Geotechnical Evaluation

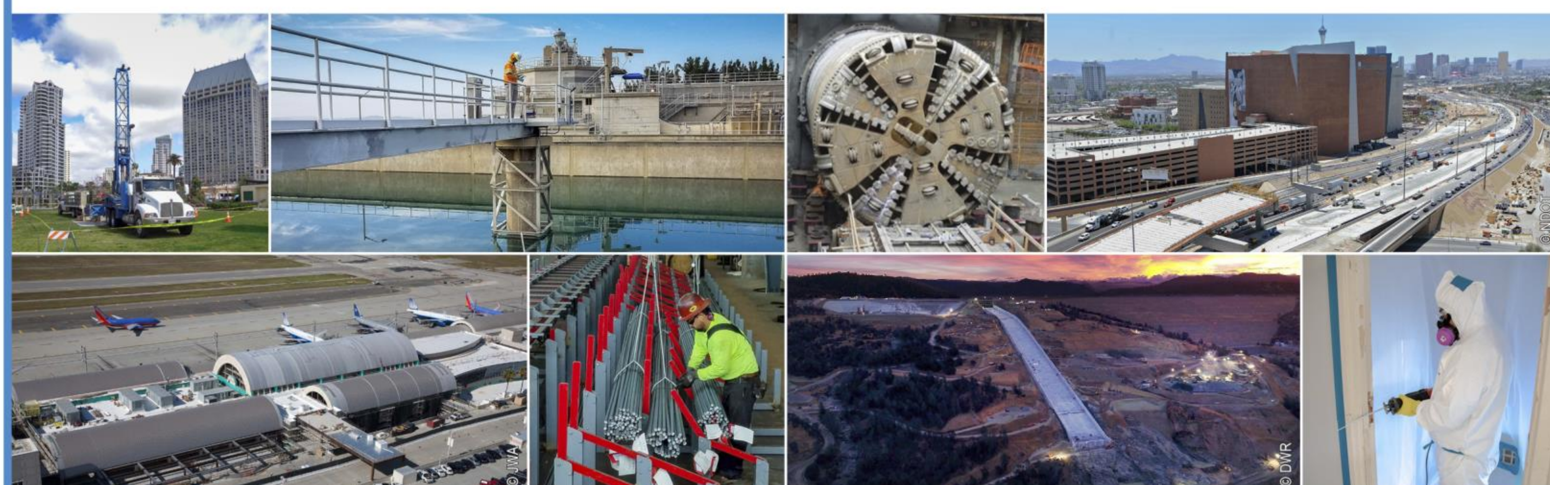
TK/PK Classrooms & Early Learning Building
Buena Park School District
Carl E. Gilbert Elementary School
7255 8th Street

Buena Park, California 90621

TELACU

604 North Eckhoff Street | Orange, California 92868

February 14, 2024 | Project No. 212502001



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Ninyo & Moore

Geotechnical & Environmental Sciences Consultants

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35+ YEARS

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Mr. Tim Spencer
TELACU
604 North Eckhoff Street | Orange, California 92868

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Spencer Marcinek, PE, GE
Senior Engineer

Michael Putt, PG, CEG
Principal Geologist

Soumitra Guha, PhD, PE, GE
Principal Engineer

SCM/MLP/SG/scs

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1 INTRODUCTION

In accordance with your request, we have performed a geotechnical evaluation for the Transitional Kindergarten (TK)/Prekindergarten (PK) Classrooms and the Early Learning Building Project at Carl E. Gilbert Elementary School located at 7255 8th Street in Buena Park, California (Figure 1). The purpose of our geotechnical services was to evaluate the soil, geologic, and groundwater conditions at the project site and to provide conclusions and recommendations regarding the geotechnical aspects of the new construction in general accordance with the 2022 California Building Code (CBC) and California Geological Survey (CGS) Note 48 (2022).

2 SCOPE OF SERVICES

Our scope of services for this project included the following:

- Project planning and coordination with the Buena Park School District (BPSD) project manager, project architect, and project engineer. We also coordinated with BPSD to schedule our field work and obtain access to the property.
- Review of readily available background material, including published geologic maps, fault and seismic hazards maps, groundwater data, topographic maps, stereoscopic aerial photographs, and project-related plans provided by the client.
- Geotechnical site reconnaissance to observe the general site conditions, mark the boring and cone penetration test (CPT) sounding locations, and coordinate with Underground Service Alert for utility clearance.
- Subsurface exploration consisting of the drilling, logging, and sampling of two hollow-stem auger exploratory borings to depths ranging from approximately 11.5 to 76.5 feet below the ground surface and two CPT soundings to depths ranging from approximately 75.3 to 100.1 feet below the ground surface. The borings were logged by a representative from our firm and bulk and relatively undisturbed soil samples were collected at selected intervals for laboratory testing.
- Laboratory testing on selected soil samples including evaluation of in-situ moisture content and dry density, gradation, percentage of particles finer than the No. 200 sieve, Atterberg limits, consolidation, direct shear strength, soil corrosivity, and R-value.
- Data compilation and engineering analyses of the information obtained from our background review, subsurface evaluation, and laboratory testing.
- Preparation of this report presenting our findings, conclusions, and recommendations pertaining to the geotechnical aspects of the design and construction of the proposed improvements.

3 SITE DESCRIPTION AND PROPOSED CONSTRUCTION

The project site is located on a rectangular-shaped grass field on the western side of Carl E. Gilbert Elementary School in Buena Park, California (Figures 1 and 2). The site is bounded by

George Ellis Park and South Knott Avenue to the west, George Ellis Park and commercial buildings to the north, school structures to the east, and 8th Street and residential properties to the south. The site latitude and longitude are approximately 33.86759 degrees north and -118.00825 degrees west, respectively (Google Earth, 2024). Based on our review of historical aerial photographs dating back to 1954, the site has not been previously developed (Historic Aerials, 2024). The site is relatively flat and slopes gently downward to the south, with elevations ranging from approximately 60 to 62 feet above the mean sea level (Google Earth, 2024).

Based on our review of the schematic design (Studio W Architects, 2024) and our discussions with you, we understand that the project involves the construction of nine TK/PK classrooms, an early learning workroom, and an administration/staff building (Figure 3). The size of the proposed one-story buildings ranges from 800 to 1,170 square feet. Other miscellaneous improvements for the project will consist of an outdoor learning area and a playground with shade structures, a new parking lot and a fire access lane, hardscape, landscaping, and utilities. It is anticipated that earthwork at the site will consist of shallow cuts and fills associated with subgrade preparation for foundations, trenching and backfilling of underground utilities, and preparing subgrades for new pavement and hardscape.

4 SUBSURFACE EVALUATION AND LABORATORY TESTING

Our subsurface exploration was performed on December 29, 2023, and consisted of the drilling, logging, and sampling of two hollow-stem auger borings and the advancement of two CPT soundings. The borings were drilled using a truck-mounted drill rig with 8-inch diameter augers to depths ranging from approximately 11½ to 76½ feet below the ground surface. The borings were logged in the field by a representative of Ninyo & Moore and representative bulk and relatively undisturbed soil samples were collected from the borings at selected depths for laboratory testing. The CPT soundings were performed using a 30-ton CPT rig with a 15 square centimeter cone to depths ranging from approximately 75.3 to 100.1 feet below the ground surface. Continuous soil profiles, including cone tip resistance and sleeve friction, were recorded during the soundings. A representative of Ninyo & Moore was on-site to observe the CPT soundings. The borings and CPT soundings were backfilled with cement-bentonite grout and patched with rapid-set concrete. Logs of the exploratory borings and CPT soundings are provided in Appendices A and B, respectively. The approximate locations of the exploratory borings and CPT soundings are presented on Figures 2 and 3.

Laboratory testing was performed on representative samples to evaluate in-situ moisture content and dry density, gradation, percentage of soil particles finer than the No. 200 sieve, Atterberg limits, consolidation, direct shear strength, corrosivity, and R-value. The results of the in-situ moisture content and dry density tests are presented on the boring logs in Appendix A. The remaining laboratory testing results are presented in Appendix C.

5 GEOLOGY AND SUBSURFACE CONDITIONS

5.1 Regional Geology Setting

The site is located in the northwestern portion of Orange County within the central block of the Los Angeles Basin in the Peninsular Ranges Geomorphic Province of California. The site is situated approximately ¾-mile to the southeast of Coyote Creek Channel, which is a tributary of the San Gabriel River and flows to the southwest. The Los Angeles Basin has been divided into four structural blocks, which are generally bounded by prominent fault systems: The Northwestern Block, the Southwestern Block, the Central Block, and the Northeastern Block (Norris and Webb, 1990). The Central Block is bordered by the Whittier Fault to the northeast, the Newport-Inglewood Fault to the southwest, and the Santa Monica Mountains to the northwest.

Regional geologic mapping indicates that the site is underlain by Holocene and late Pleistocene-age young alluvial fan deposits (Saucedo, et al., 2016). The alluvial deposits are described as consisting of poorly consolidated, poorly sorted, clay, sand, gravel, and cobble alluvial fan and valley deposits. A regional geologic map is shown on Figure 4.

5.2 Subsurface Conditions

Materials encountered during our subsurface evaluation generally consisted of fill underlain by alluvium. Grass was encountered at the ground surface at the boring and CPT sounding locations. The thickness of the fill encountered in borings B-1 and B-2 ranged from approximately 2.5 to 3 feet. The fill generally consisted of moist, medium dense clayey sand. A trace amount of gravel was encountered in the fill in boring B-1. Alluvium was encountered beneath the fill to the total depth explored of approximately 76.5 feet in the borings. The alluvium generally consisted of moist to wet, medium dense to very dense poorly graded sand, clayey sand, and silty sand, and stiff to hard sandy lean clay. Variable amounts of gravel were encountered in the alluvium. Detailed descriptions of the materials encountered in our borings and CPT soundings are presented in Appendices A and B, respectively. Our interpretation of the subsurface conditions is shown in Cross Section A-A' (Figure 5).

5.3 Groundwater

Groundwater was initially encountered in exploratory boring B-1 during drilling at a depth of approximately 36 feet below the ground surface. After drilling was paused for 25 minutes, groundwater was measured again at a depth of approximately 30 feet below the ground surface. The groundwater depth observed at the time of drilling is not considered a stabilized groundwater condition and may vary from the recorded level. Relatively high moisture contents from Boring B-1 at depths of 15 and 25 feet suggest that groundwater could be shallower than 30 feet deep. Regional maps indicate that the historic high depth to groundwater at the project site is approximately 10 feet below the ground surface (California Division of Mines and Geology [CDMG], 1998). Groundwater levels are subject to variation due to seasonal rainfall, irrigation, groundwater pumping, subsurface stratigraphy, topography, and other factors which may not have been evident at the time of our evaluation.

6 FLOOD HAZARDS

Based on our review of flood insurance rate maps for the project area (Federal Emergency Management Agency [FEMA], 2009), the project site is not located in the 100-year Flood Hazard Zone, A99. Zone A99 includes areas to be protected from a 100-year flood by the Federal Flood Protection System under construction at the time of publication of the FEMA map; no base flood elevations are given. The site is located within Other Areas of Flood Hazard – Zone X (areas considered to have a 0.2 percent annual chance of flood and areas considered to have a 1 percent annual chance of flood with an average depth of less than 1 foot or with drainage areas less than 1 square mile).

7 FAULTING, SEISMICITY AND GEOLOGIC HAZARDS

The site is located in a seismically active area, as is the majority of southern California. The numerous faults in southern California include active, potentially active, and inactive faults. As defined by CGS, active faults are faults that have ruptured within Holocene time (approximately the last 11,000 years). Potentially active faults are those that show evidence of movement during Quaternary time (approximately the last 1.6 million years), but for which evidence of Holocene movement has not been established. Inactive faults have not ruptured in the last approximately 1.6 million years.

The site is not located within a State of California Earthquake Fault Zone (formerly known as an Alquist-Priolo Special Studies Zone) (CGS, 2018). Based on our review of referenced geologic literature, geologic maps, stereoscopic aerial photographs, and our geologic field reconnaissance, no active faults are known to cross the subject site. The active Puente Hills (Coyote Hills segment) fault is mapped approximately 1.1 miles (United States Geological Survey [USGS], 2008) north of the site. The approximate locations of major faults in the region and their geographic relationship to the site are shown on Figure 6.

Historical earthquakes with a magnitude of 6.0 or more, or earthquakes that have caused significant loss of life and property within approximately 62 miles (100 kilometers) of the subject site were obtained from the CGS Regional Geologic Hazards and Mapping Program website (CGS, 2007b) and are presented in Table 1. The nearest historical earthquake with a magnitude of 6.0 or more is the Long Beach earthquake, which occurred on March 11, 1933. Based on our review, no historic evidence exists for tectonic fault rupture along the Newport-Inglewood fault, the source of the 1933 Long Beach earthquake (CDMG, 1976).

Table 1 – Historical Earthquakes

Date	Name, Location, or Region Affected	Approximate Fault to Site Distance in miles (kilometers)	Magnitude
March 11, 1933	Long Beach	11.6 (18.7)	6.4
October 1, 1987	Whittier Narrows	14.6 (23.5)	6.0
January 17, 1994	Northridge	38.6 (62.1)	6.7
December 8, 1812	Wrightwood	40.3 (64.9)	7.3
July 22, 1899	Wrightwood	41.7 (67.1)	6.4
February 9, 1971	San Fernando	43.7 (70.3)	6.6
December 25, 1899	San Jacinto and Hemet	58.1 (93.4)	6.7
April 21, 1918	San Jacinto	58.5 (94.1)	6.8

Note:
CGS, 2007b.

The principal seismic hazards that may impact the site are surface fault rupture, ground motion, liquefaction, dynamic settlement, lateral spreading, landsliding, and tsunamis and seiches. Brief descriptions of these principal seismic hazards are discussed in the following sections.

7.1 Surface Fault Rupture

Based on our review of the referenced literature and our site reconnaissance, no active faults are known to cross the project site. Therefore, the probability of damage from surface fault rupture is considered to be low. However, lurching or cracking of the ground surface as a result of nearby seismic events is possible.

7.2 Site-Specific Ground Motion

Considering the proximity of the site to active faults capable of producing a maximum moment magnitude of 6.0 or more, the project area has a high potential for experiencing strong ground motion. The 2022 CBC specifies that the risk-targeted maximum considered earthquake (MCE_R) ground motion response accelerations be used to evaluate seismic loads for design of buildings and other structures. Based on the measurements collected from our CPT sounding, the average shear wave velocity in the upper 30 meters (100 feet) of the subsurface profile (V_{S30}) is estimated to be approximately 241 meters per second (792 feet per second). In accordance with Chapter 20 of the American Society of Civil Engineers (ASCE) Publication 7-16 (2016) for the Minimum Design Loads and Associated Criteria for Building and Other Structures, the site classification is Site Class D (stiff soil).

Per the 2022 CBC, site-specific ground motion hazard analysis shall be performed in accordance with Section 21.2 of ASCE 7-16 for structures on a Site Class D site with a mapped MCE_R, 5 percent damped, spectral response acceleration parameter at a period of 1 second (S_1) greater than or equal to 0.2g. We calculated that the S_1 for the site is equal to 0.542g using the 2024 Applied Technology Council (ATC) seismic design tool (web-based); therefore, a site-specific ground motion hazard analysis was performed for the project area.

The site-specific ground motion hazard analysis consisted of the review of available seismologic information for nearby faults and performance of probabilistic seismic hazard analysis (PSHA) and deterministic seismic hazard analysis (DSHA) to develop acceleration response spectrum curves corresponding to the MCE_R for 5 percent damping. Prior to the site-specific ground motion hazard analysis, we obtained the mapped seismic ground motion values and developed the mapped MCE_R response spectrum for 5 percent damping in accordance with Section 11.4 of ASCE 7-16 using the 2024 ATC seismic design tool. The depths to V_S = 1,000 meters per second (3,281 feet per second) and V_S = 2,500 meters per second (8,202 feet per second) are assumed to be 750 meters (2,460 feet) and 3,700 meters (12,139 feet), respectively. These values were evaluated using the Open Seismic Hazard Analysis (OpenSHA) software developed by USGS (2021).

The 2014 next generation attenuation (NGA) West-2 relationships were used to evaluate the site-specific ground motions. The NGA relationships that we used for developing the probabilistic and deterministic response spectra are by Chiou and Youngs (2014), Campbell and Bozorgnia (2014), Boore, Stewart, Seyhan, and Atkinson (2014), and Abrahamson, Silva, and Kamai (2014). The OpenSHA software (USGS, 2021) was used for performing the PSHA. The Calculation of Weighted Average 2014 NGA Models spreadsheet by the Pacific Earthquake Engineering Research Center (PEER) was used for performing the DSHA (Seyhan, 2014).

PSHA was performed for earthquake hazards having a 2 percent chance of being exceeded in 50 years multiplied by the risk coefficients per Section 21.2.1.1 of ASCE 7-16. The maximum rotated components of ground motions were considered in PSHA with 5 percent damping. For the DSHA, we analyzed accelerations from characteristic earthquakes on active faults within the region using the hazard curves and deaggregation plots at the site obtained from the USGS Unified Hazard Tool application (USGS, 2024c). A magnitude 7.5 event on the Compton fault with a rupture distance of 11.5 kilometers (7.2 miles) from the site was evaluated to be the controlling earthquake. Hence, the DSHA was performed for the site using this event and corrections were made to the spectral accelerations for the 84th percentile of the maximum rotated component of ground motion with 5 percent damping.

The site-specific MCE_R response spectrum was taken as the lesser of the spectral response acceleration at any period from the PSHA and DSHA, and the site-specific general response spectrum was determined by taking two-thirds of the MCE_R response spectrum with some conditions in accordance with Section 21.3 of ASCE 7-16. Figure 7 presents the site-specific MCE_R response spectrum and the site-specific design response spectrum. The mapped design response spectrum calculated in accordance with Section 11.4 of ASCE 7-16 is also presented on Figure 7 for comparison. The site-specific spectral response acceleration parameters, consistent with the 2022 CBC, are provided in Section 9.2 for the evaluation of seismic loads on buildings and other structures. The site-specific maximum considered earthquake geometric mean (MCE_G) peak ground acceleration, PGA_M, was calculated as 0.709g. Results of our site-specific ground motion hazard analysis are presented in Appendix D.

7.3 Liquefaction Potential

Liquefaction is the phenomenon in which loosely deposited granular soils and cohesionless fine-grained soils located below the water table undergo rapid loss of shear strength due to excess pore pressure generation when subjected to strong earthquake-induced ground shaking. Ground shaking of sufficient duration results in the loss of grain-to-grain contact due to a rapid rise in pore water pressure. This causes the soil to behave as a fluid for a short period of time. Liquefaction is known generally to occur in saturated or near-saturated cohesionless soils at depths shallower than 50 feet below the ground surface. Factors known to influence liquefaction potential include composition and thickness of soil layers, grain size, relative density, groundwater level, degree of saturation, and both intensity and duration of ground shaking.

The State of California Seismic Hazards Zones Map (Figure 8) indicates that the project site is located within a mapped area considered subject to seismically induced liquefaction hazards. Accordingly, the liquefaction potential of the subsurface soils was evaluated using the data from our CPT soundings. The liquefaction analysis was based on the National Center for Earthquake Engineering Research procedure (Youd et al., 2001) developed from the methods originally recommended by Seed and Idriss (1982) using the computer program LiquefyPro (CivilTech, 2019). A groundwater depth of 10 feet was used in our analysis based on the reported historic high groundwater depth (CDMG, 1998). A PGA_M of 0.709g was used in our analysis for a design earthquake magnitude of 7.5. Our liquefaction analysis indicates that the medium dense granular soil layers below the groundwater table are susceptible to liquefaction during the design seismic event. Results of our liquefaction analysis are presented in Appendix E.

7.4 Dynamic Settlement

As a result of liquefaction, the proposed improvements may be subject to liquefaction-induced settlement. In order to estimate the amount of post-earthquake settlement, the method proposed by Tokimatsu and Seed (1987) was used in which the seismically induced cyclic stress ratios and corrected N-values are related to the volumetric strain of the soil. The amount of soil settlement during a strong seismic event depends on the thickness of the liquefiable layers and the density and/or consistency of the soils.

Under the current conditions, a post-earthquake total settlement ranging from approximately 1.8 to 2.3 inches is calculated for the site. Based on the guidelines presented in CGS Note 48 (2022) and assuming relatively uniform subsurface stratigraphy across the site, we estimate differential settlement on the order of approximately 1.1 inch over a horizontal distance of about 65 feet.

7.5 Lateral Spreading

Lateral spreading of the ground surface during an earthquake usually takes place along weak shear zones that have formed within a liquefiable soil layer. Lateral spread has generally been observed to take place in the direction of a free-face (i.e., retaining wall, slope, and channel), but has also been observed to a lesser extent on ground surfaces with very gentle slopes. An empirical model developed by Bartlett and Youd (1995, revised 2002) is typically used to predict the amount of horizontal ground displacement within a site. For sites located in proximity to a free-face, the amount of lateral ground displacement is strongly correlated with the distance of the site from the free-face. Other factors such as earthquake magnitude, distance from the earthquake epicenter, thickness of the liquefiable layers, and the fines content and particle sizes of the liquefiable layers also affect the amount of lateral ground displacement. Due to the relatively flat site conditions and lack of a free-face in the vicinity, seismically induced lateral spread is not a design consideration.

7.6 Landsliding

The site is located in an area of relatively flat terrain. There are no mapped landslides on site or in the vicinity. Landsliding is not considered to be a potential hazard at the site.

7.7 Tsunamis and Seiches

Tsunamis are long wavelength, seismic, sea waves (long compared to ocean depth) generated by the sudden movements of the ocean floor during submarine earthquakes, landslides, or volcanic activity. Seiches are waves generated in a large, enclosed body of water. The project area is not mapped within an area considered susceptible to tsunamis or seiches inundation (California Department of Conservation, 2024). Therefore, damage due to tsunamis or seiches is not a design consideration.

8 DISCUSSIONS AND CONCLUSIONS

Based on our review of geotechnical literature, our subsurface evaluation, and our experience in the area, it is our opinion that the proposed project is feasible from a geotechnical standpoint, provided that the following recommendations are incorporated into the design and construction of the project. In general, the following conclusions were made:

- Based on our exploratory borings, the site is underlain by undocumented fill overlying alluvial deposits. Fill soils were encountered to depths ranging from approximately 2.5 to 3 feet below the ground surface. The fill generally consisted of moist, medium dense clayey sand. The alluvial materials generally consisted of moist to wet, medium dense to very dense poorly graded sand, clayey sand, and silty sand, and stiff to hard sandy lean clay. Variable amounts of gravel were encountered in the fill and alluvium.

- Documentation regarding the placement and compaction of fill soils and original ground preparation is unknown. Due to the unknowns regarding the original ground preparation and the compaction of the existing fill soils, there is a potential for settlement of the fill and/or shallow alluvium under the new improvements.

- Excavations into the underlying fill and alluvial deposits should be feasible with grading equipment in good working order.

- We anticipate that excavated soils should be generally suitable for use as compacted fill following moisture-conditioning, provided they are free of trash, debris, roots, vegetation, deleterious materials, and cobbles or hard lumps of materials in excess of 4 inches in diameter.

- On-site soils should be considered as Type C soils in accordance with the Occupational Safety and Health Administration (OSHA) soil classifications. The on-site soils will be subject to caving.

- Groundwater was encountered during drilling of exploratory boring B-1 at a depth of approximately 30 feet below the ground surface. The historical high groundwater level has been mapped at a depth of approximately 10 feet below the ground surface. Fluctuations in the groundwater level may occur as a result of variations in seasonal precipitation, irrigation practices, and other factors.

- The subject site is not located within a State of California Earthquake Fault Zone (Alquist-Priolo Special Studies Zone). The probability of surface fault rupture or secondary ground deformation is considered low at the site.

- The PGA_M was estimated to be 0.709g based on our site-specific ground motion hazard analysis.
- The site is mapped within a State of California Seismic Hazards Zone as being potentially liquefiable (CDMG, 1999). Our evaluation indicates that medium dense granular soil layers occurring below the historic high groundwater level are susceptible to liquefaction during the design seismic event.
- Liquefaction-induced ground settlement is estimated to be on the order of approximately 1.8 to 2.3 inches. A differential settlement on the order of 1.1 inches over a horizontal distance of about 65 feet may be anticipated.
- The site is not located in an area considered susceptible to landsliding, tsunamis, or seiches.
- The site is located within a "Zone X" designated flood area (FEMA, 2009).
- Based on our laboratory test results, the near-surface site soils can be classified as corrosive based on California Department of Transportation (Caltrans, 2021) corrosion guidelines.

9 RECOMMENDATIONS

The following sections include our geotechnical recommendations for the proposed site improvements. These recommendations are based on our evaluation of the site geotechnical conditions and our understanding of the planned construction. The proposed site improvements should be constructed in accordance with the requirements of the applicable governing agencies. Grading and building foundation plans were not available for review at the time of this report. It is important that Ninyo & Moore be notified and given an opportunity to reevaluate our recommendations once the information becomes available and prior to bidding the project for construction.

9.1 Earthwork

Earthwork at the site is anticipated to consist of site clearing, relatively shallow cuts and fills associated with subgrade preparation for foundations, trenching and backfilling for new utilities, pavement construction, and finish grading for establishment of site drainage. Earthwork should be performed in accordance with the requirements of the applicable governing agencies and the recommendations presented in the following sections.

9.1.1 Construction Plan Review and Preconstruction Conference

We recommend that the grading and construction plans be submitted to Ninyo & Moore for review to evaluate conformance to the geotechnical recommendations provided in this report. We further recommend that a preconstruction conference be held in order to discuss the grading recommendations presented in this report. The owner and/or their representative, the governing agencies' representatives, the civil engineer, Ninyo & Moore, and the contractor should be in attendance to discuss the work plan, project schedule, and earthwork requirements.

9.1.2 Site Cleaning and Preparation

Prior to performing excavations or other earthwork, the proposed area of improvements should be cleared of surface obstructions, debris, pavement, abandoned utilities, and other deleterious materials. Existing utilities within the project limits should be re-routed or protected from damage by construction activities. Materials generated from the clearing operations should be removed from the project site and disposed at a legal dumpsite.

9.1.3 Excavation Characteristics

Based on our field exploration, we anticipate that excavations within the existing fill and alluvial materials at the site may be accomplished with earthmoving equipment in good working condition. The soils generally consisted of moist to wet, medium dense to very dense poorly graded sand, clayey sand, and silty sand, and stiff to hard sandy lean clay. Scattered gravel should be anticipated. Contractors should make their own independent evaluation of the excavatability of the on-site materials prior to submitting their bids.

9.1.4 Treatment of Near-Surface Soils

In order to provide suitable support and reduce the potential of settlement, we recommend that the soil beneath the proposed building sites be removed and recompacted to a depth of 3 or more feet beneath the footing bottoms, or the depth of the existing fill soils, whichever is deeper. The limits of excavations should extend laterally so that the excavation bottoms are approximately 5 feet beyond the outside edges of the foundation footprints, or a distance corresponding to the depth of the excavation, whichever is farther. The excavation bottoms should expose competent native alluvial soils and should be evaluated by a Ninyo & Moore representative during the excavation work. Additional excavation of loose, soft, and/or wet areas may be appropriate, depending on our observation during construction

The removal and recompaction work should consist of 1) excavating to the depths discussed above, 2) scarifying, moisture-conditioning, and compacting the exposed subgrade soils to a depth of 8 inches or more, and 3) placing the excavated materials back as compacted fill. The fill soils should be moisture-conditioned generally above the optimum moisture content and should be compacted to a relative compaction of 90 percent as evaluated by ASTM International (ASTM) test method D 1557.

Prior to placement of the new structural pavement sections, the subgrade soils should be prepared appropriately. In areas of the proposed pavement sections, concrete walkways, and other hardscape improvements, we recommend that the top 8 inches of subgrade soils be scarified and compacted to approximately 90 percent or more at a moisture content slightly above the laboratory optimum as evaluated by ASTM D 1557.

9.1.5 Temporary Excavations and Shoring

We recommend that trenches and excavations be designed and constructed in accordance with the OSHA regulations. These regulations provide shoring design parameters for excavations and trenches up to 20 feet deep based on the soil types encountered. Although not anticipated, if trenches over 20 feet deep are needed, they should be designed by the contractor’s engineer based on site-specific geotechnical analyses.

We anticipate that site excavations will be laid-back using temporary slopes. Some of the near-surface soils at the site are granular with little fines content and may be subject to caving and are, therefore, not anticipated to be stable in vertical excavations. In addition, bedding materials for existing pipelines, if encountered, may also be prone to caving. Depending on seasonal precipitation, some soft ground may be present at the ground surface resulting in unstable conditions for equipment and/or temporary excavations. Based on the granular nature of the near-surface on-site soils, excavations should be sloped at an inclination no steeper than 1.5:1 (horizontal to vertical). For planning purposes, we recommend that the on-site soils be considered as Type C soils in accordance with the OSHA soil classification.

Where slopes cannot be laid back, shoring will be appropriate. Where shoring systems are used for site excavations, they should be designed for the anticipated soil conditions using the lateral earth pressure values shown on Figures 9 and 10 for braced and cantilevered excavations, respectively. The recommended design pressures are based on the assumption that the shoring system will be constructed without raising the ground surface elevation behind the shored sidewalls of the excavation, groundwater will not be present, that there will be no surcharge loads, such as soil stockpiles and construction materials, and that no loads will act above a 1:1 (horizontal to vertical) plane ascending from the base of the shoring system. For a shoring system subjected to the above-mentioned surcharge loads, the contractor should include the effect of these loads on the lateral earth pressures acting on the shored walls.

We anticipate that settlement of the ground surface will occur behind the shored excavations. The amount of settlement depends heavily on the type of shoring system, the contractor’s workmanship, and soil conditions. To reduce the potential for distress to adjacent improvements, we recommend that the shoring system be designed to limit the ground settlement behind the shoring system to 0.5 inch or less. Possible causes of settlement that should be addressed include settlement during installation of the shoring elements, excavation for structure construction, construction vibrations, and removal of the support system. We recommend that shoring installation be evaluated carefully by the contractor prior to construction.

The contractor should retain a qualified and experienced engineer to design the shoring system. The shoring parameters presented in this report are minimum requirements, and the contractor should evaluate the adequacy of these parameters and make the appropriate modifications for their design. We recommend that the contractor take appropriate measures to protect workers. OSHA requirements pertaining to worker safety should be observed.

9.1.6 Fill Material

In general, the on-site soils should be suitable for use as compacted fill and trench backfill provided that they are free of trash, debris, roots, vegetation, deleterious materials, and contamination. Fill should generally be free of rocks or lumps of material in excess of 4 inches in diameter. Rocks or hard lumps larger than approximately 4 inches in diameter should be broken into smaller pieces or should be removed from the site. On-site soils used as fill will involve moisture-conditioning to achieve the appropriate moisture content for compaction.

Imported materials, if used, should consist of clean, non-expansive, granular material, which conforms to the “Greenbook” for structure backfill. The imported materials should also meet the Caltrans (2021) criteria for non-corrosive soils (i.e., soils having a minimum resistivity greater than 1,500 ohm-cm, a chloride concentration less than 500 parts per million [ppm], a sulfate concentration of less than 0.15 percent (1,500 ppm), and a pH value greater than 5.5). Import materials for use as fill should be evaluated by the geotechnical consultant prior to importing. The contractor should be responsible for the uniformity of import material brought to the site.

9.1.7 Fill Placement and Compaction

Fill soils placed should be compacted in horizontal lifts to a relative compaction of 90 percent as evaluated by ASTM D 1557. The lift thickness for fill soils will vary depending on the type of compaction equipment used but should generally be placed in horizontal lifts not exceeding 8 inches in loose thickness. Fill soils should be placed at generally slightly above the optimum moisture content as evaluated by ASTM D 1557. Special care should be taken to avoid damage to utility lines when compacting fill and subgrade materials.

9.2 Site-Specific Seismic Design Considerations

Design of the proposed improvements should be performed in accordance with the requirements of the governing jurisdictions and applicable building codes. Table 2 presents the spectral response acceleration parameters in accordance with the CBC (2022) guidelines.

Table 2 – 2022 California Building Code Seismic Design Criteria

Site Coefficients and Spectral Response Acceleration Parameters	Values
Site Class	D
Site Amplification Factor, F_a	1.000
Site Amplification Factor, F_v	1.758
Mapped Spectral Response Acceleration at 0.2-second Period, S_s	1.531g
Mapped Spectral Response Acceleration at 1.0-second Period, S_1	0.542g
Site-Specific Spectral Response Acceleration at 0.2-second Period, S_{MS}	1.660g
Site-Specific Spectral Response Acceleration at 1.0-second Period, S_{M1}	1.772g
Site-Specific Design Spectral Response Acceleration at 0.2-second Period, S_{DS}	1.107g
Site-Specific Design Spectral Response Acceleration at 1.0-second Period, S_{D1}	1.181g
Site-Specific Maximum Considered Earthquake Geometric Mean (MCE_G) Peak Ground Acceleration, PGA_M	0.709g

9.3 Foundations

The proposed buildings may be supported on shallow foundations, including spread and continuous footings, bearing on fill material compacted in accordance with the recommendations presented in the Earthwork section of this report. Foundations should be designed in accordance with structural considerations and the following recommendations. In addition, requirements of the appropriate governing jurisdictions and applicable building codes should be considered in the design of the structures.

9.3.1 Spread Footings

Spread footings should have an embedment depth of 2 feet below the lowest adjacent finished grade and be supported on compacted fill. Continuous footings should have a width of 2 feet or more. Isolated pad footings should have a width of 3 feet or more. Footings constructed near existing underground utility lines should be deepened such that the utility line is located above a 1:1 (horizontal to vertical) plane projected downward from the base of the footing. Spread footings should be reinforced with no less than two No. 4 steel reinforcing bars, one placed near the top and one placed near the bottom of the footings, and further detailed in accordance with the recommendations of the structural engineer.

Spread footings, as described above and bearing on compacted fill, may be designed using a net allowable bearing capacity of 2,500 pounds per square foot (psf). The net allowable bearing capacity may be increased by 500 and 250 psf per foot of increase in depth and width, respectively, up to a value of 3,500 psf. Total and differential static settlements for footings designed in accordance with the above recommendations are estimated to be on the order of 0.5 inch and 0.25 inch over a horizontal span of 40 feet, respectively.

Footings bearing on compacted fill may be designed using a coefficient of friction of 0.35, where the total frictional resistance equals the coefficient of friction times the dead load. The footings may be designed using a passive resistance value of 350 psf per foot of depth up to a value of 3,500 psf. The allowable lateral resistance can be taken as the sum of the frictional resistance and passive resistance, provided the passive resistance does not exceed one-half of the total allowable resistance. The net allowable bearing capacity and passive resistance may be increased by one-third when considering loads of short duration such as wind or seismic forces.

9.3.2 Slabs-On-Grade

Buildings supported on shallow footings should have floor slabs designed by the project structural engineer based on the anticipated loading conditions. Building floor slabs should be underlain by compacted fill prepared in accordance with the recommendations presented in the Earthwork section of our report. We recommend that floor slabs be 5 inches thick or more and reinforced with no less than No. 3 steel reinforcing bars placed 24 inches on-center (each way) or more placed near the mid-height of the slab. The placement of the reinforcement in the slab is vital for satisfactory performance.

The floor slab and foundations should be tied together by extending the slab reinforcement into the footings. The slab should be underlain by a 4-inch-thick capillary break (consisting of either sand or crushed rock) overlain by a polyethylene vapor retarder (with a thickness of 10 mils or more). The steel reinforcements for the floor slab shall be placed on the vapor retarder using chairs, as appropriate. The vapor retarder is recommended in areas where moisture-sensitive floor coverings are anticipated. Soils underlying the slabs should be moisture-conditioned and compacted in accordance with the recommendations presented in this report prior to concrete placement. Joints should be constructed at intervals designed by the structural engineer to help reduce random cracking of the slab.

9.3.3 Shade Structure Foundations

We anticipate that shade structures for the outdoor learning area and a playground will be supported on drilled pier foundations. Drilled pier foundations for the shade structures should have a diameter of 12 inches or more. We recommend that the drilled pier foundations be designed using the formulas for embedded posts and poles in accordance with Section 1807.3 of the 2022 CBC. The drilled piers may be designed using an allowable side friction value of 120 psf under static loading conditions starting at a depth of 1 foot below the ground surface. In addition, an allowable resistance of 80 psf for uplift can also be used for design. The lateral capacity of the drilled piers may be evaluated using a lateral bearing pressure of 150 psf per foot of depth, up to a value of 1,500 psf per foot of depth. The passive resistance may be considered to act on an area equal to the product of the effective width (two times the pier diameter) and the embedded length of the pier. These calculations assume that the poles have a minimum spacing of three times the pole diameter.

9.4 Underground Utilities

We anticipate that utility pipelines will be supported on fill and/or alluvial deposits. The depths of the pipelines are not known; however, we anticipate that the pipe invert depths will not exceed 5 feet. Trenches should not be excavated parallel to building footings. If needed, trenches can be excavated adjacent to a continuous footing, provided that the bottom of the trench is located above a 1:1 (horizontal to vertical) plane projected downward from a point 6 inches above the bottom of the adjacent footing. Utility lines that cross beneath footings should be encased in concrete below the footing. To reduce the potential for pipe to building differential settlement due to liquefaction which could cause pipe shearing; we recommend that a pipe joint be located close to the exterior of the building. The type of joint should be such that relative movement can be accommodated without distress. The pipe connections should be sufficiently flexible to withstand differential settlement on the order of 1.5 inches.

9.4.1 Pipe Bedding

We recommend that pipelines be supported on 4 inches or more of granular bedding material. Bedding material should be placed around pipe zones to 1 foot or more above the top of the pipe. The bedding material should be classified as sand, be free of organic material, and have a sand equivalent (SE) of 30 or more. We do not recommend gravel be used for bedding material. It has been our experience that the voids within gravel material are sufficiently large to allow fines to migrate into the voids, thereby creating the potential for sinkholes and depressions to develop at the ground surface.

Special care should be taken not to allow voids beneath and around the pipe. Compaction of the bedding material and backfill should proceed along both sides of the pipe concurrently. Trench backfill, including bedding material, should be placed in accordance with the recommendations presented in the Earthwork section of this report.

9.4.2 Modulus of Soil Reaction

The modulus of soil reaction is used to characterize the stiffness of soil backfill placed on the sides of buried flexible pipelines for the purpose of evaluating lateral deflection caused by the weight of the backfill above the pipe. We recommend that a modulus of soil reaction of 1,000 pounds per square inch (psi) be used for design, provided that granular bedding material is placed adjacent to the pipe, as recommended in this report.

9.4.3 Trench Backfill

Based on our subsurface evaluation, the on-site soils should generally be suitable for re-use as trench backfill provided they are free of organic material, clay lumps, debris, and rocks more than approximately 4 inches in diameter. We recommend that trench backfilling be in general conformance with the Standard Specifications for Public Works Construction ("Greenbook") for structure backfill. Fill should be moisture-conditioned to at or slightly above the laboratory optimum. Wet soils should be allowed to dry to a moisture content near the optimum prior to their placement as trench backfill. Trench backfill should be compacted to a relative compaction of 90 percent or more. Lift thickness for backfill will depend on the type of compaction equipment utilized, but fill should generally be placed in horizontal lifts not exceeding 8 inches in loose thickness. Special care should be exercised to avoid damaging the pipe during compaction of the backfill.

As an alternative to the use of on-site soils for backfill, the trenches may be backfilled with a controlled low strength material (CLSM) in accordance with Greenbook Section 206.1. This alternative may result in reflective cracking in the pavement areas along the edges of the trench resulting from the rigid backfill and the overlying flexible pavements. In order to reduce the potential for reflective cracking, the CLSM backfill could be placed to within one foot of the pavement structural section. At that depth, on-site soils could be placed above the CLSM and compacted to the recommendations previously presented.

9.5 Sidewalks and Hardscape

We recommend that new exterior concrete sidewalks and flatwork (hardscape) have a thickness of 4 inches and be appropriately reinforced. The hardscape should be underlain by 4 inches of clean sand and installed with crack-control joints at an appropriate spacing as designed by the structural engineer to reduce the potential for shrinkage cracking. Positive drainage should be established and maintained adjacent to flatwork. To reduce the potential for differential offset, joints between the new hardscape and adjacent curbs, existing hardscape, building walls, and/or other structures, and between sections of new hardscape, may be doweled.

9.6 Preliminary Pavement Design

We anticipate that the new parking lot, driveways, and the new student-drop off area will be constructed using both asphalt concrete (AC) and Portland cement concrete (PCC). A fire lane will also be constructed on the west side of the classrooms. Traffic loading information was not available for our design at the time of preparation of this report. For planning purposes, we evaluated the structural pavement sections assuming a traffic index (TI) of 5 for light-duty pavements and a TI of 6 and 7 for heavy-duty pavements. A TI of 5 is generally associated with light automobile traffic (passenger cars); a TI of 6 is generally associated with driveways, light truck driveways, and frequent commercial automobile traffic; and a TI of 7 is generally associated with roadways and periodic heavy truck traffic.

We performed preliminary pavement design based on our evaluation of the subgrade soil conditions and our laboratory testing. The R-value characteristics of the subgrade soils were evaluated from a representative near-surface soil sample obtained from our exploratory borings. Laboratory R-value testing indicates that the R-value of the materials encountered is 45, which was used for the pavement design. Our pavement analysis was performed using the methodology outlined by the Highway Design Manual (Caltrans, 2023) and the Navy Pavement Design Manual (Naval Facilities Engineering Command [NAVFAC], 1979). The analysis assumes an approximately 20-year design life for new pavement. For the design of PCC pavement, we assumed a 28-day compressive strength of concrete of 2,500 psi. Based on the R-value and TIs, recommendations for new pavement construction are provided in Table 3.

Table 3 – Preliminary Structural Pavement Sections

Traffic Index	AC over CAB or AC over CMB (inches)	AC (inches)	PCC (inches)
≤ 5.0	3 over 4½	5	6
6.0	3½ over 4½	6½	6½
7.0	4 over 6	7½	8½

Notes:
AC – Asphalt Concrete
CAB – Crushed Aggregate Base
CMB – Crushed Miscellaneous Base
PCC – Portland Cement Concrete with a 28-day compressive strength of 2,500 psi

Prior to placement of new pavement materials, we recommend that the top 12 inches of subgrade soils be removed and recompacted to a relative compaction of 95 percent in accordance with ASTM D 1557. Aggregate base material should conform to the latest specifications in Section 200-2.2 for crushed aggregate base or Section 200-2.4 for crushed miscellaneous base of the Greenbook and should be compacted to a relative compaction of 95 percent in accordance with ASTM D 1557. AC should conform to Section 203-6 of the Greenbook and should be compacted to a relative compaction of 95 percent in accordance with ASTM D 1560 or California Test Method (CT) 366. We recommend that 2 inches of aggregate base be placed underneath the PCC.

Pavement sections should be selected based on actual anticipated traffic loading conditions and evaluation of the subgrade materials, including R-value testing, at the time of construction. We recommend that the paving operations be observed and tested by Ninyo & Moore. We further recommend that the mix design for the various pavements be made by an engineering company specialized in this type of work.

9.7 Corrosivity

Laboratory testing was performed on a representative sample of near-surface soil to evaluate pH, electrical resistivity, water-soluble chloride content, and water-soluble sulfate content. The soil pH and electrical resistivity tests were performed in general accordance with CT 643. Chloride content testing was performed in general accordance with CT 422. Sulfate content testing was performed in general accordance with CT 417. The laboratory test results are presented in Appendix C.

The soil pH was measured at approximately 8.3 and the electrical resistivity was measured at approximately 1,267 ohm-centimeters. The chloride content of the sample was measured at approximately 45 ppm. The sulfate content of the tested sample was measured at approximately 0.003 percent (30 ppm). Based on the laboratory test results and Caltrans (2021) criteria, the project site can be classified as a corrosive site, which is defined as having earth materials with more than 500 ppm chlorides, more than 0.15 percent sulfates (i.e., 1,500 ppm), a pH of 5.5 or less, or an electrical resistivity of less than 1,500 ohm-centimeters. If corrosion susceptible improvements are planned on site, we recommend that a corrosion engineer be consulted for further evaluation and recommendations.

9.8 Concrete Placement

Concrete in contact with soil or water that contains high concentrations of water-soluble sulfates can be subject to premature chemical and/or physical deterioration. Based on the CBC (2022), the potential for sulfate attack is negligible for water-soluble sulfate contents in soil ranging from

0.00 to 0.10 percent by weight, moderate for water-soluble sulfate contents ranging from 0.10 to 0.20 percent by weight, severe for water-soluble sulfate contents ranging from 0.20 to 2.00 percent by weight, and very severe for water-soluble sulfate contents over 2.00 percent by weight. The soil sample tested for this evaluation, using CT 417, indicates a water-soluble sulfate content of approximately 0.003 percent by weight (i.e., 30 ppm). Accordingly, the on-site soils are considered to have a negligible potential for sulfate attack. However, due to the potential variability of the on-site soils, consideration should be given to using Type II/V cement for the project.

In order to reduce the potential for shrinkage cracks in the concrete during curing, we recommend that the concrete for the proposed structures be placed with a slump of 4 inches based on ASTM C 143. The slump should be checked periodically at the site prior to concrete placement. We further recommend that concrete cover over reinforcing steel for foundations be provided in accordance with CBC (2022). The structural engineer should be consulted for additional concrete specifications.

9.9 Drainage

Good surface drainage is imperative for satisfactory site performance. Positive drainage should be provided and maintained to channel surface water away from foundations and off-site. Positive drainage is defined as a slope of two percent or more for a distance of 5 feet or more away from foundations and tops of slopes. Runoff should then be transported by the use of swales or pipes into a collective drainage system. Surface waters should not be allowed to pond adjacent to foundations or on pavements. Concentrated runoff should not be allowed to flow over asphalt pavement as this can result in early deterioration of the pavement. We recommend that structures have roof drains and downspouts installed to collect runoff. Area drains for landscaped and paved areas are recommended.

9.10 Landscaping

Project landscaping should consist of drought tolerant plants. Landscape irrigation should be kept to a level just sufficient to maintain plant vigor. Overwatering should not be permitted.

10 CONSTRUCTION OBSERVATION

The recommendations provided in this report are based on our understanding of the proposed project and on our evaluation of the data collected based on subsurface conditions disclosed by widely spaced exploratory borings and CPT soundings. It is imperative that the interpolated subsurface conditions be checked by our representative during construction. Observation and testing of compacted fill and backfill should also be performed by our representative during construction. We further recommend that the project plans and specifications be reviewed by this office prior to construction. It should be noted that, upon review of these documents, some recommendations presented in this report might be revised or modified.

During construction, we recommend that the duties of the geotechnical consultant include, but not be limited to:

- Observing clearing, grubbing, and removals.
- Observing excavation bottoms and the placement and compaction of fill, including trench backfill.
- Evaluating imported materials prior to their use as fill.
- Performing field tests to evaluate fill compaction.
- Observing foundation excavations for bearing materials and cleaning prior to placement of reinforcing steel or concrete.

The recommendations provided in this report assume that Ninyo & Moore will be retained as the geotechnical consultant during the construction phase of this project. If another geotechnical consultant is selected, we request that the selected consultant indicate to BPSD and to our firm in writing that our recommendations are understood and that they are in full agreement with our recommendations.

11 LIMITATIONS

The field evaluation, laboratory testing, and geotechnical analyses presented in this geotechnical report have been conducted in general accordance with current practice and the standard of care exercised by geotechnical consultants performing similar tasks in the project area. No warranty, expressed or implied, is made regarding the conclusions, recommendations, and opinions presented in this report. There is no evaluation detailed enough to reveal every subsurface condition. Variations may exist and conditions not observed or described in this report may be encountered during construction. Uncertainties relative to subsurface conditions can be reduced through additional subsurface exploration. Additional subsurface evaluation will be performed upon request. Please also note that our evaluation was limited to assessment of the geotechnical aspects of the project, and did not include evaluation of environmental concerns or the presence of hazardous materials.

This document is intended to be used only in its entirety. No portion of the document, by itself, is designed to completely represent any aspect of the project described herein. Ninyo & Moore should be contacted if the reader requires additional information or has questions regarding the content, interpretations presented, or completeness of this document.

This report is intended for design purposes only. It does not provide sufficient data to prepare an accurate bid by contractors. It is suggested that the bidders and their geotechnical consultant perform an independent evaluation of the subsurface conditions in the project area. The independent evaluations may include, but not be limited to, review of other geotechnical reports prepared for the adjacent areas, site reconnaissance, and additional exploration and laboratory testing.

Our conclusions, recommendations, and opinions are based on an analysis of the observed site conditions. If geotechnical conditions different from those described in this report are encountered, our office should be notified, and additional recommendations, if warranted, will be provided upon request. It should be understood that the conditions of a site could change with time as a result of natural processes or the activities of man at the subject site or nearby sites. In addition, changes to the applicable laws, regulations, codes, and standards of practice may occur due to government action or the broadening of knowledge. The findings of this report may, therefore, be invalidated over time, in part or in whole, by changes over which Ninyo & Moore has no control.

This report is intended exclusively for use by the client. Any use or reuse of the findings, conclusions, and/or recommendations of this report by parties other than the client is undertaken at said parties' sole risk.

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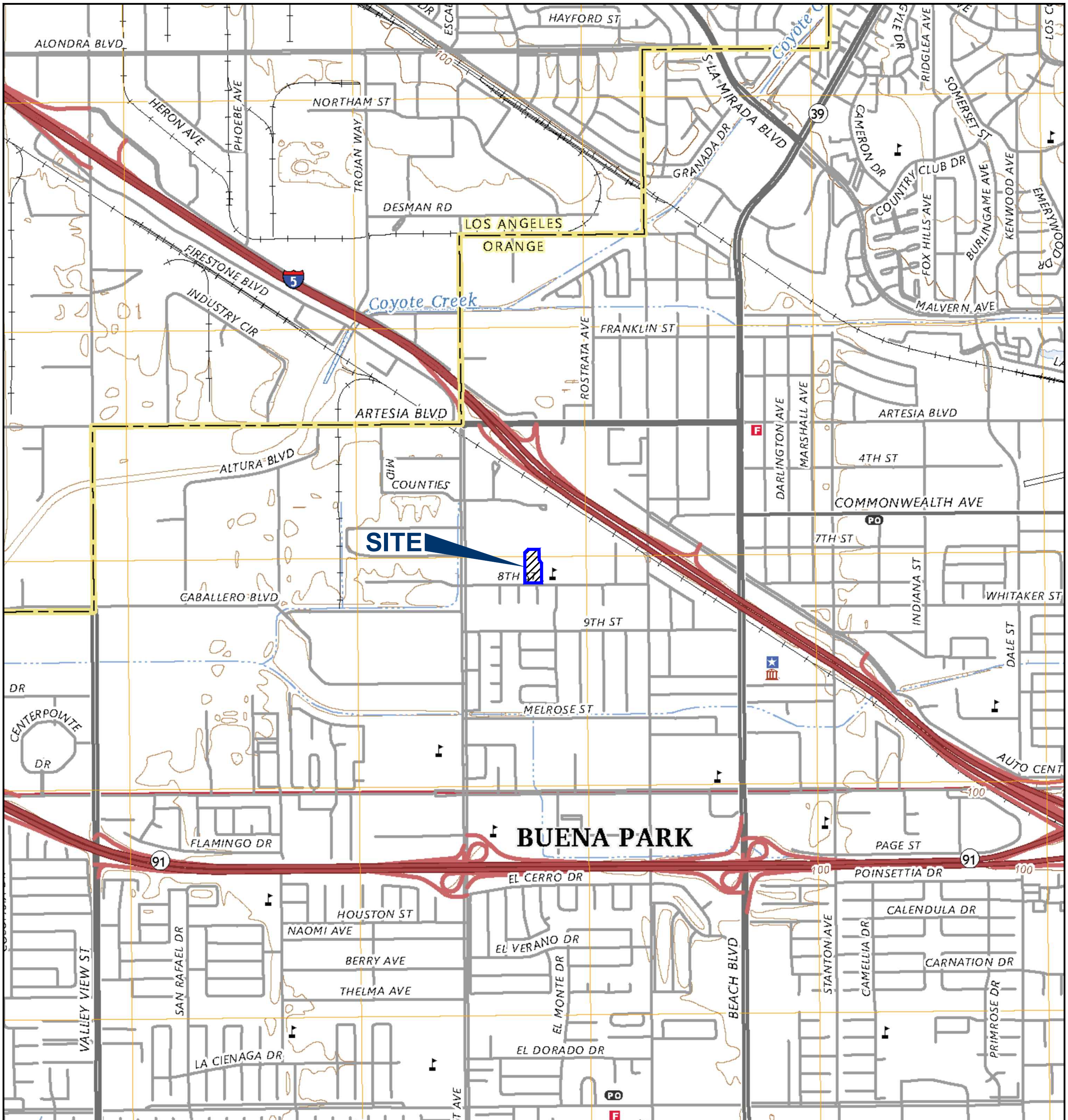
FIGURES



NOTE: DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE. I REFERENCE: USGS, 2024A.

N

FEET

0 2,000 4,000

212502001.dwg_SL 02/12/2024 JDP, GK

FIGURE 1

SITE LOCATION

CARL E. GILBERT ELEMENTARY SCHOOL TK/PK CLASSROOMS
BUENA PARK, CALIFORNIA

212502001 I 2/24

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

LEGEND

B-2 TD=11.5 — BORING; TD=TOTAL DEPTH IN FEET

CPT-2 TD=75.3 — CONE PENETRATION TEST; TD=TOTAL DEPTH IN FEET

A A' — CROSS SECTION

PROJECT LIMITS

N

FEET 0 80 160

NOTE: DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE. I REFERENCE: GOOGLE EARTH, 2024.

212502001.dwg_SA 02/12/2024 JDP, GK

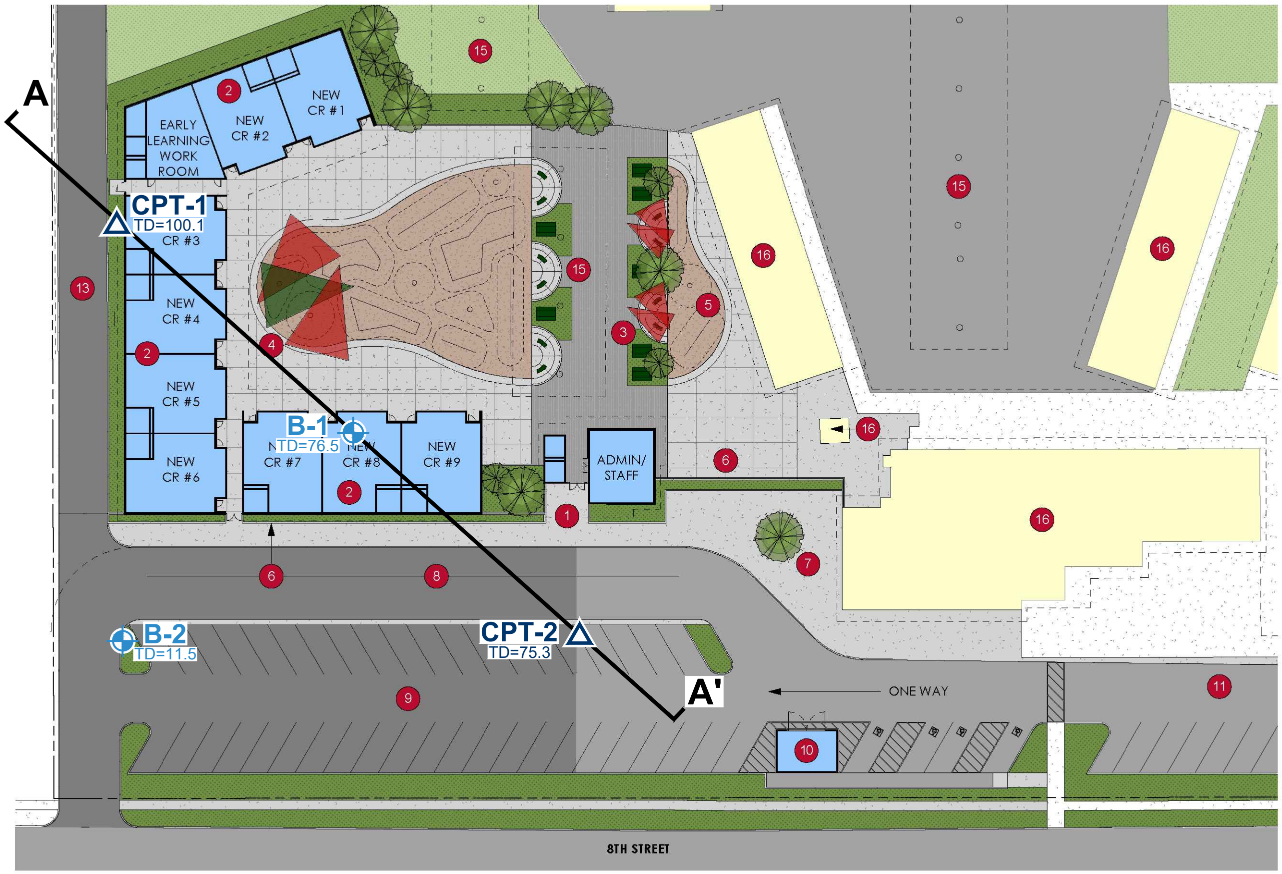
FIGURE 2

SITE AERIAL WITH BORING AND CPT SOUNDING LOCATIONS

CARL E. GILBERT ELEMENTARY SCHOOL TK/PK CLASSROOMS
BUENA PARK, CALIFORNIA

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

212502001 I 2/24



SCOPE OF WORK

1. Building A - Gated Entry, Administration and Staff Room
2. Building B - 9 TK Classrooms and Early Learning Work Room
3. Outdoor Learning Area with Shade Sails and Trees
4. Early Childhood Playground Area with Shade Sails
5. Early Childhood Playground Area
6. Ornamental Fencing Connecting to Existing Building
7. Tree Well Surrounded by Concrete Bench
8. New Student Drop Off
9. New Parking Layout
10. New Trash Enclosure
11. Existing Student Drop Off
12. Exisiting Parking Lot 1 (Parking Striping to be Updated)
13. New Fire Access Lane
14. Area for Future Growth
15. Existing Solar Arrays
16. Existing Buildings

LEGEND

B-2 TD=11.5 — BORING; TD=TOTAL DEPTH IN FEET

CPT-2 TD=75.3 — CONE PENETROMETER TEST; TD=TOTAL DEPTH IN FEET

A A' — CROSS SECTION

N

FEET 0 80 160

NOTE: DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE. I REFERENCE: STUDIO W ARCHITECTS, 2024.

212502001.dwg_SP 02/12/2024 JDP, GK

FIGURE 3

SITE PLAN WITH BORING AND CPT SOUNDING LOCATIONS

CARL E. GILBERT ELEMENTARY SCHOOL TK/PK CLASSROOMS
BUENA PARK, CALIFORNIA

212502001 I 2/24

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LEGEND

Qya 2	YOUNG ALLUVIUM, UNDIVIDED	Qvof	VERY OLD ALLUVIAL FAN DEPOSITS, UNDIVIDED
Qyf	YOUNG ALLUVIAL FAN DEPOSITS		GEOLOGIC CONTACT
Qof	OLD ALLUVIAL FAN DEPOSITS, UNDIVIDED		

N

FEET

0 4,000 8,000

NOTE: DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE. I REFERENCE: SAUCEDO ET AL., 2016.

212502001.dwg_RG 02/12/2024 JDP, GK

FIGURE 4

REGIONAL GEOLOGY

CARL E. GILBERT ELEMENTARY SCHOOL TK/PK CLASSROOMS
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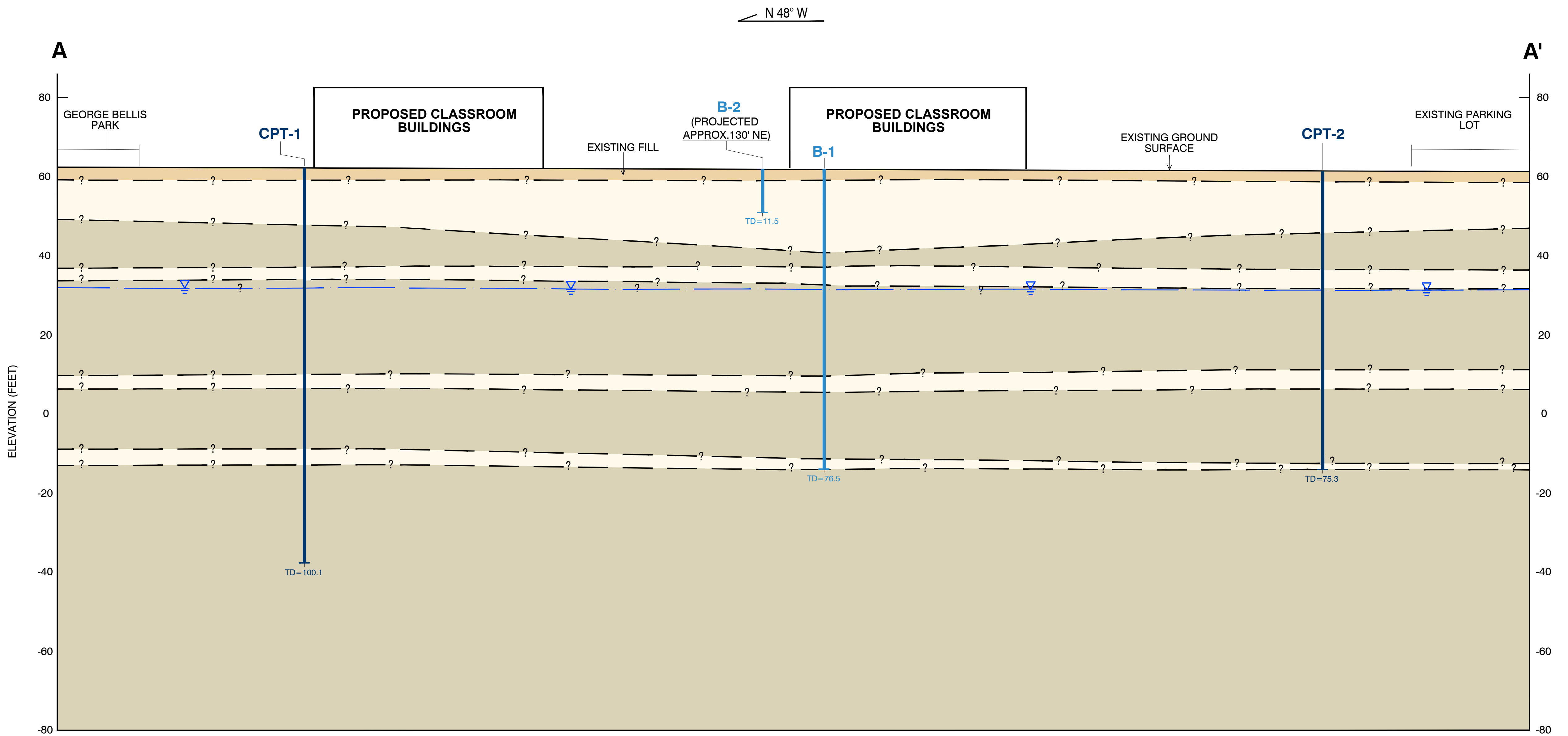

LEGEND

— — — —?—	GEOLOGIC CONTACT; QUERIED WHERE UNCERTAIN		EXISTING FILL
B-2 TD=11.5	BORING; TD=TOTAL DEPTH IN FEET		FINE GRAINED (CH, CL, HIGH PLASTICITY ML)
CPT-2 TD=75.3	CONE PENETRATION TEST; TD=TOTAL DEPTH IN FEET		COARSE GRAINED SOILS (SP, SP-SM, SM, LOW PLASTICITY ML)
			GROUNDWATER

FEET 0 30 60

NOTE: DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE.

212502001.dwg_CSA 02/14/2024 JDP, GK

FIGURE 5

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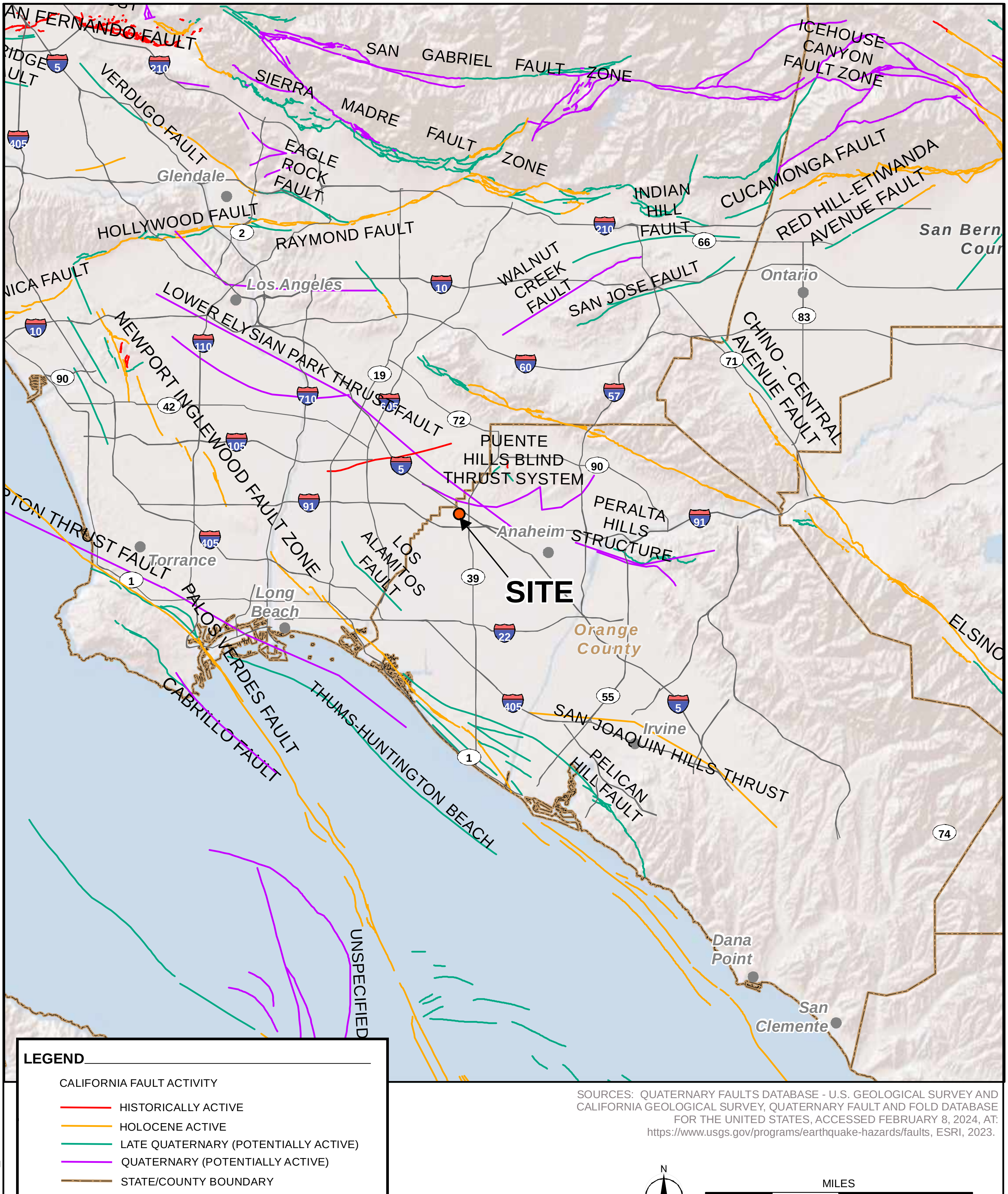
CROSS SECTION A-A'

CARL E. GILBERT ELEMENTARY SCHOOL TK/PK CLASSROOMS
BUENA PARK, CALIFORNIA

212502001 I 2/24



SOURCES: QUATERNARY FAULTS DATABASE - U.S. GEOLOGICAL SURVEY AND CALIFORNIA GEOLOGICAL SURVEY, QUATERNARY FAULT AND FOLD DATABASE FOR THE UNITED STATES, ACCESSED FEBRUARY 8, 2024, AT: https://www.usgs.gov/programs/earthquake-hazards/faults, ESRI, 2023.

NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE.

212502001_FL.mxd 2/8/2024 JDP

FIGURE 6

FAULT LOCATIONS

CARL E. GILBERT ELEMENTARY SCHOOL TK/PK CLASSROOMS
BUENA PARK, CALIFORNIA

212502001 | 2/24

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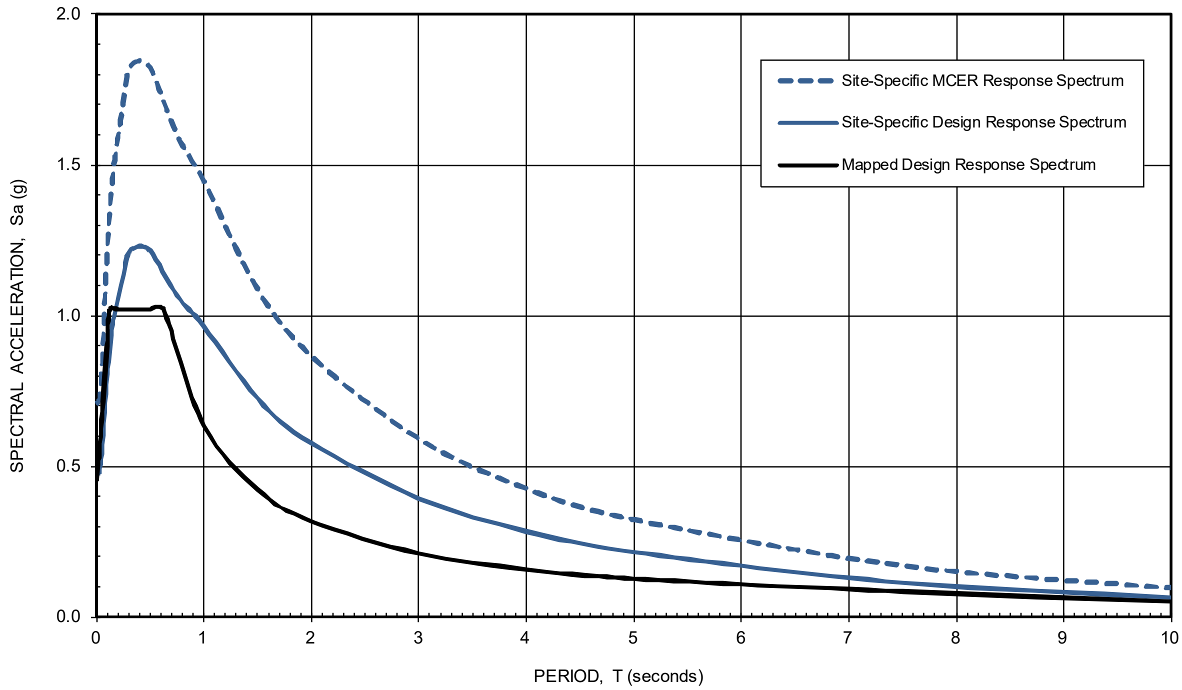
PERIOD (seconds)	SITE-SPECIFIC MCE_R RESPONSE SPECTRUM Sa (g)	SITE-SPECIFIC DESIGN RESPONSE SPECTRUM Sa (g)
0.010	0.710	0.474
0.020	0.716	0.477
0.030	0.726	0.484
0.050	0.814	0.543
0.075	1.014	0.676
0.100	1.210	0.807
0.150	1.456	0.971
0.200	1.589	1.059
0.250	1.705	1.137
0.300	1.815	1.210
0.400	1.845	1.230

PERIOD (seconds)	SITE-SPECIFIC MCE_R RESPONSE SPECTRUM Sa (g)	SITE-SPECIFIC DESIGN RESPONSE SPECTRUM Sa (g)
0.500	1.823	1.215
0.750	1.599	1.066
1.000	1.447	0.965
1.500	1.087	0.725
2.000	0.866	0.577
3.000	0.591	0.394
4.000	0.426	0.284
5.000	0.323	0.215
7.500	0.170	0.113
10.000	0.097	0.064

S_{MS} = 1.660 g	S_{M1} = 1.772 g	S_{DS} = 1.107 g	S_{D1} = 1.181 g	PGA_M = 0.709 g



NOTES:

1 The probabilistic ground motion spectral response accelerations are based on the risk-targeted Maximum Considered Earthquake (MCER) having a 2% probability of exceedance in 50 years in the maximum direction using the Chiou & Youngs (2014), Campbell & Bozorgnia (2014), Boore et al. (2014), and Abrahamson et al. (2014) attenuation relationships and the risk coefficients per ASCE 7-16 Section 21.2.1.1.

2 The deterministic ground motion spectral response accelerations are the 84th percentile geometric mean values in the maximum direction using the Chiou & Youngs (2014), Campbell & Bozorgnia (2014), Boore et al. (2014), and Abrahamson et al. (2014) attenuation relationships for deep soil sites considering a Mw 7.5 event on the Compton fault zone located 11.5 kilometers from the site. It conforms with the lower bound limit per ASCE 7-16 Section 21.2.2.

3 The Site-Specific MCER Response Spectrum is the lesser of the spectral ordinates of the deterministic and probabilistic accelerations at each period per ASCE 7-16 Section 21.2.3. The Site-Specific Design Response Spectrum conforms with the lower bound limit per ASCE 7-16 Section 21.3.

4 The Mapped Design Response Spectrum is computed from the mapped spectral ordinates modified for Site Class D (stiff soil profile) per ASCE 7-16 Section 11.4. It is presented for the sake of comparison.

FIGURE 7

ACCELERATION RESPONSE SPECTRA

CARL E. GILBERT ELEMENTARY SCHOOL TK/PK CLASSROOMS
BUENA PARK, CALIFORNIA

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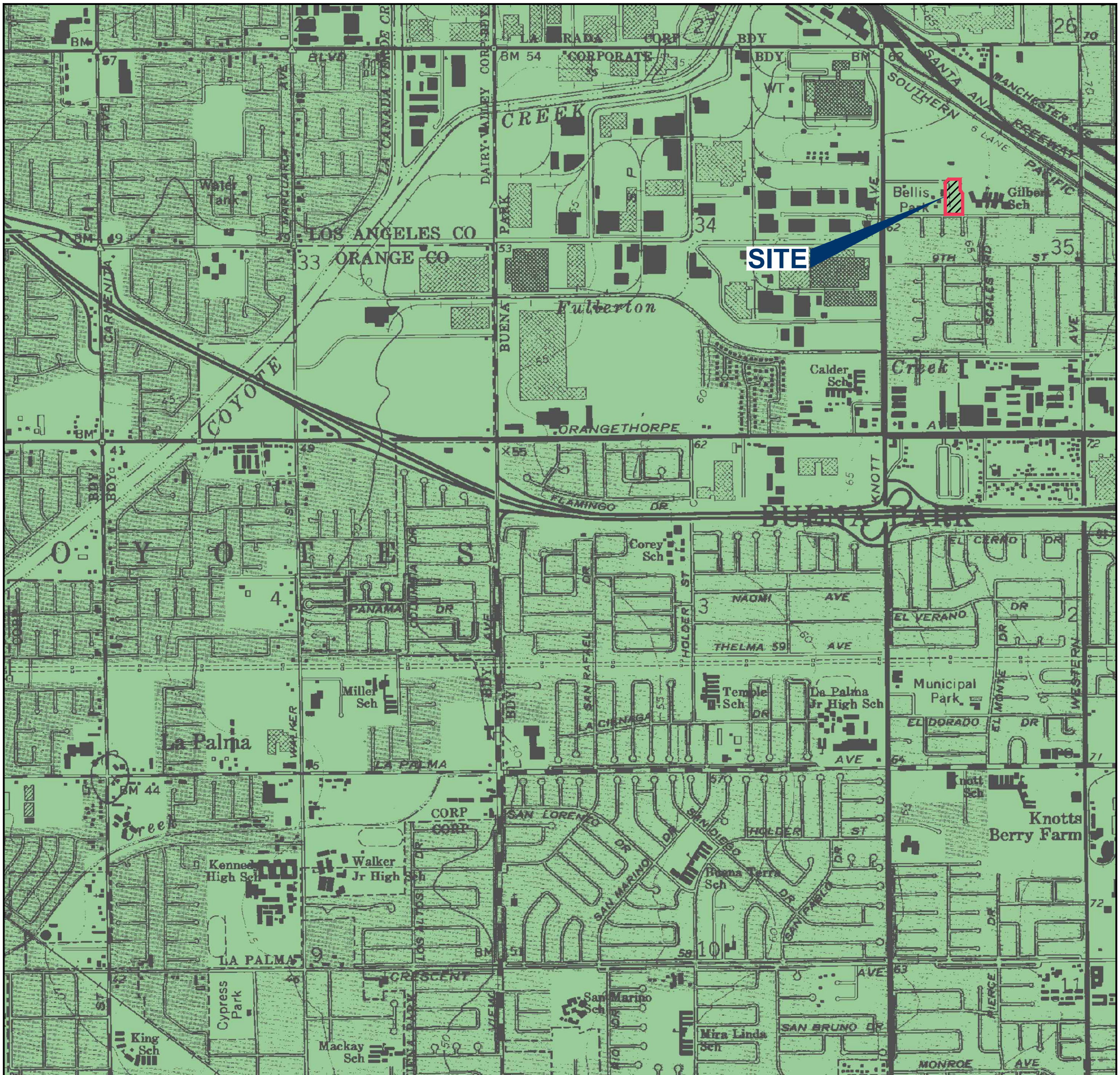

LEGEND

LIQUEFACTION

Areas where historic occurrence of liquefaction, or local geological, geotechnical and groundwater conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

N

FEET

0 2,000 4,000

NOTE: DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE. I REFERENCE: CDMG, 1999.

212502001.dwg_SHZ 02/12/2024 JDP, GK

FIGURE 8

SEISMIC HAZARD ZONES

CARL E. GILBERT ELEMENTARY SCHOOL TK/PK CLASSROOMS
BUENA PARK, CALIFORNIA

212502001 I 2/24

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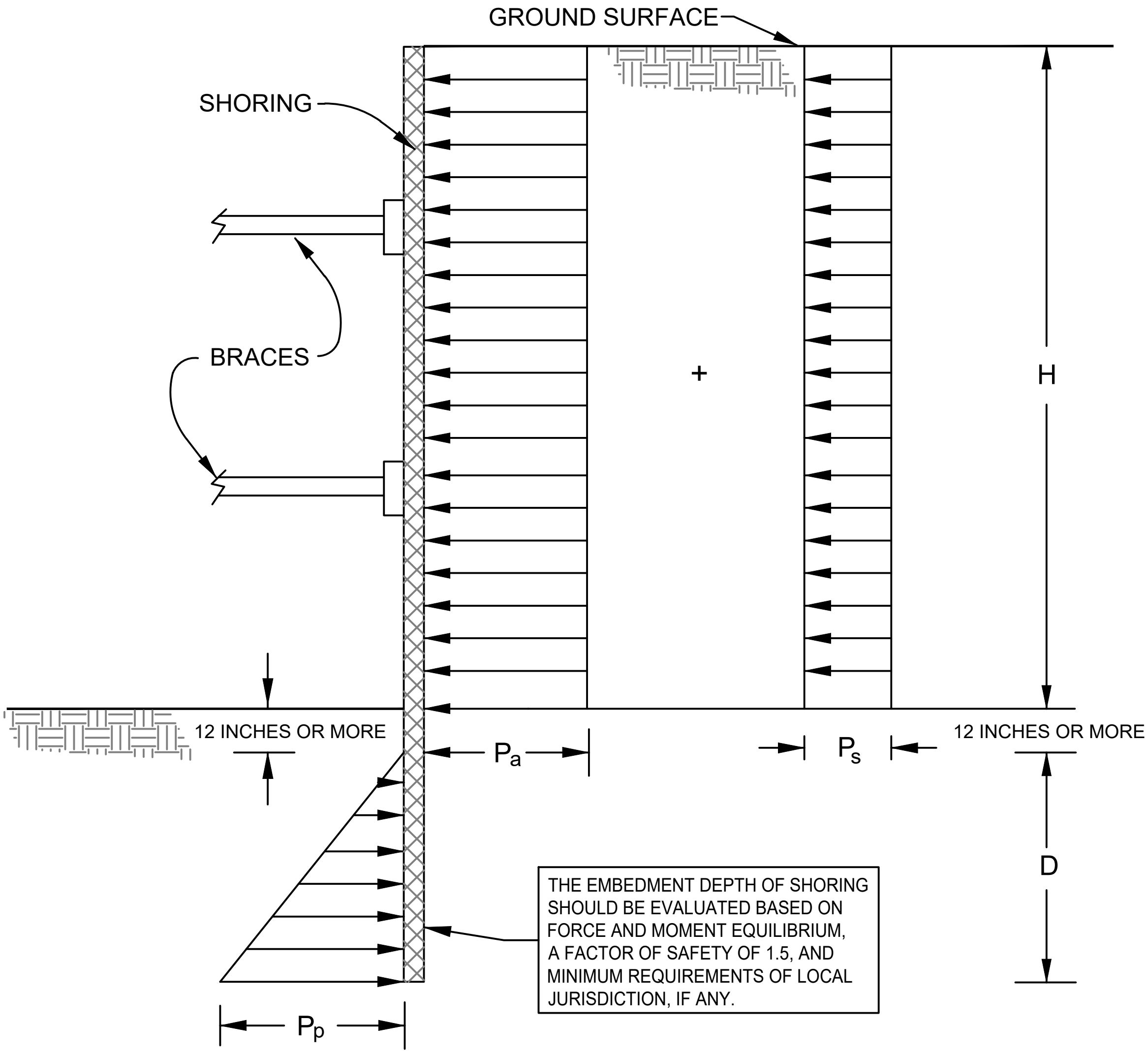


NOTES:

1. APPARENT LATERAL EARTH PRESSURE, P_a
   P_a = 25H psf
2. CONSTRUCTION TRAFFIC INDUCED SURCHARGE PRESSURE, P_s
   P_s = 120 psf
3. PASSIVE LATERAL EARTH PRESSURE, P_p
   P_p = 350D psf
4. ASSUMES GROUNDWATER IS NOT PRESENT
5. SURCHARGES FROM EXCAVATED SOIL OR CONSTRUCTION MATERIALS ARE NOT INCLUDED
6. H AND D ARE IN FEET

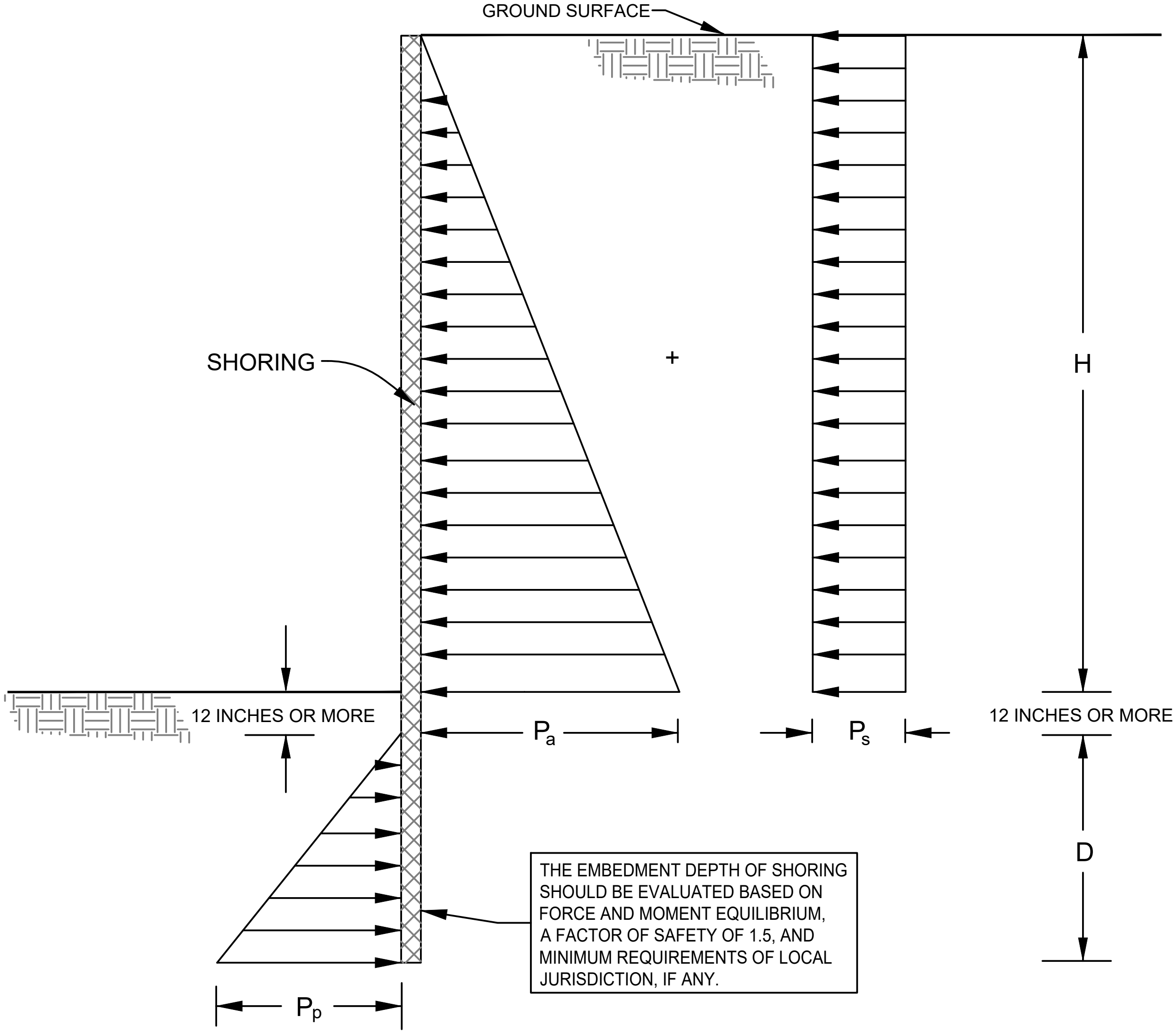
NOT TO SCALE

FIGURE 9

LATERAL EARTH PRESSURES FOR BRACED EXCAVATION

CARL E. GILBERT ELEMENTARY SCHOOL TK/PK CLASSROOMS
BUENA PARK, CALIFORNIA

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants



NOTES:

1. ACTIVE LATERAL EARTH PRESSURE, P_a
   P_a = 39H psf
2. CONSTRUCTION TRAFFIC INDUCED SURCHARGE PRESSURE, P_s
   P_s = 120 psf
3. PASSIVE LATERAL EARTH PRESSURE, P_p
   P_p = 350D psf
4. ASSUMES GROUNDWATER IS NOT PRESENT
5. H AND D ARE IN FEET

NOT TO SCALE

212502001.dwg_LEP-CS1 02/08/2024 JDP

FIGURE 10

LATERAL EARTH PRESSURES FOR TEMPORARY CANTILEVERED SHORING

CARL E. GILBERT ELEMENTARY SCHOOL TK/PK CLASSROOMS
BUENA PARK, CALIFORNIA

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

APPENDIX A

Boring Logs

APPENDIX A

BORING LOGS

Field Procedure for the Collection of Disturbed Samples
Disturbed soil samples were obtained in the field using the following methods.

Bulk Samples
Bulk samples of representative earth materials were obtained from the exploratory borings. The samples were bagged and transported to the laboratory for testing.

The Standard Penetration Test (SPT) Sampler
Disturbed drive samples of earth materials were obtained by means of a Standard Penetration Test sampler. The sampler is composed of a split barrel with an external diameter of 2 inches and an unlined internal diameter of $1^3/_8$ inches. The sampler was driven into the ground 12 to 18 inches with a 140-pound hammer falling freely from a height of 30 inches in general accordance with ASTM D 1586. The blow counts were recorded for every 6 inches of penetration; the blow counts reported on the logs are those for the last 12 inches of penetration. Soil samples were observed and removed from the sampler, bagged, sealed, and transported to the laboratory for testing.

Field Procedure for the Collection of Relatively Undisturbed Samples
Relatively undisturbed soil samples were obtained in the field using the following method.

The Modified Split-Barrel Drive Sampler
The sampler, with an external diameter of 3 inches, was lined with 1-inch-long, thin brass rings with inside diameters of approximately 2.4 inches. The sample barrel was driven into the ground with the weight of a hammer of the drill rig in general accordance with ASTM D 3550. The driving weight was permitted to fall freely. The approximate length of the fall, the weight of the hammer or bar, and the number of blows per foot of driving are presented on the boring logs as an index to the relative resistance of the materials sampled. The samples were removed from the sample barrel in the brass rings, sealed, and transported to the laboratory for testing.

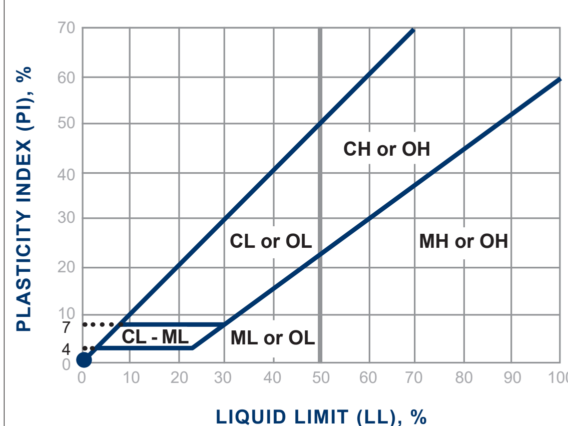
Soil Classification Chart Per ASTM D 2488

Primary Divisions			Secondary Divisions: Group Symbol	Secondary Divisions: Group Name
COARSE-GRAINED SOILS more than 50% retained on No. 200 sieve	**GRAVEL** more than 50% of coarse fraction retained on No. 4 sieve	CLEAN GRAVEL less than 5% fines	GW	well-graded GRAVEL
			GP	poorly graded GRAVEL
		GRAVEL with DUAL CLASSIFICATIONS 5% to 12% fines	GW-GM	well-graded GRAVEL with silt
			GP-GM	poorly graded GRAVEL with silt
			GW-GC	well-graded GRAVEL with clay
			GP-GC	poorly graded GRAVEL with clay
		GRAVEL with FINES more than 12% fines	GM	silty GRAVEL
			GC	clayey GRAVEL
			GC-GM	silty, clayey GRAVEL
	SAND 50% or more of coarse fraction passes No. 4 sieve	CLEAN SAND less than 5% fines	SW	well-graded SAND
			SP	poorly graded SAND
		SAND with DUAL CLASSIFICATIONS 5% to 12% fines	SW-SM	well-graded SAND with silt
			SP-SM	poorly graded SAND with silt
			SW-SC	well-graded SAND with clay
			SP-SC	poorly graded SAND with clay
		SAND with FINES more than 12% fines	SM	silty SAND
			SC	clayey SAND
			SC-SM	silty, clayey SAND
FINE-GRAINED SOILS 50% or more passes No. 200 sieve	**SILT and CLAY** liquid limit less than 50%	INORGANIC	CL	lean CLAY
			ML	SILT
			CL-ML	silty CLAY
		ORGANIC	OL (PI > 4)	organic CLAY
			OL (PI < 4)	organic SILT
	SILT and CLAY liquid limit 50% or more	INORGANIC	CH	fat CLAY
			MH	elastic SILT
		ORGANIC	OH (plots on or above "A"-line)	organic CLAY
			OH (plots below "A"-line)	organic SILT
	Highly Organic Soils		PT	Peat

Grain Size

Description		Sieve Size	Grain Size	Approximate Size
Boulders		> 12"	> 12"	Larger than basketball-sized
Cobbles		3 - 12"	3 - 12"	Fist-sized to basketball-sized
Gravel	Coarse	3/4 - 3"	3/4 - 3"	Thumb-sized to fist-sized
	Fine	#4 - 3/4"	0.19 - 0.75"	Pea-sized to thumb-sized
Sand	Coarse	#10 - #4	0.079 - 0.19"	Rock-salt-sized to pea-sized
	Medium	#40 - #10	0.017 - 0.079"	Sugar-sized to rock-salt-sized
	Fine	#200 - #40	0.0029 - 0.017"	Flour-sized to sugar-sized
Fines		Passing #200	< 0.0029"	Flour-sized and smaller

Plasticity Chart



Apparent Density - Coarse-Grained Soil

Apparent Density	Spooling Cable or Cathead: SPT (blows/foot)	Spooling Cable or Cathead: Modified Split Barrel (blows/foot)	Automatic Trip Hammer: SPT (blows/foot)	Automatic Trip Hammer: Modified Split Barrel (blows/foot)
Very Loose	≤ 4	≤ 8	≤ 3	≤ 5
Loose	5 - 10	9 - 21	4 - 7	6 - 14
Medium Dense	11 - 30	22 - 63	8 - 20	15 - 42
Dense	31 - 50	64 - 105	21 - 33	43 - 70
Very Dense	> 50	> 105	> 33	> 70

Consistency - Fine-Grained Soil

Consistency	Spooling Cable or Cathead: SPT (blows/foot)	Spooling Cable or Cathead: Modified Split Barrel (blows/foot)	Automatic Trip Hammer: SPT (blows/foot)	Automatic Trip Hammer: Modified Split Barrel (blows/foot)
Very Soft	< 2	< 3	< 1	< 2
Soft	2 - 4	3 - 5	1 - 3	2 - 3
Firm	5 - 8	6 - 10	4 - 5	4 - 6
Stiff	9 - 15	11 - 20	6 - 10	7 - 13
Very Stiff	16 - 30	21 - 39	11 - 20	14 - 26
Hard	> 30	> 39	> 20	> 26

BORING LOG EXPLANATION SHEET

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	
0								Bulk sample.
								Modified split-barrel drive sampler.
								No recovery with modified split-barrel drive sampler.
								Sample retained by others.
								Standard Penetration Test (SPT).
5								No recovery with a SPT.
			XX/XX					Shelby tube sample. Distance pushed in inches/length of sample recovered in inches.
								No recovery with Shelby tube sampler.
								Continuous Push Sample.
								Seepage.
10								Groundwater encountered during drilling.
								Groundwater measured after drilling.
							SM	MAJOR MATERIAL TYPE (SOIL): Solid line denotes unit change.
							CL	Dashed line denotes material change.
								Attitudes: Strike/Dip b: Bedding c: Contact j: Joint f: Fracture F: Fault cs: Clay Seam s: Shear bss: Basal Slide Surface sf: Shear Fracture sz: Shear Zone sbs: Shear Bedding Surface
15								
								The total depth line is a solid line that is drawn at the bottom of the boring.
20								

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DATE DRILLED 12/29/23 BORING NO. B-1 GROUND ELEVATION 61' ± (MSL) SHEET 1 OF 3 METHOD OF DRILLING 8" Hollow-Stem Auger (Baja Exploration) DRIVE WEIGHT 140 lbs. (Auto. Trip Hammer) DROP 30" SAMPLED BY RAF LOGGED BY RAF REVIEWED BY SCM/MLP **DESCRIPTION/INTERPRETATION**
0							SC	FILL: Brown, moist, medium dense, clayey SAND; trace gravel.
							SP	ALLUVIUM: Light brown, moist, medium dense, poorly graded SAND.
			24	3.5	94.1			
10			15					
							SC	Gray, moist, medium dense, clayey SAND.
			22	19.2	109.9			
20			9				CL	Grayish brown, moist, stiff, sandy lean CLAY.
							SM	Brown to grayish brown, moist, medium dense, silty SAND.
			37	21.9	106.0			
30			10				CL	Grayish brown, moist, stiff, sandy lean CLAY. @ 30': Groundwater measured after drilling was paused for 25 minutes.
			15	27.3	95.8			Very stiff. @ 36': Groundwater encountered during drilling.
40								

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DATE DRILLED	12/29/23	BORING NO.	B-1
GROUND ELEVATION	61' ± (MSL)	SHEET	2 OF 3
METHOD OF DRILLING	8" Hollow-Stem Auger (Baja Exploration)		
DRIVE WEIGHT	140 lbs. (Auto. Trip Hammer)	DROP	30"
SAMPLED BY	RAF	LOGGED BY	RAF
REVIEWED BY	SCM/MLP		

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
40			19				CL	ALLUVIUM: (Continued) Gray, wet, very stiff, sandy lean CLAY; caliche deposits.
			14					
50			32	18.4	110.2			Hard; interbedded sand layers.
							SC	Brown, wet, dense, clayey SAND.
			21				CL	Brown to reddish brown, wet, hard, sandy lean CLAY; caliche deposits.
60			43					Iron oxidation staining.
			17					Very stiff.
70			34					Hard.
							SP-SM	Brown to reddish brown, wet, very dense, poorly graded SAND with silt.
			41					
80								Total Depth = 76.5 feet. Groundwater was encountered at approximately 36 feet during drilling. Groundwater was measured at approximately 30 feet after drilling was paused for 25 minutes. Backfilled with cement-bentonite grout on 12/29/23.

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DATE DRILLED 12/29/23 BORING NO. B-1 GROUND ELEVATION 61' ± (MSL) SHEET 3 OF 3 METHOD OF DRILLING 8" Hollow-Stem Auger (Baja Exploration) DRIVE WEIGHT 140 lbs. (Auto. Trip Hammer) DROP 30" SAMPLED BY RAF LOGGED BY RAF REVIEWED BY SCM/MLP **DESCRIPTION/INTERPRETATION**
80								Notes: Groundwater may rise to a level higher than that measured in borehole due to relatively slow rate of seepage in clay and several other factors as discussed in the report. Please refer to the report for groundwater monitoring recommendations. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents
90								
100								
110								
120								

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0	■						SC	FILL: Brown to light brown, moist, medium dense, clayey SAND.
	■						SP	ALLUVIUM: Light brown, moist, medium dense, poorly graded SAND.
		■	23	2.6	97.7			
10		◤	14				CL	Brown, moist, very stiff, sandy lean CLAY.
								Total Depth = 11.5 feet. Groundwater was not encountered during drilling. Backfilled with cement-bentonite grout on 12/29/23. Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
20								
30								
40								

DATE DRILLED 12/29/23 BORING NO. B-2

GROUND ELEVATION 61' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING 8" Hollow-Stem Auger (Baja Exploration)

DRIVE WEIGHT 140 lbs. (Auto. Trip Hammer) DROP 30"

SAMPLED BY RAF LOGGED BY RAF REVIEWED BY SCM/MLP

APPENDIX B

CPT Soundings

APPENDIX B

CPT SOUNDINGS

Field Procedure for Cone Penetration Testing

The CPT soundings described in this report were conducted by Kehoe Testing & Engineering in general accordance with ASTM D 5778. The cone penetrometer assembly used for this project consisted of a conical tip and a cylindrical friction sleeve. The conical tip had an apex angle of 60 degrees and a cross-section area of approximately 15 square centimeters. The interior of the CPT probe was instrumented with strain gauges that allowed simultaneous measurement of cone tip and friction sleeve resistance during penetration. The cone hydraulically pushed into the soil using the reaction mass of a specially designed 30-ton truck at a constant rate while the cone tip resistance and sleeve friction were recorded at an approximately 1-inch interval and stored in digital form. The computer generated logs presented in the following pages include cone resistance, friction resistance, friction ratio, and interpreted soil types. The soil type interpretations were based on the method proposed by Robertson (2010).

SUMMARY

OF

CONE PENETRATION TEST DATA

Project:

Carl E. Gilbert Elementary School
7255 8th Street
Buena Park, CA
December 29, 2023

Prepared for:

Mr. Spencer Marcinek
Ninyo & Moore
475 Goddard, Ste 200
Irvine, CA 92618-4605
Office (949) 753-7070 / Fax (949) 753-7071

Prepared by:

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

TABLE OF CONTENTS

SUMMARY

OF

CONE PENETRATION TEST DATA

1. INTRODUCTION

This report presents the results of a Cone Penetration Test (CPT) program carried out for the Carl E. Gilbert Elementary School project located at 7255 8th Street in Buena Park, California. The work was performed by Kehoe Testing & Engineering (KTE) on December 29, 2023. The scope of work was performed as directed by Ninyo & Moore personnel.

2. SUMMARY OF FIELD WORK

The fieldwork consisted of performing CPT soundings at two locations to determine the soil lithology. A summary is provided in **TABLE 2.1**.

LOCATION	DEPTH OF CPT (ft)	COMMENTS/NOTES:
CPT-1	100	
CPT-2	75	

TABLE 2.1 - Summary of CPT Soundings

3. FIELD EQUIPMENT & PROCEDURES

The CPT soundings were carried out by **KTE** using an integrated electronic cone system manufactured by Vertek. The CPT soundings were performed in accordance with ASTM standards (D5778). The cone penetrometers were pushed using a 30-ton CPT rig. The cone used during the program was a 15 cm^2 cone with a cone net area ratio of 0.83. The following parameters were recorded at approximately 2.5 cm depth intervals:

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

At location CPT-1, shear wave measurements were obtained at approximately 5-foot intervals. The shear wave is generated using an air-actuated hammer, which is located inside the front jack of the CPT rig. The cone has a triaxial geophone, which recorded the shear wave signal generated by the air hammer.

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

4. CONE PENETRATION TEST DATA & INTERPRETATION

The Cone Penetration Test data is presented in graphical form in the attached Appendix. These plots were generated using the CPeT-IT program. Penetration depths are referenced to ground surface. The soil behavior type on the CPT plots is derived from the attached CPT SBT plot (Robertson, "Interpretation of Cone Penetration Test…", 2009) and presents major soil lithologic changes. The stratigraphic interpretation is based on relationships between cone resistance (qc), sleeve friction (fs), and penetration pore pressure (u). The friction ratio (Rf), which is sleeve friction divided by cone resistance, is a calculated parameter that is used along with cone resistance to infer soil behavior type. Generally, cohesive soils (clays) have high friction ratios, low cone resistance and generate excess pore water pressures. Cohesionless soils (sands) have lower friction ratios, high cone bearing and generate little (or negative) excess pore water pressures.

The CPT data files have also been provided. These files can be imported in CPeT-IT (software by GeoLogismiki) and other programs to calculate various geotechnical parameters.

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

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

Sincerely,

KEHOE TESTING & ENGINEERING

Steven P. Kehoe
President

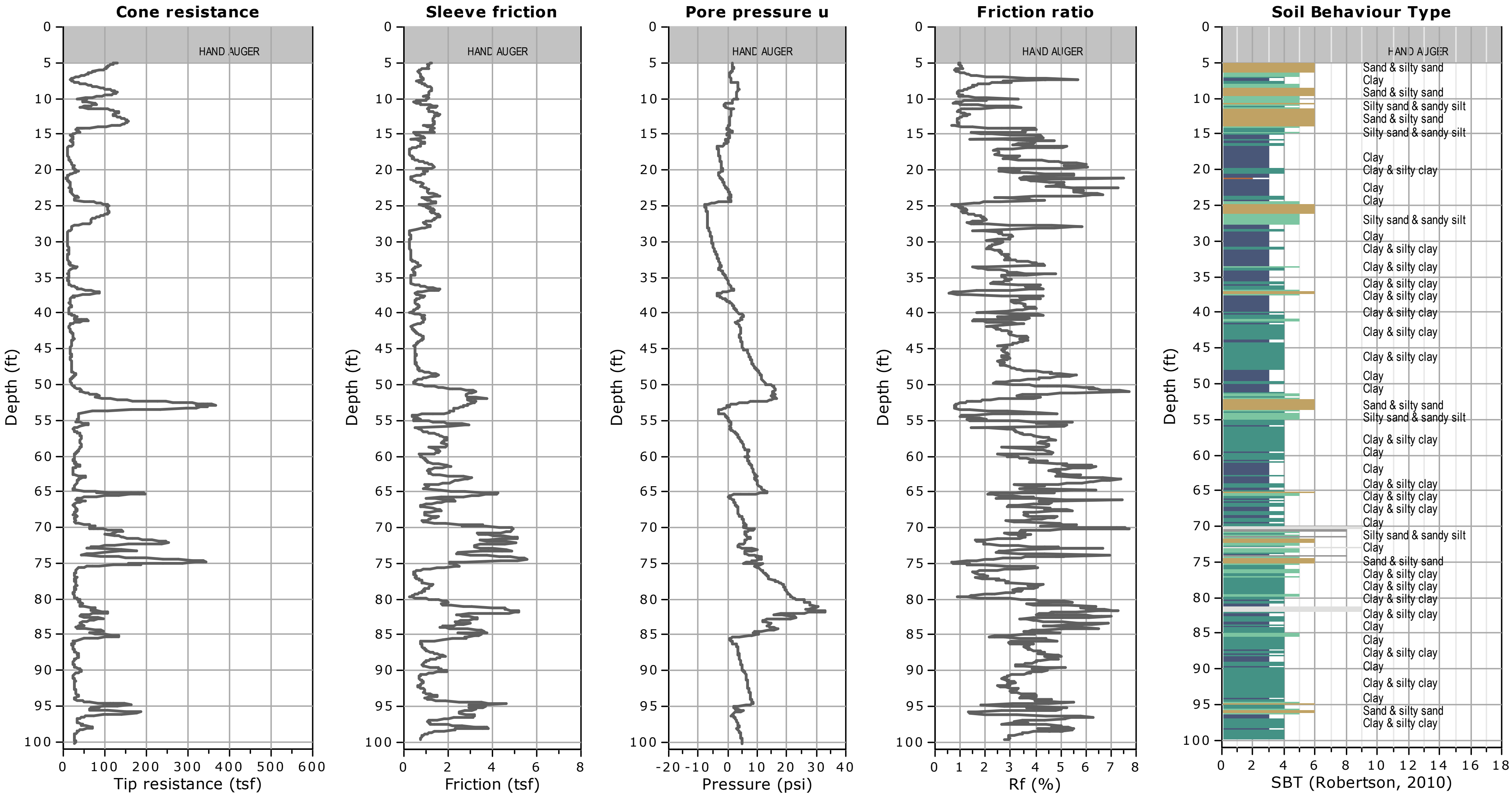
01/04/24-aga-6077

APPENDIX

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

Project: **Ninyo & Moore / Carl E. Gilbert Elementary School**
Location: **7255 8th St, Buena Park, CA**

CPT-1
Total depth: 100.14 ft, Date: 12/29/2023



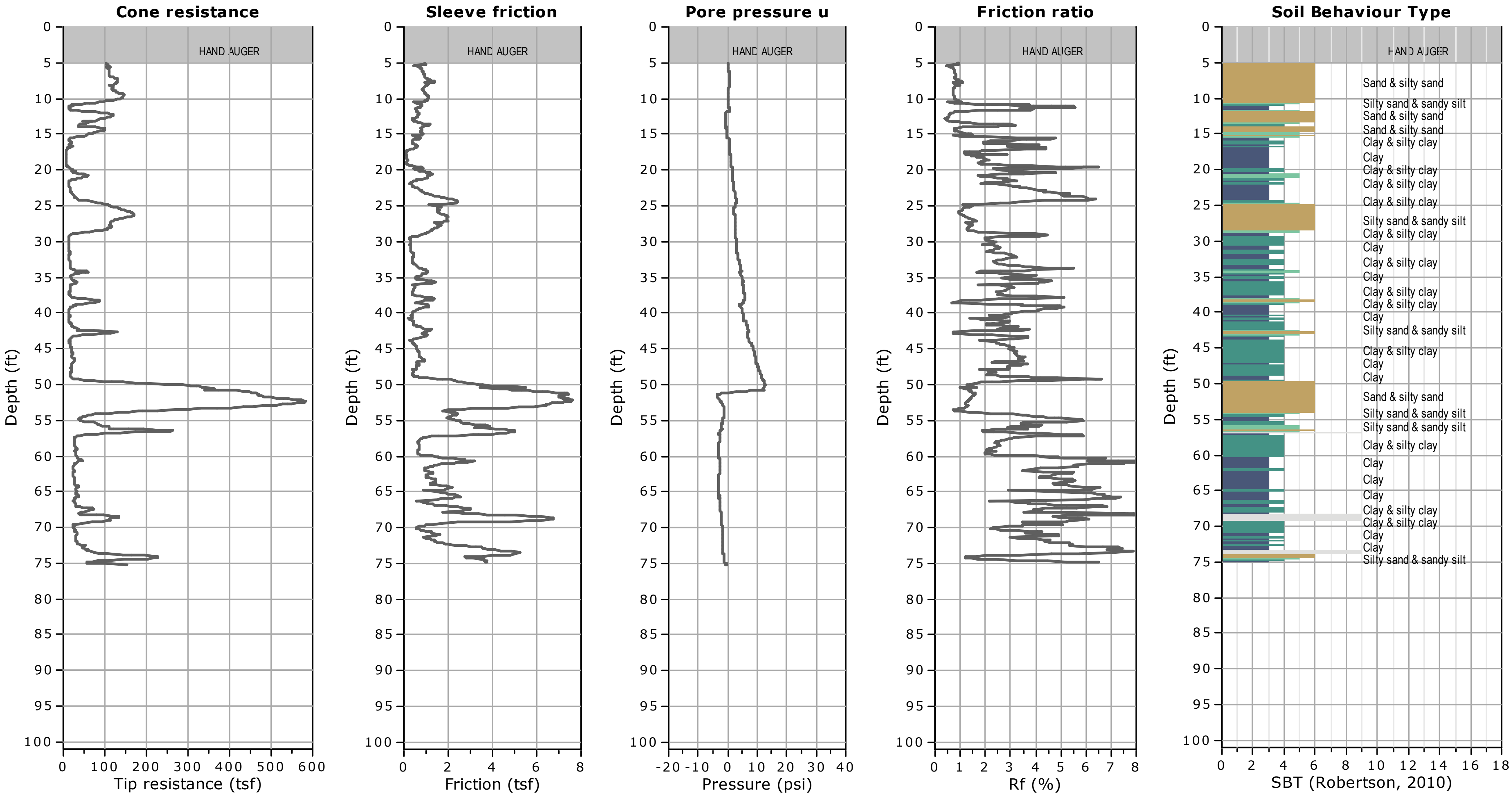
Kehoe Testing and Engineering
714-901-7270
steve@kehoetesting.com
www.kehoetesting.com

Project: **Ninyo & Moore / Carl E. Gilbert Elementary School**

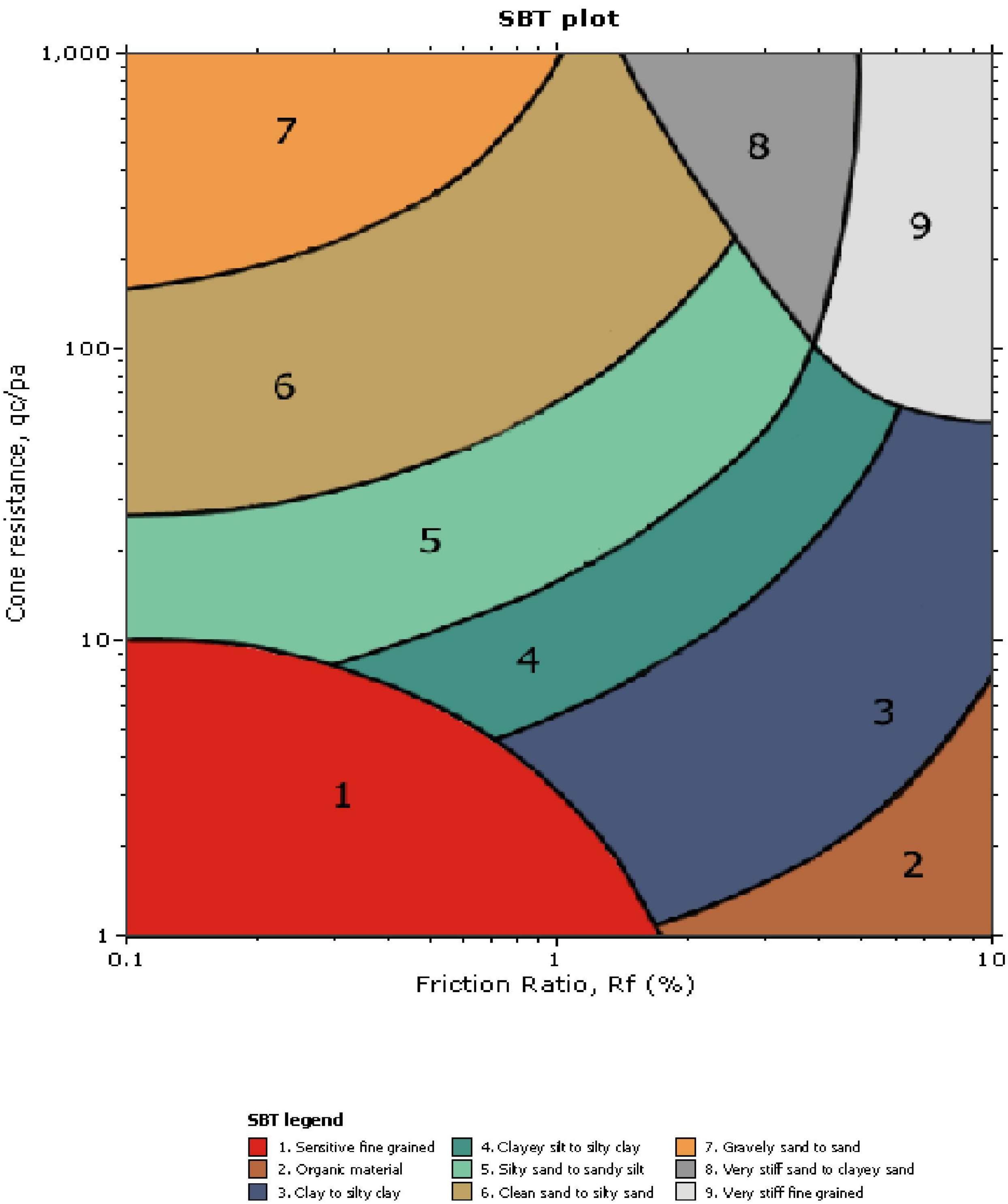
CPT-2

Location: **7255 8th St, Buena Park, CA**

Total depth: 75.30 ft, Date: 12/29/2023



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



Ninyo & Moore
Carl E. Gilbert Elementary School
Buena Park, CA

CPT Shear Wave Measurements

Location	Tip Depth (ft)	Geophone Depth (ft)	Travel Distance (ft)	S-Wave Arrival (msec)	S-Wave Velocity from Surface (ft/sec)	Interval S-Wave Velocity (ft/sec)
CPT-1	5.02	4.02	4.49	7.78	577	
	10.04	9.04	9.26	17.12	541	511
	15.06	14.06	14.20	25.26	562	607
	20.08	19.08	19.18	35.44	541	489
	25.07	24.07	24.15	43.44	556	621
	30.02	29.02	29.09	50.52	576	697
	35.04	34.04	34.10	58.44	583	633
	40.12	39.12	39.17	65.84	595	685
	45.08	44.08	44.13	72.84	606	708
	50.03	49.03	49.07	79.00	621	803
	55.05	54.05	54.09	85.20	635	809
	60.07	59.07	59.10	91.00	649	865
	65.06	64.06	64.09	96.12	667	974
	70.08	69.08	69.11	101.48	681	936
	75.07	74.07	74.10	106.60	695	974
	80.05	79.05	79.08	112.44	703	852
	85.07	84.07	84.09	117.66	715	961
	90.06	89.06	89.08	122.78	726	974
	95.08	94.08	94.10	127.84	736	992
	100.10	99.10	99.12	132.96	745	980

Shear Wave Source Offset - 2 ft

S-Wave Velocity from Surface = Travel Distance/S-Wave Arrival
Interval S-Wave Velocity = (Travel Dist2-Travel Dist1)/(Time2-Time1)

APPENDIX C

Laboratory Testing

APPENDIX C

LABORATORY TESTING

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

In-Place Moisture and Density Tests
The moisture content and dry density of relatively undisturbed samples obtained from the exploratory borings were evaluated in general accordance with ASTM D 2937. The test results are presented on the logs of the exploratory borings in Appendix A.

Gradation Analysis
Gradation analysis tests were performed on selected representative soil samples in general accordance with ASTM D 422. The grain-size distribution curves are shown on Figures C-1 and C-2. The test results were utilized in evaluating the soil classifications in accordance with the USCS.

200 Wash
An evaluation of the percentage of particles finer than the No. 200 sieve in selected samples was performed in general accordance with ASTM D 1140. The results of the tests are presented on Figure C-3.

Atterberg Limits
Tests were performed on a selected representative fine-grained soil sample to evaluate the liquid limit, plastic limit, and plasticity index in general accordance with ASTM D 4318. The test results were utilized to evaluate the soil classification in accordance with the USCS. The test results and classification are shown on Figure C-4.

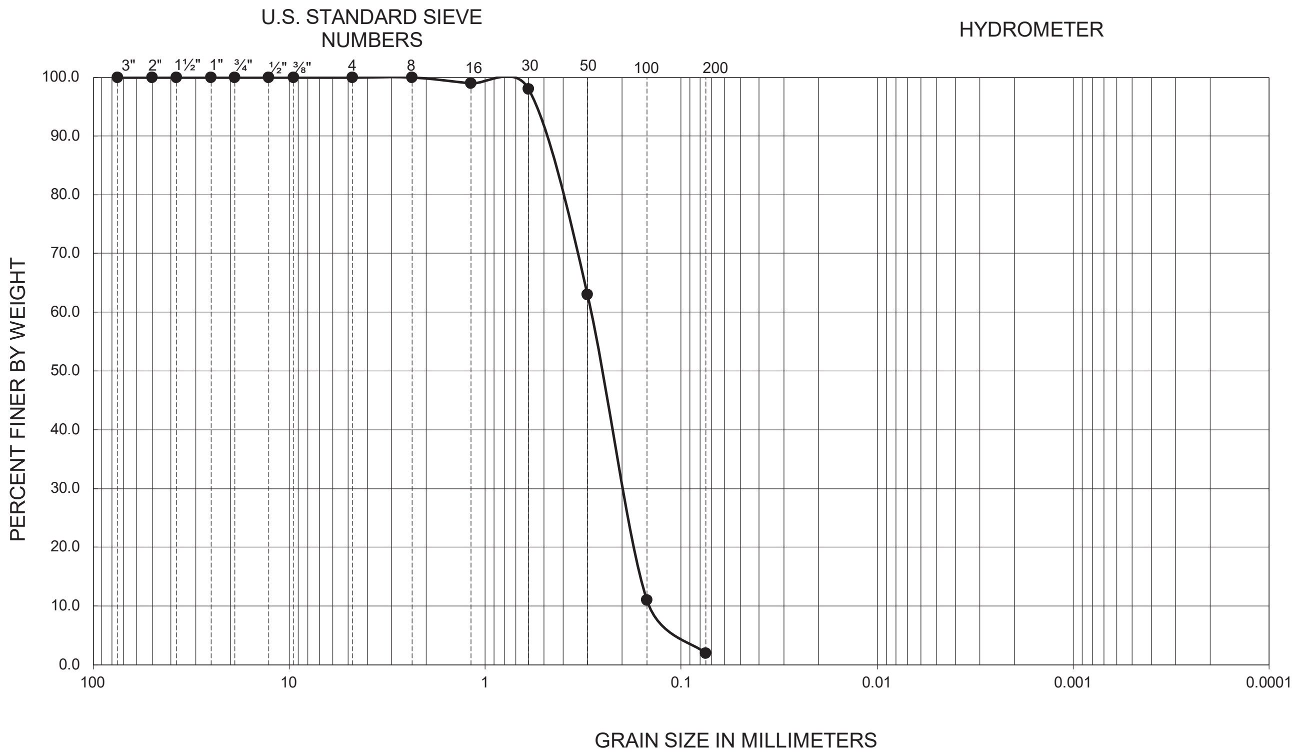
Consolidation Test
A consolidation test was performed on a selected relatively undisturbed soil sample in general accordance with ASTM D 2435. The sample was inundated during testing to represent adverse field conditions. The percent of consolidation for each load cycle was recorded as a ratio of the amount of vertical compression to the original height of the sample. The results of the test are summarized on Figure C-5.

Direct Shear Test
A direct shear test was performed on a relatively undisturbed sample in general accordance with ASTM D 3080 to evaluate the shear strength characteristics of the selected material. The sample was inundated during shearing to represent adverse field conditions. The results are shown on Figure C-6.

Soil Corrosivity Tests
Soil pH and minimum resistivity tests were performed on a representative soil sample in general accordance with CT 643. The chloride content of the selected sample was evaluated in general accordance with CT 422. The sulfate content of the selected sample was evaluated in general accordance with CT 417. The test results are presented on Figure C-7.

R-Value
The resistance value, or R-value, for site soils was evaluated in general accordance with CT 301. A sample was prepared and evaluated for exudation pressure and expansion pressure. The equilibrium R-value is reported as the lesser or more conservative of the two calculated results. The test result is shown on Figure C-8.

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	B-1	5.0-6.5	--	--	--	0.14	0.20	0.29	2.1	1.0	2	SP

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 6913

FIGURE C-1

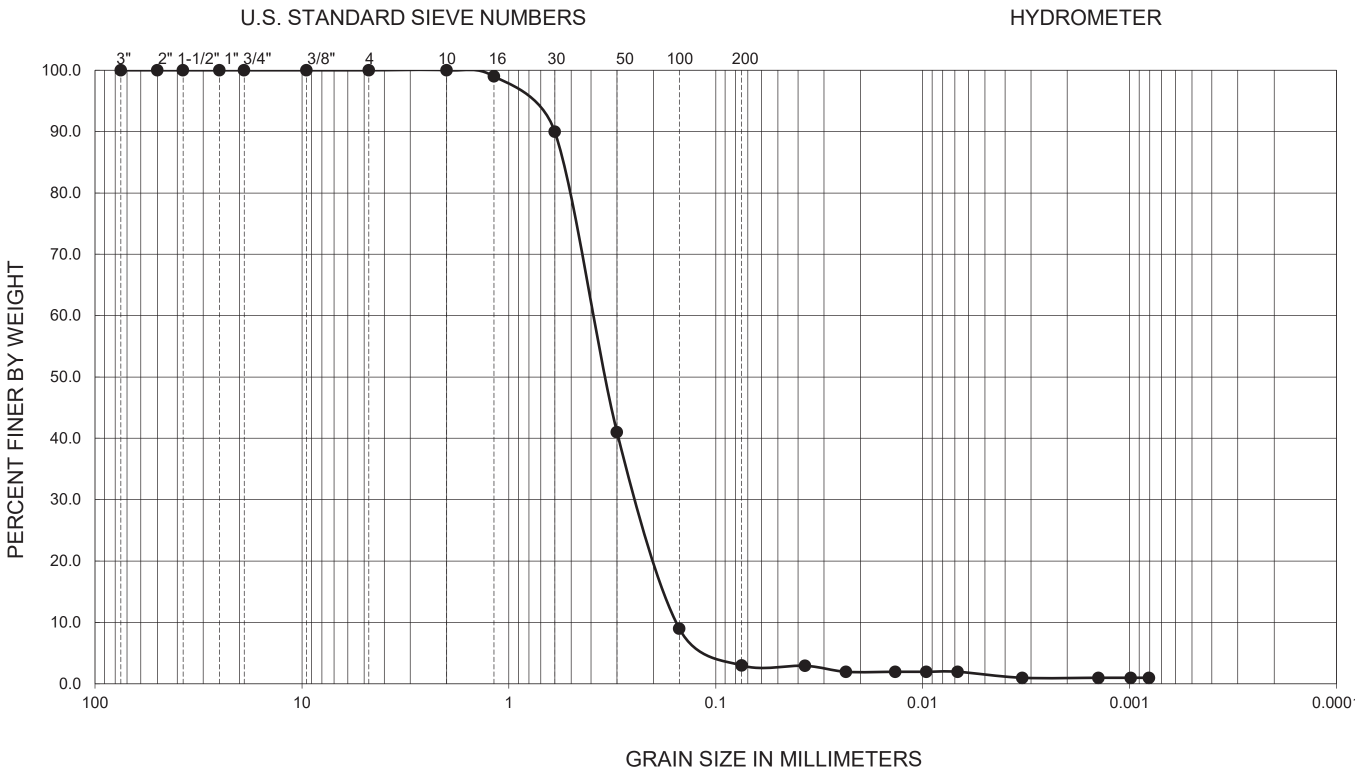
GRADATION TEST RESULTS

CARL E. GILBERT ELEMENTARY SCHOOL TK/PK CLASSROOMS
BUENA PARK, CALIFORNIA

212502001 | 2/24

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	USCS
●	B-2	5.0-6.5	--	--	--	0.160	0.250	0.390	2.4	1.0	3	SP

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 6913

FIGURE C-2

GRADATION TEST RESULTS

CARL E. GILBERT ELEMENTARY SCHOOL TK/PK CLASSROOMS
BUENA PARK, CALIFORNIA

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

SAMPLE LOCATION	SAMPLE DEPTH (ft)	DESCRIPTION	PERCENT PASSING NO. 4	PERCENT PASSING NO. 200	USCS (TOTAL SAMPLE)
B-1	15.0-16.5	CLAYEY SAND	100	26	SC
B-1	25.0-26.5	SILTY SAND	100	22	SM
B-1	35.0-36.5	SANDY LEAN CLAY	100	50	CL
B-2	0.0-3.0	CLAYEY SAND	100	35	SC

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 1140

FIGURE C-3

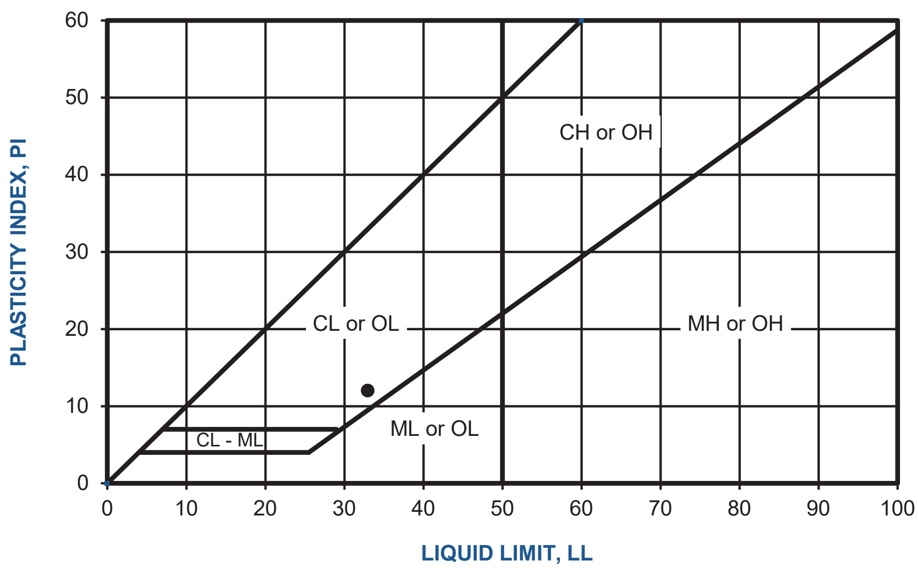
NO. 200 SIEVE ANALYSIS TEST RESULTS

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

CARL E. GILBERT ELEMENTARY SCHOOL TK/PK CLASSROOMS
BUENA PARK, CALIFORNIA

212502001 | 2/24

SYMBOL	LOCATION	DEPTH (ft)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	USCS CLASSIFICATION (Fraction Finer Than No. 40 Sieve)	USCS
●	B-1	35.0-36.5	33	21	12	CL	CL



PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 4318

FIGURE C-4

ATTERBERG LIMITS TEST RESULTS

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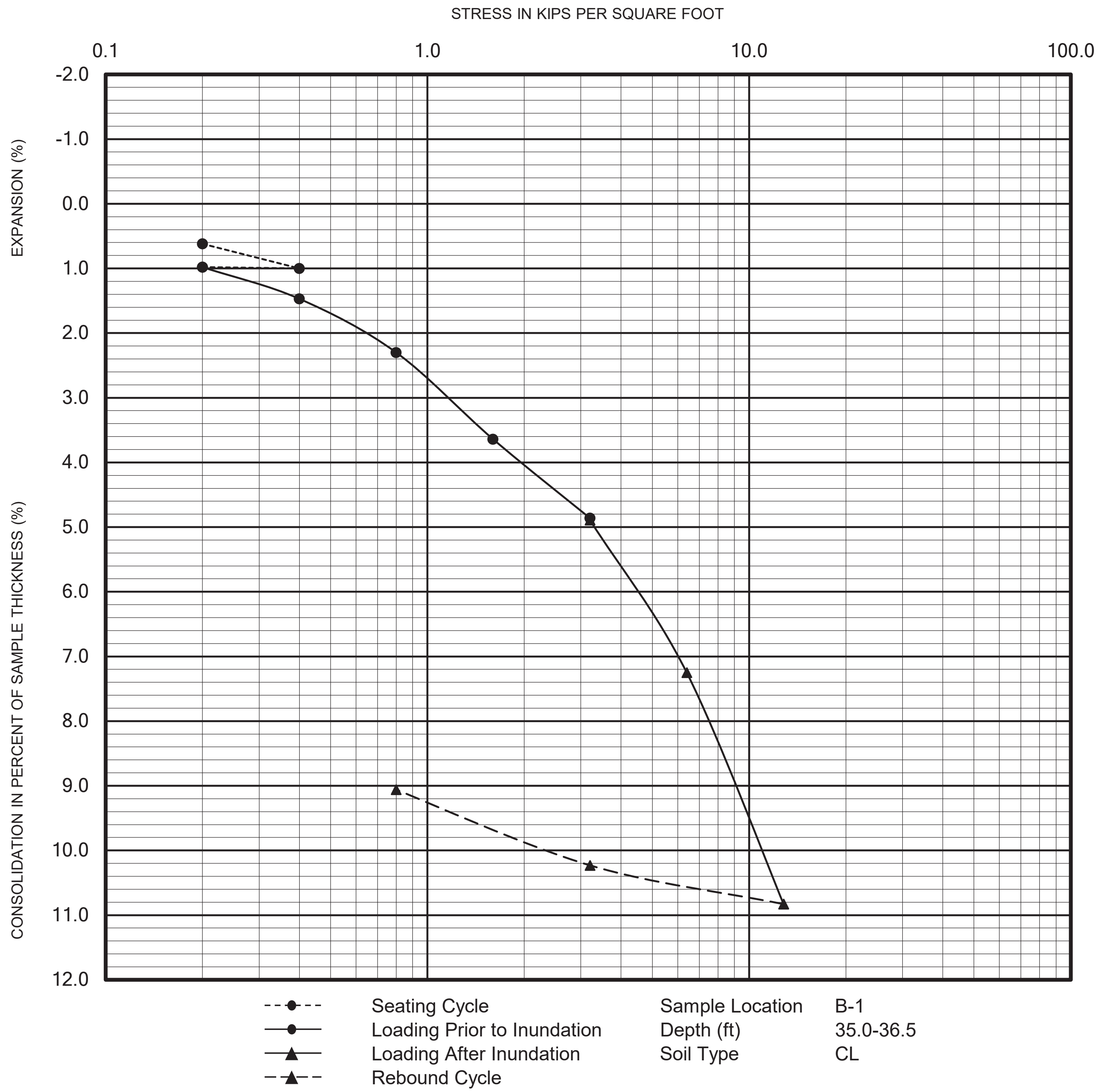
Geotechnical & Environmental Sciences Consultants

CARL E. GILBERT ELEMENTARY SCHOOL TK/PK CLASSROOMS
BUENA PARK, CALIFORNIA

212502001 | 2/24



Sample Location	B-1
Depth (ft)	35.0-36.5
Soil Type	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2435

FIGURE C-5

CONSOLIDATION TEST RESULTS

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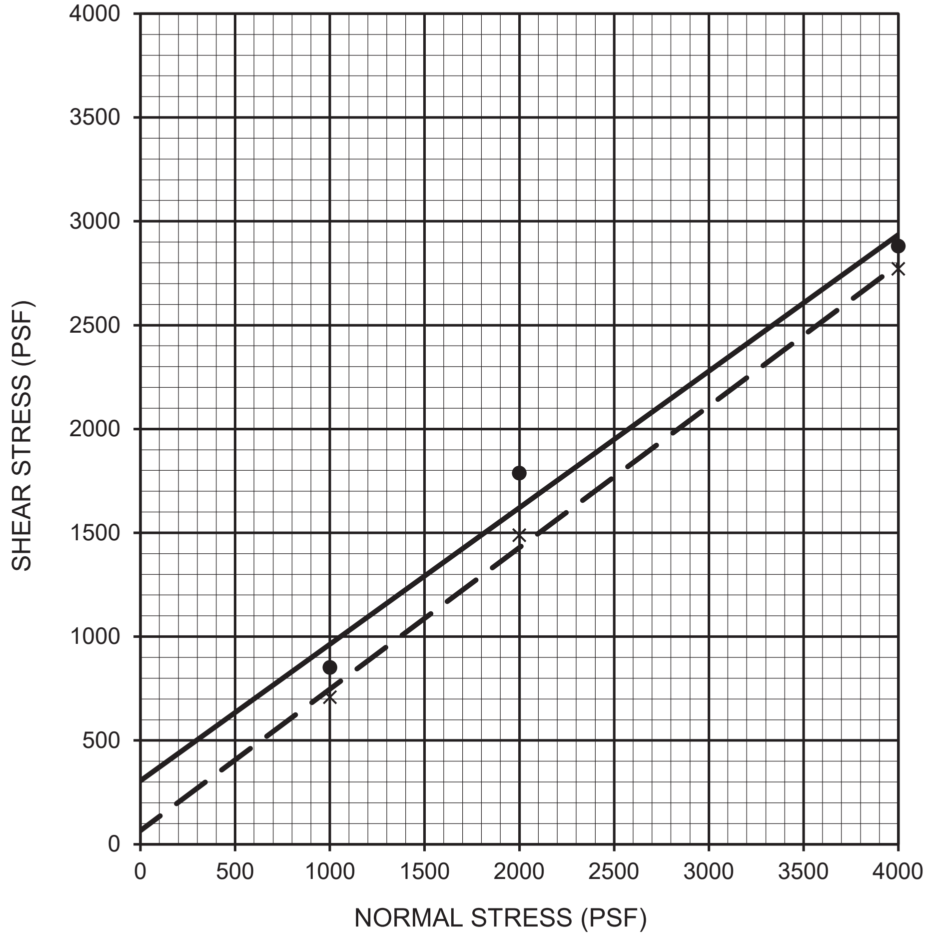
CARL E. GILBERT ELEMENTARY SCHOOL TK/PK CLASSROOMS
BUENA PARK, CALIFORNIA

212502001 | 2/24



Description	Symbol	Sample Location	Depth (ft)	Shear Strength	Cohesion (psf)	Friction Angle (degrees)	Soil Type
POORLY GRADED SAND	—●—	B-1	5.0-6.5	Peak	306	33	SP
POORLY GRADED SAND	– – X – –	B-1	5.0-6.5	Ultimate	66	34	SP

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 3080

FIGURE C-6

DIRECT SHEAR TEST RESULTS

CARL E. GILBERT ELEMENTARY SCHOOL TK/PK CLASSROOMS
BUENA PARK, CALIFORNIA

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SAMPLE LOCATION	SAMPLE DEPTH (ft)	pH [1]	RESISTIVITY [1] (ohm-cm)	SULFATE CONTENT [2]		CHLORIDE CONTENT [3] (ppm)
				(ppm)	(%)	
B-1	0.0-2.5	8.3	1,267	30	0.003	45

[1] PERFORMED IN GENERAL ACCORDANCE WITH CALIFORNIA TEST METHOD 643
[2] PERFORMED IN GENERAL ACCORDANCE WITH CALIFORNIA TEST METHOD 417
[3] PERFORMED IN GENERAL ACCORDANCE WITH CALIFORNIA TEST METHOD 422

FIGURE C-7

CORROSIVITY TEST RESULTS

CARL E. GILBERT ELEMENTARY SCHOOL TK/PK CLASSROOMS
BUENA PARK, CALIFORNIA

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

SAMPLE LOCATION	SAMPLE DEPTH (ft)	SOIL TYPE	R-VALUE
B-2	0.0-3.0	SC	45

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2844/CT 301

R-VALUE TEST RESULTS

CARL E. GILBERT ELEMENTARY SCHOOL TK/PK CLASSROOMS
BUENA PARK, CALIFORNIA

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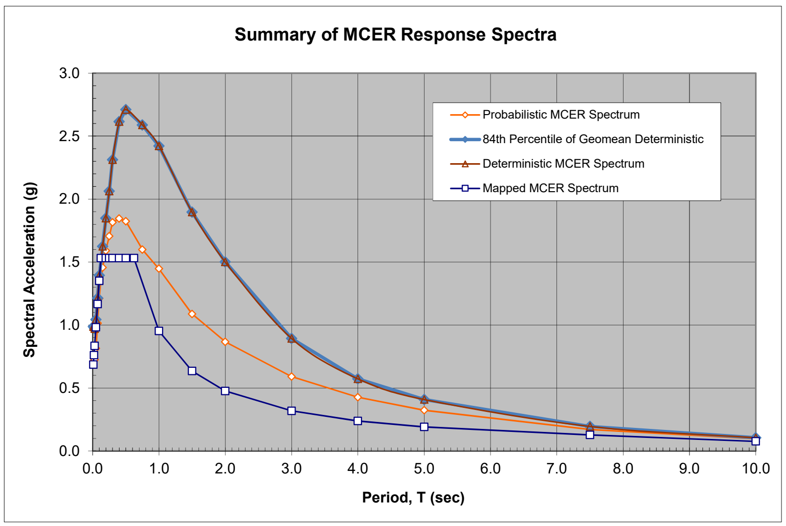
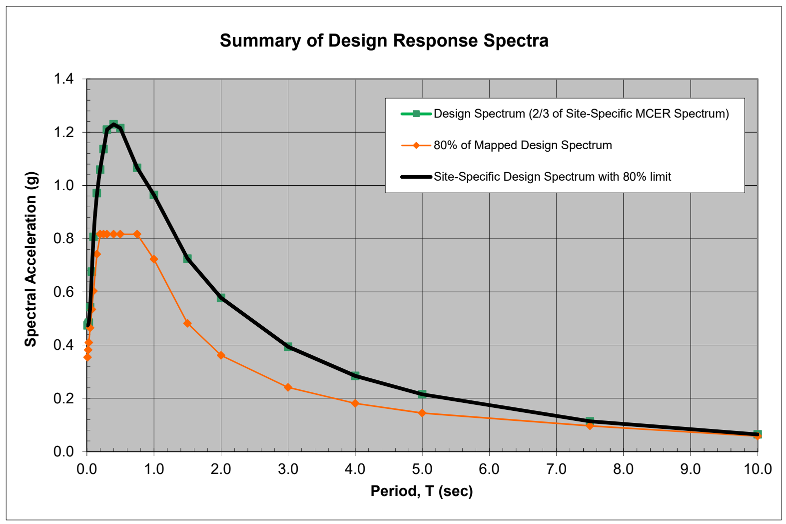
APPENDIX D

Site-Specific Ground Motion Hazard Analysis

Site Class	Mapped Spectral Response Acceleration Parameters		Site Coefficients		Spectral Response Acceleration Parameters Adjusted for		Design Spectral Response Acceleration Parameters		Period			Vs30 (m/sec)	Risk Coefficients			PGA		Site-Specific MCE_G PGA
	Ss (g)	S1 (g)	Fa	Fv	Sms (g)	Sm1 (g)	Sds (g)	Sd1 (g)	To (sec)	Ts (sec)	TL (sec)		C_{RS}	C_{R1}	Ratio	F_{PGA}	PGA_M (g)	PGA_M (g)
D	1.531	0.542	1.000	1.758	1.531	0.953	1.021	0.635	0.124	0.622	8.0	241	0.911	0.91	-0.00125	1.1	0.719	0.709

Mapped Design Response Spectrum (Fa and Fv per Section 11.4 of ASCE 7 -16)		Mapped MCE_R Response Spectrum (Fa and Fv per Section 11.4 of ASCE 7 -16)	Period (sec)	Probabilistic MCE_R Response Spectrum				Deterministic MCE_R Response Spectrum				Site-Specific MCE_R Response Spectrum	Site-Specific MCE_R Response Spectrum - 150% Limit of Design	Mapped Design Response Spectrum (Fa and Fv per Section 21.3 of ASCE 7-16)	80% of Mapped Design Response Spectrum (Fa and Fv per Section 21.3 of ASCE 7-16)	Site-Specific Design Response Spectrum	Site-Specific Design Response Spectrum with 80% Limit
				Geomean 2% in 50 Years	Max Horiz Direction Response to Geomean	Geomean 2% in 50 Years Rotated	1% Chance of Collapse in 50 Years (Method 1)	84th Percentile of Geomean	Max Horiz Direction Response to Geomean	84th Percentile of Geomean Rotated	Deterministic Limit on Response Spectrum						
Period (sec)	Sa (g)	Sa (g)		Sa (g)	Max/Mean	Sa (g)	Sa (g)	Sa (g)	Max/Mean	Sa (g)	Sa (g)	Sa (g)	Sa (g)	Sa (g)	Sa (g)	Sa (g)	Sa (g)
0.01	0.457	0.686	0.01	0.709	1.100	0.780	0.710	0.897	1.100	0.986	0.986	0.710	0.710	0.443	0.354	0.474	**0.474**
0.02	0.507	0.760	0.02	0.714	1.100	0.786	0.716	0.895	1.100	0.985	0.985	0.716	0.716	0.477	0.382	0.477	**0.477**
0.03	0.556	0.834	0.03	0.725	1.100	0.797	0.726	0.883	1.100	0.971	0.971	0.726	0.726	0.512	0.410	0.484	**0.484**
0.05	0.654	0.981	0.05	0.812	1.100	0.893	0.814	0.948	1.100	1.043	1.043	0.814	0.814	0.581	0.465	0.543	**0.543**
0.075	0.777	1.166	0.075	1.012	1.100	1.113	1.014	1.103	1.100	1.213	1.213	1.014	1.014	0.668	0.534	0.676	**0.676**
0.1	0.900	1.350	0.1	1.208	1.100	1.328	1.210	1.267	1.100	1.393	1.393	1.210	1.210	0.754	0.603	0.807	**0.807**
0.124	1.021	1.531	0.15	1.453	1.100	1.599	1.456	1.476	1.100	1.623	1.623	1.456	1.456	0.927	0.742	0.971	**0.971**
0.2	1.021	1.531	0.2	1.586	1.100	1.744	1.589	1.680	1.100	1.848	1.848	1.589	1.589	1.021	0.817	1.059	**1.059**
0.25	1.021	1.531	0.25	1.682	1.113	1.871	1.705	1.854	1.113	2.063	2.063	1.705	1.705	1.021	0.817	1.137	**1.137**
0.3	1.021	1.531	0.3	1.771	1.125	1.992	1.815	2.055	1.125	2.312	2.312	1.815	1.815	1.021	0.817	1.210	**1.210**
0.4	1.021	1.531	0.4	1.761	1.150	2.026	1.845	2.274	1.150	2.615	2.615	1.845	1.845	1.021	0.817	1.230	**1.230**
0.5	1.021	1.531	0.5	1.704	1.175	2.002	1.823	2.307	1.175	2.710	2.710	1.823	1.823	1.021	0.817	1.215	**1.215**
0.622	1.021	1.531	0.75	1.420	1.238	1.757	1.599	2.091	1.238	2.588	2.588	1.599	1.599	1.021	0.817	1.066	**1.066**
1	0.635	0.953	1	1.223	1.300	1.590	1.447	1.863	1.300	2.421	2.421	1.447	1.447	0.903	0.723	0.965	**0.965**
1.5	0.423	0.635	1.5	0.902	1.325	1.195	1.087	1.431	1.325	1.896	1.896	1.087	1.087	0.602	0.482	0.725	**0.725**
2	0.318	0.476	2	0.705	1.350	0.951	0.866	1.112	1.350	1.501	1.501	0.866	0.866	0.452	0.361	0.577	**0.577**
3	0.212	0.318	3	0.464	1.400	0.649	0.591	0.637	1.400	0.892	0.892	0.591	0.591	0.301	0.241	0.394	**0.394**
4	0.159	0.238	4	0.323	1.450	0.468	0.426	0.395	1.450	0.573	0.573	0.426	0.426	0.226	0.181	0.284	**0.284**
5	0.127	0.191	5	0.236	1.500	0.355	0.323	0.272	1.500	0.408	0.408	0.323	0.323	0.181	0.145	0.215	**0.215**
7.5	0.085	0.127	7.5	0.125	1.500	0.187	0.170	0.130	1.500	0.194	0.194	0.170	0.170	0.120	0.096	0.113	**0.113**
10	0.051	0.076	10	0.071	1.500	0.106	0.097	0.070	1.500	0.105	0.105	0.097	0.097	0.072	0.058	0.064	**0.064**





Deterministic Seismic Hazard Analysis Input	
Compton	
M_W:	7.5
R_{RUP} (km):	11.5
R_{JB} (km):	0.0
R_X (km):	19.5
Ry0 (km):	999
V_{S30} (m/sec):	241
U:	0
F_{RV}:	1
F_{NM}:	0
F_{HW}:	1
Dip (deg):	20
Z_{TOR} (km):	5.2
Z_{HYP} (km):	999
$Z_{1.0}$ (km):	0.75
$Z_{2.5}$ (km):	3.7
W (km):	30.4
Vs30Flag:	measured
F_{AS}:	no
Region	California
Weight of Ground Motion Prediction Equations	
Chiou & Youngs (2014)	0.25
Campbell & Bozorgnia (2014)	0.25
Boore et al. (2014)	0.25
Abrahamson et al. (2014)	0.25

Paste the results from Site Specific GM_NGA_Models here

Geometric Mean of Deterministic Seismic Hazard Analysis Output (84th Percentile)

Period (sec)	S_a (g)
0.01	0.897
0.02	0.895
0.03	0.883
0.05	0.948
0.075	1.103
0.1	1.267
0.15	1.476
0.2	1.680
0.25	1.854
0.3	2.055
0.4	2.274
0.5	2.307
0.75	2.091
1	1.863
1.5	1.431
2	1.112
3	0.637
4	0.395
5	0.272
7.5	0.130
10	0.070

Chiou & Youngs (2014)		Campbell & Bozorgnia (2014)		Boore et al. (2014)		Abrahamson et al. (2014)	
Site Param List:		**Site Param List:**		**Site Param List:**		**Site Param List:**	
Longitude	-118.00825	Longitude	-118.00825	Longitude	-118.00825	Longitude	-118.00825
Latitude	33.867589	Latitude	33.867589	Latitude	33.867589	Latitude	33.867589
Vs30	241	Vs30	241	Vs30	241	Vs30	241
Vs30 Type	Measured	Vs30 Type	Measured	Vs30 Type	Measured	Vs30 Type	Measured
Depth 1.0 km/sec (m)	750	Depth 1.0 km/sec (m)	750	Depth 1.0 km/sec (m)	750	Depth 1.0 km/sec (m)	750
Depth 2.5 km/sec (km)	3.7	Depth 2.5 km/sec (km)	3.7	Depth 2.5 km/sec (km)	3.7	Depth 2.5 km/sec (km)	3.7

IMR Param List:	
Gaussian Truncation	None
Tectonic Region	Active Shallow Crust
Component	RotD50
Std Dev Type	Total
Additional Epistemic Uncertainty	(Disabled)
IML/Prob Param List:	
Map Type	IML@Prob
Probability	0.02
Forecast Param List:	
Eqk Rup Forecast	Mean UCERF3
Mean UCERF3 Presets	(POISSON ONLY) Both FM Branch Averaged
Apply Aftershock Filter	False
Aleatory Mag-Area StdDev	0
Background Seismicity	Include
Treat Background Seismicity As	Point Sources
Use Quad Surfaces (otherwise gridded)	False
Fault Grid Spacing	1
Probability Model	Poisson
Sect Upper Depth Averaging Tolerance (km)	100
Use Mean Upper Depth	True
Rup Mag Averaging Tolerance	1
Rupture Rake To Use	Def. Model Mean
Fault Model(s)	Both
Ignore Cache	FALSE
TimeSpan Param List:	
Duration (Years)	50

Probabilistic Seismic Hazard Analysis (2% in 50 years)							
Chiou & Youngs (2014)		Campbell & Bozorgnia (2014)		Boore et al. (2014)		Abrahamson et al. (2014)	
Period (sec)	S_a (g)	Period (sec)	S_a (g)	Period (sec)	S_a (g)	Period (sec)	S_a (g)
0.01	0.726	0.01	0.567	0.01	0.816	0.01	0.751
0.02	0.733	0.02	0.572	0.02	0.828	0.02	0.749
0.03	0.756	0.03	0.591	0.03	0.857	0.03	0.721
0.05	0.827	0.05	0.671	0.05	1.041	0.05	0.753
0.075	0.988	0.075	0.876	0.075	1.400	0.075	0.867
0.1	1.151	0.1	1.070	0.1	1.668	0.1	1.035
0.15	1.399	0.15	1.236	0.15	1.815	0.15	1.421
0.2	1.631	0.2	1.317	0.2	1.722	0.2	1.711
0.25	1.795	0.25	1.421	0.25	1.655	0.25	1.897
0.3	1.873	0.3	1.575	0.3	1.648	0.3	2.023
0.4	1.883	0.4	1.614	0.4	1.536	0.4	2.061
0.5	1.834	0.5	1.617	0.5	1.467	0.5	1.937
0.75	1.559	0.75	1.465	0.75	1.187	0.75	1.497
1	1.308	1	1.225	1	1.150	1	1.214
1.5	0.947	1.5	0.891	1.5	0.874	1.5	0.897
2	0.742	2	0.686	2	0.730	2	0.664
3	0.451	3	0.450	3	0.536	3	0.424
4	0.280	4	0.301	4	0.420	4	0.307
5	0.179	5	0.215	5	0.338	5	0.240
7.5	0.076	7.5	0.101	7.5	0.204	7.5	0.155
10	0.040	10	0.050	10	0.117	10	0.107

ATC Hazards by Location

Search Information

Coordinates:	33.867589, -118.008246
Elevation:	61 ft
Timestamp:	2024-01-25T23:25:56.574Z
Hazard Type:	Seismic
Reference Document:	ASCE7-16
Risk Category:	II
Site Class:	D

Basic Parameters

Name	Value	Description
S_S	1.531	MCE_R ground motion (period=0.2s)
S_1	0.542	MCE_R ground motion (period=1.0s)
S_{MS}	1.531	Site-modified spectral acceleration value
S_{M1}	0.953 * null	Site-modified spectral acceleration value
S_{DS}	1.021	Numeric seismic design value at 0.2s SA
S_{D1}	0.542 * null	Numeric seismic design value at 1.0s SA

* See Section 11.4.8

Additional Information

Name	Value	Description
SDC	* null	Seismic design category
F_a	1	Site amplification factor at 0.2s
F_v	1.758 * null	Site amplification factor at 1.0s
CR_S	0.911	Coefficient of risk (0.2s)
CR_1	0.91	Coefficient of risk (1.0s)
PGA	0.653	MCE_G peak ground acceleration
F_{PGA}	1.1	Site amplification factor at PGA
PGA_M	0.719	Site modified peak ground acceleration
T_L	8	Long-period transition period (s)
SsRT	1.531	Probabilistic risk-targeted ground motion (0.2s)
SsUH	1.681	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
SsD	2.424	Factored deterministic acceleration value (0.2s)
S1RT	0.542	Probabilistic risk-targeted ground motion (1.0s)
S1UH	0.595	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
S1D	0.813	Factored deterministic acceleration value (1.0s)
PGAd	0.978	Factored deterministic acceleration value (PGA)

* See Section 11.4.8

The results indicated here DO NOT reflect any state or local amendments to the values or any delineation lines made during the building code adoption process. Users should confirm any output obtained from this tool with the local Authority Having Jurisdiction before proceeding with design.

Please note that the ATC Hazards by Location website will not be updated to support ASCE 7-22. Find out why.

Disclaimer

Ninyo & Moore
Carl E. Gilbert Elementary School
Buena Park, CA

CPT Shear Wave Measurements

Location	Tip Depth (ft)	Geophone Depth (ft)	Travel Distance (ft)	S-Wave Arrival (msec)	S-Wave Velocity from Surface (ft/sec)	Interval S-Wave Velocity (ft/sec)	Ti= Di/Vi
CPT-1	5.02	4.02	4.49	7.78	577		#DIV/0!
	10.04	9.04	9.26	17.12	541	511	0.00934
	15.06	14.06	14.20	25.26	562	607	0.00814
	20.08	19.08	19.18	35.44	541	489	0.01018
	25.07	24.07	24.15	43.44	556	621	0.008
	30.02	29.02	29.09	50.52	576	697	0.00708
	35.04	34.04	34.10	58.44	583	633	0.00792
	40.12	39.12	39.17	65.84	595	685	0.0074
	45.08	44.08	44.13	72.84	606	708	0.007
	50.03	49.03	49.07	79.00	621	803	0.00616
	55.05	54.05	54.09	85.20	635	809	0.0062
	60.07	59.07	59.10	91.00	649	865	0.0058
	65.06	64.06	64.09	96.12	667	974	0.00512
	70.08	69.08	69.11	101.48	681	936	0.00536
	75.07	74.07	74.10	106.60	695	974	0.00512
	80.05	79.05	79.08	112.44	703	852	0.00584
	85.07	84.07	84.09	117.66	715	961	0.00522
	90.06	89.06	89.08	122.78	726	974	0.00512
	95.08	94.08	94.10	127.84	736	992	0.00506
	100.10	99.10	99.12	132.96	745	980	0.00512
						Sum	0.12518
						Vs, avg.	791.8 ft/s 241.3 m/s

Shear Wave Source Offset - 2 ft

S-Wave Velocity from Surface = Travel Distance/S-Wave Arrival
Interval S-Wave Velocity = (Travel Dist2-Travel Dist1)/(Time2-Time1)

Site data for Location: 33.867589, -118.008246

Source: CGS/Wills VS30 Map (2015)
Type: Vs30
Type Flag: Inferred
Value: 228.2

Source: Thompson VS30 Map (2018)
Type: Vs30
Type Flag: Inferred
Value: 228.2

Source: CGS/Wills Site Classification Map (2006)
Type: Vs30
Type Flag: Inferred
Value: 280.0

Source: Global Vs30 from Topographic Slope (Wald & Allen 2008)
Type: Vs30
Type Flag: Inferred
Value: 216.15733357379213

Source: SCEC Community Velocity Model Version 4, Iteration 26, Basin Depth
Type: Depth to Vs = 2.5 km/sec
Type Flag: Inferred
Value: 3.7

Source: SCEC Community Velocity Model Version 4, Iteration 26, Basin Depth
Type: Depth to Vs = 1.0 km/sec
Type Flag: Inferred
Value: 0.75

Source: SCEC CCA, Iteration 6, Basin Depth
Type: Depth to Vs = 2.5 km/sec
Type Flag: Inferred
Value: NaN

Source: SCEC CCA, Iteration 6, Basin Depth
Type: Depth to Vs = 1.0 km/sec
Type Flag: Inferred
Value: NaN

Source: SCEC Community Velocity Model Version 4 Basin Depth
Type: Depth to Vs = 2.5 km/sec
Type Flag: Inferred
Value: 3.740378662109375

Source: SCEC Community Velocity Model Version 4 Basin Depth
Type: Depth to Vs = 1.0 km/sec
Type Flag: Inferred
Value: 0.7142999267578125

Source: SCEC/Harvard Community Velocity Model Version 11.9.x Basin Depth

Type: Depth to Vs = 2.5 km/sec
Type Flag: Inferred
Value: 4.58

Source: SCEC/Harvard Community Velocity Model Version 11.9.x Basin Depth
Type: Depth to Vs = 1.0 km/sec
Type Flag: Inferred
Value: 0.78

Source: SCEC CCA, Iteration 6, Basin Depth
Type: Depth to Vs = 2.5 km/sec
Type Flag: Inferred
Value: NaN

Source: SCEC CCA, Iteration 6, Basin Depth
Type: Depth to Vs = 1.0 km/sec
Type Flag: Inferred
Value: NaN

Source: USGS Bay Area Velocity Model Release 8.3.0
Type: Depth to Vs = 2.5 km/sec
Type Flag: Inferred
Value: NaN

Source: USGS Bay Area Velocity Model Release 8.3.0
Type: Depth to Vs = 1.0 km/sec
Type Flag: Inferred
Value: NaN

U.S. Geological Survey - Earthquake Hazards Program

Unified Hazard Tool

Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the U.S. Seismic Design Maps web tools (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

Please also see the new USGS Earthquake Hazard Toolbox for access to the most recent NSHMs for the conterminous U.S. and Hawaii.

Input

Edition

Dynamic: Conterminous U.S. 2014 (update) (4.2.0)

Latitude

Decimal degrees

33.867589

Longitude

Decimal degrees, negative values for western longitudes

-118.008246

Site Class

259 m/s (Site class D)

Spectral Period

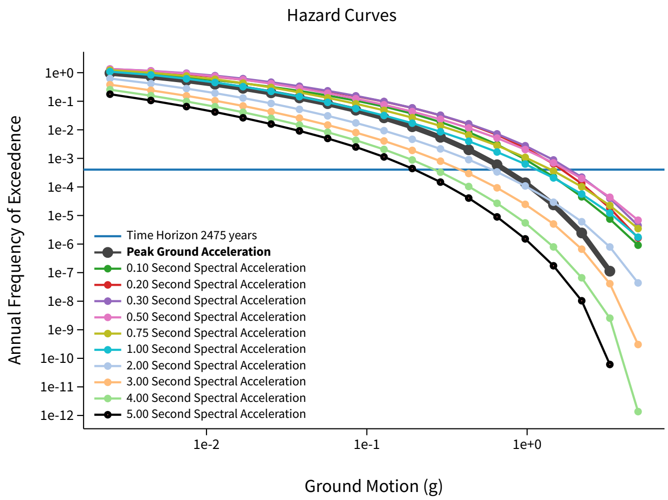
Peak Ground Acceleration

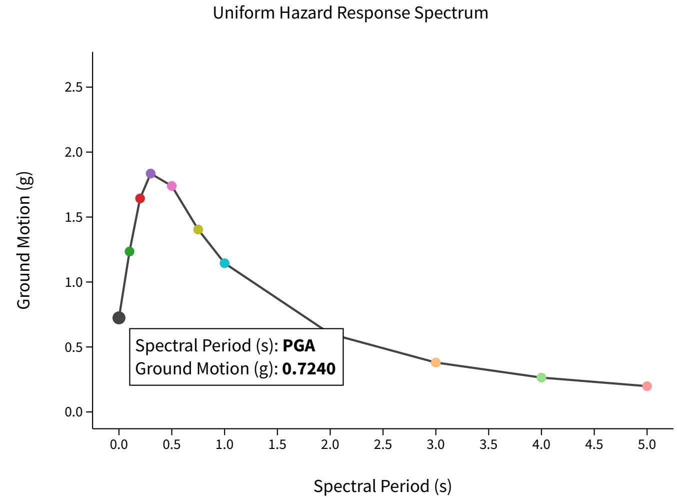
Time Horizon

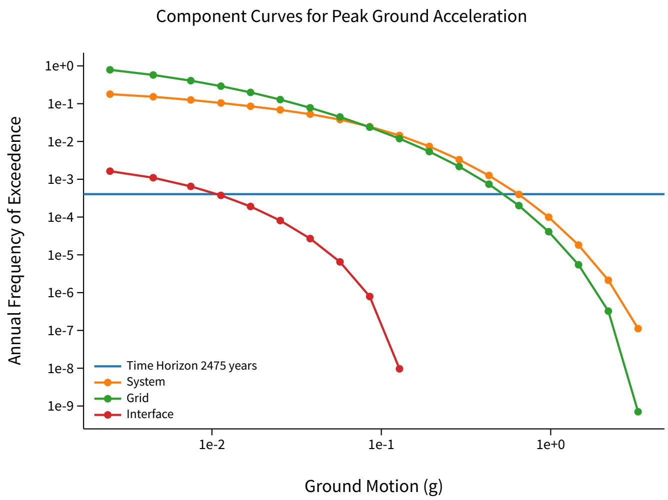
Return period in years

2475

Hazard Curve





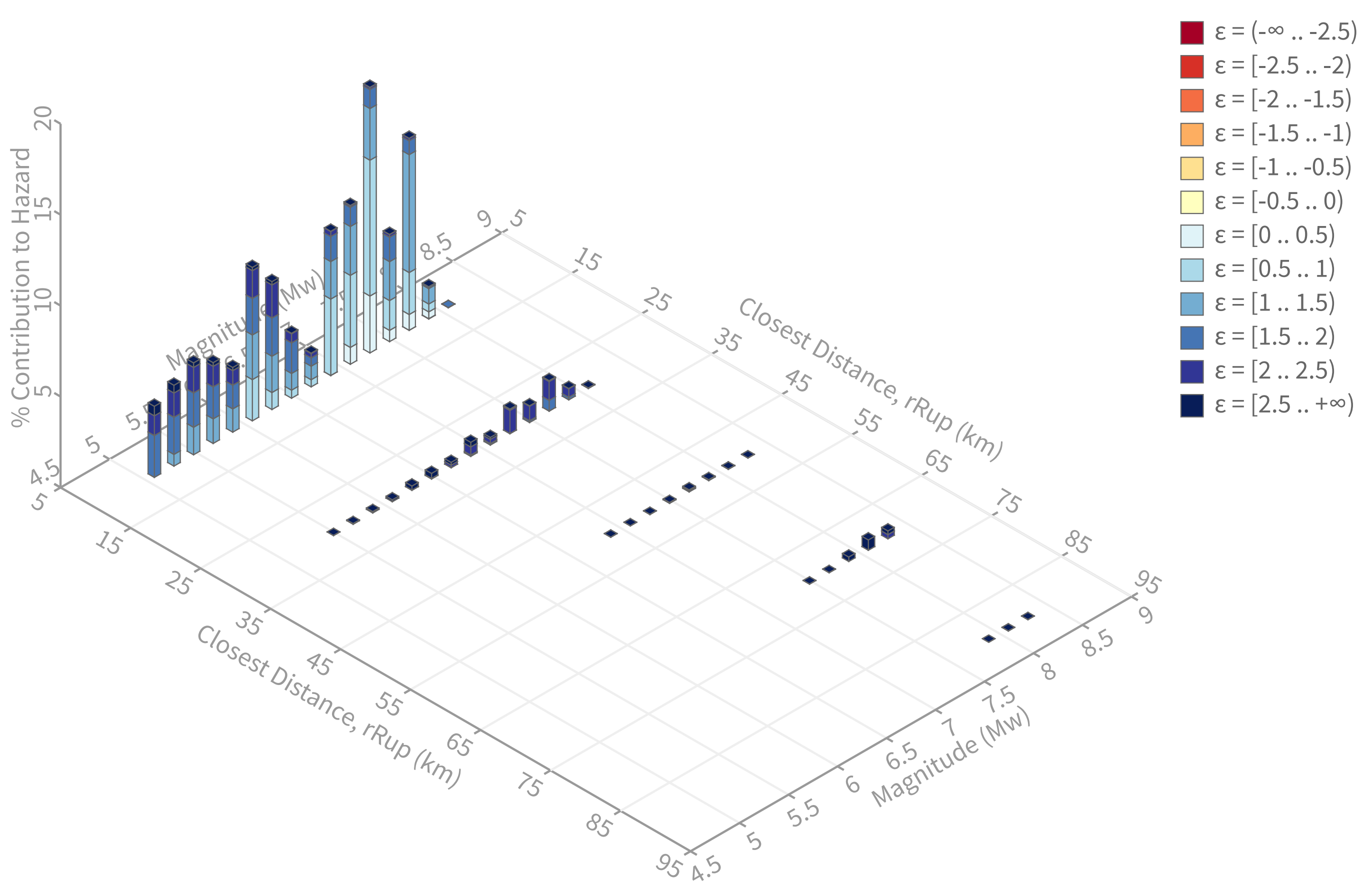


View Raw Data

^ Deaggregation

Component

Total



Summary statistics for, Deaggregation: Total

Deaggregation targets

Return period: 2475 yrs
Exceedance rate: 0.0004040404 yr^{-1}
PGA ground motion: 0.7239539 g

Recovered targets

Return period: 2927.3428 yrs
Exceedance rate: 0.00034160673 yr^{-1}

Totals

Binned: 100 %
Residual: 0 %
Trace: 0.08 %

Mean (over all sources)

m: 6.73
r: 11.72 km
ε_0: 1.38 σ

Mode (largest m-r bin)

m: 7.3
r: 10.29 km
ε_0: 0.78 σ
Contribution: 14.6 %

Mode (largest m-r-ε_0 bin)

m: 7.3
r: 9.56 km
ε_0: 0.66 σ
Contribution: 7.47 %

Discretization

r: min = 0.0, max = 1000.0, Δ = 20.0 km
m: min = 4.4, max = 9.4, Δ = 0.2
ε: min = -3.0, max = 3.0, Δ = 0.5 σ

Epsilon keys

ε0: [-∞ .. -2.5)
ε1: [-2.5 .. -2.0)
ε2: [-2.0 .. -1.5)
ε3: [-1.5 .. -1.0)
ε4: [-1.0 .. -0.5)
ε5: [-0.5 .. 0.0)
ε6: [0.0 .. 0.5)
ε7: [0.5 .. 1.0)
ε8: [1.0 .. 1.5)
ε9: [1.5 .. 2.0)
ε10: [2.0 .. 2.5)
ε11: [2.5 .. +∞]

Deaggregation Contributors

Source Set ↳ Source	Type	r	m	ε_0	lon	lat	az	%
UC33brAvg_FM32	System							36.50
Puente Hills (Coyote Hills) [1]		5.70	7.25	0.88	117.994°W	33.902°N	18.54	8.74
Compton [0]		11.54	7.25	0.59	118.112°W	33.746°N	215.31	6.72
Puente Hills (Santa Fe Springs) [0]		10.06	7.30	1.32	118.033°W	33.948°N	345.49	3.46
Anaheim [2]		5.55	7.08	0.64	118.031°W	33.852°N	229.16	2.92
Whittier alt 2 [5]		11.82	7.10	1.62	117.963°W	33.966°N	20.91	2.20
Newport-Inglewood alt 2 [3]		15.04	7.50	1.52	118.110°W	33.763°N	218.79	2.18
Anaheim [1]		5.61	6.08	1.04	118.024°W	33.846°N	211.22	1.14
Puente Hills (LA) [0]		17.25	7.19	1.82	118.116°W	33.990°N	323.84	1.04
UC33brAvg_FM31	System							31.36
Compton [0]		11.54	7.21	0.60	118.112°W	33.746°N	215.31	6.40
Puente Hills [1]		10.41	7.37	1.23	118.010°W	33.945°N	359.11	4.94
Whittier alt 1 [6]		11.88	6.90	1.73	117.961°W	33.966°N	21.79	3.81
Newport-Inglewood alt 1 [3]		15.06	7.51	1.49	118.111°W	33.763°N	219.22	2.96
Anaheim [2]		5.55	7.03	0.66	118.031°W	33.852°N	229.16	2.88
Anaheim [1]		5.61	6.08	1.04	118.024°W	33.846°N	211.22	1.14
Peralta Hills [1]		11.59	7.05	1.63	117.885°W	33.854°N	97.63	1.03
UC33brAvg_FM32 (opt)	Grid							16.93
PointSourceFinite: -118.008, 33.899		6.19	5.64	1.42	118.008°W	33.899°N	0.00	4.05
PointSourceFinite: -118.008, 33.899		6.19	5.64	1.42	118.008°W	33.899°N	0.00	4.05
PointSourceFinite: -118.008, 33.935		8.73	5.71	1.78	118.008°W	33.935°N	0.00	1.29
PointSourceFinite: -118.008, 33.935		8.73	5.71	1.78	118.008°W	33.935°N	0.00	1.29
UC33brAvg_FM31 (opt)	Grid							15.21
PointSourceFinite: -118.008, 33.899		6.19	5.62	1.43	118.008°W	33.899°N	0.00	3.38
PointSourceFinite: -118.008, 33.899		6.19	5.62	1.43	118.008°W	33.899°N	0.00	3.38
PointSourceFinite: -118.008, 33.935		8.72	5.72	1.78	118.008°W	33.935°N	0.00	1.30
PointSourceFinite: -118.008, 33.935		8.72	5.72	1.78	118.008°W	33.935°N	0.00	1.30

APPENDIX E

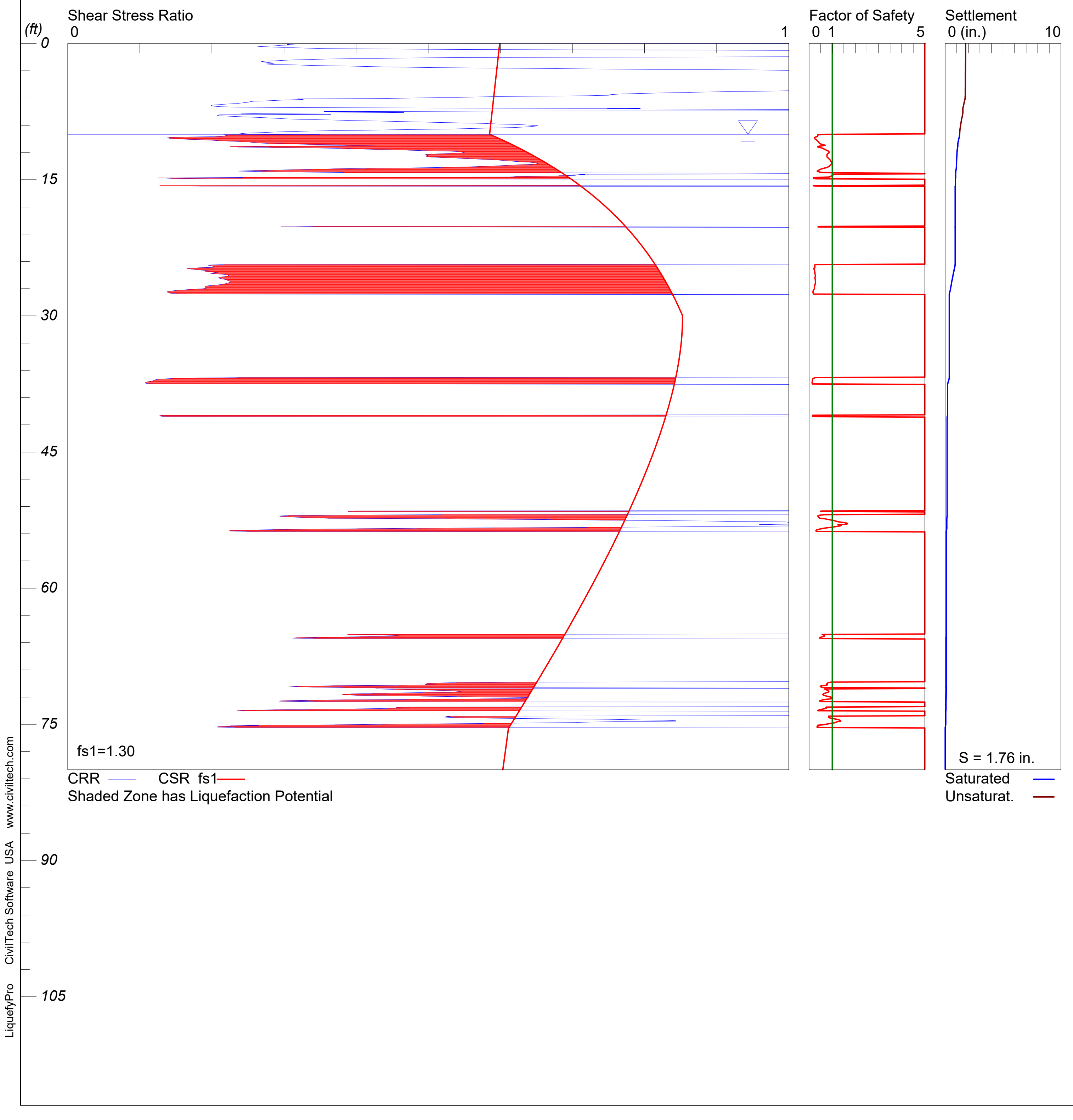
Liquefaction Analysis

LIQUEFACTION ANALYSIS

Carl E Gilbert ES

Hole No.=CPT-1 Water Depth=10 ft Surface Elev.=62

Magnitude=7.5
Acceleration=0.709g



****

LIQUEFACTION ANALYSIS CALCULATION DETAILS

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Font: Courier New, Regular, Size 8 is recommended for this report.

Licensed to , 1/26/2024 1:12:00 PM

Input File Name: G:\Projects\200000 - Irvine\212500 - 212549\212502\212502001\Electronic Project File\Data Analysis & Calculations\Liquefaction\CPT-1_liqpro.liq

Title: Carl E Gilbert ES

Subtitle: 212502001

Input Data:

Surface Elev.=62

Hole No.=CPT-1

Depth of Hole=80.00 ft

Water Table during Earthquake= 10.00 ft

Water Table during In-Situ Testing= 30.00 ft

Max. Acceleration=0.71 g

Earthquake Magnitude=7.50

No-Liquefiable Soils: Based on Analysis

1. CPT Calulation Method: Modify Robertson*
2. Settlement Analysis Method: Tokimatsu/Seed
3. Fines Correction for Liquefaction: Stark/Olson et al.*
4. Fine Correction for Settlement: During Liquefaction*
5. Settlement Calculation in: All zones*
9. User request factor of safety (apply to CSR) , User= 1.3
   Plot one CSR curve (fs1=User)
10. Average two input data between two Depths: Yes*

* Recommended Options

In-Situ Test Data:

Depth ft	qc atm	fs atm	Rf %	Gamma pcf	Fines %	D50 mm
0.00	1.30	0.09	7.15	120.00	*	0.50
2.85	68.84	1.19	1.73	120.00	*	0.50
6.36	63.21	0.66	1.04	120.00	*	0.50
10.03	51.80	1.02	1.97	120.00	*	0.50
13.19	155.10	1.36	0.88	120.00	*	0.50
16.36	23.03	0.77	3.33	120.00	*	0.50
20.02	31.61	1.06	3.35	120.00	*	0.50
23.42	21.99	1.47	6.69	120.00	*	0.50
26.98	66.59	1.37	2.06	120.00	*	0.50
31.02	12.47	0.25	2.04	120.00	*	0.50
34.92	12.04	0.33	2.77	120.00	*	0.50
38.76	15.67	0.56	3.59	120.00	*	0.50
42.67	18.36	0.55	3.02	120.00	*	0.50
46.39	16.71	0.49	2.96	120.00	*	0.50
50.29	26.06	1.37	5.24	120.00	*	0.50
54.16	37.15	0.83	2.24	120.00	*	0.50

58.41	43.82	1.93	4.40	120.00	*	0.50
62.52	24.59	1.33	5.39	120.00	*	0.50
66.47	40.18	1.69	4.21	120.00	*	0.50
70.36	126.90	4.87	3.84	120.00	*	0.50
74.64	336.80	4.36	1.30	120.00	*	0.50
78.83	27.02	0.93	3.43	120.00	*	0.50

* Modify Robertson method generates Fines from qc/fs. Inputted Fines are not relevant.

Output Results:

Calculation segment, dz=0.050 ft
User defined Print Interval, dp=1.00 ft

Peak Ground Acceleration (PGA), a_max = 0.71g

CSR Calculation:

Depth ft	gamma pcf	sigma atm	gamma' pcf	sigma' atm	rd	mZ g	a(z) g	CSR	x fs1	=CSRfs
0.00	120.00	0.000	120.00	0.000	1.00	0.000	0.709	0.46	1.30	0.60
1.00	120.00	0.057	120.00	0.057	1.00	0.000	0.709	0.46	1.30	0.60
2.00	120.00	0.113	120.00	0.113	1.00	0.000	0.709	0.46	1.30	0.60
3.00	120.00	0.170	120.00	0.170	0.99	0.000	0.709	0.46	1.30	0.59
4.00	120.00	0.227	120.00	0.227	0.99	0.000	0.709	0.46	1.30	0.59
5.00	120.00	0.284	120.00	0.284	0.99	0.000	0.709	0.46	1.30	0.59
6.00	120.00	0.340	120.00	0.340	0.99	0.000	0.709	0.45	1.30	0.59
7.00	120.00	0.397	120.00	0.397	0.98	0.000	0.709	0.45	1.30	0.59
8.00	120.00	0.454	120.00	0.454	0.98	0.000	0.709	0.45	1.30	0.59
9.00	120.00	0.510	120.00	0.510	0.98	0.000	0.709	0.45	1.30	0.59
10.00	120.00	0.567	57.60	0.567	0.98	0.000	0.709	0.45	1.30	0.59
11.00	120.00	0.624	57.60	0.594	0.97	0.000	0.709	0.47	1.30	0.61
12.00	120.00	0.680	57.60	0.622	0.97	0.000	0.709	0.49	1.30	0.64
13.00	120.00	0.737	57.60	0.649	0.97	0.000	0.709	0.51	1.30	0.66
14.00	120.00	0.794	57.60	0.676	0.97	0.000	0.709	0.52	1.30	0.68
15.00	120.00	0.851	57.60	0.703	0.97	0.000	0.709	0.54	1.30	0.70
16.00	120.00	0.907	57.60	0.730	0.96	0.000	0.709	0.55	1.30	0.72
17.00	120.00	0.964	57.60	0.758	0.96	0.000	0.709	0.56	1.30	0.73
18.00	120.00	1.021	57.60	0.785	0.96	0.000	0.709	0.57	1.30	0.75
19.00	120.00	1.077	57.60	0.812	0.96	0.000	0.709	0.58	1.30	0.76
20.00	120.00	1.134	57.60	0.839	0.95	0.000	0.709	0.59	1.30	0.77
21.00	120.00	1.191	57.60	0.866	0.95	0.000	0.709	0.60	1.30	0.78
22.00	120.00	1.248	57.60	0.894	0.95	0.000	0.709	0.61	1.30	0.79
23.00	120.00	1.304	57.60	0.921	0.95	0.000	0.709	0.62	1.30	0.80
24.00	120.00	1.361	57.60	0.948	0.94	0.000	0.709	0.62	1.30	0.81
25.00	120.00	1.418	57.60	0.975	0.94	0.000	0.709	0.63	1.30	0.82
26.00	120.00	1.474	57.60	1.003	0.94	0.000	0.709	0.64	1.30	0.83
27.00	120.00	1.531	57.60	1.030	0.94	0.000	0.709	0.64	1.30	0.83
28.00	120.00	1.588	57.60	1.057	0.93	0.000	0.709	0.65	1.30	0.84
29.00	120.00	1.644	57.60	1.084	0.93	0.000	0.709	0.65	1.30	0.85
30.00	120.00	1.701	57.60	1.111	0.93	0.000	0.709	0.66	1.30	0.85
31.00	120.00	1.758	57.60	1.139	0.92	0.000	0.709	0.66	1.30	0.85

32.00	120.00	1.815	57.60	1.166	0.91	0.000	0.709	0.66	1.30	0.85
33.00	120.00	1.871	57.60	1.193	0.91	0.000	0.709	0.65	1.30	0.85
34.00	120.00	1.928	57.60	1.220	0.90	0.000	0.709	0.65	1.30	0.85
35.00	120.00	1.985	57.60	1.248	0.89	0.000	0.709	0.65	1.30	0.85
36.00	120.00	2.041	57.60	1.275	0.88	0.000	0.709	0.65	1.30	0.85
37.00	120.00	2.098	57.60	1.302	0.87	0.000	0.709	0.65	1.30	0.84
38.00	120.00	2.155	57.60	1.329	0.86	0.000	0.709	0.65	1.30	0.84
39.00	120.00	2.212	57.60	1.356	0.86	0.000	0.709	0.64	1.30	0.84
40.00	120.00	2.268	57.60	1.384	0.85	0.000	0.709	0.64	1.30	0.83
41.00	120.00	2.325	57.60	1.411	0.84	0.000	0.709	0.64	1.30	0.83
42.00	120.00	2.382	57.60	1.438	0.83	0.000	0.709	0.64	1.30	0.83
43.00	120.00	2.438	57.60	1.465	0.82	0.000	0.709	0.63	1.30	0.82
44.00	120.00	2.495	57.60	1.492	0.82	0.000	0.709	0.63	1.30	0.82
45.00	120.00	2.552	57.60	1.520	0.81	0.000	0.709	0.63	1.30	0.81
46.00	120.00	2.608	57.60	1.547	0.80	0.000	0.709	0.62	1.30	0.81
47.00	120.00	2.665	57.60	1.574	0.79	0.000	0.709	0.62	1.30	0.80
48.00	120.00	2.722	57.60	1.601	0.78	0.000	0.709	0.61	1.30	0.80
49.00	120.00	2.779	57.60	1.629	0.78	0.000	0.709	0.61	1.30	0.79
50.00	120.00	2.835	57.60	1.656	0.77	0.000	0.709	0.61	1.30	0.79
51.00	120.00	2.892	57.60	1.683	0.76	0.000	0.709	0.60	1.30	0.78
52.00	120.00	2.949	57.60	1.710	0.75	0.000	0.709	0.60	1.30	0.78
53.00	120.00	3.005	57.60	1.737	0.74	0.000	0.709	0.59	1.30	0.77
54.00	120.00	3.062	57.60	1.765	0.73	0.000	0.709	0.59	1.30	0.76
55.00	120.00	3.119	57.60	1.792	0.73	0.000	0.709	0.58	1.30	0.76
56.00	120.00	3.176	57.60	1.819	0.72	0.000	0.709	0.58	1.30	0.75
57.00	120.00	3.232	57.60	1.846	0.71	0.000	0.709	0.57	1.30	0.74
58.00	120.00	3.289	57.60	1.874	0.70	0.000	0.709	0.57	1.30	0.74
59.00	120.00	3.346	57.60	1.901	0.69	0.000	0.709	0.56	1.30	0.73
60.00	120.00	3.402	57.60	1.928	0.69	0.000	0.709	0.56	1.30	0.72
61.00	120.00	3.459	57.60	1.955	0.68	0.000	0.709	0.55	1.30	0.72
62.00	120.00	3.516	57.60	1.982	0.67	0.000	0.709	0.55	1.30	0.71
63.00	120.00	3.572	57.60	2.010	0.66	0.000	0.709	0.54	1.30	0.70
64.00	120.00	3.629	57.60	2.037	0.65	0.000	0.709	0.54	1.30	0.70
65.00	120.00	3.686	57.60	2.064	0.65	0.000	0.709	0.53	1.30	0.69
66.00	120.00	3.743	57.60	2.091	0.64	0.000	0.709	0.53	1.30	0.68
67.00	120.00	3.799	57.60	2.119	0.63	0.000	0.709	0.52	1.30	0.68
68.00	120.00	3.856	57.60	2.146	0.62	0.000	0.709	0.51	1.30	0.67
69.00	120.00	3.913	57.60	2.173	0.61	0.000	0.709	0.51	1.30	0.66
70.00	120.00	3.969	57.60	2.200	0.60	0.000	0.709	0.50	1.30	0.65
71.00	120.00	4.026	57.60	2.227	0.60	0.000	0.709	0.50	1.30	0.65
72.00	120.00	4.083	57.60	2.255	0.59	0.000	0.709	0.49	1.30	0.64
73.00	120.00	4.140	57.60	2.282	0.58	0.000	0.709	0.48	1.30	0.63
74.00	120.00	4.196	57.60	2.309	0.57	0.000	0.709	0.48	1.30	0.62
75.00	120.00	4.253	57.60	2.336	0.56	0.000	0.709	0.47	1.30	0.61
76.00	120.00	4.310	57.60	2.363	0.56	0.000	0.709	0.47	1.30	0.61
77.00	120.00	4.366	57.60	2.391	0.56	0.000	0.709	0.47	1.30	0.61
78.00	120.00	4.423	57.60	2.418	0.55	0.000	0.709	0.47	1.30	0.61
79.00	120.00	4.480	57.60	2.445	0.55	0.000	0.709	0.47	1.30	0.61
80.00	120.00	4.536	57.60	2.472	0.55	0.000	0.709	0.46	1.30	0.60

CSR is based on water table at 10.00 during earthquake

CRR Calculation from CPT data, using Modify Robertson's Method:
(Fines content is determined by qc and fric.)

Depth ft	qc atm	fric. atm	n	Q	Rf	Ic	Cq	Fines %	Kc	qc1n atm	qc1f atm	CRR7.5
0.00			1.00	1.30E5	7.15	2.65						
0.00	1.30	0.09	1.00	1.30E5	7.15	2.65	1.00	NoLiq	1.00	1.30	1.30	2.08
1.00			1.00	1.80E2	5.47	2.30						
1.00			0.50	4.31E1	5.47	2.68						
1.00			0.70	7.66E1	5.47	2.52						
1.00	10.27	0.56	0.70	7.66E1	5.47	2.52	7.45	31.57	0.71	76.59	263.47	1.78
2.00			1.00	3.14E2	1.13	1.60						
2.00			0.50	1.06E2	1.13	1.93						
2.00	35.78	0.40	0.50	1.06E2	1.13	1.93	2.97	11.02	0.16	106.23	126.59	0.27
3.00			1.00	4.82E2	1.73	1.66						
3.00			0.50	1.99E2	1.73	1.87						
3.00	82.21	1.42	0.50	1.99E2	1.73	1.87	2.42	9.70	0.13	199.32	227.91	1.18
4.00			1.00	5.15E2	1.54	1.60						
4.00			0.50	2.46E2	1.54	1.77						
4.00	117.13	1.80	0.50	2.46E2	1.54	1.77	2.10	7.58	0.07	245.93	264.10	1.79
5.00			1.00	4.54E2	0.97	1.46						
5.00			0.50	2.42E2	0.97	1.62						
5.00	129.00	1.25	0.50	2.42E2	0.97	1.62	1.88	4.75	0.00	242.26	242.26	1.40
6.00			1.00	2.70E2	0.79	1.53						
6.00			0.50	1.58E2	0.79	1.69						
6.00	92.33	0.73	0.50	1.58E2	0.79	1.69	1.71	5.98	0.03	158.29	162.54	0.48
7.00			1.00	7.76E1	2.56	2.27						
7.00			0.50	4.95E1	2.56	2.41						
7.00	31.21	0.79	0.50	4.95E1	2.56	2.41	1.59	26.76	0.58	49.54	118.27	0.23
8.00			1.00	1.09E2	1.82	2.06						
8.00			0.50	7.43E1	1.82	2.18						
8.00	50.02	0.90	0.50	7.43E1	1.82	2.18	1.48	18.32	0.36	74.26	115.23	0.22
9.00			1.00	2.46E2	0.93	1.61						
9.00			0.50	1.76E2	0.93	1.71						
9.00	125.85	1.17	0.50	1.76E2	0.93	1.71	1.40	6.26	0.03	176.16	182.31	0.64
10.00			1.00	5.95E1	3.14	2.41						
10.00			0.50	4.55E1	3.14	2.50						
10.00	34.30	1.06	0.50	4.55E1	3.14	2.50	1.33	30.49	0.68	45.55	142.58	0.35
11.00			1.00	1.02E2	2.11	2.13						
11.00			0.50	8.10E1	2.11	2.20						
11.00	63.99	1.34	0.50	8.10E1	2.11	2.20	1.27	18.86	0.37	81.02	128.64	0.28
12.00			1.00	1.92E2	1.08	1.73						
12.00			0.50	1.59E2	1.08	1.78						
12.00	131.03	1.41	0.50	1.59E2	1.08	1.78	1.21	7.80	0.07	158.84	171.65	0.55
13.00			1.00	2.04E2	0.87	1.64						
13.00			0.50	1.76E2	0.87	1.69						
13.00	151.26	1.30	0.50	1.76E2	0.87	1.69	1.16	5.84	0.02	176.17	180.21	0.62
14.00			1.00	1.05E2	1.43	2.00						
14.00			0.50	9.48E1	1.43	2.03						
14.00	84.46	1.20	0.50	9.48E1	1.43	2.03	1.12	13.78	0.23	94.79	123.80	0.26
15.00			1.00	2.26E1	2.96	2.71						
15.00	20.08	0.57	1.00	2.26E1	2.96	2.71	1.00	NoLiq	1.00	20.08	20.08	2.08

16.00			1.00	2.07E1	4.01	2.82						
16.00	19.71	0.75	1.00	2.07E1	4.01	2.82	1.00	NoLiq	1.00	19.71	19.71	2.08
17.00			1.00	9.30E0	3.62	3.07						
17.00	9.93	0.32	1.00	9.30E0	3.62	3.07	1.00	NoLiq	1.00	9.93	9.93	2.08
18.00			1.00	9.35E0	3.33	3.05						
18.00	10.56	0.32	1.00	9.35E0	3.33	3.05	1.00	NoLiq	1.00	10.56	10.56	2.08
19.00			1.00	1.65E1	5.62	2.99						
19.00	18.88	1.00	1.00	1.65E1	5.62	2.99	1.00	NoLiq	1.00	18.88	18.88	2.08
20.00			1.00	2.63E1	3.48	2.70						
20.00	31.02	1.04	1.00	2.63E1	3.48	2.70	1.00	NoLiq	1.00	31.02	31.02	2.08
21.00			1.00	7.05E0	4.01	3.19						
21.00	9.58	0.34	1.00	7.05E0	4.01	3.19	1.00	NoLiq	1.00	9.58	9.58	2.08
22.00			1.00	1.30E1	5.31	3.05						
22.00	17.48	0.86	1.00	1.30E1	5.31	3.05	1.00	NoLiq	1.00	17.48	17.48	2.08
23.00			1.00	1.30E1	6.15	3.10						
23.00	18.27	1.04	1.00	1.30E1	6.15	3.10	1.00	NoLiq	1.00	18.27	18.27	2.08
24.00			1.00	1.89E1	3.90	2.84						
24.00	27.13	1.01	1.00	1.89E1	3.90	2.84	1.00	NoLiq	1.00	27.13	27.13	2.08
25.00			1.00	7.54E1	0.85	1.96						
25.00			0.50	9.09E1	0.85	1.90						
25.00	108.27	0.90	0.50	9.09E1	0.85	1.90	0.84	10.34	0.14	90.93	106.05	0.19
26.00			1.00	7.30E1	1.22	2.07						
26.00			0.50	8.99E1	1.22	2.00						
26.00	109.10	1.32	0.50	8.99E1	1.22	2.00	0.82	13.02	0.21	89.85	114.34	0.22
27.00			1.00	4.23E1	2.09	2.40						
27.00			0.50	5.36E1	2.09	2.32						
27.00	66.29	1.35	0.50	5.36E1	2.09	2.32	0.81	23.42	0.49	53.57	105.43	0.19
28.00			1.00	1.17E1	5.87	3.12						
28.00	20.18	1.09	1.00	1.17E1	5.87	3.12	1.00	NoLiq	1.00	20.18	20.18	2.08
29.00			1.00	5.32E0	3.19	3.24						
29.00	10.39	0.28	1.00	5.32E0	3.19	3.24	1.00	NoLiq	1.00	10.39	10.39	2.08
30.00			1.00	5.38E0	2.85	3.21						
30.00	10.85	0.26	1.00	5.38E0	2.85	3.21	1.00	NoLiq	1.00	10.85	10.85	2.08
31.00			1.00	6.20E0	2.36	3.12						
31.00	12.49	0.25	1.00	6.20E0	2.36	3.12	1.00	NoLiq	1.00	12.49	12.49	2.08
32.00			1.00	5.36E0	3.28	3.24						
32.00	11.23	0.31	1.00	5.36E0	3.28	3.24	1.00	NoLiq	1.00	11.23	11.23	2.08
33.00			1.00	7.42E0	4.57	3.21						
33.00	15.12	0.61	1.00	7.42E0	4.57	3.21	1.00	NoLiq	1.00	15.12	15.12	2.08
34.00			1.00	7.15E0	3.11	3.13						
34.00	14.88	0.40	1.00	7.15E0	3.11	3.13	1.00	NoLiq	1.00	14.88	14.88	2.08
35.00			1.00	5.39E0	3.31	3.24						
35.00	11.90	0.33	1.00	5.39E0	3.31	3.24	1.00	NoLiq	1.00	11.90	11.90	2.08
36.00			1.00	6.77E0	4.12	3.21						
36.00	14.67	0.52	1.00	6.77E0	4.12	3.21	1.00	NoLiq	1.00	14.67	14.67	2.08
37.00			1.00	3.98E1	1.01	2.23						
37.00			0.50	5.63E1	1.01	2.11						
37.00	77.48	0.76	0.50	5.63E1	1.01	2.11	0.73	16.12	0.30	56.31	80.08	0.13
38.00			1.00	7.04E0	4.77	3.24						
38.00	15.67	0.64	1.00	7.04E0	4.77	3.24	1.00	NoLiq	1.00	15.67	15.67	2.08
39.00			1.00	8.74E0	4.02	3.12						
39.00	19.22	0.68	1.00	8.74E0	4.02	3.12	1.00	NoLiq	1.00	19.22	19.22	2.08

40.00			1.00	6.08E0	2.87	3.17						
40.00	14.28	0.35	1.00	6.08E0	2.87	3.17	1.00	NoLiq	1.00	14.28	14.28	2.08
41.00			1.00	2.82E1	1.57	2.47						
41.00			0.50	4.15E1	1.57	2.33						
41.00	58.76	0.89	0.50	4.15E1	1.57	2.33	0.71	23.69	0.50	41.53	82.90	0.13
42.00			1.00	6.20E0	2.85	3.16						
42.00	14.97	0.36	1.00	6.20E0	2.85	3.16	1.00	NoLiq	1.00	14.97	14.97	2.08
43.00			1.00	1.02E1	3.31	3.01						
43.00	23.43	0.70	1.00	1.02E1	3.31	3.01	1.00	NoLiq	1.00	23.43	23.43	2.08
44.00			1.00	8.15E0	4.00	3.14						
44.00	19.47	0.68	1.00	8.15E0	4.00	3.14	1.00	NoLiq	1.00	19.47	19.47	2.08
45.00			1.00	7.33E0	3.18	3.12						
45.00	18.03	0.49	1.00	7.33E0	3.18	3.12	1.00	NoLiq	1.00	18.03	18.03	2.08
46.00			1.00	7.51E0	3.07	3.11						
46.00	18.66	0.49	1.00	7.51E0	3.07	3.11	1.00	NoLiq	1.00	18.66	18.66	2.08
47.00			1.00	7.80E0	3.08	3.09						
47.00	19.55	0.52	1.00	7.80E0	3.08	3.09	1.00	NoLiq	1.00	19.55	19.55	2.08
48.00			1.00	7.68E0	4.02	3.16						
48.00	19.55	0.68	1.00	7.68E0	4.02	3.16	1.00	NoLiq	1.00	19.55	19.55	2.08
49.00			1.00	8.90E0	5.34	3.19						
49.00	22.53	1.06	1.00	8.90E0	5.34	3.19	1.00	NoLiq	1.00	22.53	22.53	2.08
50.00			1.00	8.30E0	3.87	3.13						
50.00	21.48	0.72	1.00	8.30E0	3.87	3.13	1.00	NoLiq	1.00	21.48	21.48	2.08
51.00			1.00	1.79E1	7.99	3.07						
51.00	43.54	3.25	1.00	1.79E1	7.99	3.07	1.00	NoLiq	1.00	43.54	43.54	2.08
52.00			1.00	4.75E1	2.69	2.44						
52.00			0.50	7.40E1	2.69	2.30						
52.00	112.19	2.93	0.50	7.40E1	2.69	2.30	0.66	22.46	0.47	73.95	138.54	0.33
53.00			1.00	1.41E2	0.83	1.74						
53.00			0.50	2.17E2	0.83	1.61						
53.00	331.19	2.71	0.50	2.17E2	0.83	1.61	0.66	4.45	0.00	217.03	217.03	1.03
54.00			1.00	1.44E1	5.28	3.02						
54.00	37.03	1.79	1.00	1.44E1	5.28	3.02	1.00	NoLiq	1.00	37.03	37.03	2.08
55.00			1.00	1.31E1	1.76	2.77						
55.00	34.44	0.55	1.00	1.31E1	1.76	2.77	1.00	NoLiq	1.00	34.44	34.44	2.08
56.00			1.00	1.16E1	1.85	2.83						
56.00	31.16	0.52	1.00	1.16E1	1.85	2.83	1.00	NoLiq	1.00	31.16	31.16	2.08
57.00			1.00	1.56E1	3.99	2.92						
57.00	41.18	1.51	1.00	1.56E1	3.99	2.92	1.00	NoLiq	1.00	41.18	41.18	2.08
58.00			1.00	1.55E1	4.61	2.96						
58.00	41.55	1.76	1.00	1.55E1	4.61	2.96	1.00	NoLiq	1.00	41.55	41.55	2.08
59.00			1.00	1.36E1	4.26	2.98						
59.00	37.29	1.45	1.00	1.36E1	4.26	2.98	1.00	NoLiq	1.00	37.29	37.29	2.08
60.00			1.00	8.67E0	3.43	3.08						
60.00	25.25	0.75	1.00	8.67E0	3.43	3.08	1.00	NoLiq	1.00	25.25	25.25	2.08
61.00			1.00	9.11E0	5.45	3.18						
61.00	26.66	1.27	1.00	9.11E0	5.45	3.18	1.00	NoLiq	1.00	26.66	26.66	2.08
62.00			1.00	7.82E0	5.45	3.24						
62.00	23.64	1.10	1.00	7.82E0	5.45	3.24	1.00	NoLiq	1.00	23.64	23.64	2.08
63.00			1.00	1.82E1	6.34	3.00						
63.00	50.88	3.00	1.00	1.82E1	6.34	3.00	1.00	NoLiq	1.00	50.88	50.88	2.08
64.00			1.00	9.76E0	3.64	3.05						

64.00	29.29	0.93	1.00	9.76E0	3.64	3.05	1.00	NoLiq	1.00	29.29	29.29	2.08
65.00			1.00	3.43E1	3.53	2.62						
65.00	94.85	3.22	1.00	3.43E1	3.53	2.62	1.00	NoLiq	1.00	94.85	94.85	2.08
66.00			1.00	1.16E1	5.55	3.11						
66.00	34.77	1.72	1.00	1.16E1	5.55	3.11	1.00	NoLiq	1.00	34.77	34.77	2.08
67.00			1.00	7.83E0	3.40	3.12						
67.00	25.03	0.72	1.00	7.83E0	3.40	3.12	1.00	NoLiq	1.00	25.03	25.03	2.08
68.00			1.00	7.86E0	4.26	3.17						
68.00	25.35	0.92	1.00	7.86E0	4.26	3.17	1.00	NoLiq	1.00	25.35	25.35	2.08
69.00			1.00	9.23E0	3.52	3.06						
69.00	29.42	0.90	1.00	9.23E0	3.52	3.06	1.00	NoLiq	1.00	29.42	29.42	2.08
70.00			1.00	2.29E1	7.21	2.96						
70.00	67.90	4.61	1.00	2.29E1	7.21	2.96	1.00	NoLiq	1.00	67.90	67.90	2.08
71.00			1.00	3.59E1	3.67	2.62						
71.00	105.09	3.71	1.00	3.59E1	3.67	2.62	1.00	NoLiq	1.00	105.09	105.09	2.08
72.00			1.00	8.60E1	1.93	2.15						
72.00			0.50	1.48E2	1.93	1.99						
72.00	248.85	4.71	0.50	1.48E2	1.93	1.99	0.59	12.66	0.20	147.51	185.43	0.67
73.00			1.00	3.16E1	4.60	2.72						
73.00	94.99	4.18	1.00	3.16E1	4.60	2.72	1.00	NoLiq	1.00	94.99	94.99	2.08
74.00			1.00	2.98E1	5.24	2.78						
74.00	90.61	4.52	1.00	2.98E1	5.24	2.78	1.00	NoLiq	1.00	90.61	90.61	2.08
75.00			1.00	9.28E1	0.77	1.86						
75.00			0.50	1.61E2	0.77	1.68						
75.00	276.05	2.08	0.50	1.61E2	0.77	1.68	0.58	5.69	0.02	161.34	164.36	0.49
76.00			1.00	9.24E0	2.23	2.96						
76.00	31.61	0.61	1.00	9.24E0	2.23	2.96	1.00	NoLiq	1.00	31.61	31.61	2.08
77.00			1.00	9.08E0	1.93	2.93						
77.00	31.45	0.52	1.00	9.08E0	1.93	2.93	1.00	NoLiq	1.00	31.45	31.45	2.08
78.00			1.00	8.60E0	5.10	3.18						
78.00	30.31	1.32	1.00	8.60E0	5.10	3.18	1.00	NoLiq	1.00	30.31	30.31	2.08
79.00			1.00	6.91E0	3.84	3.19						
79.00	25.45	0.81	1.00	6.91E0	3.84	3.19	1.00	NoLiq	1.00	25.45	25.45	2.08
80.00			1.00	9.03E0	3.99	3.10						
80.00	32.21	1.11	1.00	9.03E0	3.99	3.10	1.00	NoLiq	1.00	32.21	32.21	2.08

Fines have been calculated, and correction is made by Modify Robertson Method.
Fines=NoLiq means the soils are not liquefiable.

CRR is based on water table at 30.00 during In-Situ Testing

Factor of Safety, - Earthquake Magnitude= 7.50:

Depth ft	sigC' atm	CRR7.5	x Ksig	=CRRv	x MSF	=CRRm	CSRfs	F.S.=CRRm/CSRfs
0.00	0.00	2.08	1.00	2.08	1.00	2.00	0.60	5.00 ^
1.00	0.04	1.78	1.00	1.78	1.00	1.78	0.60	5.00
2.00	0.07	0.27	1.00	0.27	1.00	0.27	0.60	5.00
3.00	0.11	1.18	1.00	1.18	1.00	1.18	0.59	5.00
4.00	0.15	1.79	1.00	1.79	1.00	1.79	0.59	5.00
5.00	0.18	1.40	1.00	1.40	1.00	1.40	0.59	5.00
6.00	0.22	0.48	1.00	0.48	1.00	0.48	0.59	5.00
7.00	0.26	0.23	1.00	0.23	1.00	0.23	0.59	5.00

8.00	0.29	0.22	1.00	0.22	1.00	0.22	0.59	5.00	
9.00	0.33	0.64	1.00	0.64	1.00	0.64	0.59	5.00	
10.00	0.37	0.35	1.00	0.35	1.00	0.35	0.59	0.60	*
11.00	0.41	0.28	1.00	0.28	1.00	0.28	0.61	0.45	*
12.00	0.44	0.55	1.00	0.55	1.00	0.55	0.64	0.86	*
13.00	0.48	0.62	1.00	0.62	1.00	0.62	0.66	0.95	*
14.00	0.52	0.26	1.00	0.26	1.00	0.26	0.68	0.38	*
15.00	0.55	2.08	1.00	2.08	1.00	2.00	0.70	5.00	^
16.00	0.59	2.08	1.00	2.08	1.00	2.00	0.72	5.00	^
17.00	0.63	2.08	1.00	2.08	1.00	2.00	0.73	5.00	^
18.00	0.66	2.08	1.00	2.08	1.00	2.00	0.75	5.00	^
19.00	0.70	2.08	1.00	2.08	1.00	2.00	0.76	5.00	^
20.00	0.74	2.08	1.00	2.08	1.00	2.00	0.77	5.00	^
21.00	0.77	2.08	1.00	2.08	1.00	2.00	0.78	5.00	^
22.00	0.81	2.08	1.00	2.08	1.00	2.00	0.79	5.00	^
23.00	0.85	2.08	1.00	2.08	1.00	2.00	0.80	5.00	^
24.00	0.88	2.08	1.00	2.08	1.00	2.00	0.81	5.00	^
25.00	0.92	0.19	1.00	0.19	1.00	0.19	0.82	0.23	*
26.00	0.96	0.22	1.00	0.22	1.00	0.22	0.83	0.26	*
27.00	1.00	0.19	1.00	0.19	1.00	0.19	0.83	0.23	*
28.00	1.03	2.08	1.00	2.08	1.00	2.00	0.84	5.00	^
29.00	1.07	2.08	1.00	2.07	1.00	2.00	0.85	5.00	^
30.00	1.11	2.08	0.99	2.06	1.00	2.00	0.85	5.00	^
31.00	1.12	2.08	0.99	2.05	1.00	2.00	0.85	5.00	^
32.00	1.14	2.08	0.98	2.05	1.00	2.00	0.85	5.00	^
33.00	1.16	2.08	0.98	2.04	1.00	2.00	0.85	5.00	^
34.00	1.18	2.08	0.98	2.04	1.00	2.00	0.85	5.00	^
35.00	1.20	2.08	0.98	2.03	1.00	2.00	0.85	5.00	^
36.00	1.21	2.08	0.97	2.02	1.00	2.00	0.85	5.00	^
37.00	1.23	0.13	0.97	0.12	1.00	0.12	0.84	0.15	*
38.00	1.25	2.08	0.97	2.01	1.00	2.00	0.84	5.00	^
39.00	1.27	2.08	0.97	2.01	1.00	2.00	0.84	5.00	^
40.00	1.28	2.08	0.96	2.00	1.00	2.00	0.83	5.00	^
41.00	1.30	0.13	0.96	0.13	1.00	0.13	0.83	0.15	*
42.00	1.32	2.08	0.96	1.99	1.00	2.00	0.83	5.00	^
43.00	1.34	2.08	0.96	1.99	1.00	2.00	0.82	5.00	^
44.00	1.35	2.08	0.95	1.98	1.00	2.00	0.82	5.00	^
45.00	1.37	2.08	0.95	1.98	1.00	2.00	0.81	5.00	^
46.00	1.39	2.08	0.95	1.97	1.00	2.00	0.81	5.00	^
47.00	1.41	2.08	0.95	1.97	1.00	2.00	0.80	5.00	^
48.00	1.43	2.08	0.94	1.96	1.00	2.00	0.80	5.00	^
49.00	1.44	2.08	0.94	1.96	1.00	2.00	0.79	5.00	^
50.00	1.46	2.08	0.94	1.95	1.00	2.00	0.79	5.00	^
51.00	1.48	2.08	0.94	1.95	1.00	2.00	0.78	5.00	^
52.00	1.50	0.33	0.93	0.31	1.00	0.31	0.78	0.39	*
53.00	1.51	1.03	0.93	0.96	1.00	0.96	0.77	1.25	
54.00	1.53	2.08	0.93	1.93	1.00	2.00	0.76	5.00	^
55.00	1.55	2.08	0.93	1.93	1.00	2.00	0.76	5.00	^
56.00	1.57	2.08	0.92	1.92	1.00	2.00	0.75	5.00	^
57.00	1.58	2.08	0.92	1.92	1.00	2.00	0.74	5.00	^
58.00	1.60	2.08	0.92	1.91	1.00	2.00	0.74	5.00	^
59.00	1.62	2.08	0.92	1.91	1.00	2.00	0.73	5.00	^

60.00	1.64	2.08	0.91	1.90	1.00	2.00	0.72	5.00 ^
61.00	1.66	2.08	0.91	1.90	1.00	2.00	0.72	5.00 ^
62.00	1.67	2.08	0.91	1.89	1.00	2.00	0.71	5.00 ^
63.00	1.69	2.08	0.91	1.89	1.00	2.00	0.70	5.00 ^
64.00	1.71	2.08	0.91	1.88	1.00	2.00	0.70	5.00 ^
65.00	1.73	2.08	0.90	1.88	1.00	2.00	0.69	5.00 ^
66.00	1.74	2.08	0.90	1.88	1.00	2.00	0.68	5.00 ^
67.00	1.76	2.08	0.90	1.87	1.00	2.00	0.68	5.00 ^
68.00	1.78	2.08	0.90	1.87	1.00	2.00	0.67	5.00 ^
69.00	1.80	2.08	0.90	1.86	1.00	2.00	0.66	5.00 ^
70.00	1.81	2.08	0.89	1.86	1.00	2.00	0.65	5.00 ^
71.00	1.83	2.08	0.89	1.85	1.00	2.00	0.65	5.00 ^
72.00	1.85	0.67	0.89	0.60	1.00	0.60	0.64	0.94 *
73.00	1.87	2.08	0.89	1.84	1.00	2.00	0.63	5.00 ^
74.00	1.89	2.08	0.88	1.84	1.00	2.00	0.62	5.00 ^
75.00	1.90	0.49	0.88	0.44	1.00	0.43	0.61	0.71 *
76.00	1.92	2.08	0.88	1.83	1.00	2.00	0.61	5.00 ^
77.00	1.94	2.08	0.88	1.83	1.00	2.00	0.61	5.00 ^
78.00	1.96	2.08	0.88	1.82	1.00	2.00	0.61	5.00 ^
79.00	1.97	2.08	0.87	1.82	1.00	2.00	0.61	5.00 ^
80.00	1.99	2.08	0.87	1.82	1.00	2.00	0.60	5.00 ^

* F.S.<1: Liquefaction Potential Zone. (If above water table: F.S.=5)
^ No-liquefiable Soils or above Water Table.
(F.S. is limited to 5, CRR is limited to 2, CSR is limited to 2)

CPT convert to SPT for Settlement Analysis:
Fines Correction for Settlement Analysis:

Depth ft	Ic	qc/N60	qc1 atm	(N1)60	Fines %	d(N1)60	(N1)60s
0.00	2.65	3.61	1.30	0.36	NoLiq	0.00	0.36
1.00	2.52	3.84	263.47	68.54	31.57	0.00	68.54
2.00	1.93	4.94	126.59	25.62	11.02	0.00	25.62
3.00	1.87	5.04	227.91	45.19	9.70	0.00	45.19
4.00	1.77	5.22	264.10	50.58	7.58	0.00	50.58
5.00	1.62	5.50	242.26	44.04	4.75	0.00	44.04
6.00	1.69	5.37	162.54	30.26	5.98	0.00	30.26
7.00	2.41	4.05	118.27	29.21	26.76	0.00	29.21
8.00	2.18	4.47	115.23	25.77	18.32	0.00	25.77
9.00	1.71	5.34	182.31	34.11	6.26	0.00	34.11
10.00	2.50	3.89	142.58	36.67	30.49	0.00	36.67
11.00	2.20	4.44	128.64	28.96	18.86	0.00	28.96
12.00	1.78	5.20	171.65	33.00	7.80	0.00	33.00
13.00	1.69	5.39	180.21	33.46	5.84	0.00	33.46
14.00	2.03	4.75	123.80	26.07	13.78	0.00	26.07
15.00	2.71	3.49	20.08	5.75	NoLiq	0.00	5.75
16.00	2.82	3.29	19.71	6.00	NoLiq	0.00	6.00
17.00	3.07	2.83	9.93	3.51	NoLiq	0.00	3.51
18.00	3.05	2.87	10.56	3.68	NoLiq	0.00	3.68
19.00	2.99	2.97	18.88	6.35	NoLiq	0.00	6.35

20.00	2.70	3.51	31.02	8.85	NoLiq	0.00	8.85
21.00	3.19	2.60	9.58	3.69	NoLiq	0.00	3.69
22.00	3.05	2.86	17.48	6.12	NoLiq	0.00	6.12
23.00	3.10	2.78	18.27	6.57	NoLiq	0.00	6.57
24.00	2.84	3.24	27.13	8.36	NoLiq	0.00	8.36
25.00	1.90	4.99	106.05	21.24	10.34	0.00	21.24
26.00	2.00	4.80	114.34	23.82	13.02	0.00	23.82
27.00	2.32	4.21	105.43	25.07	23.42	0.00	25.07
28.00	3.12	2.74	20.18	7.37	NoLiq	0.00	7.37
29.00	3.24	2.51	10.39	4.14	NoLiq	0.00	4.14
30.00	3.21	2.57	10.85	4.23	NoLiq	0.00	4.23
31.00	3.12	2.74	12.49	4.55	NoLiq	0.00	4.55
32.00	3.24	2.50	11.23	4.48	NoLiq	0.00	4.48
33.00	3.21	2.57	15.12	5.88	NoLiq	0.00	5.88
34.00	3.13	2.72	14.88	5.47	NoLiq	0.00	5.47
35.00	3.24	2.50	11.90	4.75	NoLiq	0.00	4.75
36.00	3.21	2.56	14.67	5.73	NoLiq	0.00	5.73
37.00	2.11	4.60	80.08	17.40	16.12	0.00	17.40
38.00	3.24	2.52	15.67	6.23	NoLiq	0.00	6.23
39.00	3.12	2.74	19.22	7.02	NoLiq	0.00	7.02
40.00	3.17	2.65	14.28	5.39	NoLiq	0.00	5.39
41.00	2.33	4.19	82.90	19.77	23.69	0.00	19.77
42.00	3.16	2.66	14.97	5.62	NoLiq	0.00	5.62
43.00	3.01	2.93	23.43	7.99	NoLiq	0.00	7.99
44.00	3.14	2.69	19.47	7.23	NoLiq	0.00	7.23
45.00	3.12	2.73	18.03	6.61	NoLiq	0.00	6.61
46.00	3.11	2.76	18.66	6.76	NoLiq	0.00	6.76
47.00	3.09	2.79	19.55	7.02	NoLiq	0.00	7.02
48.00	3.16	2.65	19.55	7.37	NoLiq	0.00	7.37
49.00	3.19	2.61	22.53	8.62	NoLiq	0.00	8.62
50.00	3.13	2.72	21.48	7.89	NoLiq	0.00	7.89
51.00	3.07	2.83	43.54	15.40	NoLiq	0.00	15.40
52.00	2.30	4.25	138.54	32.58	22.46	0.00	32.58
53.00	1.61	5.53	217.03	39.22	4.45	0.00	39.22
54.00	3.02	2.92	37.03	12.68	NoLiq	0.00	12.68
55.00	2.77	3.38	34.44	10.19	NoLiq	0.00	10.19
56.00	2.83	3.27	31.16	9.51	NoLiq	0.00	9.51
57.00	2.92	3.11	41.18	13.23	NoLiq	0.00	13.23
58.00	2.96	3.04	41.55	13.68	NoLiq	0.00	13.68
59.00	2.98	2.99	37.29	12.45	NoLiq	0.00	12.45
60.00	3.08	2.81	25.25	8.99	NoLiq	0.00	8.99
61.00	3.18	2.62	26.66	10.18	NoLiq	0.00	10.18
62.00	3.24	2.52	23.64	9.37	NoLiq	0.00	9.37
63.00	3.00	2.96	50.88	17.16	NoLiq	0.00	17.16
64.00	3.05	2.86	29.29	10.25	NoLiq	0.00	10.25
65.00	2.62	3.66	94.85	25.93	NoLiq	0.00	25.93
66.00	3.11	2.76	34.77	12.60	NoLiq	0.00	12.60
67.00	3.12	2.74	25.03	9.12	NoLiq	0.00	9.12
68.00	3.17	2.64	25.35	9.60	NoLiq	0.00	9.60
69.00	3.06	2.84	29.42	10.37	NoLiq	0.00	10.37
70.00	2.96	3.03	67.90	22.43	NoLiq	0.00	22.43
71.00	2.62	3.66	105.09	28.70	NoLiq	0.00	28.70

72.00	1.99	4.82	185.43	38.44	12.66	0.00	38.44
73.00	2.72	3.46	94.99	27.42	NoLiq	0.00	27.42
74.00	2.78	3.36	90.61	26.98	NoLiq	0.00	26.98
75.00	1.68	5.40	164.36	30.43	5.69	0.00	30.43
76.00	2.96	3.04	31.61	10.40	NoLiq	0.00	10.40
77.00	2.93	3.09	31.45	10.18	NoLiq	0.00	10.18
78.00	3.18	2.62	30.31	11.59	NoLiq	0.00	11.59
79.00	3.19	2.61	25.45	9.77	NoLiq	0.00	9.77
80.00	3.10	2.76	32.21	11.66	NoLiq	0.00	11.66

(N1)60s has been fines corrected in liquefaction analysis, therefore d(N1)60=0.
(N1)60 is converted from qc1, (N1)60s is after fines correction
Fines=NoLiq means the soils are not liquefiable.

Settlement of Saturated Sands:
Settlement Analysis Method: Tokimatsu/Seed

Depth ft	CSRsf	/ MSF*	=CSRm	F.S.	Fines %	(N1)60s	Dr %	ec %	dsz in.	dsp in.	S in.
79.95	0.60	1.00	0.60	5.00	NoLiq	11.41	53.80	2.348	0.0E0	0.000	0.000
79.00	0.61	1.00	0.61	5.00	NoLiq	9.77	49.99	2.588	0.0E0	0.000	0.000
78.00	0.61	1.00	0.61	5.00	NoLiq	11.59	54.21	2.324	0.0E0	0.000	0.000
77.00	0.61	1.00	0.61	5.00	NoLiq	10.18	50.98	2.513	0.0E0	0.000	0.000
76.00	0.61	1.00	0.61	5.00	NoLiq	10.40	51.49	2.481	0.0E0	0.000	0.000
75.00	0.61	1.00	0.61	0.71	5.69	30.43	91.03	0.695	4.2E-3	0.046	0.046
74.00	0.62	1.00	0.62	5.00	NoLiq	26.98	83.61	1.066	0.0E0	0.008	0.053
73.00	0.63	1.00	0.63	5.00	NoLiq	27.42	84.50	1.039	0.0E0	0.013	0.066
72.00	0.64	1.00	0.64	0.94	12.66	38.44	100.00	0.000	0.0E0	0.009	0.075
71.00	0.65	1.00	0.65	5.00	NoLiq	28.70	87.19	0.916	0.0E0	0.010	0.086
70.00	0.65	1.00	0.65	5.00	NoLiq	22.43	74.93	1.350	0.0E0	0.003	0.088
69.00	0.66	1.00	0.66	5.00	NoLiq	10.37	51.42	2.485	0.0E0	0.000	0.088
68.00	0.67	1.00	0.67	5.00	NoLiq	9.60	49.56	2.620	0.0E0	0.000	0.088
67.00	0.68	1.00	0.68	5.00	NoLiq	9.12	48.38	2.707	0.0E0	0.000	0.088
66.00	0.68	1.00	0.68	5.00	NoLiq	12.60	56.40	2.192	0.0E0	0.000	0.088
65.00	0.69	1.00	0.69	5.00	NoLiq	25.93	81.52	1.132	0.0E0	0.009	0.097
64.00	0.70	1.00	0.70	5.00	NoLiq	10.25	51.13	2.501	0.0E0	0.000	0.097
63.00	0.70	1.00	0.70	5.00	NoLiq	17.16	65.37	1.740	0.0E0	0.000	0.097
62.00	0.71	1.00	0.71	5.00	NoLiq	9.37	49.01	2.661	0.0E0	0.000	0.097
61.00	0.72	1.00	0.72	5.00	NoLiq	10.18	50.97	2.513	0.0E0	0.000	0.097
60.00	0.72	1.00	0.72	5.00	NoLiq	8.99	48.06	2.731	0.0E0	0.000	0.097
59.00	0.73	1.00	0.73	5.00	NoLiq	12.45	56.08	2.211	0.0E0	0.000	0.097
58.00	0.74	1.00	0.74	5.00	NoLiq	13.68	58.65	2.049	0.0E0	0.000	0.097
57.00	0.74	1.00	0.74	5.00	NoLiq	13.23	57.73	2.108	0.0E0	0.000	0.097
56.00	0.75	1.00	0.75	5.00	NoLiq	9.51	49.36	2.635	0.0E0	0.000	0.097
55.00	0.76	1.00	0.76	5.00	NoLiq	10.19	50.98	2.512	0.0E0	0.000	0.097
54.00	0.76	1.00	0.76	5.00	NoLiq	12.68	56.56	2.182	0.0E0	0.000	0.097
53.00	0.77	1.00	0.77	1.25	4.45	39.22	100.00	0.000	0.0E0	0.042	0.139
52.00	0.78	1.00	0.78	0.39	22.46	32.58	96.19	0.380	2.3E-3	0.026	0.166
51.00	0.78	1.00	0.78	5.00	NoLiq	15.40	62.05	1.888	0.0E0	0.000	0.166
50.00	0.79	1.00	0.79	5.00	NoLiq	7.89	45.18	2.932	0.0E0	0.000	0.166
49.00	0.79	1.00	0.79	5.00	NoLiq	8.62	47.11	2.799	0.0E0	0.000	0.166

48.00	0.80	1.00	0.80	5.00	NoLiq	7.37	43.77	3.057	0.0E0	0.000	0.166
47.00	0.80	1.00	0.80	5.00	NoLiq	7.02	42.79	3.195	0.0E0	0.000	0.166
46.00	0.81	1.00	0.81	5.00	NoLiq	6.76	42.06	3.295	0.0E0	0.000	0.166
45.00	0.81	1.00	0.81	5.00	NoLiq	6.61	41.62	3.356	0.0E0	0.000	0.166
44.00	0.82	1.00	0.82	5.00	NoLiq	7.23	43.38	3.113	0.0E0	0.000	0.166
43.00	0.82	1.00	0.82	5.00	NoLiq	7.99	45.47	2.913	0.0E0	0.000	0.166
42.00	0.83	1.00	0.83	5.00	NoLiq	5.62	38.68	3.742	0.0E0	0.000	0.166
41.00	0.83	1.00	0.83	0.15	23.69	19.77	70.13	1.522	9.1E-3	0.026	0.192
40.00	0.83	1.00	0.83	5.00	NoLiq	5.39	37.99	3.829	0.0E0	0.009	0.201
39.00	0.84	1.00	0.84	5.00	NoLiq	7.02	42.80	3.194	0.0E0	0.000	0.201
38.00	0.84	1.00	0.84	5.00	NoLiq	6.23	40.51	3.504	0.0E0	0.000	0.201
37.00	0.84	1.00	0.84	0.15	16.12	17.40	65.83	1.720	1.0E-2	0.120	0.321
36.00	0.85	1.00	0.85	5.00	NoLiq	5.73	39.03	3.698	0.0E0	0.029	0.351
35.00	0.85	1.00	0.85	5.00	NoLiq	4.75	35.96	4.109	0.0E0	0.000	0.351
34.00	0.85	1.00	0.85	5.00	NoLiq	5.47	38.22	3.800	0.0E0	0.000	0.351
33.00	0.85	1.00	0.85	5.00	NoLiq	5.88	39.47	3.640	0.0E0	0.000	0.351
32.00	0.85	1.00	0.85	5.00	NoLiq	4.48	35.10	4.251	0.0E0	0.000	0.351
31.00	0.85	1.00	0.85	5.00	NoLiq	4.55	35.33	4.214	0.0E0	0.000	0.351
30.00	0.85	1.00	0.85	5.00	NoLiq	4.23	34.25	4.388	0.0E0	0.000	0.351
29.00	0.85	1.00	0.85	5.00	NoLiq	4.14	33.95	4.436	0.0E0	0.000	0.351
28.00	0.84	1.00	0.84	5.00	NoLiq	7.37	43.77	3.058	0.0E0	0.000	0.351
27.00	0.83	1.00	0.83	0.23	23.42	25.07	79.85	1.185	7.1E-3	0.110	0.461
26.00	0.83	1.00	0.83	0.26	13.02	23.82	77.50	1.263	7.6E-3	0.142	0.603
25.00	0.82	1.00	0.82	0.23	10.34	21.24	72.77	1.425	8.5E-3	0.158	0.761
24.00	0.81	1.00	0.81	5.00	NoLiq	8.36	46.44	2.845	0.0E0	0.103	0.863
23.00	0.80	1.00	0.80	5.00	NoLiq	6.57	41.53	3.368	0.0E0	0.000	0.863
22.00	0.79	1.00	0.79	5.00	NoLiq	6.12	40.21	3.544	0.0E0	0.000	0.863
21.00	0.78	1.00	0.78	5.00	NoLiq	3.69	32.43	4.675	0.0E0	0.000	0.863
20.00	0.77	1.00	0.77	5.00	NoLiq	8.85	47.68	2.757	0.0E0	0.001	0.864
19.00	0.76	1.00	0.76	5.00	NoLiq	6.35	40.88	3.454	0.0E0	0.000	0.864
18.00	0.75	1.00	0.75	5.00	NoLiq	3.68	32.40	4.679	0.0E0	0.000	0.864
17.00	0.73	1.00	0.73	5.00	NoLiq	3.51	31.82	4.769	0.0E0	0.000	0.864
16.00	0.72	1.00	0.72	5.00	NoLiq	6.00	39.84	3.593	0.0E0	0.000	0.864
15.00	0.70	1.00	0.70	5.00	NoLiq	5.75	39.07	3.691	0.0E0	0.015	0.879
14.00	0.68	1.00	0.68	0.38	13.78	26.07	81.80	1.123	6.7E-3	0.045	0.924
13.00	0.66	1.00	0.66	0.95	5.84	33.46	98.45	0.209	1.3E-3	0.057	0.981
12.00	0.64	1.00	0.64	0.86	7.80	33.00	97.26	0.298	1.8E-3	0.041	1.022
11.00	0.61	1.00	0.61	0.45	18.86	28.96	87.76	0.882	5.3E-3	0.075	1.098
10.00	0.59	1.00	0.59	0.60	30.49	36.67	100.00	0.000	0.0E0	0.151	1.249

Settlement of Saturated Sands=1.249 in.
qc1 and (N1)60 is after fines correction in liquefaction analysis
(N1)60s is converted from qc1 and after fines correction
dsz is per each segment, dz=0.05 ft
dsp is per each print interval, dp=1.00 ft
S is cumulated settlement at this depth

Settlement of Unsaturated Sands:

Depth	sigma'	sigC'	(N1)60s	CSRsf	Gmax	g*Ge/Gm	g_eff	ec7.5	Cec	ec	dsz	dsp	S
ft	atm	atm			atm			%		%	in.	in.	in.
9.95	0.56	0.37	27.20	0.59	813.58	4.1E-4	0.3029	0.1987	1.06	0.2098	2.52E-3	0.003	0.003

9.00	0.51	0.33	34.11	0.59	834.38	3.6E-4	1.0000	0.4582	1.06	0.4838	5.81E-3	0.081	0.083
8.00	0.45	0.29	25.77	0.59	716.49	3.7E-4	1.0000	0.7064	1.06	0.7458	8.95E-3	0.143	0.227
7.00	0.40	0.26	29.21	0.59	698.79	3.3E-4	1.0000	0.5925	1.06	0.6255	7.51E-3	0.072	0.299
6.00	0.34	0.22	30.26	0.59	654.60	3.1E-4	0.4799	0.2696	1.06	0.2846	3.42E-3	0.173	0.473
5.00	0.28	0.18	44.04	0.59	677.16	2.5E-4	0.0720	0.0228	1.06	0.0240	2.88E-4	0.018	0.490
4.00	0.23	0.15	50.58	0.59	634.21	2.1E-4	0.1465	0.0463	1.06	0.0489	5.87E-4	0.005	0.495
3.00	0.17	0.11	45.19	0.59	529.04	1.9E-4	0.0498	0.0158	1.06	0.0166	2.00E-4	0.006	0.502
2.00	0.11	0.07	25.62	0.60	357.57	1.9E-4	0.0483	0.0344	1.06	0.0363	4.36E-4	0.010	0.511
1.00	0.06	0.04	68.54	0.60	350.90	9.7E-5	0.0189	0.0060	1.06	0.0063	7.57E-5	0.003	0.515
0.00	0.00	0.00	0.36	0.60	0.81	7.4E-6	0.0010	0.0048	1.06	0.0050	0.00E0	0.001	0.516

Settlement of Unsaturated Sands=0.516 in.
(N1)60s is converted from qc1 and after fines correction
dsz is per each segment, dz=0.05 ft
dsp is per each print interval, dp=1.00 ft
S is cumulated settlement at this depth

Total Settlement of Saturated and Unsaturated Sands=1.765 in.
Differential Settlement=0.882 to 1.165 in.

Units: Unit: qc, fs, Stress or Pressure = atm (1.0581tsf); Unit Weight = pcf; Depth = ft; Settlement = in.

1 atm (atmosphere) = 1.0581 tsf(1 tsf = 1 ton/ft2 = 2 kip/ft2)
1 atm (atmosphere) = 101.325 kPa(1 kPa = 1 kN/m2 = 0.001 Mpa)

SPT	Field data from Standard Penetration Test (SPT)
BPT	Field data from Becker Penetration Test (BPT)
qc	Field data from Cone Penetration Test (CPT) [atm (tsf)]
fs	Friction from CPT testing [atm (tsf)]
Rf	Ratio of fs/qc (%)
gamma	Total unit weight of soil
gamma'	Effective unit weight of soil
Fines	Fines content [%]
D50	Mean grain size
Dr	Relative Density
sigma	Total vertical stress [atm]
sigma'	Effective vertical stress [atm]
sigC'	Effective confining pressure [atm]
rd	Acceleration reduction coefficient by Seed
a_max.	Peak Ground Acceleration (PGA) in ground surface
mZ	Linear acceleration reduction coefficient X depth
a_min.	Minimum acceleration under linear reduction, mZ
CRRv	CRR after overburden stress correction, CRRv=CRR7.5 * Ksig
CRR7.5	Cyclic resistance ratio (M=7.5)
Ksig	Overburden stress correction factor for CRR7.5
CRRm	After magnitude scaling correction CRRm=CRRv * MSF
MSF	Magnitude scaling factor from M=7.5 to user input M
CSR	Cyclic stress ratio induced by earthquake
CSRfs	CSRfs=CSR*fs1 (Default fs1=1)
fs1	First CSR curve in graphic defined in #9 of Advanced page
fs2	2nd CSR curve in graphic defined in #9 of Advanced page
F.S.	Calculated factor of safety against liquefaction F.S.=CRRm/CSRsf
Cebs	Energy Ratio, Borehole Dia., and Sampling Method Corrections

Cr	Rod Length Corrections
Cn	Overburden Pressure Correction
(N1)60	SPT after corrections, (N1)60=SPT * Cr * Cn * Cebs
d(N1)60	Fines correction of SPT
(N1)60f	(N1)60 after fines corrections, (N1)60f=(N1)60 + d(N1)60
Cq	Overburden stress correction factor
qc1	CPT after Overburden stress correction
dqc1	Fines correction of CPT
qc1f	CPT after Fines and Overburden correction, qc1f=qc1 + dqc1
qc1n	CPT after normalization in Robertson's method
Kc	Fine correction factor in Robertson's Method
qc1f	CPT after Fines correction in Robertson's Method
Ic	Soil type index in Suzuki's and Robertson's Methods
(N1)60s	(N1)60 after settlement fines corrections
CSRm	After magnitude scaling correction for Settlement calculation CSRm=CSRsf / MSF*
CSRfs	Cyclic stress ratio induced by earthquake with user inputed fs
MSF*	Scaling factor from CSR, MSF*=1, based on Item 2 of Page C.
ec	Volumetric strain for saturated sands
dz	Calculation segment, dz=0.050 ft
dsz	Settlement in each segment, dz
dp	User defined print interval
dsp	Settlement in each print interval, dp
Gmax	Shear Modulus at low strain
g_eff	gamma_eff, Effective shear Strain
g*Ge/Gm	gamma_eff * G_eff/G_max, Strain-modulus ratio
ec7.5	Volumetric Strain for magnitude=7.5
Cec	Magnitude correction factor for any magnitude
ec	Volumetric strain for unsaturated sands, ec=Cec * ec7.5
NoLiq	No-Liquefy Soils

References:

1. NCEER Workshop on Evaluation of Liquefaction Resistance of Soils. Youd, T.L., and Idriss, I.M., eds., Technical Report NCEER 97-0022.
   SP117. Southern California Earthquake Center. Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for
   Analyzing and Mitigating Liquefaction in California. University of Southern California. March 1999.
2. RECENT ADVANCES IN SOIL LIQUEFACTION ENGINEERING AND SEISMIC SITE RESPONSE EVALUATION, Paper No. SPL-2, PROCEEDINGS: Fourth International Conference on Recent Advances in Geotechnical Earthquake Engineering and Soil Dynamics, San Diego, CA, March 2001.
3. RECENT ADVANCES IN SOIL LIQUEFACTION ENGINEERING: A UNIFIED AND CONSISTENT FRAMEWORK, Earthquake Engineering Research Center, Report No. EERC 2003-06 by R.B Seed and etc. April 2003.

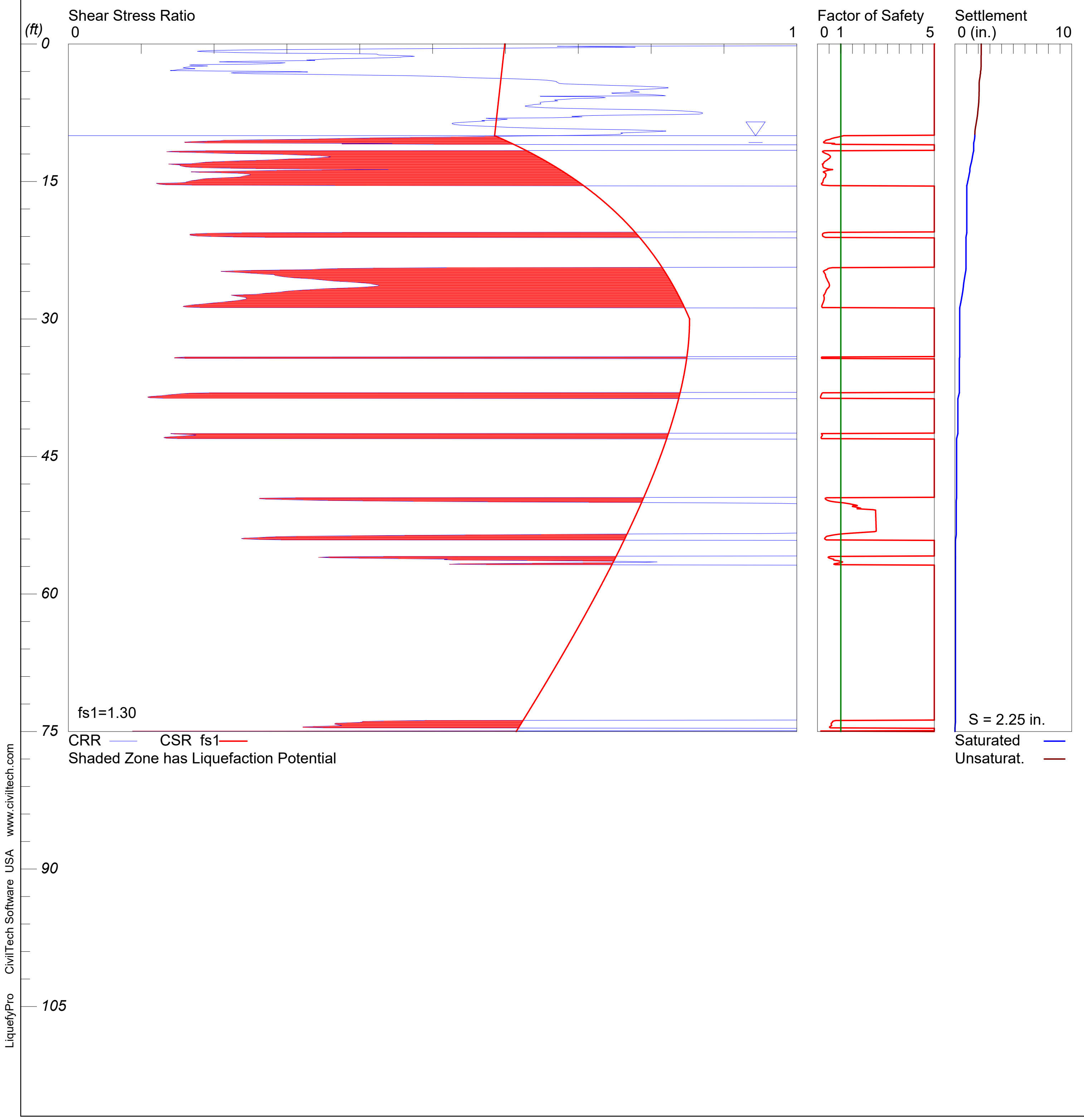
Note: Print Interval you selected does not show complete results. To get complete results, you should select 'Segment' in Print Interval (Item 12, Page C).

LIQUEFACTION ANALYSIS

Carl E Gilbert ES

Hole No.=CPT-2 Water Depth=10 ft Surface Elev.=63

Magnitude=7.5
Acceleration=0.709g



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LIQUEFACTION ANALYSIS CALCULATION DETAILS

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Input File Name: G:\Projects\200000 - Irvine\212500 - 212549\212502\212502001\Electronic Project File\Data Analysis & Calculations\Liquefaction\CPT-2_liqpro.liq
Title: Carl E Gilbert ES
Subtitle: 212502001

Input Data:
Surface Elev.=63
Hole No.=CPT-2
Depth of Hole=75.00 ft
Water Table during Earthquake= 10.00 ft
Water Table during In-Situ Testing= 30.00 ft
Max. Acceleration=0.71 g
Earthquake Magnitude=7.50
No-Liquefiable Soils: CL, OL are Non-Liq. Soil
1. CPT Calulation Method: Modify Robertson*
2. Settlement Analysis Method: Tokimatsu/Seed
3. Fines Correction for Liquefaction: Stark/Olson et al.*
4. Fine Correction for Settlement: During Liquefaction*
5. Settlement Calculation in: All zones*
9. User request factor of safety (apply to CSR) ,   User= 1.3
   Plot one CSR curve (fs1=User)
10. Average two input data between two Depths: Yes*
* Recommended Options

In-Situ Test Data:

Depth ft	qc atm	fs atm	Rf %	Gamma pcf	Fines %	D50 mm
0.00	0.09	0.29	325.56	120.00	*	0.50
1.17	17.37	0.57	3.29	120.00	*	0.50
2.91	12.77	0.22	1.73	120.00	*	0.50
4.23	90.78	0.68	0.75	120.00	*	0.50
5.89	110.70	0.81	0.73	120.00	*	0.50
7.05	119.00	0.95	0.80	120.00	*	0.50
8.56	117.80	0.86	0.73	120.00	*	0.50
10.23	111.20	1.02	0.92	120.00	*	0.50
11.77	46.21	0.55	1.20	120.00	*	0.50
13.54	47.78	1.11	2.31	120.00	*	0.50
15.49	22.76	0.74	3.25	120.00	*	0.50
17.02	9.21	0.41	4.42	120.00	*	0.50
18.52	7.64	0.16	2.11	120.00	*	0.50
20.19	29.19	0.85	2.91	120.00	*	0.50
21.93	13.12	0.31	2.38	120.00	*	0.50
24.03	34.23	2.19	6.39	120.00	*	0.50

26.38	168.00	1.95	1.16	120.00	*	0.50
28.64	64.20	1.11	1.72	120.00	*	0.50
31.41	14.94	0.31	2.06	120.00	*	0.50
33.75	15.46	0.81	5.24	120.00	*	0.50
35.83	30.84	1.27	4.11	120.00	*	0.50
38.11	72.97	1.32	1.80	120.00	*	0.50
39.72	12.68	0.48	3.80	120.00	*	0.50
41.19	13.90	0.41	2.99	120.00	*	0.50
43.09	47.69	1.09	2.28	120.00	*	0.50
44.99	19.63	0.58	2.98	120.00	*	0.50
47.13	18.76	0.70	3.74	120.00	*	0.50
48.86	17.20	0.56	3.27	120.00	*	0.50
50.90	431.80	5.86	1.36	120.00	*	0.50
52.59	561.60	6.71	1.20	120.00	*	0.50
54.63	40.39	1.91	4.73	120.00	*	0.50
56.55	256.60	4.99	1.94	120.00	*	0.50
58.92	32.58	0.70	2.15	120.00	*	0.50
61.08	28.93	1.93	6.69	120.00	*	0.50
63.72	25.80	1.26	4.87	120.00	*	0.50
65.86	30.40	2.17	7.14	120.00	*	0.50
68.13	43.13	3.40	7.89	120.00	*	0.50
70.16	25.63	0.60	2.33	120.00	*	0.50
72.35	37.09	2.02	5.44	120.00	*	0.50
74.72	84.00	3.77	4.49	120.00	*	0.50

* Modify Robertson method generates Fines from qc/fs. Inputted Fines are not relevant.

Output Results:

Calculation segment, dz=0.050 ft

User defined Print Interval, dp=1.00 ft

Peak Ground Acceleration (PGA), a_max = 0.71g

CSR Calculation:

Depth ft	gamma pcf	sigma atm	gamma' pcf	sigma' atm	rd	mZ g	a(z) g	CSR	x fs1	=CSRfs
0.00	120.00	0.000	120.00	0.000	1.00	0.000	0.709	0.46	1.30	0.60
1.00	120.00	0.057	120.00	0.057	1.00	0.000	0.709	0.46	1.30	0.60
2.00	120.00	0.113	120.00	0.113	1.00	0.000	0.709	0.46	1.30	0.60
3.00	120.00	0.170	120.00	0.170	0.99	0.000	0.709	0.46	1.30	0.59
4.00	120.00	0.227	120.00	0.227	0.99	0.000	0.709	0.46	1.30	0.59
5.00	120.00	0.284	120.00	0.284	0.99	0.000	0.709	0.46	1.30	0.59
6.00	120.00	0.340	120.00	0.340	0.99	0.000	0.709	0.45	1.30	0.59
7.00	120.00	0.397	120.00	0.397	0.98	0.000	0.709	0.45	1.30	0.59
8.00	120.00	0.454	120.00	0.454	0.98	0.000	0.709	0.45	1.30	0.59
9.00	120.00	0.510	120.00	0.510	0.98	0.000	0.709	0.45	1.30	0.59
10.00	120.00	0.567	57.60	0.567	0.98	0.000	0.709	0.45	1.30	0.59
11.00	120.00	0.624	57.60	0.594	0.97	0.000	0.709	0.47	1.30	0.61
12.00	120.00	0.680	57.60	0.622	0.97	0.000	0.709	0.49	1.30	0.64
13.00	120.00	0.737	57.60	0.649	0.97	0.000	0.709	0.51	1.30	0.66

14.00	120.00	0.794	57.60	0.676	0.97	0.000	0.709	0.52	1.30	0.68
15.00	120.00	0.851	57.60	0.703	0.97	0.000	0.709	0.54	1.30	0.70
16.00	120.00	0.907	57.60	0.730	0.96	0.000	0.709	0.55	1.30	0.72
17.00	120.00	0.964	57.60	0.758	0.96	0.000	0.709	0.56	1.30	0.73
18.00	120.00	1.021	57.60	0.785	0.96	0.000	0.709	0.57	1.30	0.75
19.00	120.00	1.077	57.60	0.812	0.96	0.000	0.709	0.58	1.30	0.76
20.00	120.00	1.134	57.60	0.839	0.95	0.000	0.709	0.59	1.30	0.77
21.00	120.00	1.191	57.60	0.866	0.95	0.000	0.709	0.60	1.30	0.78
22.00	120.00	1.248	57.60	0.894	0.95	0.000	0.709	0.61	1.30	0.79
23.00	120.00	1.304	57.60	0.921	0.95	0.000	0.709	0.62	1.30	0.80
24.00	120.00	1.361	57.60	0.948	0.94	0.000	0.709	0.62	1.30	0.81
25.00	120.00	1.418	57.60	0.975	0.94	0.000	0.709	0.63	1.30	0.82
26.00	120.00	1.474	57.60	1.003	0.94	0.000	0.709	0.64	1.30	0.83
27.00	120.00	1.531	57.60	1.030	0.94	0.000	0.709	0.64	1.30	0.83
28.00	120.00	1.588	57.60	1.057	0.93	0.000	0.709	0.65	1.30	0.84
29.00	120.00	1.644	57.60	1.084	0.93	0.000	0.709	0.65	1.30	0.85
30.00	120.00	1.701	57.60	1.111	0.93	0.000	0.709	0.66	1.30	0.85
31.00	120.00	1.758	57.60	1.139	0.92	0.000	0.709	0.66	1.30	0.85
32.00	120.00	1.815	57.60	1.166	0.91	0.000	0.709	0.66	1.30	0.85
33.00	120.00	1.871	57.60	1.193	0.91	0.000	0.709	0.65	1.30	0.85
34.00	120.00	1.928	57.60	1.220	0.90	0.000	0.709	0.65	1.30	0.85
35.00	120.00	1.985	57.60	1.248	0.89	0.000	0.709	0.65	1.30	0.85
36.00	120.00	2.041	57.60	1.275	0.88	0.000	0.709	0.65	1.30	0.85
37.00	120.00	2.098	57.60	1.302	0.87	0.000	0.709	0.65	1.30	0.84
38.00	120.00	2.155	57.60	1.329	0.86	0.000	0.709	0.65	1.30	0.84
39.00	120.00	2.212	57.60	1.356	0.86	0.000	0.709	0.64	1.30	0.84
40.00	120.00	2.268	57.60	1.384	0.85	0.000	0.709	0.64	1.30	0.83
41.00	120.00	2.325	57.60	1.411	0.84	0.000	0.709	0.64	1.30	0.83
42.00	120.00	2.382	57.60	1.438	0.83	0.000	0.709	0.64	1.30	0.83
43.00	120.00	2.438	57.60	1.465	0.82	0.000	0.709	0.63	1.30	0.82
44.00	120.00	2.495	57.60	1.492	0.82	0.000	0.709	0.63	1.30	0.82
45.00	120.00	2.552	57.60	1.520	0.81	0.000	0.709	0.63	1.30	0.81
46.00	120.00	2.608	57.60	1.547	0.80	0.000	0.709	0.62	1.30	0.81
47.00	120.00	2.665	57.60	1.574	0.79	0.000	0.709	0.62	1.30	0.80
48.00	120.00	2.722	57.60	1.601	0.78	0.000	0.709	0.61	1.30	0.80
49.00	120.00	2.779	57.60	1.629	0.78	0.000	0.709	0.61	1.30	0.79
50.00	120.00	2.835	57.60	1.656	0.77	0.000	0.709	0.61	1.30	0.79
51.00	120.00	2.892	57.60	1.683	0.76	0.000	0.709	0.60	1.30	0.78
52.00	120.00	2.949	57.60	1.710	0.75	0.000	0.709	0.60	1.30	0.78
53.00	120.00	3.005	57.60	1.737	0.74	0.000	0.709	0.59	1.30	0.77
54.00	120.00	3.062	57.60	1.765	0.73	0.000	0.709	0.59	1.30	0.76
55.00	120.00	3.119	57.60	1.792	0.73	0.000	0.709	0.58	1.30	0.76
56.00	120.00	3.176	57.60	1.819	0.72	0.000	0.709	0.58	1.30	0.75
57.00	120.00	3.232	57.60	1.846	0.71	0.000	0.709	0.57	1.30	0.74
58.00	120.00	3.289	57.60	1.874	0.70	0.000	0.709	0.57	1.30	0.74
59.00	120.00	3.346	57.60	1.901	0.69	0.000	0.709	0.56	1.30	0.73
60.00	120.00	3.402	57.60	1.928	0.69	0.000	0.709	0.56	1.30	0.72
61.00	120.00	3.459	57.60	1.955	0.68	0.000	0.709	0.55	1.30	0.72
62.00	120.00	3.516	57.60	1.982	0.67	0.000	0.709	0.55	1.30	0.71
63.00	120.00	3.572	57.60	2.010	0.66	0.000	0.709	0.54	1.30	0.70
64.00	120.00	3.629	57.60	2.037	0.65	0.000	0.709	0.54	1.30	0.70
65.00	120.00	3.686	57.60	2.064	0.65	0.000	0.709	0.53	1.30	0.69

66.00	120.00	3.743	57.60	2.091	0.64	0.000	0.709	0.53	1.30	0.68
67.00	120.00	3.799	57.60	2.119	0.63	0.000	0.709	0.52	1.30	0.68
68.00	120.00	3.856	57.60	2.146	0.62	0.000	0.709	0.51	1.30	0.67
69.00	120.00	3.913	57.60	2.173	0.61	0.000	0.709	0.51	1.30	0.66
70.00	120.00	3.969	57.60	2.200	0.60	0.000	0.709	0.50	1.30	0.65
71.00	120.00	4.026	57.60	2.227	0.60	0.000	0.709	0.50	1.30	0.65
72.00	120.00	4.083	57.60	2.255	0.59	0.000	0.709	0.49	1.30	0.64
73.00	120.00	4.140	57.60	2.282	0.58	0.000	0.709	0.48	1.30	0.63
74.00	120.00	4.196	57.60	2.309	0.57	0.000	0.709	0.48	1.30	0.62
75.00	120.00	4.253	57.60	2.336	0.56	0.000	0.709	0.47	1.30	0.61

CSR is based on water table at 10.00 during earthquake

CRR Calculation from CPT data, using Modify Robertson's Method:
(Fines content is determined by qc and fric.)

Depth ft	qc atm	fric. atm	n	Q	Rf	Ic	Cq	Fines %	Kc	qc1n atm	qc1f atm	CRR7.5
0.00			1.00	9.00E3	325.59	3.76						
0.00	0.09	0.29	1.00	9.00E3	325.59	3.76	1.00	NoLiq	1.00	0.09	0.09	2.08
1.00			1.00	2.23E2	2.86	2.02						
1.00			0.50	5.34E1	2.86	2.42						
1.00	12.72	0.36	0.50	5.34E1	2.86	2.42	4.20	27.13	0.59	53.41	130.56	0.29
2.00			1.00	1.07E2	2.55	2.17						
2.00			0.50	3.62E1	2.55	2.51						
2.00	12.20	0.31	0.50	3.62E1	2.55	2.51	2.97	31.13	0.70	36.21	119.81	0.24
3.00			1.00	7.73E1	2.68	2.29						
3.00			0.50	3.23E1	2.68	2.56						
3.00	13.32	0.35	0.50	3.23E1	2.68	2.56	2.42	33.53	0.76	32.29	135.60	0.31
4.00			1.00	3.86E2	0.66	1.36						
4.00			0.50	1.84E2	0.66	1.59						
4.00	87.79	0.58	0.50	1.84E2	0.66	1.59	2.10	4.22	0.00	184.33	184.33	0.66
5.00			1.00	3.61E2	0.90	1.49						
5.00			0.50	1.93E2	0.90	1.67						
5.00	102.65	0.93	0.50	1.93E2	0.90	1.67	1.88	5.56	0.01	192.77	195.68	0.78
6.00			1.00	3.20E2	0.77	1.47						
6.00			0.50	1.87E2	0.77	1.63						
6.00	109.07	0.83	0.50	1.87E2	0.77	1.63	1.71	4.85	0.00	186.99	186.99	0.69
7.00			1.00	2.92E2	0.81	1.51						
7.00			0.50	1.84E2	0.81	1.65						
7.00	116.15	0.94	0.50	1.84E2	0.81	1.65	1.59	5.24	0.01	184.35	185.55	0.67
8.00			1.00	2.72E2	0.88	1.56						
8.00			0.50	1.84E2	0.88	1.68						
8.00	123.89	1.09	0.50	1.84E2	0.88	1.68	1.48	5.69	0.02	183.93	187.38	0.69
9.00			1.00	2.45E2	0.72	1.53						
9.00			0.50	1.76E2	0.72	1.63						
9.00	125.40	0.90	0.50	1.76E2	0.72	1.63	1.40	4.89	0.00	175.53	175.53	0.58
10.00			1.00	2.42E2	0.79	1.56						
10.00			0.50	1.83E2	0.79	1.64						
10.00	137.88	1.08	0.50	1.83E2	0.79	1.64	1.33	5.12	0.00	183.10	183.70	0.66
11.00			1.00	3.14E1	4.04	2.69						
11.00	20.24	0.79	1.00	3.14E1	4.04	2.69	1.00	NoLiq	1.00	20.24	20.24	2.08

12.00			1.00	1.43E2	0.67	1.68						
12.00			0.50	1.19E2	0.67	1.74						
12.00	98.22	0.65	0.50	1.19E2	0.67	1.74	1.21	6.93	0.05	119.06	125.53	0.26
13.00			1.00	1.11E2	0.48	1.69						
13.00			0.50	9.59E1	0.48	1.74						
13.00	82.37	0.39	0.50	9.59E1	0.48	1.74	1.16	6.87	0.05	95.94	100.98	0.18
14.00			1.00	8.27E1	1.29	2.04						
14.00			0.50	7.46E1	1.29	2.08						
14.00	66.43	0.85	0.50	7.46E1	1.29	2.08	1.12	15.18	0.27	74.55	102.39	0.18
15.00			1.00	6.76E1	1.47	2.15						
15.00			0.50	6.33E1	1.47	2.17						
15.00	58.38	0.84	0.50	6.33E1	1.47	2.17	1.08	17.99	0.35	63.30	96.89	0.16
16.00			1.00	1.83E1	2.19	2.70						
16.00	17.49	0.36	1.00	1.83E1	2.19	2.70	1.00	NoLiq	1.00	17.49	17.49	2.08
17.00			1.00	9.09E0	4.90	3.16						
17.00	9.73	0.43	1.00	9.09E0	4.90	3.16	1.00	NoLiq	1.00	9.73	9.73	2.08
18.00			1.00	6.25E0	1.84	3.06						
18.00	7.40	0.12	1.00	6.25E0	1.84	3.06	1.00	NoLiq	1.00	7.40	7.40	2.08
19.00			1.00	6.40E0	2.00	3.07						
19.00	7.97	0.14	1.00	6.40E0	2.00	3.07	1.00	NoLiq	1.00	7.97	7.97	2.08
20.00			1.00	1.89E1	2.68	2.74						
20.00	22.61	0.58	1.00	1.89E1	2.68	2.74	1.00	NoLiq	1.00	22.61	22.61	2.08
21.00			1.00	3.85E1	2.32	2.46						
21.00			0.50	4.31E1	2.32	2.43						
21.00	47.03	1.06	0.50	4.31E1	2.32	2.43	0.92	27.47	0.60	43.09	107.75	0.20
22.00			1.00	9.18E0	2.87	3.02						
22.00	12.70	0.33	1.00	9.18E0	2.87	3.02	1.00	NoLiq	1.00	12.70	12.70	2.08
23.00			1.00	1.29E1	4.75	3.03						
23.00	18.07	0.80	1.00	1.29E1	4.75	3.03	1.00	NoLiq	1.00	18.07	18.07	2.08
24.00			1.00	2.35E1	6.56	2.92						
24.00	33.37	2.10	1.00	2.35E1	6.56	2.92	1.00	NoLiq	1.00	33.37	33.37	2.08
25.00			1.00	7.89E1	1.36	2.07						
25.00			0.50	9.51E1	1.36	2.01						
25.00	113.27	1.52	0.50	9.51E1	1.36	2.01	0.84	13.33	0.22	95.14	122.35	0.25
26.00			1.00	1.12E2	0.97	1.86						
26.00			0.50	1.38E2	0.97	1.80						
26.00	167.10	1.61	0.50	1.38E2	0.97	1.80	0.82	8.08	0.08	137.62	149.94	0.39
27.00			1.00	7.93E1	1.62	2.12						
27.00			0.50	9.94E1	1.62	2.05						
27.00	122.99	1.96	0.50	9.94E1	1.62	2.05	0.81	14.38	0.25	99.39	132.61	0.30
28.00			1.00	7.02E1	1.35	2.11						
28.00			0.50	8.98E1	1.35	2.03						
28.00	113.11	1.50	0.50	8.98E1	1.35	2.03	0.79	13.79	0.23	89.76	117.28	0.23
29.00			1.00	1.17E1	4.52	3.05						
29.00	20.91	0.87	1.00	1.17E1	4.52	3.05	1.00	NoLiq	1.00	20.91	20.91	2.08
30.00			1.00	6.95E0	2.62	3.10						
30.00	13.53	0.31	1.00	6.95E0	2.62	3.10	1.00	NoLiq	1.00	13.53	13.53	2.08
31.00			1.00	5.96E0	2.86	3.17						
31.00	12.07	0.30	1.00	5.96E0	2.86	3.17	1.00	NoLiq	1.00	12.07	12.07	2.08
32.00			1.00	7.15E0	3.59	3.16						
32.00	14.38	0.45	1.00	7.15E0	3.59	3.16	1.00	NoLiq	1.00	14.38	14.38	2.08
33.00			1.00	8.63E0	2.68	3.02						

33.00	17.27	0.41	1.00	8.63E0	2.68	3.02	1.00	NoLiq	1.00	17.27	17.27	2.08
34.00			1.00	1.31E1	4.20	2.99						
34.00	25.71	1.00	1.00	1.31E1	4.20	2.99	1.00	NoLiq	1.00	25.71	25.71	2.08
35.00			1.00	8.88E0	3.26	3.06						
35.00	18.31	0.53	1.00	8.88E0	3.26	3.06	1.00	NoLiq	1.00	18.31	18.31	2.08
36.00			1.00	1.05E1	2.49	2.93						
36.00	21.61	0.49	1.00	1.05E1	2.49	2.93	1.00	NoLiq	1.00	21.61	21.61	2.08
37.00			1.00	6.79E0	2.92	3.13						
37.00	14.95	0.38	1.00	6.79E0	2.92	3.13	1.00	NoLiq	1.00	14.95	14.95	2.08
38.00			1.00	2.53E1	2.87	2.66						
38.00	50.68	1.39	1.00	2.53E1	2.87	2.66	1.00	NoLiq	1.00	50.68	50.68	2.08
39.00			1.00	1.02E1	5.45	3.14						
39.00	22.14	1.09	1.00	1.02E1	5.45	3.14	1.00	NoLiq	1.00	22.14	22.14	2.08
40.00			1.00	5.54E0	3.65	3.26						
40.00	13.21	0.40	1.00	5.54E0	3.65	3.26	1.00	NoLiq	1.00	13.21	13.21	2.08
41.00			1.00	5.39E0	3.09	3.23						
41.00	13.12	0.33	1.00	5.39E0	3.09	3.23	1.00	NoLiq	1.00	13.12	13.12	2.08
42.00			1.00	1.14E1	3.40	2.98						
42.00	25.42	0.78	1.00	1.14E1	3.40	2.98	1.00	NoLiq	1.00	25.42	25.42	2.08
43.00			1.00	3.18E1	1.57	2.42						
43.00			0.50	4.73E1	1.57	2.29						
43.00	67.79	1.03	0.50	4.73E1	1.57	2.29	0.70	22.03	0.45	47.27	86.68	0.14
44.00			1.00	5.85E0	2.86	3.18						
44.00	14.68	0.35	1.00	5.85E0	2.86	3.18	1.00	NoLiq	1.00	14.68	14.68	2.08
45.00			1.00	8.10E0	3.42	3.10						
45.00	19.65	0.58	1.00	8.10E0	3.42	3.10	1.00	NoLiq	1.00	19.65	19.65	2.08
46.00			1.00	8.56E0	3.81	3.11						
46.00	20.91	0.70	1.00	8.56E0	3.81	3.11	1.00	NoLiq	1.00	20.91	20.91	2.08
47.00			1.00	8.61E0	3.53	3.09						
47.00	21.30	0.66	1.00	8.61E0	3.53	3.09	1.00	NoLiq	1.00	21.30	21.30	2.08
48.00			1.00	7.47E0	2.51	3.06						
48.00	19.11	0.41	1.00	7.47E0	2.51	3.06	1.00	NoLiq	1.00	19.11	19.11	2.08
49.00			1.00	7.68E0	4.84	3.21						
49.00	19.82	0.83	1.00	7.68E0	4.84	3.21	1.00	NoLiq	1.00	19.82	19.82	2.08
50.00			1.00	1.16E2	1.33	1.94						
50.00			0.50	1.76E2	1.33	1.82						
50.00	263.86	3.47	0.50	1.76E2	1.33	1.82	0.67	8.52	0.09	176.03	194.27	0.76
51.00			1.00	1.94E2	1.43	1.81						
51.00			0.50	2.95E2	1.43	1.70						
51.00	444.73	6.34	0.50	2.95E2	1.43	1.70	0.66	6.15	0.03	294.90	304.22	2.08
52.00			1.00	2.32E2	1.39	1.75						
52.00			0.50	3.53E2	1.39	1.65						
52.00	535.98	7.40	0.50	3.53E2	1.39	1.65	0.66	5.12	0.00	353.30	354.47	2.08
53.00			1.00	2.03E2	1.31	1.77						
53.00			0.50	3.12E2	1.31	1.66						
53.00	476.28	6.20	0.50	3.12E2	1.31	1.66	0.66	5.30	0.01	312.11	314.65	2.08
54.00			1.00	4.40E1	2.32	2.42						
54.00			0.50	6.96E1	2.32	2.27						
54.00	106.80	2.41	0.50	6.96E1	2.32	2.27	0.65	21.51	0.44	69.58	124.42	0.26
55.00			1.00	1.55E1	6.39	3.05						
55.00	40.13	2.36	1.00	1.55E1	6.39	3.05	1.00	NoLiq	1.00	40.13	40.13	2.08
56.00			1.00	4.49E1	3.00	2.49						

56.00			0.50	7.17E1	3.00	2.34						
56.00	111.32	3.24	0.50	7.17E1	3.00	2.34	0.64	24.11	0.51	71.70	146.41	0.37
57.00			1.00	2.38E1	5.68	2.88						
57.00	61.32	3.30	1.00	2.38E1	5.68	2.88	1.00	NoLiq	1.00	61.32	61.32	2.08
58.00			1.00	9.45E0	2.78	3.00						
58.00	26.58	0.65	1.00	9.45E0	2.78	3.00	1.00	NoLiq	1.00	26.58	26.58	2.08
59.00			1.00	1.17E1	2.33	2.88						
59.00	32.63	0.68	1.00	1.17E1	2.33	2.88	1.00	NoLiq	1.00	32.63	32.63	2.08
60.00			1.00	1.12E1	4.71	3.07						
60.00	31.74	1.33	1.00	1.12E1	4.71	3.07	1.00	NoLiq	1.00	31.74	31.74	2.08
61.00			1.00	1.04E1	8.40	3.26						
61.00	29.86	2.22	1.00	1.04E1	8.40	3.26	1.00	NoLiq	1.00	29.86	29.86	2.08
62.00			1.00	9.30E0	3.99	3.09						
62.00	27.45	0.95	1.00	9.30E0	3.99	3.09	1.00	NoLiq	1.00	27.45	27.45	2.08
63.00			1.00	8.35E0	5.06	3.19						
63.00	25.29	1.10	1.00	8.35E0	5.06	3.19	1.00	NoLiq	1.00	25.29	25.29	2.08
64.00			1.00	8.84E0	5.85	3.21						
64.00	26.87	1.36	1.00	8.84E0	5.85	3.21	1.00	NoLiq	1.00	26.87	26.87	2.08
65.00			1.00	9.97E0	6.06	3.18						
65.00	30.16	1.60	1.00	9.97E0	6.06	3.18	1.00	NoLiq	1.00	30.16	30.16	2.08
66.00			1.00	8.42E0	7.42	3.29						
66.00	26.34	1.68	1.00	8.42E0	7.42	3.29	1.00	NoLiq	1.00	26.34	26.34	2.08
67.00			1.00	9.59E0	7.73	3.26						
67.00	29.79	2.01	1.00	9.59E0	7.73	3.26	1.00	NoLiq	1.00	29.79	29.79	2.08
68.00			1.00	1.20E1	8.28	3.21						
68.00	36.81	2.73	1.00	1.20E1	8.28	3.21	1.00	NoLiq	1.00	36.81	36.81	2.08
69.00			1.00	3.80E1	5.63	2.73						
69.00	108.95	5.91	1.00	3.80E1	5.63	2.73	1.00	NoLiq	1.00	108.95	108.95	2.08
70.00			1.00	6.96E0	2.78	3.11						
70.00	23.40	0.54	1.00	6.96E0	2.78	3.11	1.00	NoLiq	1.00	23.40	23.40	2.08
71.00			1.00	1.03E1	5.46	3.14						
71.00	33.06	1.58	1.00	1.03E1	5.46	3.14	1.00	NoLiq	1.00	33.06	33.06	2.08
72.00			1.00	1.01E1	5.12	3.13						
72.00	32.68	1.46	1.00	1.01E1	5.12	3.13	1.00	NoLiq	1.00	32.68	32.68	2.08
73.00			1.00	1.67E1	7.88	3.09						
73.00	52.10	3.78	1.00	1.67E1	7.88	3.09	1.00	NoLiq	1.00	52.10	52.10	2.08
74.00			1.00	7.36E1	1.62	2.15						
74.00			0.50	1.28E2	1.62	1.98						
74.00	217.55	3.47	0.50	1.28E2	1.62	1.98	0.59	12.32	0.20	127.74	158.77	0.45
75.00			1.00	1.77E1	0.00	3.56						
75.00	56.03	0.00	1.00	1.77E1	0.00	3.56	1.00	NoLiq	1.00	56.03	56.03	2.08

Fines have been calculated, and correction is made by Modify Robertson Method.
Fines=NoLiq means the soils are not liquefiable.
CRR is based on water table at 30.00 during In-Situ Testing

Factor of Safety, - Earthquake Magnitude= 7.50:

Depth ft	sigC' atm	CRR7.5	x Ksig	=CRRv	x MSF	=CRRm	CSRfs	F.S.=CRRm/CSRfs
0.00	0.00	2.08	1.00	2.08	1.00	2.00	0.60	5.00 ^
1.00	0.04	0.29	1.00	0.29	1.00	0.29	0.60	5.00

2.00	0.07	0.24	1.00	0.24	1.00	0.24	0.60	5.00
3.00	0.11	0.31	1.00	0.31	1.00	0.31	0.59	5.00
4.00	0.15	0.66	1.00	0.66	1.00	0.66	0.59	5.00
5.00	0.18	0.78	1.00	0.78	1.00	0.78	0.59	5.00
6.00	0.22	0.69	1.00	0.69	1.00	0.69	0.59	5.00
7.00	0.26	0.67	1.00	0.67	1.00	0.67	0.59	5.00
8.00	0.29	0.69	1.00	0.69	1.00	0.69	0.59	5.00
9.00	0.33	0.58	1.00	0.58	1.00	0.58	0.59	5.00
10.00	0.37	0.66	1.00	0.66	1.00	0.66	0.59	1.12
11.00	0.41	2.08	1.00	2.08	1.00	2.00	0.61	5.00 ^
12.00	0.44	0.26	1.00	0.26	1.00	0.26	0.64	0.41 *
13.00	0.48	0.18	1.00	0.18	1.00	0.18	0.66	0.27 *
14.00	0.52	0.18	1.00	0.18	1.00	0.18	0.68	0.26 *
15.00	0.55	0.16	1.00	0.16	1.00	0.16	0.70	0.24 *
16.00	0.59	2.08	1.00	2.08	1.00	2.00	0.72	5.00 ^
17.00	0.63	2.08	1.00	2.08	1.00	2.00	0.73	5.00 ^
18.00	0.66	2.08	1.00	2.08	1.00	2.00	0.75	5.00 ^
19.00	0.70	2.08	1.00	2.08	1.00	2.00	0.76	5.00 ^
20.00	0.74	2.08	1.00	2.08	1.00	2.00	0.77	5.00 ^
21.00	0.77	0.20	1.00	0.20	1.00	0.20	0.78	0.25 *
22.00	0.81	2.08	1.00	2.08	1.00	2.00	0.79	5.00 ^
23.00	0.85	2.08	1.00	2.08	1.00	2.00	0.80	5.00 ^
24.00	0.88	2.08	1.00	2.08	1.00	2.00	0.81	5.00 ^
25.00	0.92	0.25	1.00	0.25	1.00	0.25	0.82	0.31 *
26.00	0.96	0.39	1.00	0.39	1.00	0.39	0.83	0.48 *
27.00	1.00	0.30	1.00	0.30	1.00	0.30	0.83	0.36 *
28.00	1.03	0.23	1.00	0.23	1.00	0.23	0.84	0.27 *
29.00	1.07	2.08	1.00	2.07	1.00	2.00	0.85	5.00 ^
30.00	1.11	2.08	0.99	2.06	1.00	2.00	0.85	5.00 ^
31.00	1.12	2.08	0.99	2.05	1.00	2.00	0.85	5.00 ^
32.00	1.14	2.08	0.98	2.05	1.00	2.00	0.85	5.00 ^
33.00	1.16	2.08	0.98	2.04	1.00	2.00	0.85	5.00 ^
34.00	1.18	2.08	0.98	2.04	1.00	2.00	0.85	5.00 ^
35.00	1.20	2.08	0.98	2.03	1.00	2.00	0.85	5.00 ^
36.00	1.21	2.08	0.97	2.02	1.00	2.00	0.85	5.00 ^
37.00	1.23	2.08	0.97	2.02	1.00	2.00	0.84	5.00 ^
38.00	1.25	2.08	0.97	2.01	1.00	2.00	0.84	5.00 ^
39.00	1.27	2.08	0.97	2.01	1.00	2.00	0.84	5.00 ^
40.00	1.28	2.08	0.96	2.00	1.00	2.00	0.83	5.00 ^
41.00	1.30	2.08	0.96	2.00	1.00	2.00	0.83	5.00 ^
42.00	1.32	2.08	0.96	1.99	1.00	2.00	0.83	5.00 ^
43.00	1.34	0.14	0.96	0.13	1.00	0.13	0.82	0.16 *
44.00	1.35	2.08	0.95	1.98	1.00	2.00	0.82	5.00 ^
45.00	1.37	2.08	0.95	1.98	1.00	2.00	0.81	5.00 ^
46.00	1.39	2.08	0.95	1.97	1.00	2.00	0.81	5.00 ^
47.00	1.41	2.08	0.95	1.97	1.00	2.00	0.80	5.00 ^
48.00	1.43	2.08	0.94	1.96	1.00	2.00	0.80	5.00 ^
49.00	1.44	2.08	0.94	1.96	1.00	2.00	0.79	5.00 ^
50.00	1.46	0.76	0.94	0.71	1.00	0.71	0.79	0.91 *
51.00	1.48	2.08	0.94	1.95	1.00	1.95	0.78	2.49
52.00	1.50	2.08	0.93	1.94	1.00	1.94	0.78	2.50
53.00	1.51	2.08	0.93	1.94	1.00	1.94	0.77	2.52

54.00	1.53	0.26	0.93	0.24	1.00	0.24	0.76	0.32	*
55.00	1.55	2.08	0.93	1.93	1.00	2.00	0.76	5.00	^
56.00	1.57	0.37	0.92	0.34	1.00	0.34	0.75	0.46	*
57.00	1.58	2.08	0.92	1.92	1.00	2.00	0.74	5.00	^
58.00	1.60	2.08	0.92	1.91	1.00	2.00	0.74	5.00	^
59.00	1.62	2.08	0.92	1.91	1.00	2.00	0.73	5.00	^
60.00	1.64	2.08	0.91	1.90	1.00	2.00	0.72	5.00	^
61.00	1.66	2.08	0.91	1.90	1.00	2.00	0.72	5.00	^
62.00	1.67	2.08	0.91	1.89	1.00	2.00	0.71	5.00	^
63.00	1.69	2.08	0.91	1.89	1.00	2.00	0.70	5.00	^
64.00	1.71	2.08	0.91	1.88	1.00	2.00	0.70	5.00	^
65.00	1.73	2.08	0.90	1.88	1.00	2.00	0.69	5.00	^
66.00	1.74	2.08	0.90	1.88	1.00	2.00	0.68	5.00	^
67.00	1.76	2.08	0.90	1.87	1.00	2.00	0.68	5.00	^
68.00	1.78	2.08	0.90	1.87	1.00	2.00	0.67	5.00	^
69.00	1.80	2.08	0.90	1.86	1.00	2.00	0.66	5.00	^
70.00	1.81	2.08	0.89	1.86	1.00	2.00	0.65	5.00	^
71.00	1.83	2.08	0.89	1.85	1.00	2.00	0.65	5.00	^
72.00	1.85	2.08	0.89	1.85	1.00	2.00	0.64	5.00	^
73.00	1.87	2.08	0.89	1.84	1.00	2.00	0.63	5.00	^
74.00	1.89	0.45	0.88	0.40	1.00	0.40	0.62	0.64	*
75.00	1.90	2.08	0.88	1.84	1.00	2.00	0.61	5.00	^

* F.S.<1: Liquefaction Potential Zone. (If above water table: F.S.=5)
^ No-liquefiable Soils or above Water Table.
(F.S. is limited to 5, CRR is limited to 2,   CSR is limited to 2)

CPT convert to SPT for Settlement Analysis:
Fines Correction for Settlement Analysis:

Depth ft	Ic	qc/N60	qc1 atm	(N1)60	Fines %	d(N1)60	(N1)60s
0.00	3.76	1.54	0.09	0.06	NoLiq	0.00	0.06
1.00	2.42	4.03	130.56	32.37	27.13	0.00	32.37
2.00	2.51	3.86	119.81	31.02	31.13	0.00	31.02
3.00	2.56	3.77	135.60	36.01	33.53	0.00	36.01
4.00	1.59	5.56	184.33	33.16	4.22	0.00	33.16
5.00	1.67	5.42	195.68	36.14	5.56	0.00	36.14
6.00	1.63	5.49	186.99	34.06	4.85	0.00	34.06
7.00	1.65	5.45	185.55	34.06	5.24	0.00	34.06
8.00	1.68	5.40	187.38	34.69	5.69	0.00	34.69
9.00	1.63	5.49	175.53	32.00	4.89	0.00	32.00
10.00	1.64	5.46	183.70	33.64	5.12	0.00	33.64
11.00	2.69	3.53	20.24	5.73	NoLiq	0.00	5.73
12.00	1.74	5.28	125.53	23.77	6.93	0.00	23.77
13.00	1.74	5.29	100.98	19.10	6.87	0.00	19.10
14.00	2.08	4.66	102.39	21.98	15.18	0.00	21.98
15.00	2.17	4.49	96.89	21.57	17.99	0.00	21.57
16.00	2.70	3.50	17.49	4.99	NoLiq	0.00	4.99
17.00	3.16	2.67	9.73	3.64	NoLiq	0.00	3.64
18.00	3.06	2.85	7.40	2.60	NoLiq	0.00	2.60

19.00	3.07	2.83	7.97	2.82	NoLiq	0.00	2.82
20.00	2.74	3.43	22.61	6.59	NoLiq	0.00	6.59
21.00	2.43	4.02	107.75	26.82	27.47	0.00	26.82
22.00	3.02	2.92	12.70	4.34	NoLiq	0.00	4.34
23.00	3.03	2.90	18.07	6.22	NoLiq	0.00	6.22
24.00	2.92	3.10	33.37	10.78	NoLiq	0.00	10.78
25.00	2.01	4.78	122.35	25.60	13.33	0.00	25.60
26.00	1.80	5.18	149.94	28.96	8.08	0.00	28.96
27.00	2.05	4.71	132.61	28.16	14.38	0.00	28.16
28.00	2.03	4.75	117.28	24.70	13.79	0.00	24.70
29.00	3.05	2.87	20.91	7.28	NoLiq	0.00	7.28
30.00	3.10	2.78	13.53	4.87	NoLiq	0.00	4.87
31.00	3.17	2.64	12.07	4.58	NoLiq	0.00	4.58
32.00	3.16	2.66	14.38	5.41	NoLiq	0.00	5.41
33.00	3.02	2.91	17.27	5.93	NoLiq	0.00	5.93
34.00	2.99	2.98	25.71	8.63	NoLiq	0.00	8.63
35.00	3.06	2.85	18.31	6.44	NoLiq	0.00	6.44
36.00	2.93	3.08	21.61	7.02	NoLiq	0.00	7.02
37.00	3.13	2.71	14.95	5.51	NoLiq	0.00	5.51
38.00	2.66	3.58	50.68	14.16	NoLiq	0.00	14.16
39.00	3.14	2.69	22.14	8.22	NoLiq	0.00	8.22
40.00	3.26	2.48	13.21	5.32	NoLiq	0.00	5.32
41.00	3.23	2.54	13.12	5.18	NoLiq	0.00	5.18
42.00	2.98	2.99	25.42	8.51	NoLiq	0.00	8.51
43.00	2.29	4.27	86.68	20.28	22.03	0.00	20.28
44.00	3.18	2.62	14.68	5.60	NoLiq	0.00	5.60
45.00	3.10	2.76	19.65	7.11	NoLiq	0.00	7.11
46.00	3.11	2.75	20.91	7.60	NoLiq	0.00	7.60
47.00	3.09	2.79	21.30	7.64	NoLiq	0.00	7.64
48.00	3.06	2.84	19.11	6.72	NoLiq	0.00	6.72
49.00	3.21	2.57	19.82	7.72	NoLiq	0.00	7.72
50.00	1.82	5.14	194.27	37.79	8.52	0.00	37.79
51.00	1.70	5.36	304.22	56.80	6.15	0.00	56.80
52.00	1.65	5.46	354.47	64.92	5.12	0.00	64.92
53.00	1.66	5.44	314.65	57.82	5.30	0.00	57.82
54.00	2.27	4.30	124.42	28.93	21.51	0.00	28.93
55.00	3.05	2.87	40.13	14.00	NoLiq	0.00	14.00
56.00	2.34	4.17	146.41	35.09	24.11	0.00	35.09
57.00	2.88	3.18	61.32	19.26	NoLiq	0.00	19.26
58.00	3.00	2.96	26.58	8.98	NoLiq	0.00	8.98
59.00	2.88	3.18	32.63	10.25	NoLiq	0.00	10.25
60.00	3.07	2.82	31.74	11.24	NoLiq	0.00	11.24
61.00	3.26	2.48	29.86	12.05	NoLiq	0.00	12.05
62.00	3.09	2.78	27.45	9.86	NoLiq	0.00	9.86
63.00	3.19	2.60	25.29	9.73	NoLiq	0.00	9.73
64.00	3.21	2.57	26.87	10.48	NoLiq	0.00	10.48
65.00	3.18	2.62	30.16	11.50	NoLiq	0.00	11.50
66.00	3.29	2.41	26.34	10.91	NoLiq	0.00	10.91
67.00	3.26	2.47	29.79	12.04	NoLiq	0.00	12.04
68.00	3.21	2.58	36.81	14.29	NoLiq	0.00	14.29
69.00	2.73	3.45	108.95	31.54	NoLiq	0.00	31.54
70.00	3.11	2.75	23.40	8.50	NoLiq	0.00	8.50

71.00	3.14	2.70	33.06	12.27	NoLiq	0.00	12.27
72.00	3.13	2.71	32.68	12.05	NoLiq	0.00	12.05
73.00	3.09	2.80	52.10	18.64	NoLiq	0.00	18.64
74.00	1.98	4.85	158.77	32.75	12.32	0.00	32.75
75.00	3.56	1.92	56.03	29.13	NoLiq	0.00	29.13

(N1)60s has been fines corrected in liquefaction analysis, therefore d(N1)60=0.
(N1)60 is converted from qc1, (N1)60s is after fines correction
Fines=NoLiq means the soils are not liquefiable.

Settlement of Saturated Sands:
Settlement Analysis Method: Tokimatsu/Seed

Depth ft	CSRsf	/ MSF*	=CSRm	F.S.	Fines %	(N1)60s	Dr %	ec %	dsz in.	dsp in.	S in.
74.95	0.62	1.00	0.62	0.14	21.83	13.94	59.17	2.016	1.2E-2	0.012	0.012
74.00	0.62	1.00	0.62	0.64	12.32	32.75	96.64	0.346	2.1E-3	0.036	0.048
73.00	0.63	1.00	0.63	5.00	NoLiq	18.64	68.08	1.617	0.0E0	0.002	0.050
72.00	0.64	1.00	0.64	5.00	NoLiq	12.05	55.22	2.264	0.0E0	0.000	0.050
71.00	0.65	1.00	0.65	5.00	NoLiq	12.27	55.68	2.236	0.0E0	0.000	0.050
70.00	0.65	1.00	0.65	5.00	NoLiq	8.50	46.80	2.820	0.0E0	0.000	0.050
69.00	0.66	1.00	0.66	5.00	NoLiq	31.54	93.64	0.554	0.0E0	0.000	0.050
68.00	0.67	1.00	0.67	5.00	NoLiq	14.29	59.88	1.980	0.0E0	0.000	0.050
67.00	0.68	1.00	0.68	5.00	NoLiq	12.04	55.20	2.265	0.0E0	0.000	0.050
66.00	0.68	1.00	0.68	5.00	NoLiq	10.91	52.66	2.414	0.0E0	0.000	0.050
65.00	0.69	1.00	0.69	5.00	NoLiq	11.50	54.00	2.336	0.0E0	0.000	0.050
64.00	0.70	1.00	0.70	5.00	NoLiq	10.48	51.66	2.471	0.0E0	0.000	0.050
63.00	0.70	1.00	0.70	5.00	NoLiq	9.73	49.88	2.596	0.0E0	0.000	0.050
62.00	0.71	1.00	0.71	5.00	NoLiq	9.86	50.21	2.572	0.0E0	0.000	0.050
61.00	0.72	1.00	0.72	5.00	NoLiq	12.05	55.22	2.264	0.0E0	0.000	0.050
60.00	0.72	1.00	0.72	5.00	NoLiq	11.24	53.41	2.371	0.0E0	0.000	0.050
59.00	0.73	1.00	0.73	5.00	NoLiq	10.25	51.14	2.501	0.0E0	0.000	0.050
58.00	0.74	1.00	0.74	5.00	NoLiq	8.98	48.04	2.732	0.0E0	0.000	0.050
57.00	0.74	1.00	0.74	5.00	NoLiq	19.26	69.21	1.564	0.0E0	0.000	0.050
56.00	0.75	1.00	0.75	0.46	24.11	35.09	100.00	0.149	8.9E-4	0.002	0.051
55.00	0.76	1.00	0.76	5.00	NoLiq	14.00	59.29	2.008	0.0E0	0.001	0.052
54.00	0.76	1.00	0.76	0.32	21.51	28.93	87.69	0.886	5.3E-3	0.010	0.062
53.00	0.77	1.00	0.77	2.52	5.30	57.82	100.00	0.000	0.0E0	0.051	0.113
52.00	0.78	1.00	0.78	2.50	5.12	64.92	100.00	0.000	0.0E0	0.000	0.113
51.00	0.78	1.00	0.78	2.49	6.15	56.80	100.00	0.000	0.0E0	0.000	0.113
50.00	0.79	1.00	0.79	0.91	8.52	37.79	100.00	0.000	0.0E0	0.000	0.113
49.00	0.79	1.00	0.79	5.00	NoLiq	7.72	44.74	2.962	0.0E0	0.031	0.145
48.00	0.80	1.00	0.80	5.00	NoLiq	6.72	41.94	3.312	0.0E0	0.000	0.145
47.00	0.80	1.00	0.80	5.00	NoLiq	7.64	44.51	2.978	0.0E0	0.000	0.145
46.00	0.81	1.00	0.81	5.00	NoLiq	7.60	44.41	2.985	0.0E0	0.000	0.145
45.00	0.81	1.00	0.81	5.00	NoLiq	7.11	43.05	3.158	0.0E0	0.000	0.145
44.00	0.82	1.00	0.82	5.00	NoLiq	5.60	38.62	3.749	0.0E0	0.000	0.145
43.00	0.82	1.00	0.82	0.16	22.03	20.28	71.04	1.485	8.9E-3	0.017	0.161
42.00	0.83	1.00	0.83	5.00	NoLiq	8.51	46.82	2.819	0.0E0	0.092	0.254
41.00	0.83	1.00	0.83	5.00	NoLiq	5.18	37.31	3.915	0.0E0	0.000	0.254
40.00	0.83	1.00	0.83	5.00	NoLiq	5.32	37.78	3.857	0.0E0	0.000	0.254

39.00	0.84	1.00	0.84	5.00	NoLiq	8.22	46.08	2.871	0.0E0	0.000	0.254
38.00	0.84	1.00	0.84	5.00	NoLiq	14.16	59.61	1.992	0.0E0	0.125	0.378
37.00	0.84	1.00	0.84	5.00	NoLiq	5.51	38.34	3.785	0.0E0	0.000	0.378
36.00	0.85	1.00	0.85	5.00	NoLiq	7.02	42.81	3.192	0.0E0	0.000	0.378
35.00	0.85	1.00	0.85	5.00	NoLiq	6.44	41.12	3.422	0.0E0	0.000	0.378
34.00	0.85	1.00	0.85	5.00	NoLiq	8.63	47.14	2.796	0.0E0	0.032	0.410
33.00	0.85	1.00	0.85	5.00	NoLiq	5.93	39.62	3.621	0.0E0	0.000	0.410
32.00	0.85	1.00	0.85	5.00	NoLiq	5.41	38.04	3.823	0.0E0	0.000	0.410
31.00	0.85	1.00	0.85	5.00	NoLiq	4.58	35.41	4.200	0.0E0	0.000	0.410
30.00	0.85	1.00	0.85	5.00	NoLiq	4.87	36.34	4.047	0.0E0	0.000	0.410
29.00	0.85	1.00	0.85	5.00	NoLiq	7.28	43.53	3.091	0.0E0	0.000	0.410
28.00	0.84	1.00	0.84	0.27	13.79	24.70	79.15	1.208	7.2E-3	0.126	0.536
27.00	0.83	1.00	0.83	0.36	14.38	28.16	86.05	0.984	5.9E-3	0.136	0.672
26.00	0.83	1.00	0.83	0.48	8.08	28.96	87.75	0.882	5.3E-3	0.097	0.769
25.00	0.82	1.00	0.82	0.31	13.33	25.60	80.88	1.152	6.9E-3	0.126	0.895
24.00	0.81	1.00	0.81	5.00	NoLiq	10.78	52.37	2.431	0.0E0	0.052	0.947
23.00	0.80	1.00	0.80	5.00	NoLiq	6.22	40.50	3.505	0.0E0	0.000	0.947
22.00	0.79	1.00	0.79	5.00	NoLiq	4.34	34.63	4.327	0.0E0	0.000	0.947
21.00	0.78	1.00	0.78	0.25	27.47	26.82	83.29	1.076	6.5E-3	0.013	0.960
20.00	0.77	1.00	0.77	5.00	NoLiq	6.59	41.57	3.362	0.0E0	0.058	1.019
19.00	0.76	1.00	0.76	5.00	NoLiq	2.82	29.35	5.634	0.0E0	0.000	1.019
18.00	0.75	1.00	0.75	5.00	NoLiq	2.60	28.56	6.164	0.0E0	0.000	1.019
17.00	0.73	1.00	0.73	5.00	NoLiq	3.64	32.28	4.698	0.0E0	0.000	1.019
16.00	0.72	1.00	0.72	5.00	NoLiq	4.99	36.73	3.986	0.0E0	0.000	1.019
15.00	0.70	1.00	0.70	0.24	17.99	21.57	73.37	1.404	8.4E-3	0.082	1.101
14.00	0.68	1.00	0.68	0.26	15.18	21.98	74.11	1.378	8.3E-3	0.161	1.262
13.00	0.66	1.00	0.66	0.27	6.87	19.10	68.92	1.578	9.5E-3	0.131	1.393
12.00	0.64	1.00	0.64	0.41	6.93	23.77	77.40	1.266	7.6E-3	0.152	1.545
11.00	0.61	1.00	0.61	5.00	NoLiq	5.73	39.02	3.698	0.0E0	0.059	1.604
10.00	0.59	1.00	0.59	1.12	5.12	33.64	98.94	0.195	1.2E-3	0.102	1.706

Settlement of Saturated Sands=1.706 in.
qc1 and (N1)60 is after fines correction in liquefaction analysis
(N1)60s is converted from qc1 and after fines correction
dsz is per each segment, dz=0.05 ft
dsp is per each print interval, dp=1.00 ft
S is cumulated settlement at this depth

Settlement of Unsaturated Sands:

Depth ft	sigma' atm	sigC' atm	(N1)60s	CSRsf	Gmax atm	g*Ge/Gm	g_eff	ec7.5 %	Cec	ec %	dsz in.	dsp in.	S in.
9.95	0.56	0.37	34.41	0.59	879.86	3.8E-4	0.2079	0.0937	1.06	0.0989	1.19E-3	0.001	0.001
9.00	0.51	0.33	32.00	0.59	816.81	3.7E-4	1.0000	0.5134	1.06	0.5421	6.51E-3	0.069	0.070
8.00	0.45	0.29	34.69	0.59	791.08	3.4E-4	1.0000	0.4435	1.06	0.4683	5.62E-3	0.130	0.200
7.00	0.40	0.26	34.06	0.59	735.49	3.2E-4	0.8108	0.3726	1.06	0.3934	4.72E-3	0.088	0.288
6.00	0.34	0.22	34.06	0.59	680.96	3.0E-4	0.2903	0.1334	1.06	0.1408	1.69E-3	0.062	0.350
5.00	0.28	0.18	36.14	0.59	633.97	2.6E-4	0.1068	0.0435	1.06	0.0459	5.51E-4	0.020	0.370
4.00	0.23	0.15	33.16	0.59	551.03	2.4E-4	1.0000	0.4828	1.06	0.5098	6.12E-3	0.020	0.390
3.00	0.17	0.11	36.01	0.59	490.51	2.1E-4	0.1065	0.0437	1.06	0.0462	5.54E-4	0.103	0.493
2.00	0.11	0.07	31.02	0.60	381.10	1.8E-4	0.0412	0.0223	1.06	0.0235	2.82E-4	0.048	0.541
1.00	0.06	0.04	32.37	0.60	273.35	1.2E-4	0.0230	0.0116	1.06	0.0122	1.47E-4	0.003	0.544

0.00	0.00	0.00	0.06	0.60	0.44	1.4E-5	0.0014	0.0066	1.06	0.0070	0.00E0	0.002	0.546

Settlement of Unsaturated Sands=0.546 in.
(N1)60s is converted from qc1 and after fines correction
dsz is per each segment, dz=0.05 ft
dsp is per each print interval, dp=1.00 ft
S is cumulated settlement at this depth

Total Settlement of Saturated and Unsaturated Sands=2.253 in.
Differential Settlement=1.126 to 1.487 in.

Units: Unit: qc, fs, Stress or Pressure = atm (1.0581tsf); Unit Weight = pcf; Depth = ft; Settlement = in.

1 atm (atmosphere) = 1.0581 tsf(1 tsf = 1 ton/ft2 = 2 kip/ft2)
1 atm (atmosphere) = 101.325 kPa(1 kPa = 1 kN/m2 = 0.001 Mpa)

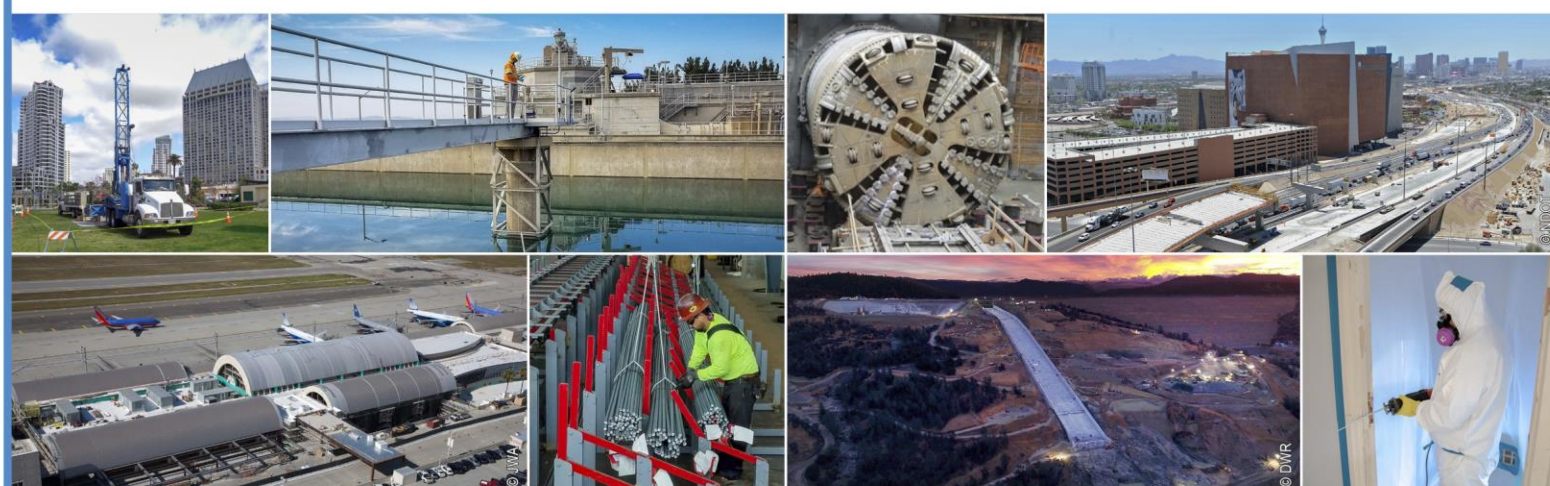
SPT	Field data from Standard Penetration Test (SPT)
BPT	Field data from Becker Penetration Test (BPT)
qc	Field data from Cone Penetration Test (CPT) [atm (tsf)]
fs	Friction from CPT testing [atm (tsf)]
Rf	Ratio of fs/qc (%)
gamma	Total unit weight of soil
gamma'	Effective unit weight of soil
Fines	Fines content [%]
D50	Mean grain size
Dr	Relative Density
sigma	Total vertical stress [atm]
sigma'	Effective vertical stress [atm]
sigC'	Effective confining pressure [atm]
rd	Acceleration reduction coefficient by Seed
a_max.	Peak Ground Acceleration (PGA) in ground surface
mZ	Linear acceleration reduction coefficient X depth
a_min.	Minimum acceleration under linear reduction, mZ
CRRv	CRR after overburden stress correction, CRRv=CRR7.5 * Ksig
CRR7.5	Cyclic resistance ratio (M=7.5)
Ksig	Overburden stress correction factor for CRR7.5
CRRm	After magnitude scaling correction CRRm=CRRv * MSF
MSF	Magnitude scaling factor from M=7.5 to user input M
CSR	Cyclic stress ratio induced by earthquake
CSRfs	CSRfs=CSR*fs1 (Default fs1=1)
fs1	First CSR curve in graphic defined in #9 of Advanced page
fs2	2nd CSR curve in graphic defined in #9 of Advanced page
F.S.	Calculated factor of safety against liquefaction F.S.=CRRm/CSRsf
Cebs	Energy Ratio, Borehole Dia., and Sampling Method Corrections
Cr	Rod Length Corrections
Cn	Overburden Pressure Correction
(N1)60	SPT after corrections, (N1)60=SPT * Cr * Cn * Cebs
d(N1)60	Fines correction of SPT
(N1)60f	(N1)60 after fines corrections, (N1)60f=(N1)60 + d(N1)60
Cq	Overburden stress correction factor
qc1	CPT after Overburden stress correction
dqc1	Fines correction of CPT
qc1f	CPT after Fines and Overburden correction, qc1f=qc1 + dqc1

qc1n	CPT after normalization in Robertson's method
Kc	Fine correction factor in Robertson's Method
qc1f	CPT after Fines correction in Robertson's Method
Ic	Soil type index in Suzuki's and Robertson's Methods
(N1)60s	(N1)60 after settlement fines corrections
CSRm	After magnitude scaling correction for Settlement calculation CSRm=CSRsf / MSF*
CSRfs	Cyclic stress ratio induced by earthquake with user inputed fs
MSF*	Scaling factor from CSR, MSF*=1, based on Item 2 of Page C.
ec	Volumetric strain for saturated sands
dz	Calculation segment, dz=0.050 ft
dsz	Settlement in each segment, dz
dp	User defined print interval
dsp	Settlement in each print interval, dp
Gmax	Shear Modulus at low strain
g_eff	gamma_eff, Effective shear Strain
g*Ge/Gm	gamma_eff * G_eff/G_max, Strain-modulus ratio
ec7.5	Volumetric Strain for magnitude=7.5
Cec	Magnitude correction factor for any magnitude
ec	Volumetric strain for unsaturated sands, ec=Cec * ec7.5
NoLiq	No-Liquefy Soils

References:

1. NCEER Workshop on Evaluation of Liquefaction Resistance of Soils. Youd, T.L., and Idriss, I.M., eds., Technical Report NCEER 97-0022.
   SP117. Southern California Earthquake Center. Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for
   Analyzing and Mitigating Liquefaction in California. University of Southern California. March 1999.
2. RECENT ADVANCES IN SOIL LIQUEFACTION ENGINEERING AND SEISMIC SITE RESPONSE EVALUATION, Paper No. SPL-2, PROCEEDINGS: Fourth International Conference on Recent Advances in Geotechnical Earthquake Engineering and Soil Dynamics, San Diego, CA, March 2001.
3. RECENT ADVANCES IN SOIL LIQUEFACTION ENGINEERING: A UNIFIED AND CONSISTENT FRAMEWORK, Earthquake Engineering Research Center, Report No. EERC 2003-06 by R.B Seed and etc. April 2003.

Note: Print Interval you selected does not show complete results. To get complete results, you should select 'Segment' in Print Interval (Item 12, Page C).



475 Goddard, Suite 200 | Irvine, California 92618 | p. 949.753.7070

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