.00	0.00	0.58	0.00
25.02	101.06	2.00	0.00	0.58	0.00	25.07	102.35	2.00	0.00	0.58	0.00
25.17	103.29	2.00	0.00	0.57	0.00	25.21	102.95	2.00	0.00	0.57	0.00
25.33	102.17	2.00	0.00	0.57	0.00	25.38	100.75	2.00	0.00	0.57	0.00
25.43	100.08	2.00	0.00	0.57	0.00	25.48	99.75	2.00	0.00	0.57	0.00
25.54	99.36	2.00	0.00	0.57	0.00	25.60	100.41	2.00	0.00	0.57	0.00
25.69	101.34	2.00	0.00	0.56	0.00	25.74	105.03	2.00	0.00	0.56	0.00
25.85	108.60	2.00	0.00	0.56	0.00	25.91	112.27	2.00	0.00	0.56	0.00
25.95	114.50	2.00	0.00	0.56	0.00	26.00	116.39	2.00	0.00	0.56	0.00
26.08	117.94	2.00	0.00	0.56	0.00	26.13	118.50	2.00	0.00	0.56	0.00
26.22	117.79	2.00	0.00	0.56	0.00	26.26	116.33	2.00	0.00	0.55	0.00
26.32	114.49	2.00	0.00	0.55	0.00	26.39	111.76	2.00	0.00	0.55	0.00
26.48	108.75	2.00	0.00	0.55	0.00	26.53	105.44	2.00	0.00	0.55	0.00
26.63	103.02	2.00	0.00	0.55	0.00	26.70	100.99	2.00	0.00	0.55	0.00
26.75	99.68	2.00	0.00	0.55	0.00	26.80	98.57	2.00	0.00	0.55	0.00
26.84	97.77	2.00	0.00	0.55	0.00	26.92	97.29	2.00	0.00	0.54	0.00

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

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
27.01	97.05	2.00	0.00	0.54	0.00	27.06	96.72	2.00	0.00	0.54	0.00
27.12	96.48	2.00	0.00	0.54	0.00	27.19	96.51	2.00	0.00	0.54	0.00
27.23	97.27	2.00	0.00	0.54	0.00	27.33	97.88	2.00	0.00	0.54	0.00
27.39	98.24	2.00	0.00	0.54	0.00	27.44	98.11	2.00	0.00	0.53	0.00
27.50	98.00	2.00	0.00	0.53	0.00	27.59	98.00	2.00	0.00	0.53	0.00
27.64	98.18	2.00	0.00	0.53	0.00	27.70	97.45	2.00	0.00	0.53	0.00
27.81	96.31	2.00	0.00	0.53	0.00	27.85	94.87	2.00	0.00	0.53	0.00
27.91	94.29	2.00	0.00	0.53	0.00	27.96	94.08	2.00	0.00	0.53	0.00
28.03	94.52	2.00	0.00	0.52	0.00	28.12	95.42	2.00	0.00	0.52	0.00
28.16	96.93	2.00	0.00	0.52	0.00	28.22	97.90	2.00	0.00	0.52	0.00
28.28	98.27	2.00	0.00	0.52	0.00	28.38	99.60	2.00	0.00	0.52	0.00
28.48	101.34	2.00	0.00	0.52	0.00	28.53	103.22	2.00	0.00	0.52	0.00
28.61	104.37	2.00	0.00	0.52	0.00	28.70	105.05	2.00	0.00	0.51	0.00
28.82	105.13	2.00	0.00	0.51	0.00	28.88	103.97	2.00	0.00	0.51	0.00
28.92	101.78	2.00	0.00	0.51	0.00	28.98	99.28	2.00	0.00	0.51	0.00
29.03	96.52	2.00	0.00	0.51	0.00	29.07	93.76	2.00	0.00	0.51	0.00
29.17	91.27	2.00	0.00	0.51	0.00	29.23	89.14	2.00	0.00	0.50	0.00
29.29	87.86	2.00	0.00	0.50	0.00	29.34	87.11	2.00	0.00	0.50	0.00
29.43	86.70	2.00	0.00	0.50	0.00	29.49	86.63	2.00	0.00	0.50	0.00
29.54	86.54	2.00	0.00	0.50	0.00	29.60	86.76	2.00	0.00	0.50	0.00
29.69	87.46	2.00	0.00	0.50	0.00	29.74	89.71	2.00	0.00	0.50	0.00
29.83	92.65	2.00	0.00	0.49	0.00	29.88	96.85	2.00	0.00	0.49	0.00
29.96	100.38	2.00	0.00	0.49	0.00	30.00	103.97	2.00	0.00	0.49	0.00
30.10	107.32	2.00	0.00	0.49	0.00	30.15	110.78	2.00	0.00	0.49	0.00
30.22	113.34	2.00	0.00	0.49	0.00	30.26	114.39	2.00	0.00	0.49	0.00
30.36	113.71	2.00	0.00	0.49	0.00	30.41	112.25	2.00	0.00	0.48	0.00
30.51	110.39	2.00	0.00	0.48	0.00	30.57	108.85	2.00	0.00	0.48	0.00
30.61	107.13	2.00	0.00	0.48	0.00	30.71	105.71	2.00	0.00	0.48	0.00
30.75	104.60	2.00	0.00	0.48	0.00	30.80	103.90	2.00	0.00	0.48	0.00
30.85	102.46	2.00	0.00	0.48	0.00	30.93	100.46	2.00	0.00	0.48	0.00
30.98	97.89	2.00	0.00	0.48	0.00	31.07	95.67	2.00	0.00	0.47	0.00
31.13	94.19	2.00	0.00	0.47	0.00	31.19	93.46	2.00	0.00	0.47	0.00
31.24	90.51	2.00	0.00	0.47	0.00	31.33	88.18	2.00	0.00	0.47	0.00
31.40	86.23	2.00	0.00	0.47	0.00	31.45	87.70	2.00	0.00	0.47	0.00
31.51	89.39	2.00	0.00	0.47	0.00	31.60	90.95	2.00	0.00	0.46	0.00
31.64	92.28	2.00	0.00	0.46	0.00	31.73	92.68	2.00	0.00	0.46	0.00
31.77	93.01	2.00	0.00	0.46	0.00	31.84	93.32	2.00	0.00	0.46	0.00
31.93	93.42	2.00	0.00	0.46	0.00	31.98	93.23	2.00	0.00	0.46	0.00
32.03	92.47	2.00	0.00	0.46	0.00	32.10	91.26	2.00	0.00	0.46	0.00
32.15	89.59	2.00	0.00	0.46	0.00	32.24	87.83	2.00	0.00	0.45	0.00
32.29	85.62	2.00	0.00	0.45	0.00	32.41	83.37	2.00	0.00	0.45	0.00
32.46	81.23	2.00	0.00	0.45	0.00	32.51	79.87	2.00	0.00	0.45	0.00
32.56	78.72	2.00	0.00	0.45	0.00	32.62	77.37	2.00	0.00	0.45	0.00
32.68	75.89	2.00	0.00	0.45	0.00	32.77	74.66	2.00	0.00	0.44	0.00
32.82	74.10	2.00	0.00	0.44	0.00	32.88	73.88	2.00	0.00	0.44	0.00
32.95	73.85	2.00	0.00	0.44	0.00	33.04	73.95	2.00	0.00	0.44	0.00
33.09	74.18	2.00	0.00	0.44	0.00	33.14	74.05	2.00	0.00	0.44	0.00
33.21	73.62	2.00	0.00	0.44	0.00	33.31	73.18	2.00	0.00	0.44	0.00

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

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
33.36	73.01	2.00	0.00	0.43	0.00	33.41	73.10	2.00	0.00	0.43	0.00
33.47	73.37	2.00	0.00	0.43	0.00	33.57	73.74	2.00	0.00	0.43	0.00
33.62	74.34	2.00	0.00	0.43	0.00	33.77	74.63	2.00	0.00	0.43	0.00
33.83	74.77	2.00	0.00	0.43	0.00	33.88	74.57	2.00	0.00	0.43	0.00
33.92	74.38	2.00	0.00	0.43	0.00	33.98	74.21	2.00	0.00	0.42	0.00
34.04	73.99	2.00	0.00	0.42	0.00	34.10	73.61	2.00	0.00	0.42	0.00
34.15	73.27	2.00	0.00	0.42	0.00	34.20	71.86	2.00	0.00	0.42	0.00
34.30	69.44	2.00	0.00	0.42	0.00	34.36	67.30	2.00	0.00	0.42	0.00
34.46	66.43	2.00	0.00	0.42	0.00	34.50	66.84	2.00	0.00	0.42	0.00
34.55	67.19	2.00	0.00	0.41	0.00	34.63	67.70	2.00	0.00	0.41	0.00
34.68	68.36	2.00	0.00	0.41	0.00	34.73	68.87	2.00	0.00	0.41	0.00
34.82	69.04	2.00	0.00	0.41	0.00	34.89	68.86	2.00	0.00	0.41	0.00
34.94	68.40	2.00	0.00	0.41	0.00	34.98	68.21	2.00	0.00	0.41	0.00
35.09	68.21	2.00	0.00	0.41	0.00	35.16	68.37	2.00	0.00	0.40	0.00
35.21	68.21	2.00	0.00	0.40	0.00	35.25	67.63	2.00	0.00	0.40	0.00
35.35	67.14	2.00	0.00	0.40	0.00	35.41	66.93	2.00	0.00	0.40	0.00
35.47	66.72	2.00	0.00	0.40	0.00	35.56	65.97	2.00	0.00	0.40	0.00
35.61	65.09	2.00	0.00	0.40	0.00	35.65	64.13	2.00	0.00	0.40	0.00
35.71	63.18	2.00	0.00	0.39	0.00	35.76	62.18	2.00	0.00	0.39	0.00
35.87	61.52	2.00	0.00	0.39	0.00	35.92	61.27	2.00	0.00	0.39	0.00
35.96	61.97	2.00	0.00	0.39	0.00	36.09	63.18	2.00	0.00	0.39	0.00
36.13	65.12	2.00	0.00	0.39	0.00	36.23	66.63	2.00	0.00	0.39	0.00
36.28	67.78	2.00	0.00	0.39	0.00	36.35	68.76	2.00	0.00	0.38	0.00
36.40	69.53	2.00	0.00	0.38	0.00	36.44	70.16	2.00	0.00	0.38	0.00
36.49	70.20	2.00	0.00	0.38	0.00	36.59	69.67	2.00	0.00	0.38	0.00
36.65	68.74	2.00	0.00	0.38	0.00	36.71	67.76	2.00	0.00	0.38	0.00
36.75	67.02	2.00	0.00	0.38	0.00	36.92	66.45	2.00	0.00	0.37	0.00
36.97	66.12	2.00	0.00	0.37	0.00	37.02	66.13	2.00	0.00	0.37	0.00
37.08	66.48	2.00	0.00	0.37	0.00	37.12	67.25	2.00	0.00	0.37	0.00
37.19	68.55	2.00	0.00	0.37	0.00	37.28	69.82	2.00	0.00	0.37	0.00
37.33	71.12	2.00	0.00	0.37	0.00	37.46	70.67	2.00	0.00	0.37	0.00
37.50	69.33	2.00	0.00	0.36	0.00	37.59	67.64	2.00	0.00	0.36	0.00
37.65	67.58	2.00	0.00	0.36	0.00	37.73	68.61	2.00	0.00	0.36	0.00
37.77	69.74	2.00	0.00	0.36	0.00	37.81	71.16	2.00	0.00	0.36	0.00
37.89	72.75	2.00	0.00	0.36	0.00	37.94	74.19	2.00	0.00	0.36	0.00
38.02	74.88	2.00	0.00	0.36	0.00	38.11	75.24	2.00	0.00	0.35	0.00
38.16	75.62	2.00	0.00	0.35	0.00	38.20	76.42	2.00	0.00	0.35	0.00
38.29	77.12	2.00	0.00	0.35	0.00	38.33	77.88	2.00	0.00	0.35	0.00
38.43	78.27	2.00	0.00	0.35	0.00	38.46	78.93	2.00	0.00	0.35	0.00
38.56	79.48	2.00	0.00	0.35	0.00	38.60	80.28	2.00	0.00	0.35	0.00
38.69	81.62	2.00	0.00	0.34	0.00	38.73	83.44	2.00	0.00	0.34	0.00
38.82	85.41	2.00	0.00	0.34	0.00	38.87	86.99	2.00	0.00	0.34	0.00
38.92	89.00	2.00	0.00	0.34	0.00	39.04	90.58	2.00	0.00	0.34	0.00
39.08	91.82	2.00	0.00	0.34	0.00	39.13	92.08	2.00	0.00	0.34	0.00
39.18	92.09	2.00	0.00	0.34	0.00	39.26	92.00	2.00	0.00	0.33	0.00
39.35	91.77	2.00	0.00	0.33	0.00	39.40	91.55	2.00	0.00	0.33	0.00
39.45	91.26	2.00	0.00	0.33	0.00	39.56	90.99	2.00	0.00	0.33	0.00
39.62	90.81	2.00	0.00	0.33	0.00	39.66	90.63	2.00	0.00	0.33	0.00

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

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
39.71	90.84	2.00	0.00	0.33	0.00	39.82	91.40	2.00	0.00	0.33	0.00
39.88	92.05	2.00	0.00	0.32	0.00	39.93	92.36	2.00	0.00	0.32	0.00
39.97	92.57	2.00	0.00	0.32	0.00	40.08	92.78	2.00	0.00	0.32	0.00
40.14	93.06	2.00	0.00	0.32	0.00	40.19	93.19	2.00	0.00	0.32	0.00
40.24	93.16	2.00	0.00	0.32	0.00	40.31	93.17	2.00	0.00	0.32	0.00
40.41	92.90	2.00	0.00	0.32	0.00	40.46	91.16	2.00	0.00	0.31	0.00
40.50	91.75	2.00	0.00	0.31	0.00	40.63	92.96	2.00	0.00	0.31	0.00
40.66	96.04	2.00	0.00	0.31	0.00	40.77	96.62	2.00	0.00	0.31	0.00
40.81	96.66	2.00	0.00	0.31	0.00	40.86	96.22	2.00	0.00	0.31	0.00
40.90	95.58	2.00	0.00	0.31	0.00	40.98	94.78	2.00	0.00	0.31	0.00
41.03	93.95	2.00	0.00	0.30	0.00	41.09	92.73	2.00	0.00	0.30	0.00
41.20	91.91	2.00	0.00	0.30	0.00	41.25	91.33	2.00	0.00	0.30	0.00
41.30	91.28	2.00	0.00	0.30	0.00	41.34	90.24	2.00	0.00	0.30	0.00
41.46	89.15	2.00	0.00	0.30	0.00	41.51	87.89	2.00	0.00	0.30	0.00
41.56	87.04	2.00	0.00	0.30	0.00	41.61	86.05	2.00	0.00	0.29	0.00
41.71	84.68	2.00	0.00	0.29	0.00	41.78	83.63	2.00	0.00	0.29	0.00
41.83	82.73	2.00	0.00	0.29	0.00	41.87	82.28	2.00	0.00	0.29	0.00
41.97	81.87	2.00	0.00	0.29	0.00	42.04	81.52	2.00	0.00	0.29	0.00
42.09	81.33	2.00	0.00	0.29	0.00	42.14	80.85	2.00	0.00	0.29	0.00
42.23	80.18	2.00	0.00	0.28	0.00	42.34	79.49	2.00	0.00	0.28	0.00
42.40	78.95	2.00	0.00	0.28	0.00	42.45	78.34	2.00	0.00	0.28	0.00
42.50	77.51	2.00	0.00	0.28	0.00	42.56	76.63	2.00	0.00	0.28	0.00
42.62	75.90	2.00	0.00	0.28	0.00	42.67	75.00	2.00	0.00	0.28	0.00
42.77	73.93	2.00	0.00	0.28	0.00	42.82	72.72	2.00	0.00	0.27	0.00
42.89	71.98	2.00	0.00	0.27	0.00	42.93	71.45	2.00	0.00	0.27	0.00
43.03	71.09	2.00	0.00	0.27	0.00	43.09	70.66	2.00	0.00	0.27	0.00
43.15	70.25	2.00	0.00	0.27	0.00	43.20	69.95	2.00	0.00	0.27	0.00
43.25	69.82	2.00	0.00	0.27	0.00	43.36	69.59	2.00	0.00	0.27	0.00
43.42	69.05	2.00	0.00	0.26	0.00	43.51	68.25	2.00	0.00	0.26	0.00
43.56	67.47	2.00	0.00	0.26	0.00	43.64	66.96	2.00	0.00	0.26	0.00
43.69	66.60	2.00	0.00	0.26	0.00	43.73	65.92	2.00	0.00	0.26	0.00
43.79	64.95	2.00	0.00	0.26	0.00	43.84	63.72	2.00	0.00	0.26	0.00
43.91	62.61	2.00	0.00	0.26	0.00	43.99	60.74	2.00	0.00	0.25	0.00
44.08	58.71	2.00	0.00	0.25	0.00	44.11	56.33	2.00	0.00	0.25	0.00
44.21	54.47	2.00	0.00	0.25	0.00	44.26	52.57	2.00	0.00	0.25	0.00
44.32	51.23	2.00	0.00	0.25	0.00	44.37	50.66	2.00	0.00	0.25	0.00
44.47	51.25	2.00	0.00	0.25	0.00	44.51	52.62	2.00	0.00	0.25	0.00
44.56	55.37	2.00	0.00	0.24	0.00	44.65	57.57	2.00	0.00	0.24	0.00
44.71	59.47	2.00	0.00	0.24	0.00	44.76	60.38	2.00	0.00	0.24	0.00
44.82	61.87	2.00	0.00	0.24	0.00	44.91	63.31	2.00	0.00	0.24	0.00
44.96	64.44	2.00	0.00	0.24	0.00	45.02	65.53	2.00	0.00	0.24	0.00
45.08	67.74	2.00	0.00	0.24	0.00	45.22	70.41	2.00	0.00	0.23	0.00
45.26	73.23	2.00	0.00	0.23	0.00	45.31	75.74	2.00	0.00	0.23	0.00
45.35	78.43	2.00	0.00	0.23	0.00	45.45	80.38	2.00	0.00	0.23	0.00
45.50	81.22	2.00	0.00	0.23	0.00	45.58	80.59	2.00	0.00	0.23	0.00
45.66	79.19	2.00	0.00	0.23	0.00	45.70	77.63	2.00	0.00	0.23	0.00
45.75	75.22	2.00	0.00	0.22	0.00	45.84	72.24	2.00	0.00	0.22	0.00
45.88	68.69	2.00	0.00	0.22	0.00	45.97	65.99	2.00	0.00	0.22	0.00

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

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
46.03	64.07	2.00	0.00	0.22	0.00	46.09	63.12	2.00	0.00	0.22	0.00
46.14	62.16	2.00	0.00	0.22	0.00	46.24	61.31	2.00	0.00	0.22	0.00
46.29	60.27	2.00	0.00	0.22	0.00	46.35	59.15	2.00	0.00	0.21	0.00
46.42	54.63	2.00	0.00	0.21	0.00	46.50	50.27	2.00	0.00	0.21	0.00
46.57	46.63	2.00	0.00	0.21	0.00	46.62	47.92	2.00	0.00	0.21	0.00
46.68	49.29	2.00	0.00	0.21	0.00	46.72	50.84	2.00	0.00	0.21	0.00
46.81	52.17	2.00	0.00	0.21	0.00	46.85	52.62	2.00	0.00	0.21	0.00
46.95	52.28	2.00	0.00	0.20	0.00	47.00	51.53	2.00	0.00	0.20	0.00
47.07	51.04	2.00	0.00	0.20	0.00	47.15	50.42	2.00	0.00	0.20	0.00
47.21	49.68	2.00	0.00	0.20	0.00	47.24	48.66	2.00	0.00	0.20	0.00
47.34	47.87	2.00	0.00	0.20	0.00	47.43	47.28	2.00	0.00	0.20	0.00
47.44	47.21	2.00	0.00	0.20	0.00	47.51	47.35	2.00	0.00	0.19	0.00
47.60	47.37	2.00	0.00	0.19	0.00	47.65	47.13	2.00	0.00	0.19	0.00
47.74	46.54	2.00	0.00	0.19	0.00	47.79	45.89	2.00	0.00	0.19	0.00
47.87	45.41	2.00	0.00	0.19	0.00	47.92	44.98	2.00	0.00	0.19	0.00
48.01	44.70	2.00	0.00	0.19	0.00	48.05	44.59	2.00	0.00	0.19	0.00
48.14	44.65	2.00	0.00	0.18	0.00	48.18	44.01	2.00	0.00	0.18	0.00
48.27	43.28	2.00	0.00	0.18	0.00	48.32	42.52	2.00	0.00	0.18	0.00
48.41	42.47	2.00	0.00	0.18	0.00	48.47	43.33	2.00	0.00	0.18	0.00
48.53	46.19	2.00	0.00	0.18	0.00	48.58	50.48	2.00	0.00	0.18	0.00
48.63	57.42	2.00	0.00	0.18	0.00	48.77	64.85	2.00	0.00	0.17	0.00
48.84	71.61	2.00	0.00	0.17	0.00	48.89	76.39	2.00	0.00	0.17	0.00
48.93	79.67	2.00	0.00	0.17	0.00	48.99	81.68	2.00	0.00	0.17	0.00
49.10	82.01	2.00	0.00	0.17	0.00	49.15	79.92	2.00	0.00	0.17	0.00
49.24	77.24	2.00	0.00	0.17	0.00	49.30	74.71	2.00	0.00	0.16	0.00
49.36	74.39	2.00	0.00	0.16	0.00	49.46	74.36	2.00	0.00	0.16	0.00
49.51	74.38	2.00	0.00	0.16	0.00	49.56	75.66	2.00	0.00	0.16	0.00
49.61	78.17	2.00	0.00	0.16	0.00	49.68	82.19	2.00	0.00	0.16	0.00
49.77	86.09	2.00	0.00	0.16	0.00	49.83	87.80	2.00	0.00	0.16	0.00
49.89	85.49	0.23	0.41	0.15	0.00	49.94	83.29	0.22	0.42	0.15	0.00
50.04	81.90	0.22	0.42	0.15	0.00						

Total estimated settlement: 0.07

Abbreviations

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

LANDMARK
Geo-Engineers and Geologists

Landmark Consultants, Inc.
780 N. 4th Street
El Centro, CA 92243

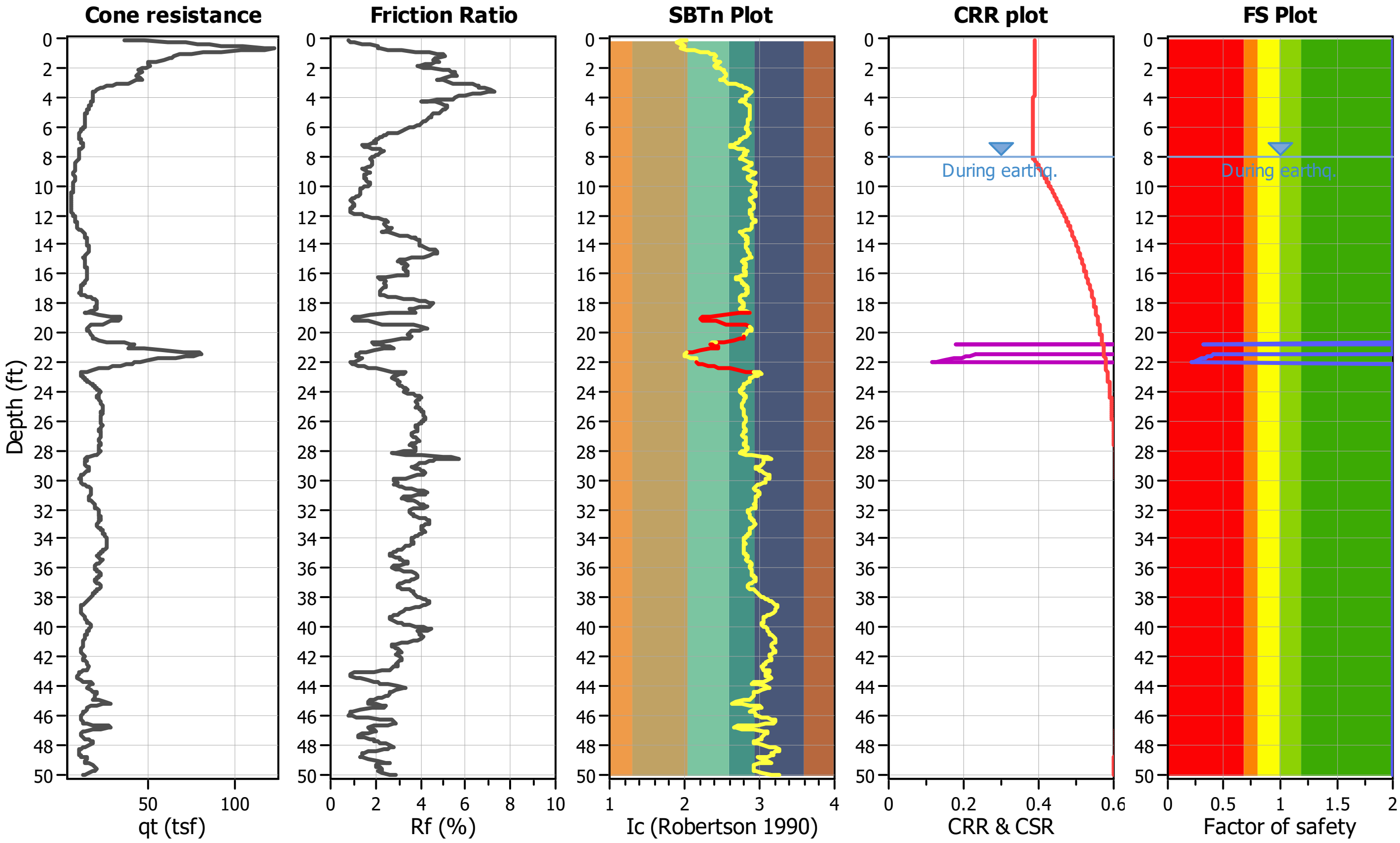
LIQUEFACTION ANALYSIS REPORT

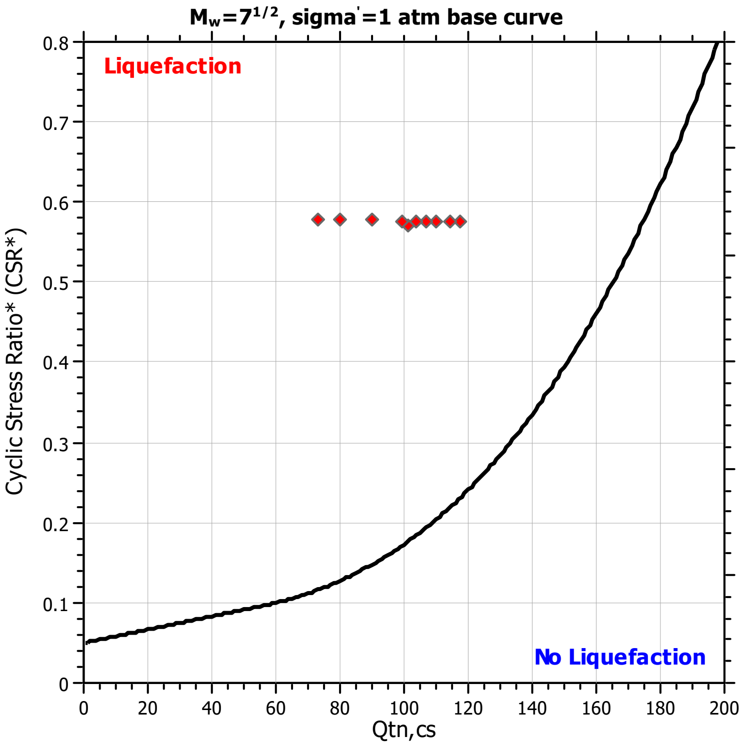
Project title : Mineral Processing Facility **Location : Calipatria, CA**

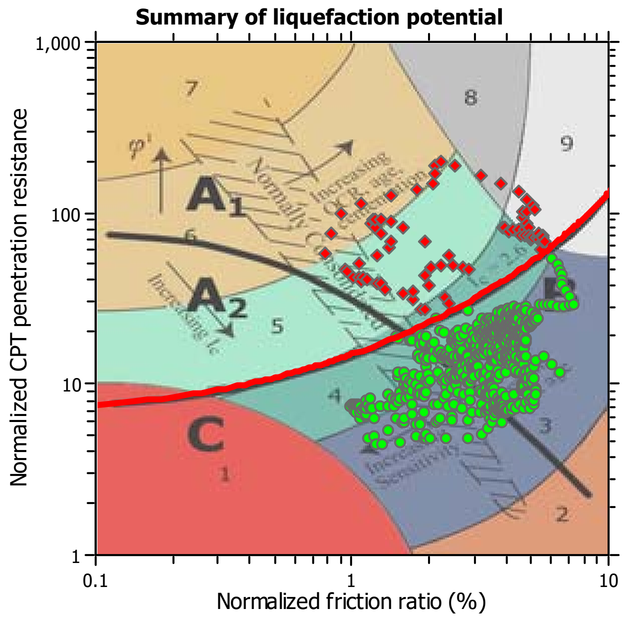
CPT file : CPT-03

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	8.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	8.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.55	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

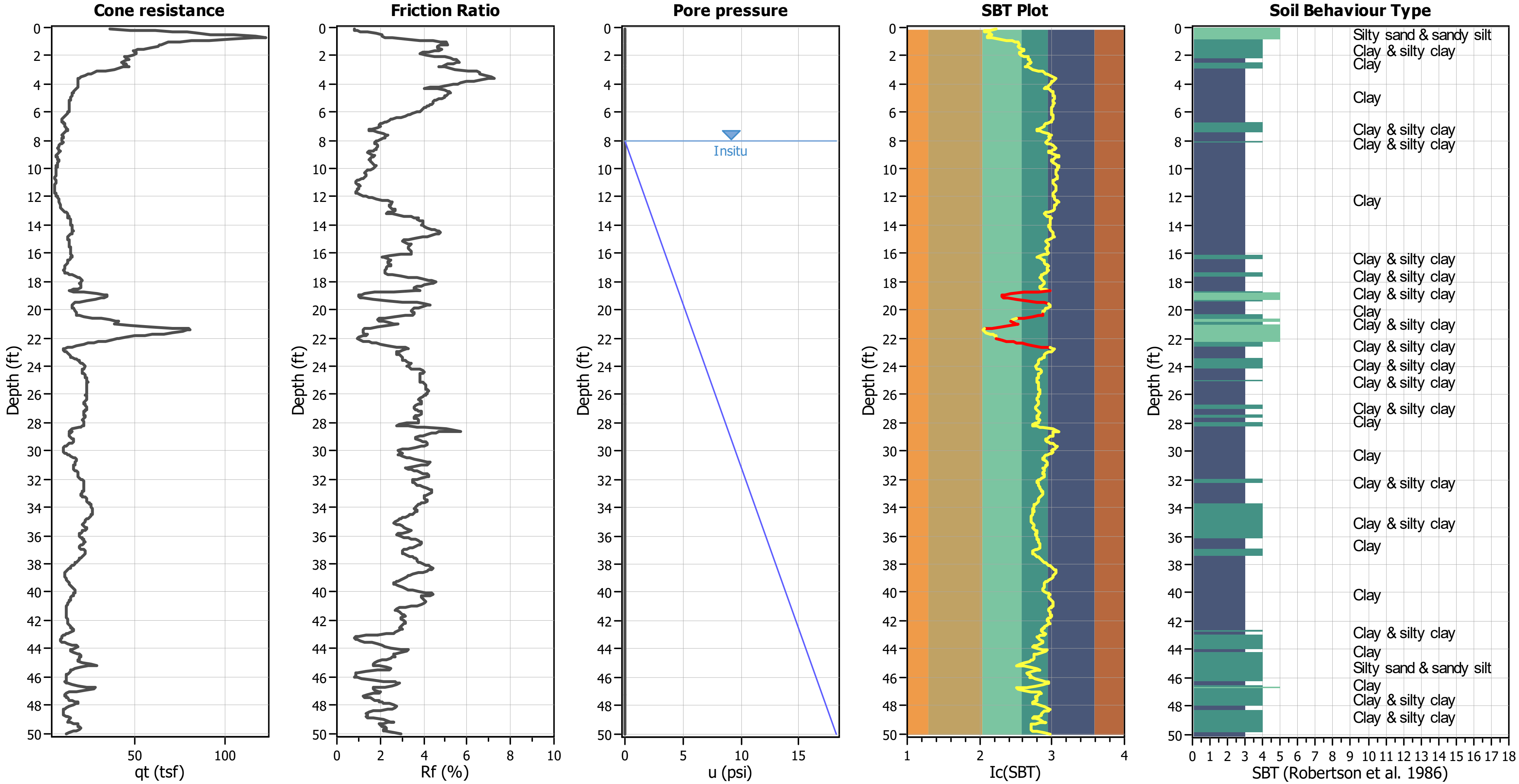






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



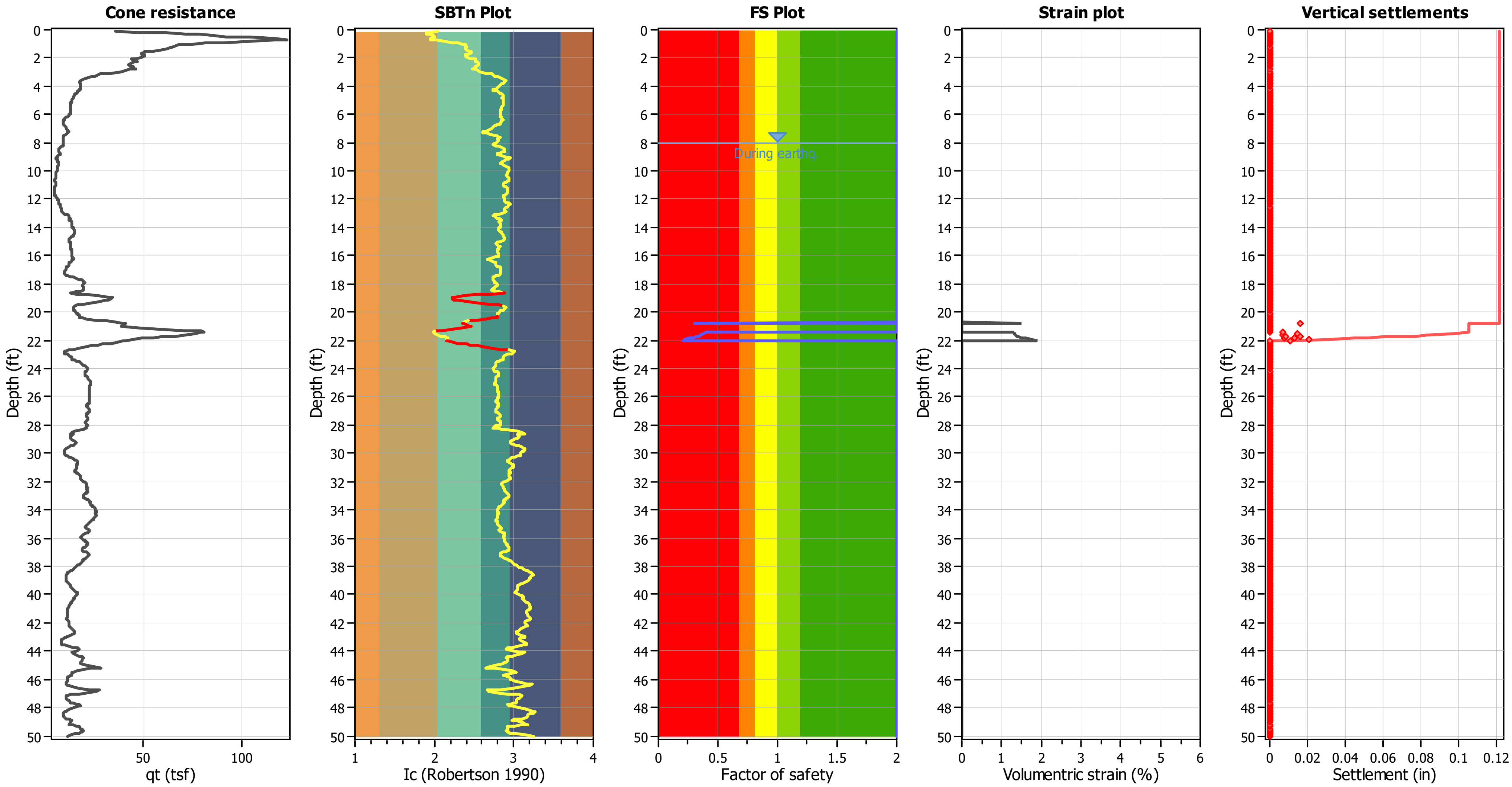
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	8.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	8.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

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

Estimation of post-earthquake settlements



Abbreviations

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

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

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
8.01	64.45	2.00	0.00	0.86	0.00	8.05	63.62	2.00	0.00	0.86	0.00
8.11	62.83	2.00	0.00	0.86	0.00	8.16	62.26	2.00	0.00	0.86	0.00
8.22	61.90	2.00	0.00	0.86	0.00	8.27	61.08	2.00	0.00	0.86	0.00
8.37	59.65	2.00	0.00	0.86	0.00	8.47	58.01	2.00	0.00	0.86	0.00
8.53	57.29	2.00	0.00	0.86	0.00	8.63	57.26	2.00	0.00	0.85	0.00
8.67	57.17	2.00	0.00	0.85	0.00	8.72	56.52	2.00	0.00	0.85	0.00
8.78	55.01	2.00	0.00	0.85	0.00	8.84	53.67	2.00	0.00	0.85	0.00
8.89	52.80	2.00	0.00	0.85	0.00	8.94	52.85	2.00	0.00	0.85	0.00
9.05	52.75	2.00	0.00	0.85	0.00	9.10	52.71	2.00	0.00	0.85	0.00
9.15	52.38	2.00	0.00	0.84	0.00	9.20	52.06	2.00	0.00	0.84	0.00
9.26	51.87	2.00	0.00	0.84	0.00	9.33	52.34	2.00	0.00	0.84	0.00
9.42	53.23	2.00	0.00	0.84	0.00	9.46	53.95	2.00	0.00	0.84	0.00
9.52	54.25	2.00	0.00	0.84	0.00	9.58	53.86	2.00	0.00	0.84	0.00
9.73	53.84	2.00	0.00	0.84	0.00	9.78	53.78	2.00	0.00	0.83	0.00
9.84	54.21	2.00	0.00	0.83	0.00	9.90	54.17	2.00	0.00	0.83	0.00
9.93	53.88	2.00	0.00	0.83	0.00	9.99	52.28	2.00	0.00	0.83	0.00
10.08	50.45	2.00	0.00	0.83	0.00	10.13	48.15	2.00	0.00	0.83	0.00
10.22	47.28	2.00	0.00	0.83	0.00	10.27	46.89	2.00	0.00	0.83	0.00
10.34	47.24	2.00	0.00	0.82	0.00	10.39	47.43	2.00	0.00	0.82	0.00
10.44	47.30	2.00	0.00	0.82	0.00	10.51	46.81	2.00	0.00	0.82	0.00
10.59	45.64	2.00	0.00	0.82	0.00	10.67	44.45	2.00	0.00	0.82	0.00
10.72	43.43	2.00	0.00	0.82	0.00	10.81	42.55	2.00	0.00	0.82	0.00
10.87	41.40	2.00	0.00	0.82	0.00	10.97	40.58	2.00	0.00	0.81	0.00
11.02	40.62	2.00	0.00	0.81	0.00	11.08	41.12	2.00	0.00	0.81	0.00
11.15	41.68	2.00	0.00	0.81	0.00	11.20	41.98	2.00	0.00	0.81	0.00
11.24	41.89	2.00	0.00	0.81	0.00	11.33	41.59	2.00	0.00	0.81	0.00
11.41	41.14	2.00	0.00	0.81	0.00	11.46	40.66	2.00	0.00	0.81	0.00
11.50	40.14	2.00	0.00	0.81	0.00	11.55	39.83	2.00	0.00	0.80	0.00
11.63	39.75	2.00	0.00	0.80	0.00	11.72	39.85	2.00	0.00	0.80	0.00
11.77	41.10	2.00	0.00	0.80	0.00	11.88	43.84	2.00	0.00	0.80	0.00
11.94	47.09	2.00	0.00	0.80	0.00	11.98	49.59	2.00	0.00	0.80	0.00
12.03	51.40	2.00	0.00	0.80	0.00	12.08	54.12	2.00	0.00	0.80	0.00
12.15	58.27	2.00	0.00	0.79	0.00	12.25	62.00	2.00	0.00	0.79	0.00
12.30	64.90	2.00	0.00	0.79	0.00	12.36	66.43	2.00	0.00	0.79	0.00
12.41	67.65	2.00	0.00	0.79	0.00	12.52	68.15	2.00	0.00	0.79	0.00
12.61	68.31	2.00	0.00	0.79	0.00	12.66	68.55	2.00	0.00	0.79	0.00
12.72	69.07	2.00	0.00	0.78	0.00	12.78	70.37	2.00	0.00	0.78	0.00
12.83	71.97	2.00	0.00	0.78	0.00	12.88	73.70	2.00	0.00	0.78	0.00
12.93	75.69	2.00	0.00	0.78	0.00	13.05	76.39	2.00	0.00	0.78	0.00
13.09	76.33	2.00	0.00	0.78	0.00	13.15	77.16	2.00	0.00	0.78	0.00
13.19	81.13	2.00	0.00	0.78	0.00	13.31	86.35	2.00	0.00	0.77	0.00
13.35	90.74	2.00	0.00	0.77	0.00	13.41	94.33	2.00	0.00	0.77	0.00
13.49	96.86	2.00	0.00	0.77	0.00	13.53	99.41	2.00	0.00	0.77	0.00
13.59	101.50	2.00	0.00	0.77	0.00	13.65	103.69	2.00	0.00	0.77	0.00
13.73	105.02	2.00	0.00	0.77	0.00	13.84	105.38	2.00	0.00	0.77	0.00
13.88	105.42	2.00	0.00	0.76	0.00	13.97	106.07	2.00	0.00	0.76	0.00
14.02	107.19	2.00	0.00	0.76	0.00	14.06	108.78	2.00	0.00	0.76	0.00
14.13	110.10	2.00	0.00	0.76	0.00	14.19	112.31	2.00	0.00	0.76	0.00

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

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
14.28	114.66	2.00	0.00	0.76	0.00	14.33	117.05	2.00	0.00	0.76	0.00
14.37	118.54	2.00	0.00	0.76	0.00	14.44	119.26	2.00	0.00	0.76	0.00
14.55	118.63	2.00	0.00	0.75	0.00	14.59	116.72	2.00	0.00	0.75	0.00
14.64	113.10	2.00	0.00	0.75	0.00	14.75	108.50	2.00	0.00	0.75	0.00
14.81	103.51	2.00	0.00	0.75	0.00	14.85	99.51	2.00	0.00	0.75	0.00
14.90	95.91	2.00	0.00	0.75	0.00	14.99	93.35	2.00	0.00	0.75	0.00
15.07	91.32	2.00	0.00	0.74	0.00	15.12	90.83	2.00	0.00	0.74	0.00
15.17	90.86	2.00	0.00	0.74	0.00	15.23	92.04	2.00	0.00	0.74	0.00
15.33	93.46	2.00	0.00	0.74	0.00	15.39	94.69	2.00	0.00	0.74	0.00
15.43	94.91	2.00	0.00	0.74	0.00	15.53	94.84	2.00	0.00	0.74	0.00
15.60	95.06	2.00	0.00	0.74	0.00	15.65	95.56	2.00	0.00	0.73	0.00
15.70	96.24	2.00	0.00	0.73	0.00	15.76	96.55	2.00	0.00	0.73	0.00
15.82	96.66	2.00	0.00	0.73	0.00	15.92	96.60	2.00	0.00	0.73	0.00
15.96	96.87	2.00	0.00	0.73	0.00	16.02	97.11	2.00	0.00	0.73	0.00
16.09	90.92	2.00	0.00	0.73	0.00	16.18	82.80	2.00	0.00	0.73	0.00
16.23	76.46	2.00	0.00	0.72	0.00	16.30	77.45	2.00	0.00	0.72	0.00
16.36	79.83	2.00	0.00	0.72	0.00	16.45	79.81	2.00	0.00	0.72	0.00
16.50	79.39	2.00	0.00	0.72	0.00	16.55	78.41	2.00	0.00	0.72	0.00
16.63	77.34	2.00	0.00	0.72	0.00	16.67	76.49	2.00	0.00	0.72	0.00
16.79	76.19	2.00	0.00	0.72	0.00	16.82	75.71	2.00	0.00	0.71	0.00
16.89	74.60	2.00	0.00	0.71	0.00	16.94	72.83	2.00	0.00	0.71	0.00
17.02	71.42	2.00	0.00	0.71	0.00	17.07	70.29	2.00	0.00	0.71	0.00
17.20	69.37	2.00	0.00	0.71	0.00	17.25	68.78	2.00	0.00	0.71	0.00
17.34	69.62	2.00	0.00	0.71	0.00	17.38	71.18	2.00	0.00	0.71	0.00
17.43	73.53	2.00	0.00	0.70	0.00	17.49	77.33	2.00	0.00	0.70	0.00
17.53	83.44	2.00	0.00	0.70	0.00	17.60	92.77	2.00	0.00	0.70	0.00
17.69	101.42	2.00	0.00	0.70	0.00	17.73	111.19	2.00	0.00	0.70	0.00
17.83	117.19	2.00	0.00	0.70	0.00	17.88	122.28	2.00	0.00	0.70	0.00
17.95	123.89	2.00	0.00	0.70	0.00	17.99	125.14	2.00	0.00	0.70	0.00
18.09	123.19	2.00	0.00	0.69	0.00	18.18	120.98	2.00	0.00	0.69	0.00
18.24	117.42	2.00	0.00	0.69	0.00	18.29	115.13	2.00	0.00	0.69	0.00
18.35	112.19	2.00	0.00	0.69	0.00	18.39	108.57	2.00	0.00	0.69	0.00
18.49	105.63	2.00	0.00	0.69	0.00	18.54	102.28	2.00	0.00	0.69	0.00
18.60	99.42	2.00	0.00	0.68	0.00	18.65	94.58	2.00	0.00	0.68	0.00
18.70	86.60	2.00	0.00	0.68	0.00	18.79	78.69	2.00	0.00	0.68	0.00
18.86	74.33	2.00	0.00	0.68	0.00	18.92	73.93	2.00	0.00	0.68	0.00
18.97	73.11	2.00	0.00	0.68	0.00	19.06	71.56	2.00	0.00	0.68	0.00
19.11	71.86	2.00	0.00	0.68	0.00	19.18	74.96	2.00	0.00	0.67	0.00
19.23	82.52	2.00	0.00	0.67	0.00	19.39	90.72	2.00	0.00	0.67	0.00
19.44	98.45	2.00	0.00	0.67	0.00	19.49	102.93	2.00	0.00	0.67	0.00
19.57	104.82	2.00	0.00	0.67	0.00	19.67	105.46	2.00	0.00	0.67	0.00
19.72	103.42	2.00	0.00	0.67	0.00	19.81	101.08	2.00	0.00	0.66	0.00
19.85	98.65	2.00	0.00	0.66	0.00	19.90	97.59	2.00	0.00	0.66	0.00
20.05	97.24	2.00	0.00	0.66	0.00	20.10	98.20	2.00	0.00	0.66	0.00
20.15	99.76	2.00	0.00	0.66	0.00	20.19	101.10	2.00	0.00	0.66	0.00
20.23	102.22	2.00	0.00	0.66	0.00	20.28	102.24	2.00	0.00	0.66	0.00
20.38	101.59	2.00	0.00	0.65	0.00	20.43	98.83	2.00	0.00	0.65	0.00
20.54	95.70	2.00	0.00	0.65	0.00	20.58	92.42	2.00	0.00	0.65	0.00

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

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
20.63	91.77	2.00	0.00	0.65	0.00	20.67	95.27	2.00	0.00	0.65	0.00
20.76	101.39	0.31	1.50	0.65	0.02	20.83	108.05	2.00	0.00	0.65	0.00
20.88	113.80	2.00	0.00	0.65	0.00	20.98	117.86	2.00	0.00	0.64	0.00
21.02	120.69	2.00	0.00	0.64	0.00	21.07	119.12	2.00	0.00	0.64	0.00
21.21	118.34	2.00	0.00	0.64	0.00	21.27	120.16	2.00	0.00	0.64	0.00
21.31	120.72	2.00	0.00	0.64	0.00	21.36	120.67	2.00	0.00	0.64	0.00
21.42	119.76	2.00	0.00	0.64	0.00	21.47	117.19	0.40	1.31	0.64	0.01
21.56	114.07	0.38	1.33	0.63	0.01	21.60	110.12	0.35	1.37	0.63	0.01
21.69	107.00	0.34	1.40	0.63	0.02	21.74	104.01	0.32	1.43	0.63	0.01
21.79	99.31	0.30	1.48	0.63	0.01	21.85	89.79	0.26	1.61	0.63	0.01
21.95	80.16	0.22	1.76	0.63	0.02	22.00	73.38	0.20	1.89	0.63	0.01
22.07	73.05	2.00	0.00	0.63	0.00	22.13	73.71	2.00	0.00	0.62	0.00
22.22	75.69	2.00	0.00	0.62	0.00	22.26	78.23	2.00	0.00	0.62	0.00
22.34	79.23	2.00	0.00	0.62	0.00	22.39	79.90	2.00	0.00	0.62	0.00
22.44	80.38	2.00	0.00	0.62	0.00	22.52	81.34	2.00	0.00	0.62	0.00
22.61	82.04	2.00	0.00	0.62	0.00	22.65	81.54	2.00	0.00	0.62	0.00
22.71	79.21	2.00	0.00	0.62	0.00	22.81	76.11	2.00	0.00	0.61	0.00
22.86	74.22	2.00	0.00	0.61	0.00	22.94	73.49	2.00	0.00	0.61	0.00
22.99	74.70	2.00	0.00	0.61	0.00	23.08	76.31	2.00	0.00	0.61	0.00
23.13	78.60	2.00	0.00	0.61	0.00	23.21	80.50	2.00	0.00	0.61	0.00
23.25	82.37	2.00	0.00	0.61	0.00	23.33	83.93	2.00	0.00	0.60	0.00
23.37	86.15	2.00	0.00	0.60	0.00	23.46	87.99	2.00	0.00	0.60	0.00
23.50	90.19	2.00	0.00	0.60	0.00	23.56	92.10	2.00	0.00	0.60	0.00
23.63	94.38	2.00	0.00	0.60	0.00	23.69	97.12	2.00	0.00	0.60	0.00
23.79	99.65	2.00	0.00	0.60	0.00	23.84	101.33	2.00	0.00	0.60	0.00
23.94	101.63	2.00	0.00	0.59	0.00	23.98	101.30	2.00	0.00	0.59	0.00
24.02	102.19	2.00	0.00	0.59	0.00	24.16	103.74	2.00	0.00	0.59	0.00
24.20	105.99	2.00	0.00	0.59	0.00	24.25	107.54	2.00	0.00	0.59	0.00
24.29	108.72	2.00	0.00	0.59	0.00	24.41	109.54	2.00	0.00	0.59	0.00
24.47	109.77	2.00	0.00	0.59	0.00	24.52	109.73	2.00	0.00	0.58	0.00
24.55	109.32	2.00	0.00	0.58	0.00	24.66	109.50	2.00	0.00	0.58	0.00
24.72	110.13	2.00	0.00	0.58	0.00	24.78	111.21	2.00	0.00	0.58	0.00
24.82	111.83	2.00	0.00	0.58	0.00	24.98	111.98	2.00	0.00	0.58	0.00
25.04	111.96	2.00	0.00	0.58	0.00	25.09	112.72	2.00	0.00	0.57	0.00
25.14	113.50	2.00	0.00	0.57	0.00	25.18	114.38	2.00	0.00	0.57	0.00
25.25	114.54	2.00	0.00	0.57	0.00	25.30	114.66	2.00	0.00	0.57	0.00
25.33	114.75	2.00	0.00	0.57	0.00	25.45	114.68	2.00	0.00	0.57	0.00
25.47	114.78	2.00	0.00	0.57	0.00	25.54	114.81	2.00	0.00	0.57	0.00
25.60	115.03	2.00	0.00	0.57	0.00	25.69	115.36	2.00	0.00	0.56	0.00
25.74	115.66	2.00	0.00	0.56	0.00	25.82	115.23	2.00	0.00	0.56	0.00
25.94	114.32	2.00	0.00	0.56	0.00	25.99	113.52	2.00	0.00	0.56	0.00
26.04	112.96	2.00	0.00	0.56	0.00	26.10	112.39	2.00	0.00	0.56	0.00
26.16	111.27	2.00	0.00	0.56	0.00	26.26	110.38	2.00	0.00	0.55	0.00
26.30	109.75	2.00	0.00	0.55	0.00	26.35	109.43	2.00	0.00	0.55	0.00
26.42	109.04	2.00	0.00	0.55	0.00	26.46	108.62	2.00	0.00	0.55	0.00
26.51	108.34	2.00	0.00	0.55	0.00	26.61	107.88	2.00	0.00	0.55	0.00
26.66	107.25	2.00	0.00	0.55	0.00	26.71	106.09	2.00	0.00	0.55	0.00
26.78	105.21	2.00	0.00	0.55	0.00	26.93	104.80	2.00	0.00	0.54	0.00

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

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
26.98	105.30	2.00	0.00	0.54	0.00	27.05	105.66	2.00	0.00	0.54	0.00
27.09	105.89	2.00	0.00	0.54	0.00	27.14	106.34	2.00	0.00	0.54	0.00
27.21	107.03	2.00	0.00	0.54	0.00	27.32	107.33	2.00	0.00	0.54	0.00
27.36	106.75	2.00	0.00	0.54	0.00	27.45	105.28	2.00	0.00	0.53	0.00
27.52	103.82	2.00	0.00	0.53	0.00	27.58	102.80	2.00	0.00	0.53	0.00
27.62	102.35	2.00	0.00	0.53	0.00	27.67	102.28	2.00	0.00	0.53	0.00
27.71	102.47	2.00	0.00	0.53	0.00	27.78	102.71	2.00	0.00	0.53	0.00
27.84	103.15	2.00	0.00	0.53	0.00	27.89	103.87	2.00	0.00	0.53	0.00
27.98	104.55	2.00	0.00	0.53	0.00	28.03	96.59	2.00	0.00	0.52	0.00
28.15	90.92	2.00	0.00	0.52	0.00	28.20	87.80	2.00	0.00	0.52	0.00
28.24	95.10	2.00	0.00	0.52	0.00	28.30	99.45	2.00	0.00	0.52	0.00
28.35	101.39	2.00	0.00	0.52	0.00	28.42	102.52	2.00	0.00	0.52	0.00
28.48	101.44	2.00	0.00	0.52	0.00	28.59	99.57	2.00	0.00	0.52	0.00
28.61	96.86	2.00	0.00	0.52	0.00	28.72	93.53	2.00	0.00	0.51	0.00
28.77	89.71	2.00	0.00	0.51	0.00	28.81	87.15	2.00	0.00	0.51	0.00
28.90	84.82	2.00	0.00	0.51	0.00	28.95	84.66	2.00	0.00	0.51	0.00
29.04	85.14	2.00	0.00	0.51	0.00	29.11	87.11	2.00	0.00	0.51	0.00
29.17	88.57	2.00	0.00	0.51	0.00	29.21	90.94	2.00	0.00	0.50	0.00
29.31	92.13	2.00	0.00	0.50	0.00	29.37	92.08	2.00	0.00	0.50	0.00
29.43	90.58	2.00	0.00	0.50	0.00	29.47	87.42	2.00	0.00	0.50	0.00
29.59	83.61	2.00	0.00	0.50	0.00	29.64	79.31	2.00	0.00	0.50	0.00
29.69	76.35	2.00	0.00	0.50	0.00	29.74	73.07	2.00	0.00	0.50	0.00
29.85	70.00	2.00	0.00	0.49	0.00	29.90	67.24	2.00	0.00	0.49	0.00
29.96	66.02	2.00	0.00	0.49	0.00	30.00	65.71	2.00	0.00	0.49	0.00
30.05	66.75	2.00	0.00	0.49	0.00	30.18	68.30	2.00	0.00	0.49	0.00
30.22	69.88	2.00	0.00	0.49	0.00	30.27	71.23	2.00	0.00	0.49	0.00
30.32	73.95	2.00	0.00	0.49	0.00	30.39	78.12	2.00	0.00	0.49	0.00
30.49	82.13	2.00	0.00	0.48	0.00	30.53	86.16	2.00	0.00	0.48	0.00
30.59	89.85	2.00	0.00	0.48	0.00	30.65	93.31	2.00	0.00	0.48	0.00
30.75	95.10	2.00	0.00	0.48	0.00	30.80	95.95	2.00	0.00	0.48	0.00
30.86	95.49	2.00	0.00	0.48	0.00	30.96	94.47	2.00	0.00	0.48	0.00
31.01	90.73	2.00	0.00	0.47	0.00	31.06	86.54	2.00	0.00	0.47	0.00
31.16	82.66	2.00	0.00	0.47	0.00	31.20	81.81	2.00	0.00	0.47	0.00
31.28	82.83	2.00	0.00	0.47	0.00	31.33	84.67	2.00	0.00	0.47	0.00
31.37	87.45	2.00	0.00	0.47	0.00	31.45	90.31	2.00	0.00	0.47	0.00
31.51	93.58	2.00	0.00	0.47	0.00	31.60	96.11	2.00	0.00	0.46	0.00
31.64	98.42	2.00	0.00	0.46	0.00	31.73	99.29	2.00	0.00	0.46	0.00
31.77	99.30	2.00	0.00	0.46	0.00	31.86	98.31	2.00	0.00	0.46	0.00
31.91	96.94	2.00	0.00	0.46	0.00	31.98	95.94	2.00	0.00	0.46	0.00
32.03	95.27	2.00	0.00	0.46	0.00	32.09	95.27	2.00	0.00	0.46	0.00
32.19	95.66	2.00	0.00	0.45	0.00	32.26	96.31	2.00	0.00	0.45	0.00
32.30	97.20	2.00	0.00	0.45	0.00	32.39	98.04	2.00	0.00	0.45	0.00
32.44	99.06	2.00	0.00	0.45	0.00	32.48	100.68	2.00	0.00	0.45	0.00
32.57	102.79	2.00	0.00	0.45	0.00	32.61	105.13	2.00	0.00	0.45	0.00
32.75	106.45	2.00	0.00	0.44	0.00	32.79	106.86	2.00	0.00	0.44	0.00
32.83	106.52	2.00	0.00	0.44	0.00	32.88	105.21	2.00	0.00	0.44	0.00
32.97	103.46	2.00	0.00	0.44	0.00	33.02	101.41	2.00	0.00	0.44	0.00
33.12	100.24	2.00	0.00	0.44	0.00	33.18	100.10	2.00	0.00	0.44	0.00

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

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
33.23	100.89	2.00	0.00	0.44	0.00	33.28	102.65	2.00	0.00	0.44	0.00
33.38	104.54	2.00	0.00	0.43	0.00	33.43	106.25	2.00	0.00	0.43	0.00
33.49	107.05	2.00	0.00	0.43	0.00	33.54	106.82	2.00	0.00	0.43	0.00
33.63	106.29	2.00	0.00	0.43	0.00	33.69	105.64	2.00	0.00	0.43	0.00
33.74	105.17	2.00	0.00	0.43	0.00	33.80	104.37	2.00	0.00	0.43	0.00
33.89	104.40	2.00	0.00	0.43	0.00	33.97	104.17	2.00	0.00	0.42	0.00
34.06	103.94	2.00	0.00	0.42	0.00	34.11	103.49	2.00	0.00	0.42	0.00
34.17	103.82	2.00	0.00	0.42	0.00	34.23	104.45	2.00	0.00	0.42	0.00
34.29	104.48	2.00	0.00	0.42	0.00	34.33	103.92	2.00	0.00	0.42	0.00
34.39	103.09	2.00	0.00	0.42	0.00	34.46	101.39	2.00	0.00	0.42	0.00
34.54	99.50	2.00	0.00	0.41	0.00	34.59	97.23	2.00	0.00	0.41	0.00
34.72	94.98	2.00	0.00	0.41	0.00	34.75	92.30	2.00	0.00	0.41	0.00
34.81	90.10	2.00	0.00	0.41	0.00	34.86	88.35	2.00	0.00	0.41	0.00
34.92	85.99	2.00	0.00	0.41	0.00	35.03	83.46	2.00	0.00	0.41	0.00
35.07	81.66	2.00	0.00	0.41	0.00	35.13	81.53	2.00	0.00	0.40	0.00
35.18	81.92	2.00	0.00	0.40	0.00	35.24	84.20	2.00	0.00	0.40	0.00
35.34	87.04	2.00	0.00	0.40	0.00	35.38	89.80	2.00	0.00	0.40	0.00
35.44	90.99	2.00	0.00	0.40	0.00	35.55	91.86	2.00	0.00	0.40	0.00
35.61	92.55	2.00	0.00	0.40	0.00	35.65	91.70	2.00	0.00	0.40	0.00
35.73	88.31	2.00	0.00	0.39	0.00	35.81	83.58	2.00	0.00	0.39	0.00
35.87	79.78	2.00	0.00	0.39	0.00	35.91	78.46	2.00	0.00	0.39	0.00
35.97	78.77	2.00	0.00	0.39	0.00	36.03	81.33	2.00	0.00	0.39	0.00
36.14	84.34	2.00	0.00	0.39	0.00	36.17	88.07	2.00	0.00	0.39	0.00
36.23	90.58	2.00	0.00	0.39	0.00	36.29	94.01	2.00	0.00	0.38	0.00
36.40	96.29	2.00	0.00	0.38	0.00	36.44	97.86	2.00	0.00	0.38	0.00
36.49	97.60	2.00	0.00	0.38	0.00	36.59	96.33	2.00	0.00	0.38	0.00
36.66	94.21	2.00	0.00	0.38	0.00	36.71	91.68	2.00	0.00	0.38	0.00
36.75	89.22	2.00	0.00	0.38	0.00	36.84	87.29	2.00	0.00	0.38	0.00
36.91	86.06	2.00	0.00	0.37	0.00	36.97	85.72	2.00	0.00	0.37	0.00
37.02	86.16	2.00	0.00	0.37	0.00	37.12	86.74	2.00	0.00	0.37	0.00
37.19	87.03	2.00	0.00	0.37	0.00	37.24	86.90	2.00	0.00	0.37	0.00
37.28	86.92	2.00	0.00	0.37	0.00	37.38	87.54	2.00	0.00	0.37	0.00
37.44	88.47	2.00	0.00	0.37	0.00	37.50	89.18	2.00	0.00	0.36	0.00
37.55	89.33	2.00	0.00	0.36	0.00	37.61	88.95	2.00	0.00	0.36	0.00
37.70	88.30	2.00	0.00	0.36	0.00	37.75	87.19	2.00	0.00	0.36	0.00
37.89	86.04	2.00	0.00	0.36	0.00	37.93	85.06	2.00	0.00	0.36	0.00
37.98	85.05	2.00	0.00	0.36	0.00	38.08	85.08	2.00	0.00	0.35	0.00
38.14	84.51	2.00	0.00	0.35	0.00	38.24	83.50	2.00	0.00	0.35	0.00
38.28	82.09	2.00	0.00	0.35	0.00	38.35	80.62	2.00	0.00	0.35	0.00
38.41	78.60	2.00	0.00	0.35	0.00	38.46	75.76	2.00	0.00	0.35	0.00
38.55	72.83	2.00	0.00	0.35	0.00	38.61	70.20	2.00	0.00	0.35	0.00
38.67	68.45	2.00	0.00	0.34	0.00	38.72	66.77	2.00	0.00	0.34	0.00
38.82	65.51	2.00	0.00	0.34	0.00	38.87	64.65	2.00	0.00	0.34	0.00
38.94	64.44	2.00	0.00	0.34	0.00	38.99	64.53	2.00	0.00	0.34	0.00
39.14	64.81	2.00	0.00	0.34	0.00	39.20	65.12	2.00	0.00	0.34	0.00
39.25	65.35	2.00	0.00	0.33	0.00	39.30	65.41	2.00	0.00	0.33	0.00
39.36	65.41	2.00	0.00	0.33	0.00	39.41	65.43	2.00	0.00	0.33	0.00
39.48	65.93	2.00	0.00	0.33	0.00	39.52	68.25	2.00	0.00	0.33	0.00

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

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
39.68	71.36	2.00	0.00	0.33	0.00	39.74	75.23	2.00	0.00	0.33	0.00
39.83	77.77	2.00	0.00	0.32	0.00	39.87	80.53	2.00	0.00	0.32	0.00
39.93	82.83	2.00	0.00	0.32	0.00	40.04	84.99	2.00	0.00	0.32	0.00
40.09	86.29	2.00	0.00	0.32	0.00	40.14	86.46	2.00	0.00	0.32	0.00
40.22	84.58	2.00	0.00	0.32	0.00	40.27	82.12	2.00	0.00	0.32	0.00
40.31	79.57	2.00	0.00	0.32	0.00	40.36	78.34	2.00	0.00	0.32	0.00
40.48	77.61	2.00	0.00	0.31	0.00	40.53	77.19	2.00	0.00	0.31	0.00
40.58	76.95	2.00	0.00	0.31	0.00	40.62	76.39	2.00	0.00	0.31	0.00
40.69	75.65	2.00	0.00	0.31	0.00	40.77	74.10	2.00	0.00	0.31	0.00
40.88	71.97	2.00	0.00	0.31	0.00	40.95	69.44	2.00	0.00	0.31	0.00
40.99	66.91	2.00	0.00	0.31	0.00	41.09	64.56	2.00	0.00	0.30	0.00
41.14	62.21	2.00	0.00	0.30	0.00	41.24	60.99	2.00	0.00	0.30	0.00
41.30	60.48	2.00	0.00	0.30	0.00	41.35	60.89	2.00	0.00	0.30	0.00
41.40	61.60	2.00	0.00	0.30	0.00	41.47	62.32	2.00	0.00	0.30	0.00
41.56	62.93	2.00	0.00	0.30	0.00	41.61	63.21	2.00	0.00	0.29	0.00
41.66	63.22	2.00	0.00	0.29	0.00	41.71	63.29	2.00	0.00	0.29	0.00
41.77	62.20	2.00	0.00	0.29	0.00	41.82	63.19	2.00	0.00	0.29	0.00
41.92	64.24	2.00	0.00	0.29	0.00	41.97	66.38	2.00	0.00	0.29	0.00
42.04	66.39	2.00	0.00	0.29	0.00	42.10	66.11	2.00	0.00	0.29	0.00
42.14	65.96	2.00	0.00	0.29	0.00	42.20	65.91	2.00	0.00	0.28	0.00
42.26	66.23	2.00	0.00	0.28	0.00	42.33	66.93	2.00	0.00	0.28	0.00
42.44	67.69	2.00	0.00	0.28	0.00	42.48	68.30	2.00	0.00	0.28	0.00
42.53	69.65	2.00	0.00	0.28	0.00	42.63	70.84	2.00	0.00	0.28	0.00
42.67	71.64	2.00	0.00	0.28	0.00	42.73	69.35	2.00	0.00	0.28	0.00
42.89	65.46	2.00	0.00	0.27	0.00	42.93	61.27	2.00	0.00	0.27	0.00
42.98	56.39	2.00	0.00	0.27	0.00	43.03	50.92	2.00	0.00	0.27	0.00
43.08	44.12	2.00	0.00	0.27	0.00	43.14	39.62	2.00	0.00	0.27	0.00
43.20	37.22	2.00	0.00	0.27	0.00	43.29	36.04	2.00	0.00	0.27	0.00
43.33	35.82	2.00	0.00	0.27	0.00	43.39	36.22	2.00	0.00	0.26	0.00
43.45	38.48	2.00	0.00	0.26	0.00	43.53	41.45	2.00	0.00	0.26	0.00
43.58	47.60	2.00	0.00	0.26	0.00	43.68	53.93	2.00	0.00	0.26	0.00
43.74	60.15	2.00	0.00	0.26	0.00	43.80	63.85	2.00	0.00	0.26	0.00
43.84	66.40	2.00	0.00	0.26	0.00	43.94	68.25	2.00	0.00	0.26	0.00
44.06	69.51	2.00	0.00	0.25	0.00	44.11	69.98	2.00	0.00	0.25	0.00
44.19	70.29	2.00	0.00	0.25	0.00	44.24	71.04	2.00	0.00	0.25	0.00
44.36	71.82	2.00	0.00	0.25	0.00	44.41	72.85	2.00	0.00	0.25	0.00
44.46	73.55	2.00	0.00	0.25	0.00	44.51	73.81	2.00	0.00	0.25	0.00
44.56	73.74	2.00	0.00	0.24	0.00	44.62	72.39	2.00	0.00	0.24	0.00
44.72	70.82	2.00	0.00	0.24	0.00	44.77	68.44	2.00	0.00	0.24	0.00
44.84	65.41	2.00	0.00	0.24	0.00	44.89	62.27	2.00	0.00	0.24	0.00
44.99	63.18	2.00	0.00	0.24	0.00	45.10	66.56	2.00	0.00	0.24	0.00
45.16	69.61	2.00	0.00	0.23	0.00	45.21	70.08	2.00	0.00	0.23	0.00
45.25	69.86	2.00	0.00	0.23	0.00	45.32	69.30	2.00	0.00	0.23	0.00
45.38	66.50	2.00	0.00	0.23	0.00	45.47	62.57	2.00	0.00	0.23	0.00
45.52	55.54	2.00	0.00	0.23	0.00	45.63	49.14	2.00	0.00	0.23	0.00
45.69	43.05	2.00	0.00	0.23	0.00	45.74	41.09	2.00	0.00	0.22	0.00
45.78	40.66	2.00	0.00	0.22	0.00	45.85	40.33	2.00	0.00	0.22	0.00
45.91	39.83	2.00	0.00	0.22	0.00	46.00	38.89	2.00	0.00	0.22	0.00

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

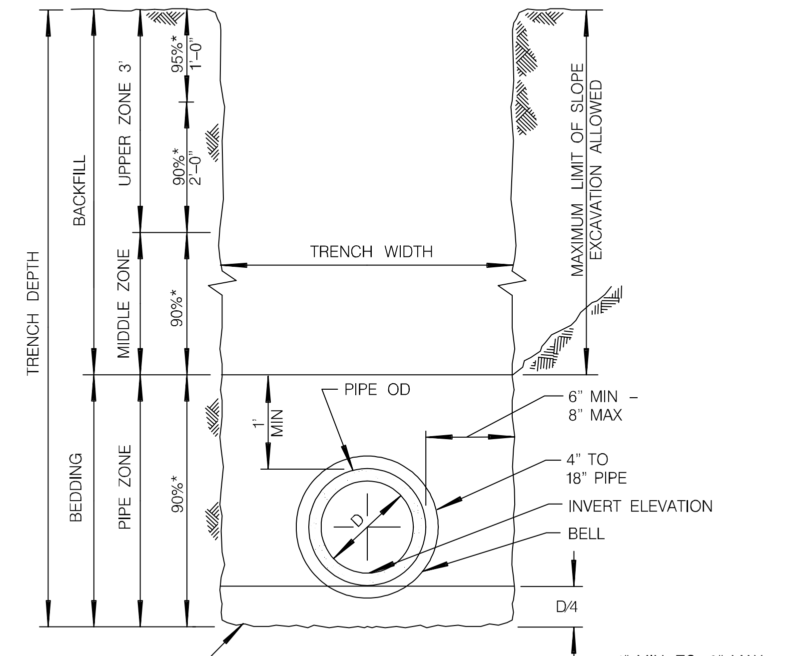
Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
46.05	40.52	2.00	0.00	0.22	0.00	46.17	43.12	2.00	0.00	0.22	0.00
46.21	49.16	2.00	0.00	0.22	0.00	46.31	53.29	2.00	0.00	0.22	0.00
46.36	57.08	2.00	0.00	0.21	0.00	46.40	59.12	2.00	0.00	0.21	0.00
46.50	61.16	2.00	0.00	0.21	0.00	46.54	65.48	2.00	0.00	0.21	0.00
46.65	69.42	2.00	0.00	0.21	0.00	46.71	71.86	2.00	0.00	0.21	0.00
46.76	71.09	2.00	0.00	0.21	0.00	46.80	69.15	2.00	0.00	0.21	0.00
46.87	67.54	2.00	0.00	0.21	0.00	46.92	64.56	2.00	0.00	0.20	0.00
47.03	60.75	2.00	0.00	0.20	0.00	47.08	55.63	2.00	0.00	0.20	0.00
47.14	51.99	2.00	0.00	0.20	0.00	47.20	48.27	2.00	0.00	0.20	0.00
47.29	45.27	2.00	0.00	0.20	0.00	47.34	43.23	2.00	0.00	0.20	0.00
47.38	43.28	2.00	0.00	0.20	0.00	47.44	44.40	2.00	0.00	0.20	0.00
47.51	48.82	2.00	0.00	0.19	0.00	47.64	52.51	2.00	0.00	0.19	0.00
47.64	57.02	2.00	0.00	0.19	0.00	47.74	59.72	2.00	0.00	0.19	0.00
47.81	62.88	2.00	0.00	0.19	0.00	47.86	64.55	2.00	0.00	0.19	0.00
47.90	66.27	2.00	0.00	0.19	0.00	48.01	65.54	2.00	0.00	0.19	0.00
48.12	62.59	2.00	0.00	0.18	0.00	48.22	57.85	2.00	0.00	0.18	0.00
48.27	53.96	2.00	0.00	0.18	0.00	48.32	51.22	2.00	0.00	0.18	0.00
48.38	47.78	2.00	0.00	0.18	0.00	48.44	44.81	2.00	0.00	0.18	0.00
48.53	42.90	2.00	0.00	0.18	0.00	48.58	42.10	2.00	0.00	0.18	0.00
48.65	42.46	2.00	0.00	0.18	0.00	48.70	43.53	2.00	0.00	0.17	0.00
48.80	45.06	2.00	0.00	0.17	0.00	48.84	46.31	2.00	0.00	0.17	0.00
48.91	48.57	2.00	0.00	0.17	0.00	48.97	52.05	2.00	0.00	0.17	0.00
49.06	55.80	2.00	0.00	0.17	0.00	49.18	57.90	2.00	0.00	0.17	0.00
49.23	58.96	2.00	0.00	0.17	0.00	49.24	60.10	2.00	0.00	0.17	0.00
49.31	60.29	2.00	0.00	0.16	0.00	49.35	61.32	2.00	0.00	0.16	0.00
49.52	62.91	2.00	0.00	0.16	0.00	49.58	65.67	2.00	0.00	0.16	0.00
49.62	67.18	2.00	0.00	0.16	0.00	49.67	67.12	2.00	0.00	0.16	0.00
49.74	66.14	2.00	0.00	0.16	0.00	49.76	64.21	2.00	0.00	0.16	0.00
49.84	62.52	2.00	0.00	0.16	0.00	49.89	60.88	2.00	0.00	0.15	0.00
49.99	59.60	2.00	0.00	0.15	0.00	50.05	58.44	2.00	0.00	0.15	0.00

Total estimated settlement: 0.12

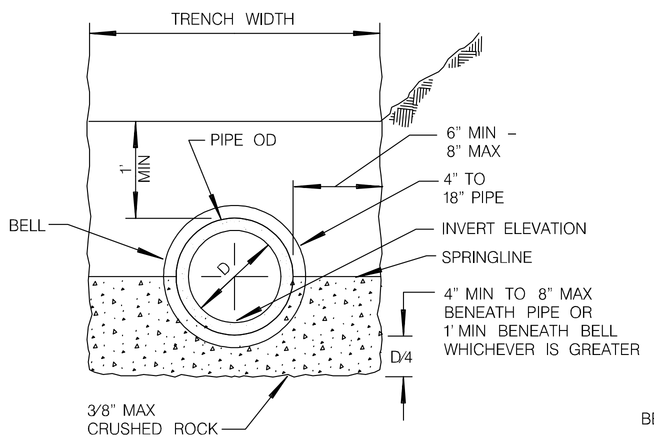
Abbreviations

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

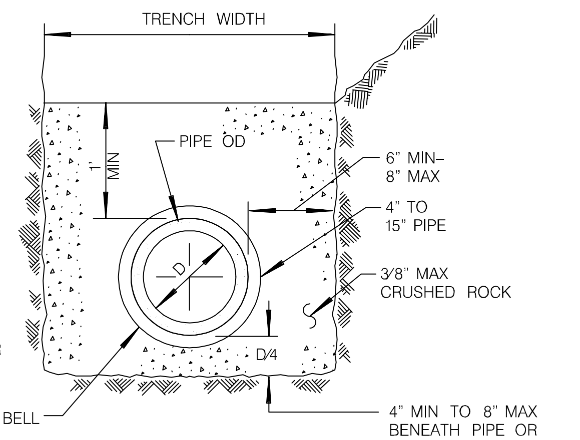
APPENDIX F



TYPE A
STANDARD INSTALLATION



TYPE B
ROCK TO SPRINGLINE



TYPE C
ROCK ENVELOPE

NOTES

1. FOR TRENCH RESURFACING IN IMPROVED STREETS, SEE STANDARD DRAWINGS SDG-107 AND SDG-108.
2. (*) INDICATES MINIMUM RELATIVE COMPACTION.
3. MINIMUM DEPTH OF COVER FROM THE TOP OF PIPE TO FINISH GRADE FOR PVC SDR 35 SEWER MAIN SHALL BE 5'. FOR SHALLOWER DEPTH, SPECIAL DESIGN IS REQUIRED. SEE SDS-101.
4. SEE TYPE A INSTALLATION FOR DETAILS NOT SHOWN FOR TYPES B AND C.
5. FOR PIPE SIZE ENCASEMENT LARGER THAN 15", MAXIMUM SIDE WALL CLEARANCE SHALL BE 12" OR AS SHOWN ON THE PLANS.
6. 6" METAL TAPE SHALL BE INSTALLED ABOVE PIPE 4" BELOW TRENCH CAP AND 12" BELOW FINISH GRADE IN UNIMPROVED STREETS.
7. 1' SAND CUSHION OR A 6" MINIMUM SAND CUSHION WITH 1" NEOPRENE PAD SHALL BE PLACED FOR CROSSINGS UTILITIES WHEN VERTICAL CLEARANCE IS 1' OR LESS. THE NEOPRENE PAD SHALL BE PLACED ON THE MOST FRAGILE UTILITY.

From: City of San Diego Standard Drawing SDS-110 (2016)

LANDMARK Geo-Engineers and Geologists **Project No.: LE19154**	**Pipe Bedding and Trench Backfill Recommendations**	**Plate F-1**