

Appendix F. Geotech Report

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Preliminary Geotechnical Evaluation OC River Walk Anaheim and Orange, California

Pacific Advanced Civil Engineering

17520 Newhope Street, Suite 200 | Fountain Valley, California 92708

October 11, 2024 | Project No. 212076001



Geotechnical | Environmental | Construction Inspection & Testing | Forensic Engineering & Expert Witness

Geophysics | Engineering Geology | Laboratory Testing | Industrial Hygiene | Occupational Safety | Air Quality | GIS

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

Preliminary Geotechnical Evaluation OC River Walk Anaheim and Orange, California

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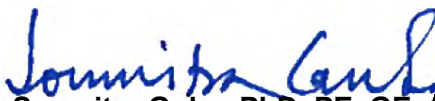
October 11, 2024 | Project No. 212076001



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1 INTRODUCTION

In accordance with your request and authorization, we have performed a preliminary geotechnical evaluation for the City of Anaheim's Orange County (OC) River Walk Project in the cities of Anaheim and Orange, California (Figure 1). We are currently providing geotechnical consulting services for the project. We previously prepared a Drilling Program Plan dated March 31, 2023, which is required by the United States Army Corps of Engineers (USACE) in order to drill borings within earth embankments under their jurisdiction. The USACE has not approved the Drilling Program Plan and they have informed the project team that Section 404 and 408 permission is needed prior to approving our proposed subsurface exploration.

We understand that Section 404 and 408 permission is a lengthy process and that as part of the USACE's review of those applications, detailed construction drawings will need to be submitted. Therefore, we have been requested to prepare a preliminary geotechnical evaluation report in order to facilitate the preparation of the construction drawings. The purpose of our study was to summarize the existing geotechnical data for the site and to provide preliminary geotechnical design considerations and geotechnical design parameters for the planned improvements. Once the Drilling Program Plan has been approved, we will perform site-specific borings, perform supplemental geotechnical engineering analyses, and prepare an updated geotechnical evaluation report for the project based on the findings from our subsurface evaluation.

2 SCOPE OF SERVICES

Our scope of services included the following:

- A review of readily available existing geotechnical information pertinent to the project including documents made available by Pacific Advanced Civil Engineering (PACE) and our in-house files.
- Review of existing as-built drawings and consultation with the project engineer regarding the geotechnical aspects of proposed construction.
- Data compilation and engineering analyses of the information obtained from our background review.
- Preparation of this preliminary geotechnical report presenting our findings, conclusions, and preliminary recommendations pertaining to the design and construction of the proposed improvements.

3 BACKGROUND AND PROPOSED CONSTRUCTION

The proposed OC River Walk project site is located within the Santa Ana River corridor between East Ball Road (or West Taft Avenue) to the north and Orangewood Avenue to the south (Figures 1

and 2). The Santa Ana River is a trapezoidal open channel with an unlined bottom and grouted rip-rap constructed on both banks of the existing channel. The Santa Ana River generally flows southwest and discharges into the Pacific Ocean. The topography of the project site consists of a trapezoidal river channel with approximately 15- to 20-foot-high embankment slopes with a gentle sloping trend overall towards the southwest.

The OC River Walk project will include constructing two river impoundment structures and making modifications to the existing Santa Ana River embankment slopes (Figure 3). The new impoundment structures will create two ponded water surface areas totaling approximately 38 acres that will allow for year-round infiltration of stormwater and infiltration of purified water delivered from the Orange County Water District's Groundwater Replenishment System (GWRS) pipeline, which is located a few feet behind the top of the western river embankment slope. Based on our review of the Master Plan (PACE, 2023), the proposed water surface elevations of the south and north impoundment structures will be 145 and 154 feet above the mean sea level (MSL), respectively. We understand that the impoundment structures will consist of a reinforced concrete slab with cutoff walls to prevent scour.

The proposed modifications to the Santa Ana River embankment slopes include constructing stepped and terraced embankments to create seating and landscape planters and may include rebuilding portions of the embankments at slope ratios of 2:1 (horizontal to vertical) in the majority of areas. Slope ratios of 1.5:1 (horizontal to vertical) will be required in certain areas depending on space limitations. Soil cement mixing is being considered to increase the stability of the embankment slopes where needed, which will involve mechanical mixing of cement with the on-site soils. Creation of the river impoundment will also necessitate new improvements where Collins Channel discharges into the Santa Ana River to mitigate the impounded water from extending into the channel. In addition, we anticipate that pump stations, drop structures, and grade control structures will be constructed as part of this project. Other miscellaneous improvements consist of landscaping, public art, a kayak launch, an overlook, and decorative stone rip rap.

The project will also include constructing a new bicycle and pedestrian bridge that will span the Santa Ana River north of Katella Avenue. Based on our review of the drawings for the pedestrian bridge (Parsons, 2023), the bridge will be approximately 376 feet long and supported on two abutments and three bents. We anticipate that steel HP piles will be used for the bridge foundations. The short term (local) and long term (degradation and contraction) scour depths at the bents are estimated to be approximately 7.7 and 11.9 feet, respectively. Scour is not anticipated at the abutments.

Other active transportation improvements for the project include extensions of the Santa Ana River Trail to connect to the Anaheim Coves trail on the west river embankment, providing trail undercrossings below the existing railroad tracks, continuing the Santa Ana River Trail on the east bank of the river between Katella Avenue and Orangewood Avenue, and widening or creating separate bicycle and pedestrian trails along selected areas of the existing Santa Ana River Trail. It is also our understanding that the Santa Ana River Trail will be widened by approximately 20 feet at the north abutment of California State Route 57 over a span of approximately 350 feet. An approximately 10-foot-high retaining wall will be constructed at the abutment. We anticipate that the retaining wall will be braced with tieback anchors.

4 PREVIOUS GEOTECHNICAL STUDIES

Previous studies performed within the site vicinity include a geotechnical exploration by Ninyo & Moore for the Burris Basin Groundwater Replenishment System Turnout Project in 2021, Harrington Geotechnical Engineering, Inc., (HGE) for the Anaheim River Walk Project and Angels Stadium Master Plan in 2021 and 2020, NMG Geotechnical, Inc., (NMG) for the Orange Mixed-Use Community and Live Entertainment Redevelopment Project in 2020, Earth Mechanics, Inc. (EMI) for the Orangewood Avenue Bridge over Santa Ana River (Widening) in 2019, Langan in 2019 for the Honda Center Parking Structures A through D, Diaz Yourman & Associates (DYA) for the Anaheim Regional Transportation Intermodal Center in 2010, Kleinfelder for the Art Center Phase 1 Project in 2009, California Department of Transportation (Caltrans) for the Santa Ana River Bridge in 1976, and the Orange County Road Department for the Ball Road Bridge Across Santa Ana River in 1967. Several of these consultant logs were included in the appendices of the referenced NMG report (2021). Additionally, NMG installed three monitoring wells in the project vicinity as part of the Orange Mixed-Use Project in 2023 to monitor groundwater levels. We also reviewed our previous reports for Orange County Water District's Burris and Lincoln Basins Reconfiguration Project (Ninyo & Moore, 2009) and the Five Coves Lincoln Basins Bypass Pipeline Project (Ninyo & Moore, 2010) that included subsurface exploration in the Santa Ana River area located upstream from the OC River Walk Project.

Logs of the relevant exploratory borings, monitoring wells, and cone penetration test (CPT) soundings that are relatively close to the site are included in Appendix A and the locations are shown on Figure 3. The results of the laboratory testing from the previous borings are included in Appendix B.

5 GEOLOGY AND SUBSURFACE CONDITIONS

5.1 Regional Geology

The subject site is located within the southerly portion of the Los Angeles Basin, which is included in the Peninsular Ranges Geomorphic Province (Norris and Webb, 1990). The Los Angeles Basin has been divided into four structural blocks, which are generally bounded by prominent fault systems, and includes the Northwestern Block, the Southwestern Block, the Central Block, and the Northeastern block. The site is located within the Central Block, which is bordered on the west by the Newport-Inglewood fault, on the east by the Whittier-Elsinore fault, on the north by the Malibu Coast-Santa Monica-Raymond fault, and on the south by the San Joaquin Hills and the Santa Ana Mountains. The Central Block is characterized by thick sequences of alluvium overlying basement rocks at depth. Basement rocks exposed in some oil wells along the margins of the Central Block consist of sedimentary Jurassic-age rocks, late Cretaceous-age plutonic rocks, and late Cretaceous to Pleistocene-age sedimentary rocks. Regional geologic mapping indicates that the project area is underlain by Holocene-age alluvial wash and fan deposits generally consisting of gravel, sand, and silt (Morton and Miller, 2006). A map of the regional geology is presented on Figure 4. The Holocene-age alluvial sediments have an estimated thickness of approximately 110 to 130 feet (Sprotte et al., 1980).

5.2 Site Geology

Based on our experience and our review of previous subsurface exploration performed within the project site vicinity, the subsurface stratigraphy of the site generally consists of artificial fill underlain by alluvium. Artificial fill materials were variable and generally consisted of sand, sand with silt, silty sand, sandy silt, silt, clayey silt, and silty clay with varying densities and consistencies. The alluvium was comprised of coarse to fine sediments ranging from silty sand, sand with silt, sand, gravelly sand, silty gravel, clayey gravel, and sandy gravel, with scattered cobbles, and clay, silty clay, clayey silt, silt, and sandy silt. The materials were generally observed to be moist to wet with consistencies that ranged from very loose to very dense in the granular non-plastic soils and very soft to hard in the fine plastic soils. As described, the soils comprising the existing fill and alluvial deposits can vary significantly both laterally and with depth. Therefore, significant variation in the soil stratigraphy observed in previous explorations necessitates conducting a site-specific exploratory program. The locations of the proposed borings are shown on Figures 2 and 3. Our interpretation of the subsurface conditions based on existing data in the project vicinity is shown on Cross Section A-A' (Figure 5).

6 GROUNDWATER

During the previous geotechnical evaluations within the project area, groundwater was encountered during drilling at depths ranging from approximately 3 to 58 feet below the ground surface. It should be noted that groundwater was not encountered in all of the borings. The groundwater depth observed at the time of drilling is not considered a stabilized groundwater condition and may vary from the recorded level. Regional maps indicate that the historic high depth to groundwater at the project site is approximately 10 to 20 feet below the ground surface (California Division of Mines and Geology [CDMG], 1997a, 1997b). The historic depth to shallow groundwater is approximately 10 feet deep along the river and becomes deeper to the east and west, beyond the river embankment.

The depth to groundwater across the project site will highly depend on the water levels in the Santa Ana River. Based on our review of the Master Plan (PACE, 2023), the proposed water surface elevations of the south and north impoundment structures will be 145 and 154 feet above the MSL, respectively. Fluctuations in groundwater levels will occur due to variations in precipitation, ground surface topography, subsurface stratification, irrigation, groundwater pumping, and other factors that may not have been evident at the time of our evaluation.

NMG installed three monitoring wells (GW-1 through GW-3) in the project vicinity as part of the OCVI Project in 2023 to monitor groundwater levels. Table 1 below summarizes the depth to groundwater measured in the monitoring wells and the corresponding elevations. Groundwater measurements were collected over the course of an approximate calendar year from February 3, 2023, to February 29, 2024.

Table 1 – Groundwater Levels in Monitoring Wells						
Monitoring Well	GW-1		GW-2		GW-3	
Surface Elevation (feet above MSL)	175.0		162.2		168.3	
Date of Measurement	Depth (feet)	Elevation (feet above MSL)	Depth (feet)	Elevation (feet above MSL)	Depth (feet)	Elevation (feet above MSL)
02/03/2023	26.6	148.4	15.0	147.2	35.5	132.8
03/09/2023	26.4	148.6	14.9	147.3	33.7	134.6
04/17/2023	25.9	149.1	14.3	147.9	32.7	135.6
05/18/2023	25.6	149.4	14.2	148.0	32.4	135.9
06/28/2023	25.6	149.4	14.2	148.0	32.1	136.2
07/17/2023	32.5	142.5	25.8	136.4	32.6	135.7
08/10/2023	34.7	140.3	29.4	132.8	34.1	134.2
09/21/2023	26.7	148.3	14.9	147.3	34.9	133.4
10/25/2023	25.9	149.1	14.4	147.8	33.1	135.2
11/29/2023	26.0	149.0	14.9	147.3	32.3	136.0
12/29/2023	26.0	149.0	14.9	147.3	32.1	136.2
01/29/2024	25.8	149.2	14.8	147.4	31.9	136.4
02/29/2024	25.4	149.6	14.8	147.4	31.2	137.2

7 FLOOD HAZARDS

Based on our review of flood insurance rate maps for the project area (Federal Emergency Management Agency [FEMA], 2009), the Santa Ana River is located in a special flood hazard area (Zone A) subject to inundation by the 1 percent annual chance flood (100-year flood). Zone A 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 (1 percent annual chance flood discharge contained in the channel); no base flood elevations are given.

8 FAULTING AND SEISMICITY

The site is in a seismically active area, as is the majority of southern California, and the potential for strong ground motion in the project area is considered significant during the design life of the proposed project. Figure 6 shows the approximate site location relative to the major faults in the region. The site is not located within a State of California Earthquake Fault Zone (EFZ) (formerly known as an Alquist-Priolo Special Studies Zone) (California Geological Survey [CGS], 2018). The nearest mapped active fault to the site is the Peralta Hills fault located approximately 3 miles north of the site (United States Geological Survey [USGS], 2024a).

The principal seismic hazards evaluated at the subject site are surface fault rupture, ground motion, liquefaction, dynamic settlement, lateral spread, and tsunamis and seiches. A brief description of these principal seismic hazards is discussed in the following sections.

8.1 Surface Fault Rupture

Based on our review of the referenced literature, 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.

8.2 Strong 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. Based on our discussions with the design team, it is our understanding that the proposed pedestrian bridge will be designed in accordance with the Caltrans Seismic Design Criteria (Caltrans, 2019a). The average shear wave velocity in the upper 30 meters (100 feet) of the subsurface profile (V_{s30}) at the site is estimated to be approximately 228 meters per second (i.e., 748 feet per second) based on our review of CGS's shear wave velocity map (2015). This corresponds to EMI's estimated V_{s30} (235 meters per second [771 feet per second]) based on

blow count correlations from their borings for the Orangewood Avenue Bridge (2020). Based on the Caltrans Acceleration Response Spectra (ARS) online web tool (Caltrans, 2024b) and using a V_{S30} of 228 meters per second for the site, a mean magnitude of 6.58 and a peak ground acceleration (PGA) of 0.51g is appropriate for the proposed pedestrian bridge. The design Caltrans ARS curve evaluated for the bridge site is presented on Figure 7.

8.3 Liquefaction and Seismically Induced Settlement

Liquefaction is the phenomenon in which loosely deposited, saturated granular soils (located below the water table) undergo rapid loss of shear strength due to development of excess pore pressure during strong earthquake-induced ground shaking. Ground shaking of sufficient duration results in the loss of grain-to-grain contact due to rapid rise in pore water pressure and it eventually 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. Liquefaction is also known to occur in relatively fine-grained soils (i.e., sandy silt and clayey silt) with a plasticity index of less than 7. 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. Based on our review of the State of California Seismic Hazard Zones maps (CDMG, 1998a, 1998b), the project site is located in an area mapped as being potentially susceptible to liquefaction (Figure 8).

Based on the referenced previous studies and our experience in the project area, the relatively loose to medium dense sand and silt layers at variable depths below the groundwater table are expected to be liquefiable during a significant seismic event. As a result of liquefaction, the proposed improvements may be subject to liquefaction-induced dynamic settlement. 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. Dynamic settlements associated with liquefaction at the site could vary from approximately 2 to 6 inches (HGE, 2021; NMG, 2020; and EMI, 2019).

8.4 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. Since the site is located within the free-faces of the Santa Ana River, there is a potential for seismically induced lateral spread at the site. EMI concluded that lateral spreading is not a design concern for the Orangewood Avenue Bridge since the potentially liquefiable thin soil layers are intermittent and discontinuous (2019).

8.5 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 tsunami or seiche inundation (California Department of Conservation, 2024). Therefore, damage due to tsunamis or seiches is not a design consideration.

9 SLOPE STABILITY ANALYSES

Slope stability analyses were performed to evaluate the stability of the proposed embankment slopes based on Cross Section A-A' (north impoundment area). The west side of the cross-section was considered to be more critical. Based on our discussions with PACE, it is our understanding that a majority of the slopes will be constructed at a slope ratio of 2:1 (horizontal to vertical), but some of slopes may need be constructed at a slope ratio of 1.5:1 (horizontal to vertical) depending on space limitations. Soil cement mixing is being considered to increase the stability of the embankment slopes where needed. Our analyses were developed for the empty (dry), full, and rapid drawdown conditions. The analyses involving empty and full water conditions considered static and pseudo-static loading. The rapid drawdown condition was conservatively modeled assuming that the phreatic surface is approximately aligned with the slope surface on the channel side.

Our slope stability analyses were performed using the Morgenstern and Price limit equilibrium option in a two-dimensional stability analysis program, Slope/W (GeoStudio, 2023). The pseudo-static analyses were performed using a coefficient of horizontal ground acceleration of 0.15 as recommended in Special Publication (SP) 117A (California Geological Survey, 2008). In general accordance with the guidelines of SP 117A and the standard of practice, our analyses considered the following design criteria: 1) a factor of safety of 1.5 for the static conditions, 2) a factor of

safety of 1.1 for the pseudo-static conditions, and 3) a factor of safety of 1.3 for the rapid drawdown condition.

The shear strength parameters used in our stability analyses were selected based on the findings from the previous field and laboratory testing and our experience with these material types. Each of the materials were assigned with homogeneous, isotropic properties and modeled using the Mohr-Coulomb constitutive model. The material properties used in our stability analyses are presented in Table 2.

Table 2 – Material Properties Used in Slope Stability Evaluation			
Earth Material	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (degree)
River Embankment Fill	115	100	32
New Engineered Fill	120	100	32
Alluvium – Sand (Medium Dense)	120	100	32
Alluvium – Sand (Dense)	120	100	34
Alluvium – Clay	120	2,000	0
Soil Cement	130	5,000	0

Notes:

psf – pounds per square feet

Our analyses incorporated the maximum water levels anticipated within the Santa Ana River as discussed in Section 6 of this report. A surface water elevation of 154 feet was considered in the Santa Ana River based on the north impoundment structure for the full and rapid drawdown conditions. The results of our global stability evaluation indicate that the proposed embankment slopes constructed at a slope ratio of 2:1 (horizontal to vertical) will have adequate factors of safety against global instability during empty, full, and rapid-drawdown scenarios under both static and pseudo-static loading conditions. However, we calculated that the embankment slopes placed at a slope ratio of 1.5:1 (horizontal to vertical) will not have adequate factors of safety against global stability during full and rapid-drawdown scenarios under both static and pseudo-static loading conditions. However, our slope stability analyses indicate that if the outer portion of the slope is removed and those materials are replaced with a stabilization fill slope with an approximately 15-foot-wide soil cement zone, the factors of safety will increase to adequate levels. The results of our slope stability analyses are summarized in Table 3 and are presented in Appendix C. We recommend that the stability of the proposed slopes be evaluated in more detail based on the findings from our subsurface evaluation and our review of the grading plans when they are available. Additionally, surcharge loads from existing improvements and surface development areas should be considered in supplemental analyses. Future seepage analyses may also be appropriate during a supplemental design phase to evaluate the effects of impounding water against the proposed embankment slopes and the potential for seepage and piping beneath the impoundment structures.

Table 3 – Summary of Slope Stability Analyses

Analysis	Calculated Factor of Safety			Required Factor of Safety
	2:1 Slope Ratio	1.5:1 Slope Ratio	1.5:1 Slope Ratio Soil Cement	
Empty – Static	1.88	1.51	1.60	1.5
Empty – Pseudo-static	1.37	1.16	1.22	1.1
Full – Static	1.75	1.45	1.51	1.5
Full – Pseudo-static	1.23	1.08	1.11	1.1
Rapid Drawdown	1.52	1.23	1.32	1.3

10 PRELIMINARY CONCLUSIONS AND RECOMMENDATIONS

The purpose of this study was to perform a preliminary evaluation of the soil, geologic, and groundwater conditions in the area of the proposed OC River Walk Project. The results from our preliminary geotechnical evaluation will be used to assist the USACE in providing the project with Section 404 and 408 permission and approving our Drilling Program Plan. Based on the preliminary evaluation, it is Ninyo & Moore's opinion that the project is feasible from a geotechnical perspective. Although there were several previous borings and CPT soundings performed in the project area, additional borings will be appropriate in areas with insufficient data (i.e., the impoundment structures, the east side of the Santa Ana River, and the proposed pedestrian bridge). Updated design and construction recommendations for the project will be provided in an updated geotechnical evaluation report based on the findings from our subsurface evaluation once our Drilling Program Plan is approved. A summary of our preliminary conclusions is presented below:

- The project area is generally anticipated to be underlain by artificial fill and alluvium consisting of moist to wet, very loose to very dense silty sand, sand with silt, sand, gravelly sand, silty gravel, clayey gravel, and sandy gravel with scattered cobbles, and very soft to hard clay, silty clay, clayey silt, silt, and sandy silt. A significant variation in the soil stratigraphy was observed in the previous explorations, which accentuates the need for conducting a site-specific exploratory program.
- In order to provide suitable support for the planned improvements (impoundment structures, pump stations, retaining walls, drop structures, and grade control structures), remedial excavation and recompaction of loose soil beneath the foundation zones should be performed. The old fills on site are anticipated to have variable degrees of compaction and are not considered suitable for support of the new improvements. We anticipate that the excavations within the Santa Ana River Channel will extend below the potential scour depth.
- Excavations during site grading should be feasible with earthmoving equipment in good working order. We anticipate that the existing fill and alluvial materials may be reused as compacted fill. Depending on seasonal variability and groundwater levels, some of the soils may have relatively high moisture contents and may involve drying or blending with drier materials in order to be used as compacted fill.
- Groundwater was encountered in some of the previous borings performed in the project area at depths ranging from approximately 3 to 58 feet below the ground surface. The historic high groundwater is reported at depths ranging from approximately 10 to 20 feet below the ground

surface. Excavations for the impoundment structures that extend below groundwater may involve construction dewatering depending on the depths and seasonal conditions. Excavations for cast-in-drilled-hole (CIDH) piles may also encounter groundwater. Fluctuations in the groundwater level are anticipated to occur as a result of the proposed water impoundment as well as variations in seasonal precipitation, irrigation practices, groundwater pumping, and other factors.

- The proposed water surface elevations of the south and north impoundment structures will be 145 and 154 feet above MSL, respectively. Based on these elevations and the elevations of the river bottom near the proposed impoundment structures, the impounded water will be on the order of 8 to 10 feet deep adjacent to the impoundment structures. The surface water level in the river is anticipated to have an impact on the groundwater level; therefore, impounding water in the river is anticipated to result in raising the groundwater elevations in the embankment slope areas adjacent to the river. Based on the generally granular nature of the alluvium, we anticipate infiltration of the impounded surface water into the subsurface soils predominantly in the vertical direction. However, the presence of less permeable silt and clay layers at depth could create a perched groundwater condition that could result in shallower depths to groundwater extending beyond the river embankment slopes. Additional groundwater monitoring during and after high river flow events should be considered to evaluate the change in groundwater elevations and the distance to which the river surface water elevation may influence the groundwater level beyond the river embankment slopes.
- The site is located within a “Zone A” designated flood area (FEMA, 2009). The lower terrace path, and portions of the middle terrace path and amphitheater seating are planned at elevations that are lower than the 100-year flood level. Proposed structural improvements below the 100-year flood zone should be designed to mitigate the potential for scour and erosion from the 100-year flood event.
- Should a 100-year flood event occur, river sediments may be deposited on the lower and middle terraces, and amphitheater seating areas. Periodic maintenance to clean-up and remove flood deposits should be planned for.
- On-site soils should be considered as Type C soils in accordance with Occupational Safety and Health Administration (OSHA) soil classifications. Sandy soils may be prone to caving during earthwork operations. Excavations that extend below groundwater or where temporary slopes are not feasible will involve shoring for safety and protection to existing improvements.
- The results of our stability analyses indicate that adequate factors of safety will be maintained for design slopes constructed at a slope ratio of 2:1 (horizontal to vertical) under static, pseudo-static, and rapid drawdown conditions. Proposed 1.5:1 (horizontal to vertical) slopes will not have adequate factors of safety against global stability during fill and rapid-drawdown scenarios. As such, proposed 1.5:1 (horizontal to vertical) slopes will need to be reconstructed as 15-foot-wide stabilization fill slopes with soil cement to increase the factors of safety.
- 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 site is mapped within a State of California Seismic Hazards Zone as being potentially liquefiable (CDMG, 1998a, 1998b). Our evaluation indicates that the relatively loose to 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 were estimated to be on the order of approximately 2 to 6 inches by previous geotechnical consultants. A site-specific exploratory program will be needed to more accurately quantify the depths to which the subsurface soils are prone to liquefaction at the project site and the dynamic settlement magnitudes at the proposed improvements.
- The site is not located in an area considered susceptible to landsliding, tsunamis, or seiches.

- Based on the previous laboratory test results in the project vicinity, the near-surface site soils can be classified as non-corrosive based on the California Department of Transportation (Caltrans, 2021b) corrosion guidelines.

As mentioned above, a detailed geotechnical evaluation including subsurface exploration should be performed to develop site-specific information and develop appropriate geotechnical recommendations for the design and construction of the OC River Walk Project. This will involve performing additional borings to evaluate liquefaction, foundations, and slope stability in more detail. The locations of the proposed borings are presented on Figures 2 and 3. Preliminary design recommendations are presented below.

10.1 Earthwork

We anticipate that earthwork at the site will include site clearing, foundation excavations for the pedestrian bridge, subgrade preparation for structures, retaining wall backfill, slope construction along the Santa Ana River, and relatively shallow grading for the new trails and bikeways. Earthwork operations should be performed in accordance with the requirements of applicable governing agencies and the recommendations presented in the following sections.

10.1.1 Construction Plan Review and Pre-Construction Conference

We recommend that grading and foundation plans be submitted to Ninyo & Moore for review to check for conformance to the recommendations provided in this preliminary report and our future report. We further recommend that a pre-construction conference be held in order to discuss the grading recommendations presented in our reports. 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.

10.1.2 Site Clearing

Prior to commencing earthwork operations, the site should be cleared of surface obstructions, abandoned utilities (if present), debris, vegetation, as well as surface soils containing organic materials. Existing utilities to remain in place should be located and then re-routed or protected from damage by construction activities. The contractor may need to implement a documentation and instrumentation program near certain improvements during construction. Obstructions that extend below the finished grade, if any, should be removed and the resulting holes filled with compacted soil. The materials generated from the clearing operations should be removed from the site and disposed at a legal dump site.

10.1.3 Excavation Characteristics

Based on the previous 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 moist to wet, very loose to very dense silty sand, sand with silt, sand, gravelly sand, silty gravel, clayey gravel, and sandy gravel, with scattered cobbles, and very soft to hard clay, silty clay, clayey silt, silt, and sandy silt. Contractors should make their own independent evaluation of the excavatability of the on-site materials prior to submitting their bids.

10.1.4 Remedial Grading for Improvements on Shallow Foundations

In order to provide suitable support for the planned improvements (impoundment structures, pump stations, retaining walls, amphitheater seating walls, drop structures, and grade control structures that will be placed on shallow foundations, remedial grading consisting of the excavation and recompaction of the existing undocumented fill and/or loose natural materials is appropriate. We recommend that excavation and recompaction extend to the depth of the undocumented fill to expose firm and unyielding alluvium or to a depth that will provide 2 to 3 feet of compacted fill below the bottom of the proposed foundations, whichever is deeper. For improvements constructed within the Santa Ana River channel, the base of the improvements should extend approximately 2 feet below the potential scour depth unless the improvements are designed to prevent scour. We understand that the impoundment structures will consist of a reinforced concrete slab with cutoff walls to prevent scour.

The limits of excavation should extend laterally 2 to 3 feet beyond the outside edges of the foundation or a distance equal to the depth of the excavation, whichever is further. Relatively competent alluvial materials should be exposed at the excavation bottoms. If the remedial grading bottom is unstable under heavy equipment loads, additional excavation may be needed to stabilize the bottom. Stabilizing the bottom may include excavating an additional 1 to 2 feet and replacing the material with aggregate base or crushed rock wrapped in filter fabric. The extent of the removals should be evaluated by Ninyo & Moore at the time of 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 the ASTM International (ASTM) test method D 1557.

10.1.5 Treatment of Near-Surface Soils for the Santa Ana River Trail

Prior to placement of the new structural pavement sections for the Santa Ana River Trail, the subgrade soils should be prepared appropriately. In areas of the proposed pavement sections, concrete walkways, bicycle paths, and other hardscape improvements, we recommend that the top 12 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.

10.1.6 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 the majority of the excavations at the site 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 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 soil in accordance with the OSHA soil classification.

Where slopes cannot be laid back, shoring will be appropriate. If there will be excavations that extend below the springline of the GWRS pipeline, such as to excavate a temporary backcut for a 1.5:1 (horizontal to vertical) soil cement stabilization fill slope or for excavations for the pedestrian bridge western abutment, shoring may be needed to support the GWRS pipeline. Where shoring systems are used for site excavations, they should be designed for the anticipated soil conditions using the lateral earth pressure values presented on Figures 9 and 10 for braced and cantilevered excavations below groundwater, 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, 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.

10.1.7 Construction Dewatering

If applicable, dewatering will be involved for excavations that extend below groundwater so that work can be performed in a relatively dry condition. Lowering the water table results in an increase in effective stresses and may induce settlement of soils beneath existing improvements. Dewatering systems should be designed to reduce the withdrawal of groundwater outside of the planned excavations. This may be achieved with a combination of shoring systems that act as cut-off walls and pumping out groundwater from within the shored excavations. Disposal of groundwater should be performed in accordance with guidelines of the Regional Water Quality Control Board and Orange County Sanitation District.

10.1.8 Slopes

We recommend that new fill slopes be constructed at slope ratios of 2:1 (horizontal to vertical) or flatter. Fill slopes constructed at 2:1 (horizontal to vertical) or flatter are anticipated to be

stable. Based on the findings from our slope stability analyses, we recommend that soil cement be used on fill slopes steeper than 2:1 (horizontal to vertical). New fill slopes should be constructed with a keyway that is approximately 15 feet wide and should extend 2 feet or more into competent alluvial soils (Figure 11). As shown on Figure 11, the soil for the fill key should be removed within a 1:1 (horizontal to vertical) projection from the proposed toe-of-slope. After the fill key is constructed, benching should be performed to remove loose surficial soils associated with the existing slopes. For the 1.5:1 (horizontal to vertical) soil cement stabilization fill slopes, the 15-foot-wide soil cement zone should be maintained from the keyway up to the top of the slope.

The need for keyway backdrains should be evaluated during grading and will depend on the soils that are used to construct the slope as well as the soils that comprise the existing slopes that the new fill slopes will be benched into. In general, if the new fill material that will be placed to construct the new slopes is similar to the soils that comprise the existing slopes, a keyway backdrain should not be needed. However, if the soils are significantly different, such as the new fill having a significantly higher percentage of fines than the existing slope soils, this condition could result in a buildup of hydrostatic pressure at the contact between the new fill and the existing fill. In this condition, installation of a keyway backdrain would be appropriate. A representative of Ninyo & Moore should observe the keyway construction and provide recommendations for subdrain systems, as appropriate.

Fill slopes should be constructed in a manner (e.g., overfilling and cutting to grade) such that the recommended degree of compaction is achieved to the finished slope face. Appropriate drainage devices should be provided to direct surface runoff away from slope faces. The project plans and specifications should contain design features and construction requirements to reduce the potential for erosion of the on-site soils both during and after construction. We recommend that routine slope maintenance be performed including repair of rills and other slope erosion features that may occur.

10.1.9 Fill Material

In general, the on-site soils should be suitable for use as embankment 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.

Recommendations for the percent cement content that will need to be added to the on-site soils in order to achieve the desired strength parameters for the 1.5:1 (horizontal to vertical) stabilization fill slopes will be provided in our forthcoming report. Varying amounts of cement will be added to representative samples of the on-site soils to evaluate the corresponding material strength. We will also evaluate the gradation, unit weight, and moisture content of the samples. Proportioning of the mix designs should be based on procedures outlined in the Federal Highway Administration (FHWA) Design Manual: Deep Mixing for Embankment and Foundation Support (2013). A shear strength of 5,000 psf (approximately 35 pounds per square inch [psi]) was considered for the soil cement in our slope stability analyses. For preliminary planning purposes, a cement content of 5 to 10 percent is anticipated.

Fill used as backfill behind retaining walls and other structure backfill should consist of free-draining, granular, non-expansive soil that conforms with the latest edition of “Greenbook” Standard Specifications for Public Works Construction for structure backfill. “Non-expansive” can be defined as soils having an expansion index (EI) of 20 or less in accordance with ASTM D 4829.

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 (2021b) criteria for non-corrosive soils (i.e., soils having a minimum resistivity greater than 1,500 ohm-centimeters, 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.

10.1.10 Fill Placement and Compaction

Fill material, including trench backfill, should be moisture-conditioned and compacted in horizontal lifts to a relative compaction of 90 percent or more as evaluated by ASTM D 1557. Fill material should be moisture-conditioned to slightly above the laboratory optimum moisture content. The lift thickness for fill soils will depend on the type of compaction equipment used but generally should not exceed 8 inches in loose thickness. Special care should be exercised to avoid damaging pipes during compaction of trench backfill. Placement and compaction of the fill soils should be in general accordance with local grading ordinances and good construction practice. Specific recommendations for placement and compaction of soil cement will be provided in our future geotechnical report based on our laboratory testing of the on-site soils with varying cement contents and our engineering analyses.

10.1.11 Pipe Bedding

We recommend that pipelines be supported on 6 inches or more of granular bedding material such as sand with a sand equivalent (SE) value of 30 or more. Bedding material should be placed and compacted around the pipe, and 12 inches or more above the top of the pipe in accordance with the current “Greenbook” Standard Specifications for Public Works. Special care should be taken not to allow voids beneath and around the pipe. Bedding material and compaction requirements should be in accordance with the recommendations of this report, the project specifications, and applicable requirements of the appropriate agencies.

10.1.12 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 psi be used for design, provided that granular bedding material is placed adjacent to the pipe, as recommended in this report.

10.2 Foundations

Based on our discussions with PACE, it is our understanding that steel HP piles will be used for the pedestrian bridge foundations. Alternatively, if construction vibrations or noise are issues at the site, cast-in-drilled-hole (CIDH) piles may also be considered for the pedestrian bridge. Shallow foundations, including spread footings and mat foundations, may be used for the proposed impoundment structures, pump stations, retaining walls, drop structures, and grade control structures. 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.

Details regarding the foundations were not available for our review at the time of this evaluation. We made numerous assumptions in our foundation analyses including pile type, pile size, pile cutoff elevation, soil parameters, depth to liquefaction zone, etc. Our preliminary foundation recommendations will need to be updated based on the findings from our site-specific subsurface evaluation.

10.2.1 Pile Design Considerations

The proposed pedestrian bridge may be supported on driven steel HP piles or cast-in-drilled-hole (CIDH) piles. We analyzed both HP 14x89 steel piles and 24-inch-diameter CIDH piles for preliminary planning purposes. The piles should extend below the liquefaction zone and be advanced into very dense alluvium. Negative skin friction caused by liquefaction and

subsequent settlement of layers above the liquefaction zone was considered in our pile capacity analyses. It is also our understanding that the bent piles are susceptible to up to approximately 11.9 feet of long-term scour. The axial capacity for the piles was analyzed using AllPile Version 7.21e (CivilTech, 2016) computer software. Soil strength parameters were estimated using existing data from sampler blow counts and laboratory test results reported in previous geotechnical evaluations at nearby sites. Axial capacities for the steel HP piles were based on side friction resistance and end bearing. End bearing was not included in our analysis for the CIDH piles. We also considered the scenario where side friction in the upper 11.9 feet was neglected for the bent piles due to scour. Plots of the depth versus ultimate axial capacity for the piles at the abutments and bents under both the static and dynamic (liquefaction) conditions and the piles at the bents due to scour are presented in Appendix D.

Per the 2022 CBC, we recommend that a factor of safety of 2.0 be used for the allowable axial capacity in compression and a factor of safety of 3.0 be used for the allowable axial capacity in uplift/tension. If the measures outlined in this report are implemented effectively, the total settlement of the CIDH piles is anticipated to be 0.5-inch or less, provided that the pile bearing materials are not significantly disturbed during construction. These estimates are based on the soil conditions observed in the previous exploratory borings, and our experience with similar geologic materials. The pile capacities presented in Appendix D should be revised, as appropriate, after additional subsurface data are obtained. Lateral pile capacities should also be analyzed when the details of the proposed foundations and the loading conditions are available. To reduce the potential for group action of the pile foundations, we recommend that piles be spaced no closer than three times the pile diameter (center-to-center spacing) to attain the estimated axial capacity.

10.2.2 Driven Pile Construction Considerations

We anticipate that high tensile stresses will be generated in the piles during driving when the piles penetrate through the looser sand layers and clay layers into the dense sand and gravel layers. The tensile stress may be high enough to damage the pile. If it is difficult to advance the piles in the dense sand and gravel layers, consideration should be given to pre-drilling the pile locations with an auger having a diameter that is 25 percent smaller than the width of the pile. The pre-drilled hole depth should be evaluated during construction.

Pre-drilled holes and piles should be installed as closely as possible to specified limits of vertical and horizontal alignment. The pile should not be out of plumb by more than 2 percent

over the length of the pile. Further, the top of the pile should be within 3 inches of the design location.

Prior to installing production piles, we recommend that a test program of an indicator pile be performed. This should consist of driving one pile as an indicator pile. The indicator pile should be evaluated using a Pile Driving Analyzer and Case Pile Wave Analysis Program to evaluate the design, to evaluate the appropriate size of hammer, and to establish refusal criteria for the project. The indicator pile should be 10 feet longer than the preliminary design length and should be installed to allow cut-off at any length. Upon completion of the indicator pile program, Ninyo & Moore can provide pile driving recommendations for the project.

The effect of the pile driving operations on structures and improvements within approximately 50 feet of the site should be evaluated. Vibration monitoring should be performed during the indicator pile program and during installation of production piles to evaluate peak particle velocities at adjacent structures and improvements. Ninyo & Moore should review the data as they are obtained.

10.2.3 CIDH Pile Construction Considerations

Our evaluation of the excavation characteristics of the on-site materials is based on the results of the previous exploratory borings and experience with similar materials. The CIDH pile drilling contractor should mobilize equipment of sufficient size and operating capability to achieve the recommended embedment length in the alluvium. The excavation technique chosen by the contractor should not adversely affect the quality or strength of the shaft side or end bearing materials.

Due to the nature of the soils, caving in the underlying materials should be anticipated during drilling/installation of CIDH piles. The contractor should be prepared to handle such conditions by adjusting drilling methods and rates, using drilling mud, and/or using temporary casing. If casing is used, the casing should be withdrawn gradually during removal. Drilling mud should be collected as it is pushed out of the drilled hole with concrete placed using the tremie method. Groundwater was encountered in the previous borings and should be expected to be encountered during drilling. The contractor should be prepared to advance the CIDH piles under such conditions.

The concrete should be placed in the annular space between the rebar cage and the drill-hole surface using the tremie method. Concrete utilized in the CIDH piles should be a fluid mix with sufficient slump so that it will fill the void between the rebar cage and the drill-hole

wall. The contractor should take care to reduce enlargement of the excavation at the tops of the CIDH piles, which could result in mushrooming of the CIDH pile top.

CIDH pile holes should be cleaned prior to placement of concrete. Care should be taken to check that the soils at the CIDH pile bottom have not been disturbed. The successful advancement of drill-holes for the construction of CIDH piles will depend largely on the suitability of the drilling equipment and the skill of the operator. The drilled foundation contractor should try to reduce the time during which the excavation remains open. The contractor should schedule the sequence of operations so that each excavation can be finished, the rebar cage placed, and the concrete poured within the same work day. CIDH pile excavations should not be left open overnight. In case of delay in placing concrete within the drill hole due to equipment breakdown or other unforeseen circumstances, casing may be used to protect the integrity of the hole.

The contractor should not place CIDH piles adjacent to each other until the first one is set. The installation of CIDH piles should be scheduled to allow the concrete in adjacent shafts to set before drilling the next shaft. CIDH piles spaced closer than about three shaft diameters (clear spacing) should be placed on alternate days.

The CIDH pile installation should be observed by the project geotechnical consultant to check that, among other things: 1) subsurface conditions are as anticipated from the borings, 2) the CIDH piles are constructed to the specified size and penetration, 3) the CIDH pile bottom is clean and competent, 4) CIDH piles are within the allowable tolerances for plumbness, and 5) reinforcements are placed per project specifications. These items are fundamental to the installation and behavior of the CIDH piles. Furthermore, we recommend the following for the installation of CIDH piles.

- The clear spacing between the rebar cage and the drill-hole surface should be three times the maximum size of the coarse aggregate used in the concrete.
- Centralizers should be installed to keep the rebar cage positioned per project specifications.
- If casing is used, a sufficient head of concrete that fills the casing should be used before pulling the casing.

10.2.4 Pole Foundations

Light poles, awnings, signs, and flag poles typically impose relatively light axial loads on pile foundations and the pile dimensions will generally be controlled by the lateral load demand. We recommend that the pole foundations have a diameter of 18 inches or more and an

embedment depth of 10 feet or more into competent soils. We recommend that pole foundations be designed for an allowable side friction of 130 psf for downward axial loads and an allowable resistance of 90 psf for uplift capacity. 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. The footing dimensions (i.e., diameter and embedment) should be evaluated by the project structural engineer. Foundations for light standards, roadside signs, and overhead signs should be designed in accordance with the Caltrans Standard Plans (Caltrans, 2022a).

10.2.5 Spread Footings and Mats

Based on Ninyo & Moore's understanding of the proposed construction, it is anticipated that the proposed impoundment structures, pump stations, retaining walls, drop structures, and grade control structures may be supported on spread footings or mats. The footings should bear on dense native soils or compacted fill material prepared in accordance with the recommendations presented in the Earthwork section of this report.

For preliminary planning purposes, shallow spread footings may be designed using a net allowable bearing capacity of 2,000 psf and should be founded approximately 18 inches or more below grade. Continuous footings should have a width of 2 feet or more. Isolated pad footings should have a width of 3 feet or more. Spread footings should be reinforced in accordance with the recommendations of the structural engineer. Total and differential settlement for footings under static load are estimated to be less than approximately 1 inch and 0.5-inch over a horizontal span of 40 feet, respectively. Mats typically experience some deflection due to loads placed on the mat and the reaction of the soils underlying the mat. On a preliminary basis, a design modulus of subgrade reaction of 50 tons per cubic foot (tcf) may be used for the compacted subgrade soils in evaluating such deflections.

The footings and mats supported on compacted fill or dense native soils 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.

10.2.6 Slabs-On-Grade

Structures supported on shallow footings should have floor slabs designed by the project structural engineer based on the anticipated loading conditions. Additionally, concrete surface finishing may be present on top of the soil cement in certain areas of the project. 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 in accordance with the recommendations of the structural engineer. 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.

10.3 Retaining Walls

We anticipate that retaining walls will be supported on shallow, spread footings founded on engineered fill. Retaining walls may be designed in accordance with the Caltrans Standard Plans (Caltrans, 2022a). We recommend that unrestrained (yielding) cantilevered retaining walls be designed in accordance with standard Caltrans Type I, V, or equivalent walls. In general, the subgrade soils should provide sufficient bearing capacity to support these retaining walls provided that the remedial grading is performed in accordance with the preceding recommendations. A coefficient of friction of 0.35 should be used between the horizontal surface of the spread footings and the underlying foundation material in order to evaluate resistance against sliding. A passive resistance value of 350 psf per foot of depth should be used in evaluating the lateral resistance of the structural footings. The allowable lateral resistance should be taken as either the sum of 50 percent of the frictional resistance and 50 percent of the passive resistance, or 100 percent of the frictional resistance only, or 100 percent of the passive resistance only, whichever is lower. Details regarding the foundations for the proposed retaining walls (type, size, loads, etc.) were not available at the time of our evaluation. Revised recommendations for the retaining walls should be provided during the design phase.

Unrestrained (yielding) cantilevered retaining walls should be designed for an equivalent fluid weight of 37 and 57 psf per foot for level and 2:1 (horizontal to vertical) sloping backfill, respectively. Restrained retaining walls may be designed for an equivalent fluid weight of 57 and 82 psf per foot for level backfill and 2:1 (horizontal to vertical) sloping backfill, respectively. These values assume free-draining conditions. Lateral earth pressures recommended for design of yielding and restrained retaining walls are provided on Figures 12 and 13, respectively. Live load surcharges should be applied with an equivalent soil depth consistent with the provisions of the AASHTO LRFD Bridge Design Specifications (8th Edition) with California Amendments. The dynamic lateral earth pressures for retaining walls were evaluated using the Mononobe-Okabe Method based on the underlying soil characteristics that may induce lateral movement of the retaining walls. For restrained retaining walls, application of the additional dynamic component will not be needed considering the at-rest earth pressure condition.

Retaining walls should have non-expansive backfill and free-draining conditions. Measures should be taken to reduce moisture build-up behind retaining walls. Wall backfill should meet the specifications for structure backfill (Caltrans, 2022b) for free-draining conditions. Abutment walls should include free-draining backfill materials and perforated drains as designed by the project civil engineer and should be constructed in accordance with Bridge Detail 3-5 on Plan B0-3 of the Standard Plans (Caltrans, 2022a). Typical subsurface drain details are presented on Figure 14.

10.3.1 Tieback Anchors

If the lateral deflection of the cantilevered portion of the retaining walls is excessive, tieback anchors may be appropriate to increase the stability of the retaining wall system. We anticipate that the proposed retaining wall at the north abutment of California State Route 57 will be braced with tieback anchors. Tieback anchors should be designed in accordance with the Ground Anchor Earth Retaining Systems section of the Caltrans Geotechnical Manual (2024c). Multiple rows of tieback anchors should be installed during cutting of the existing slope (top-down construction). A preliminary allowable unit pullout resistance of 1,500 psf should be considered in design for the bonded portion of the anchor. The anchors should be placed at an angle of approximately 15 degrees below the horizontal plane and spaced accordingly in the horizontal and vertical directions to meet the design loads. An effective bond diameter of at least 12 inches should be used in estimating the bond length of the grouted anchors. Depending on the grouting method employed during construction, the actual bond diameter may be larger than 12 inches. Moreover, the design bond length may be revised based on the pullout testing of the anchors during construction. A friction coefficient of 0.35 may be used for the tieback anchors and soil interface. The tieback lengths

may also need modification if underground utilities are present near the slope areas. More detailed recommendations for the tieback anchors (length, spacing, locations, etc.) should be provided during the detailed design phase of the project once detailed drawings are available after the additional borings have been performed for the project.

10.3.2 Tieback Anchor Construction Considerations

The anchor installation and wall construction should be performed by a specialized contractor having significant experience in tieback installations. The construction should be performed in a phased, “top down” manner starting at the top of the slope and proceeding gradually to the bottom. In each phase, anchor installation in a row should be preceded by removal of unsuitable materials (e.g., loose topsoil) from the slope face and followed by placement of the wall lagging. Slope excavations should be performed in accordance with the published guidelines of OSHA. On-site soil materials may be considered as Type C soils in accordance with the OSHA guidelines.

The anchors should be installed at the design angle below the horizontal plane with a tolerance of ± 2 degrees at the bearing plate. The bonded portion of the anchor should be filled with structural concrete or grout following placement of the tendon inside the anchor hole. We recommend the use of high-pressure grouting technique for installation of the anchors with effective grout pressure of 50 psi or higher. The grouting pressure may increase the effective diameter of the bonded portion of the anchor (grout bulb) by permeating into the subsurface soils. The pullout capacity of these anchors will be dependent predominantly on the success of applying and maintaining a high grout pressure during installation. The unbonded portion of the anchor may be filled with lean concrete, slurry, or clean sand. However, the unbonded portion of the anchor should be free to move.

Anchor installation and wall construction should be observed by Ninyo & Moore. The contractor should provide equipment and instrumentation needed to check placement of tendons and concrete within the anchor holes. The grout pump should be equipped with a pressure gauge capable of measuring a grout pressure of up to 100 psi. The quantity of grout and the grout pressure should be recorded by the contractor for each anchor. The anchors should be tested to check the design allowable pullout capacity.

10.3.3 Tieback Anchor Testing

The tieback anchors should be tested during construction to evaluate the design assumptions and allowable pullout capacities. The contractor should provide equipment and instrumentation needed to check the adequacy of the tiebacks. A dial gauge capable of

measuring displacements to 0.01-inch precision should be used to measure the anchor movement. A hydraulic jack and pump should be used to apply the test load, and the jack and a calibrated pressure gauge should be used to measure the load. The standard testing procedures typically consist of the following methods.

- **Performance Tests** – These tests are performed on a limited number of production anchors to check that 1) the design load may be safely carried, 2) effective bonded length corresponds to the design requirements, and 3) the residual movement is within tolerable range. The performance test consists of incrementally applying cycles of anchor loading and unloading until the reference test load is attained. In order to evaluate the long-term creep potential, each load increment is maintained until the measured deflection is negligible (i.e., displacement rate is smaller than a specified displacement increment per log cycle of load-hold time) and a creep test is conducted under the reference test load. The reference test load should be 200 percent of the design allowable pullout capacity. A “long” test should be performed over 24 hours based on a maximum total deflection of 12 inches and maximum deflection after load application of 0.75 inch. A “short” test should be performed over 30 minutes based on a maximum total deflection of 12 inches and maximum deflection after load application of 0.25 inch. The “long” performance test should be conducted on three of the tieback anchors and the “short” performance test should be conducted on five percent of the tieback anchors.
- **Proof Tests** – These tests are performed on each tieback anchor to check that the load-deflection behavior of the production anchor is consistent with the specified acceptance criteria. The proof test consists of a single cycle of incremental loading to the reference test load (i.e., 150 percent of the design allowable pullout capacity) followed by unloading. Each load increment is maintained until the measured deflection is negligible.

The performance and proof test schedules for the anchors, including the load increments, load hold periods, acceptance criteria, and repair mechanism of failed test anchors, should be developed by the contractor utilizing experience on similar projects and anchor design/testing recommendations and guidelines presented in this report. In general, the acceptance criteria for the tested anchors should be based on the following aspects.

- In order to allow the load transfer to reach the anchor bond length, the deflection of the anchor head should exceed 80 percent of the calculated elastic elongation of the unbonded tendon length.
- Total anchor deflection measured at the reference test load should not exceed the calculated elastic elongation of the tendon length measured from the anchor head to the center of the bond length.
- Creep displacement should not exceed 0.10 inch during the final log cycle of the load-hold period.

The test schedules of the tieback anchors and the acceptance criteria should be included in the project plans. Ninyo & Moore should be given the opportunity to review the project plans to check compliance with design and construction recommendations presented herein.

In order to maintain the long-term performance of the tieback anchors, the anchor head and the unbonded portion of the tiebacks should be protected against corrosion. Various corrosion protection methods are commercially available (e.g., anticorrosion grease, resin-bonded epoxy, encapsulation, secondary grouting, etc.). A corrosion protection method suitable for the present application should be provided by a specialized contractor who has experience with tieback installation in similar environment.

10.4 Preliminary Pavement Design

We anticipate that the new multi-use paths may consist of new asphalt concrete (AC) and Portland Cement Concrete (PCC) pavement. Traffic loading information was not available for our design at the time of preparation of this report. For planning purposes, we have assumed traffic index (TI) values of 5.0 and 6.0 for the preliminary design of pavement sections. A TI of 5.0 is generally used for designing pavements that will be subjected to relatively light passenger vehicles. A TI of 6.0 is generally used for designing pavements that are subjected to relatively light passenger vehicles and periodic heavy equipment/truck traffic.

We performed preliminary pavement design based on our evaluation of the subgrade soil conditions and review of previous laboratory testing. Laboratory testing performed on representative subgrade soil samples in the project vicinity performed by others indicated R-values ranging from approximately 72 to 74. Due to the variation of subgrade soils along the alignment, a design R-value of 60 was assumed in our preliminary analysis. Our pavement analysis was performed using the methodology outlined by the Highway Design Manual (Caltrans, 2023b) 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. The preliminary pavement section recommendations are summarized in Table 4.

Table 4 – Preliminary Structural Pavement Sections			
Traffic Index	AC/CAB or CMB (inches)	Full Depth AC (inches)	PCC (inches)
≤5.0	3 over 4.5	4	5.5
6.0	4 over 4.5	5	6

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

We recommend that approximately 2 inches of crushed aggregate/miscellaneous base be placed under the PCC. Prior to placement of aggregate base materials, we recommend that the top 12 inches of subgrade soils be scarified and compacted to a relative compaction of 90 percent in

accordance with ASTM D 1557. If full-depth AC pavement is used, we recommend that the subgrade soils be recompacted to a relative compaction of 95 percent.

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) 304.

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.

10.5 Decomposed Granite Trails

Decomposed granite, if used, should have a thickness of 6 inches underlain by 4 inches of aggregate base material. Prior to placement of the new natural surface trail, the upper approximately 12 inches of the subgrade beneath new natural surface trail should be scarified, moisture-conditioned, and compacted to a relative compaction of 90 percent as evaluated by ASTM D 1557.

The aggregate base material should be placed at a relative compaction of 95 percent or more as evaluated by ASTM D 1557. Aggregate base material should conform to the latest specifications in Section 200-2.2 for CAB or Section 200-2.4 for CMB of the Greenbook.

10.6 Corrosivity

The corrosion potential of the site soils was evaluated using the results of selected representative samples obtained in the project vicinity performed by others. Laboratory testing was performed to evaluate pH, minimum electrical resistivity, soluble sulfate, and chloride content. The soil pH and minimum resistivity tests were generally performed in accordance with CT 643. The test for chloride content of the soils was generally performed using CT 422. Sulfate testing was performed in general accordance with CT 417. The previous laboratory test results are presented in Appendix B.

The pH of the tested samples ranged from approximately 7.5 to 8.1. The electrical resistivity ranged from approximately 1,900 to 13,000 ohm-centimeters. The chloride content ranged from

approximately 10 to 128 ppm and the sulfate content ranged from non-detect to 0.0950 percent (i.e., 950 ppm). Based on the laboratory test results and Caltrans criteria (2021b), the project site can be classified as a non-corrosive site, which is defined as having earth materials with a pH of 5.5 or more, chloride concentrations of 500 ppm or less, sulfate concentration of 0.15 percent (i.e., 1,500 ppm) or less, or an electrical resistivity of 1,500 ohm-centimeters or more. We recommend that a corrosion engineer be consulted for further evaluation and recommendations.

10.7 Concrete Placement

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 samples tested during the previous geotechnical evaluations in the project vicinity performed by others, using CT 417, indicates water-soluble sulfate contents ranging from approximately non-detect to 0.0950 percent (i.e., 950 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 and since the test results are close to the moderate range, 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 recommend that concrete cover over reinforcing steel for foundations be provided in accordance with CBC (2022). We also recommend that crack control joints be provided in sidewalks and exterior hardscape in accordance with the recommendations of the structural engineer to reduce the potential for distress due to minor soil movement and concrete shrinkage. The structural engineer should be consulted for additional concrete specifications.

10.8 Drainage

Positive surface drainage is imperative for satisfactory site performance. Positive drainage should be provided and maintained to direct surface water away from foundations and off-site. Positive drainage is defined as a slope of 2 percent or more for a distance of 5 feet or more away from foundations and tops of slopes. Runoff should then be directed by the use of swales or pipes into a collective drainage system. Surface water should not be allowed to pond adjacent to foundations or pavement. Area drains for landscaped and paved areas are recommended.

11 CONSTRUCTION MONITORING PROGRAM

To reduce the potential for construction related claims, construction monitoring programs should be implemented to monitor ground vibrations, ground surface settlement, and lateral movement of shoring support systems. These monitoring programs should be in-place and conducted prior to the start of construction to reduce the potential for damage claims and to facilitate settlement of legitimate damage claims. The resulting data should be reviewed and evaluated during construction and distributed to appropriate parties during the course of construction.

11.1 Documentation of Existing Conditions

We recommend that pre-construction condition surveys be performed on structures and railroad crossings within approximately 50 feet of the proposed excavations prior to construction. This distance should be extended to 100 feet adjacent to proposed excavations if driven and/or vibratory sheet or soldier piles are installed. This survey should include locating existing cracks and measuring widths of cracks, in combination with video documentation of existing conditions. In addition, interviews should be conducted with utility owners so that existing knowledge about the age, type, and maintenance history of affected utilities is available prior to construction.

11.2 Construction Vibrations

People can perceive vibrations from construction activities at significantly lower levels than might cause cosmetic damage to structures. The Transportation and Construction Vibration Guidance Manual (Caltrans, 2020) indicates that transient vibrations, such as from pile installation or construction activities, may be noticeable at peak particle velocities as low as 0.035 inches per second (ips). The vibrations from the construction activities may be disturbing and result in complaints and/or damage claims at peak particle velocities as low as 0.2 to 0.4 ips. However, these vibration levels are well below the level considered to cause cosmetic damage to residential construction.

There is also the possibility of settlement of the soil during construction activities due to vibrations. This settlement may result in damage to structures and improvements. If the construction vibrations can be maintained below a peak particle velocity of 0.2 ips, the settlement can likely be limited to acceptable levels based on past projects in similar conditions.

For the above stated reasons, we recommend that seismographs be used in the early stages of construction to monitor the vibrations. Seismographs should be located near structures and improvements next to the construction activities. Additional seismographs should be located at various structures and improvements farther from the construction activities to monitor vibrations

as a function of distance from the sites. Periodic vibration monitoring is recommended during other construction activities. After review of the data obtained, the number of seismographs may be reduced at the discretion of the client and the geotechnical consultant.

11.3 Ground Surface Settlement

We recommend that arrays of ground surface settlement points be installed around the proposed excavations. The contractor should submit a monitoring plan showing the proposed locations of settlement points for review and approval by the project engineer. We recommend that the contractor be responsible for maintaining total settlement at any survey point to less than 0.5 inch. If the settlement reaches this limit, we recommend that further review of construction methodologies be performed and appropriate changes be made.

11.4 Lateral Movement for Shoring Support System

It may be appropriate to install inclinometers or establish survey points behind excavations next to existing slopes. The inclinometers or survey points should be monitored and evaluated daily during excavation activities to provide an advanced warning system of potential problems. As discussed previously, we recommend that the shoring system be designed to limit the ground settlement behind the shoring system to 0.5 inch or less to reduce the potential for distress to adjacent structures/improvements. If settlements reach 0.25 inch, we recommend that a review of the contractor's methods be performed and appropriate changes be made, if needed.

11.5 Groundwater Monitoring

If construction dewatering is performed, settlement of the ground surface and adjacent structures may also be caused by drawdown of the water table. We recommend that the contractor monitor water levels outside of the excavations. To monitor the groundwater levels outside of the excavations, we recommend that groundwater monitoring wells be installed. The monitoring wells should be installed at locations that will be accessible during construction. The groundwater levels should be monitored daily during dewatering as appropriate.

12 ADDITIONAL GEOTECHNICAL STUDIES

The available subsurface information does not provide sufficient data to complete the design recommendations for the OC River Walk Project. This geotechnical evaluation was performed for preliminary planning purposes. During its design phase, the structure details and locations may change. We are scheduled to perform a subsurface evaluation and geotechnical laboratory testing after the project team receives Section 404 and 408 permission from the USACE and after our Drilling Program Plan is approved. We will perform supplemental geotechnical engineering

analyses and prepare an updated geotechnical evaluation report for the project based on the findings from our subsurface evaluation. The design of project improvements should be based on the subsequent geotechnical evaluation results and recommendations.

13 LIMITATIONS

The geotechnical analyses presented in this report have been conducted in accordance with current engineering practice and the standard of care exercised by reputable geotechnical consultants performing similar tasks in this area. No other warranty, implied or expressed, is made regarding the preliminary conclusions, recommendations, and professional opinions expressed in this report. Our preliminary conclusions and recommendations are based on a review of readily available geotechnical literature, geologic and seismic data, and an analysis of the observed conditions. Variations may exist and conditions not observed or described in this report may be encountered

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 exclusively for use by the client and for preliminary design. This report is not intended for final design. 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.

14 REFERENCES

- Abrahamson, N.A., Silva, W.J. and Kamai, R., 2014, Summary of the ASK14 Ground Motion Relation for Active Crustal Regions, *Earthquake Spectra*: Vol. 30, No. 3, pp. 1025-1055, dated August.
- Accu-Test Soil Laboratory Incorporated, 1979, Preliminary Geotechnical Investigation for the Proposed Commercial Development, 700 Eckhoff Street, Orange County, California, Job No. #F-6445-79, dated April 12.
- American Association of State Highway and Transportation Officials (AASHTO), 2020, LRFD Bridge Design Specifications, 9th Edition.
- American Concrete Institute (ACI), 2022, ACI Collection of Concrete Codes, Specifications, and Practices.
- American Concrete Institute, 2022, Building Code Requirements for Structural Concrete (ACI 318-19) and Commentary (ACI 318R-19).
- American Society of Civil Engineers, 2016, Minimum Design Loads for Buildings and Other Structures, Standard ASCE/SEI 7-16.
- Applied Technology Council, 2024, Hazards by Location, <https://hazards.atcouncil.org/>
- ASTM International (ASTM), 2022, Annual Book of ASTM Standards, West Conshohocken, Pennsylvania.
- Atik, Linda A. and Sitar, N., 2010, Seismic Earth Pressures on Cantilever Retaining Structures, *ASCE Journal of Geotechnical and Geoenvironmental Engineering*, Vol. 136, No. 10, October 1.
- Bartlett, S.F., and Youd, T.L., 1995, Empirical Prediction of Liquefaction-Induced Lateral Spread *Journal of Geotechnical Engineering*, American Society of Civil Engineers, Vol. 121, No. 4, 316-329, dated April.
- Boore, D.M., Stewart, J.P., Seyhan, E., and Atkinson, G.M., 2014, NGA-West2 Equations for Predicting PGA, PGV, and 5% Damped PSA for Shallow Crustal Earthquakes, *Earthquake Spectra*, Vol. 30, No. 3, pp. 1057-1085, dated August.
- Bowles, J.E., 1996, *Foundation Analysis and Design*, Fifth Edition, The McGraw-Hill Companies, Inc.
- Building Seismic Safety Council, 2015, National Earthquake Hazards Reduction Program (NEHRP) Recommended Seismic Provisions for New Buildings and Other Structures (FEMA P-1051), dated July.
- California Building Standards Commission, 2022, California Building Code: California Code of Regulations, Title 24, Part 2, Volumes 1 and 2, based on the 2021 International Building Code.
- California Department of Conservation, 2024, California Tsunami Maps, <https://www.conservation.ca.gov/cgs/tsunami/maps>.
- California Department of Conservation, Division of Mines and Geology (CDMG), 1976, Environmental Geology of Orange County, California, Open File Report 79-8 LA.
- California Department of Conservation, Division of Mines and Geology (CDMG), State of California, 1997a, Seismic Hazard Zone Report for the Anaheim and Newport Beach 7.5 Minute Quadrangles, Orange County, California: Seismic Hazard Zone Report 003.
- California Department of Conservation, Division of Mines and Geology, State of California, 1997b, Seismic Hazard Zone Report for the Orange 7.5-Minute Quadrangle, Orange County, California: Seismic Hazard Zone Report 011.

California Department of Conservation, Division of Mines and Geology, State of California, 1998a, Seismic Hazard Zones Official Map, Anaheim Quadrangle, 7.5-Minute Series, Scale 1:24,000, dated April 15.

California Department of Conservation, Division of Mines and Geology, State of California, 1998b, Seismic Hazard Zones Official Map, Orange Quadrangle, 7.5-Minute Series: Scale 1:24,000, Open-File Report 97-19, dated April 15.

California Department of Transportation (Caltrans), 1976, Log of Test Borings No. 1 through No. 4, Santa Ana River Bridge, Bridge No. 55-400, Post Mile 120, dated April 15.

California Department of Transportation, 2011, Trenching and Shoring Manual, dated August.

California Department of Transportation, 2013, Seismic Design Criteria, Version 1.7, dated April.

California Department of Transportation, 2014, Caltrans Supplement to FHWA Culvert Repair Practices Manual, Design Information Bulletin 83-04, dated August 1.

California Department of Transportation, 2015a, Bridge Design Specifications Manual, dated January 24.

California Department of Transportation, 2015b, Caltrans Encroachment Permits, Guidelines and Specifications for Trenchless Technology Projects, dated January.

California Department of Transportation, 2017, Foundation Reports for Bridges, dated February.

California Department of Transportation, 2019a, Caltrans Seismic Design Criteria, Version 2.0, dated April.

California Department of Transportation, 2019b, California Amendments to the AASHTO LRFD Bridge Design Specifications (2017 Eighth Edition), dated April.

California Department of Transportation, Division of Environmental Analysis, Environmental Engineering, Hazardous Waste, Air, Noise, Paleontology Office, 2020, Transportation and Construction Vibration Guidance Manual, dated April.

California Department of Transportation, 2021a, Geotechnical Design Reports, dated February.

California Department of Transportation, 2021b, Corrosion Guidelines, Version 3.2, Division of Engineering Services, Materials Engineering and Testing Services, Corrosion Technology Branch, dated May.

California Department of Transportation, 2022a, Standard Plans.

California Department of Transportation, 2022b, Standard Specifications.

California Department of Transportation, 2022c, Standard Special Provisions.

California Department of Transportation, 2023a, Soil and Rock Logging, Classification, and Presentation Manual.

California Department of Transportation, 2023b, Highway Design Manual, Seventh Edition, dated September 29.

California Department of Transportation, 2024a, CalME Online Software Program (V3.DD002.0), <http://www.ucprc.ucdavis.edu/calme/>.

California Department of Transportation, 2024b, Caltrans ARS Online (V3.1.0), <https://arsonline.dot.ca.gov/>.

California Department of Transportation, 2024c, Geotechnical Manual.

California Geological Survey (CGS), 2008, Guidelines for Evaluating and Mitigating Seismic Hazards in California, Special Publication 117A, dated September 11.

- California Geological Survey, 2010, Fault Activity Map of California, <http://maps.conservation.ca.gov/cgs/fam/>.
- California Geological Survey, 2015, CGS Map Sheet 48: Shear-wave Velocity in Upper 30m of Surficial Geology (Vs30); <https://maps.conservation.ca.gov/cgs/DataViewer/>, dated May 24.
- California Geological Survey, 2018, Earthquake Fault Zones, A Guide for Government Agencies, Property Owners/Developers, and Geoscience Practitioners for Assessing Fault Rupture Hazards in California: Special Publication 42.
- California Geological Survey, 2024, Earthquake Zones of Required Investigation, <https://maps.conservation.ca.gov/cgs/EQZApp/app/>.
- Campbell, K.W., and Bozorgnia, Y., 2014, NGA-West2 Ground Motion Model for the Average Horizontal Components of PGA, PGV, and 5% Damped Linear Acceleration Response Spectra, Earthquake Spectra, Vol. 30, No. 3, pp. 1087-1115, dated August.
- Chiou, B. S.-J., and Youngs, R.R., 2014, Update of the Chiou and Youngs NGA Model for the Average Horizontal Component of Peak Ground Motion and Response Spectra, Earthquake Spectra, August 2014, Vol. 30, No. 3, dated August.
- City of Anaheim, Community Services Department, 2022, Request for Proposal, OC River Walk, Design, Environmental, and Regulatory Permitting, dated May 6.
- CivilTech Software, 2016, AllPile version 7.21e.
- CivilTech Software, 2019, Liquefy Pro (Version 5.9d), A Computer Program for Liquefaction and Settlement Analysis.
- Diaz Yourman & Associates, 2012a, Geotechnical Services, Stadium Pavilion and Baggage Tunnels – Anaheim Regional Transportation Intermodal Center, Anaheim, California, Project No. 2009-021, dated March 27, 2012.
- Diaz Yourman & Associates, 2012b, Geotechnical Report, Intermodal Terminal Building, Pedestrian Concourse Bridge, Service Yard Building, Phase 1 – Anaheim Regional Transportation Intermodal Center, Anaheim, California, Project No. 2009-021, dated April 2, 2012.
- Diaz Yourman & Associates, 2012c, Foundation Report, Phase 1 – Anaheim Regional Transportation Intermodal Center, Douglass Road Underpass Bridge (Replace), Anaheim, California, Project No. 2009-021, dated April 4, 2012.
- Earth Mechanics, Inc., 2019, Foundation Report, Orangewood Avenue Bridge over Santa Ana River (Widening), City of Orange, Orange County, California, EMI Project No. 17-126, dated August 30.
- Earth Mechanics, Inc., 2020, Foundation Report, Orangewood Avenue Bridge over Santa Ana River (Widening), City of Orange, Orange County, California, EMI Project No. 17-126, dated September 14.
- EJN & Associates, Inc., 1987, Compaction Report, Corner of Collins & Eckhoff, Orange, California, Job No. 86-229-2, dated January 20.
- Federal Emergency Management Agency, 2009, Flood Insurance Rate Maps, Orange County, California, Map Numbers 06059C0142J, 06059C0153J, and 06059C0161J, dated December 3.
- Federal Highway Administration, 1999, Ground Anchors and Anchored Systems, Geotechnical Engineering Circular No. 4, Publication No. FHWA-IF-99-015, dated June.

- Federal Highway Administration, 2013, Federal Highway Administration Design Manual: Deep Mixing for Embankment and Foundation Support, Publication No. FHWA-HRT-13-046, dated October.
- GeoStudio, 2023, SLOPE/W (version 23.1.0.520) Software: for Slope Stability Analysis.
- Google Earth, 2023, <http://earth.google.com>.
- Harrington Geotechnical Engineering, Inc., 2020, Geotechnical Feasibility Investigation for Development of Proposed Angels Stadium Master Plan, 2000 Gene Autry Way, Anaheim, CA, HGEI Project No. 20-01-3950, dated July 29 (Revised).
- Harrington Geotechnical Engineering, Inc., 2021, Preliminary Geotechnical Engineering Investigation and Infiltration Study for the City of Anaheim's Community Services Department, Anaheim River Walk Project, HGEI Project 21-ANA-0491, dated July 21.
- Historical Aerials, 2024, Website for Viewing Aerial Photographs, www.historicaerials.com.
- H.V. Lawmaster & Co., Inc., 1976, Soil Compaction Report, Progress Report No. 1, Varco International Inc. Phase 1 Addition, 600 North Eckhoff Street, Orange, California, File No. 75-7770, dated January 13.
- Idriss, I. M., and Boulanger, R. W., 2008, Soil liquefaction during earthquakes, Earthquake Engineering Research Institute, Monograph MNO-12.
- Ishihara, K. and Yoshimine, M. (1992) "Evaluation of settlements in sand deposits following liquefaction during earthquakes," Soils and Foundations, 32 (1), 173-188.
- Jennings, C.W., and Bryant, W.A., 2010, Fault Activity Map: California Geological Survey, California Geologic Data Map Series, Map No. 6, Scale 1:750,000.
- Joint Cooperative Committee of the Southern California Chapter of the American Public Works Association and Southern California Districts of the Associated General Contractors of California, 2021, "Greenbook," Standard Specifications for Public Works Construction: BNI Building News, Los Angeles, California.
- Kenneth G. Osborne & Associates, 1988, Geotechnical Investigation, Office Building and Warehouse, 800 North Eckhoff Street, Orange, California, Job No. 4952, dated April 7, revised September 19.
- Kleinfelder, 2009, Geotechnical Feasibility Study, Proposed Artic Phase 1 Project, Anaheim, CA, dated October 23.
- Kleinfelder, 2003, Report of Geotechnical Study (Revised), Proposed Burris Pit Basin Reconfiguration, Anaheim, CA, dated October 7.
- Kleinfelder, 2002, Report of Data Review, Burris Pit Basin - Levee Stability, Anaheim, CA, dated January 10.
- Krazan & Associates, Inc., 2001, Final Soils Report, Extended Stay America, Katella/Main Stadium Promenade, Orange, California, Project No. 116-00094, dated March 13.
- Langan, 2019, Preliminary Geotechnical Investigation and Site-Specific Response Spectra – Honda Center Parking Structures A through D, Anaheim, California, Project No. 721019101, dated October 31, 2019.
- Leighton Consulting, Inc., 2013a, Draft Geotechnical Exploration and Analysis, Burris Pump Station Project for Orange County Water District, Anaheim, California, dated March 11.
- Leighton Consulting, Inc., 2013b, Project Memorandum, Geotechnical Analysis of Planned Setback from Center Levee to Borrow Areas, Burris Pump Station Project for Orange County Water District, Anaheim, California, revised date June 21.

- Leighton Consulting, Inc., 2014, Draft Geotechnical Report of Phase I Grading and Supplemental Recommendations for Phase II Construction, Burris Pump Station Project, Anaheim, California, dated January 23.
- LeRoy Crandall and Associates, 1989, Phase 1 Report of Preliminary Study, Proposed Anaheim Arena, Katella Avenue and Douglas Road, Anaheim, California, dated November 29.
- Michael Baker International, 2022, Basis of Design Report, Santa Ana River at Orangewood Avenue Bridge Crossing, Anaheim, California, Scour Analysis, Project Number 159416, dated March.
- Moore and Taber, 1988, Geotechnical Study, Five Coves/Burris Improvements, Santa Ana River, Anaheim, California, dated April 13.
- Morton, D.M., 2004, Preliminary Digital Geologic Map of the Santa Ana 30'x 60' Quadrangle, Southern California, Version 2.0: United States Geological Survey, Open-File Report 99-172, Scale 1:100,000.
- Morton, D.M., and Miller, F.K., 2006, Geologic Map of the Santa Ana 30'x 60' Quadrangle, Southern California, Version 2.0: United States Geological Survey, Open-File Report 99 172, Scale 1:100,000.
- Morton, P.K., Miller, R.V, and J.R. Evans, 1976, Environmental Geology of Orange County, California: California Division of Mines and Geology Open File Report 79-8 LA, Scale 1:48,000.
- Naval Facilities Engineering Command (NAVFAC), 1979, Pavement Design Manual, D.M. 5.4, dated October.
- Naval Facilities Engineering Command, 1982, Foundations and Earth Structures Design Manuals, dated May.
- Ninyo & Moore, 2009, Geotechnical Evaluation, Burris and Lincoln Basins Reconfiguration Project, Orange County Water District, Anaheim, California, dated May 5.
- Ninyo & Moore, 2010, Geotechnical Evaluation, Five Coves and Lincoln Basins Bypass Pipeline Project, Orange County Water District, Anaheim, California, dated May 10.
- Ninyo & Moore, 2011, As-Graded Geotechnical Report, Burris and Lincoln Basins Reconfiguration Project, Orange County Water District, Anaheim, California, dated June 21.
- Ninyo & Moore, 2021, Geotechnical Evaluation, Burris Basin Groundwater Replenishment System Turnout Project, Anaheim, California, Project No. 211071001, dated December 15.
- Ninyo & Moore, 2022, Proposal for Geotechnical Consulting Services, OC River Walk, City of Anaheim, California, Proposal No. 04-03580, dated May 24.
- Ninyo & Moore, 2023a, Drilling Program Plan, OC River Walk, City of Anaheim, Anaheim, California, Project No. 212076001, dated March 31.
- Ninyo & Moore, 2023b, Proposal for Additional Geotechnical Consulting Services, OC River Walk, City of Anaheim, California, Project No. 212076001, dated September 28.
- NMG Geotechnical, Inc., 2021, Supplemental Geotechnical Exploration and Planning Study, ocV!be Mixed-Use Community and Live Entertainment Redevelopment Project, Platinum Triangle, City of Anaheim, California, Project No. 20065-01, dated May 24.
- NMG Geotechnical, Inc., 2024, Groundwater Monitoring Well Readings, ocV!be, Anaheim, California, dated May 24.
- Norris, R.M., and Webb, R.W., 1990, Geology of California, Second Edition: John Wiley & Sons.

- Orange County Road Department, 1967, Log of Test Borings, Ball Road Bridge Across Santa Ana River.
- Orange County Water District, 1994, As-Built Drawings, Santa Ana River Inflatable Dams Project, Five Coves Inflatable Dam and By-Pass Structures, dated March.
- Pacific Advanced Civil Engineering, Inc. (PACE), 2021, OC River Walk Engineering Feasibility Study, dated November.
- Pacific Advanced Civil Engineering, Inc., 2023, Master Plan, Orangewood Avenue to Ball Road, dated March 13.
- Parsons, 2023, Draft Advance Planning Study, OC River Walk Pedestrian Bridge.
- Robertson, 2010, Soil Behavior Type from the CPT: An Update, 2nd International Symposium on Cone Penetration Testing, CPT' 10, Huntington Beach, California, USA, www.cpt10.com.
- Seed, H.B., and Idriss, I.M., 1982, Ground Motions and Soil Liquefaction During Earthquakes, Volume 5 of Engineering Monographs on Earthquake Criteria, Structural Design, and Strong Motion Records: Berkeley, Earthquake Engineering Research Institute.
- Seyhan, E, 2014, Weighted Average 2014 NGA West-2 GMPE, Pacific Earthquake Engineering Research Center.
- Southern California Earthquake Data Center, 2024, <https://scedc.caltech.edu/earthquake/santasusana.html>.
- Sprotte, E.C., Fuller, D.R., Greenwood, R.B., and Mumm, H.A., 1980, Classification and Mapping of Quaternary Sedimentary Deposits For Purposes of Seismic Zonation, South Coastal Los Angeles Basin, Orange County, California: California Division of Mines and Geology Open File Report 80-19, Scale 1:48,000.
- State of California, Department of Water Resources, 2024, Water Data Library Station Map, <https://wdl.water.ca.gov/waterdatalibrary/>.
- State of California, State Water Resources Control Board, 2024, GeoTracker Database System, <http://geotracker.swrcb.ca.gov/>.
- United States Army Corps of Engineers (USACE), 1988, Plans Titled Lower Santa Ana River Channel, Plan and Profile, Santa Ana River Mainstem, California, Phase II General Design Memorandum, Sheets 23, 24, and 25 of 105.
- United States Army Corps of Engineers, 1988, Santa Ana River, Design Memorandum No. 1, Phase II GDM on the Santa Ana River Mainstem including Santiago Creek, Volume 3, Lower Santa Ana River, Geotechnical Appendix A, dated August.
- United States Army Corps of Engineers, 2014, Engineering and Design, Drilling in Earth Embankment Dams and Levees, Regulation No. 1110-1-1807, dated December 31.
- United States Army Corps of Engineers, 2018, Water Resource Policies and Authorities, Policy and Procedural Guidance for Processing Requests to Alter US Army Corps of Engineers Civil Works Projects Pursuant to 33 USC 408, EC 1165-2-220, dated September 10.
- United States Department of Agriculture (USDA), 1952, Aerial Photographs, Flight No. AXK-5K, Photograph Nos. 83 through 85, dated December 26, Scale 1:20,000.
- United States Geological Survey (USGS), 1901 (Reprinted 1932), Anaheim, California Quadrangle Map, 15 Minute Series: Scale 1:62,500.
- United States Geological Survey, 1964 (Photorevised 1981), Orange, California Quadrangle Map, 7.5 Minute Series: Scale 1:24,000.

- United States Geological Survey, 2008, National Seismic Hazard Maps, http://geohazards.usgs.gov/cfusion/hazfaults_search/hf_search_main.cfm.
- United States Geological Survey, 2022, USGS US Topo 7.5-Minute Map for Anaheim, CA: USGS – National Geospatial Technical Operations Center.
- United States Geological Survey, 2024a, Unified Hazard Tool; <https://earthquake.usgs.gov/hazards/interactive/>.
- United States Geological Survey, 2024b, Quaternary Fault and Fold Database of the United States, <https://www.usgs.gov/natural-hazards/earthquakehazards/hazards>.
- United States Geological Survey and Southern California Earthquake Center, 2021, Open Seismic Hazard Analysis, Version 1.5.2, released June 3, <http://www.opensha.org/>.
- URS Corporation, 2006, Feasibility Study for the Burris Pit Recharge Basin Reconfiguration Project, dated July 6.
- Youd, T.L., Idriss, I.M., Andrus, R.D., Arango, I., Castro, G., Christian, J.T., Dobry, R., Finn, W.D., Harder, L.F., Hynes, M.E., Ishihara, K., Koester, J.P., Liao, S.S.C., Marcuson, W.F., Martin, G.R., Mitchell, J.K., Moriwaki, Y., Power, M.S., Robertson, P.K., Seed, R.B., and Stokoe, K.H., II., 2001, Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils, *Journal of Geotechnical and Geoenvironmental Engineering*: American Society of Civil Engineering 124(10), pp. 817-833.
- Youd, T.L., Hansen, C.M., and Bartlett, S.F., 2002, Revised Multilinear Regression Equations for Prediction of Lateral Spread Displacement, *Journal of Geotechnical and Geoenvironmental Engineer*, Vol. 128, No. 12, American Society of Civil Engineers, December 1.

FIGURES

1 212076001 SL.dwg 10/09/2024 (October 2024) GK



NOTE: DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE. | REFERENCE: USGS, 2022.

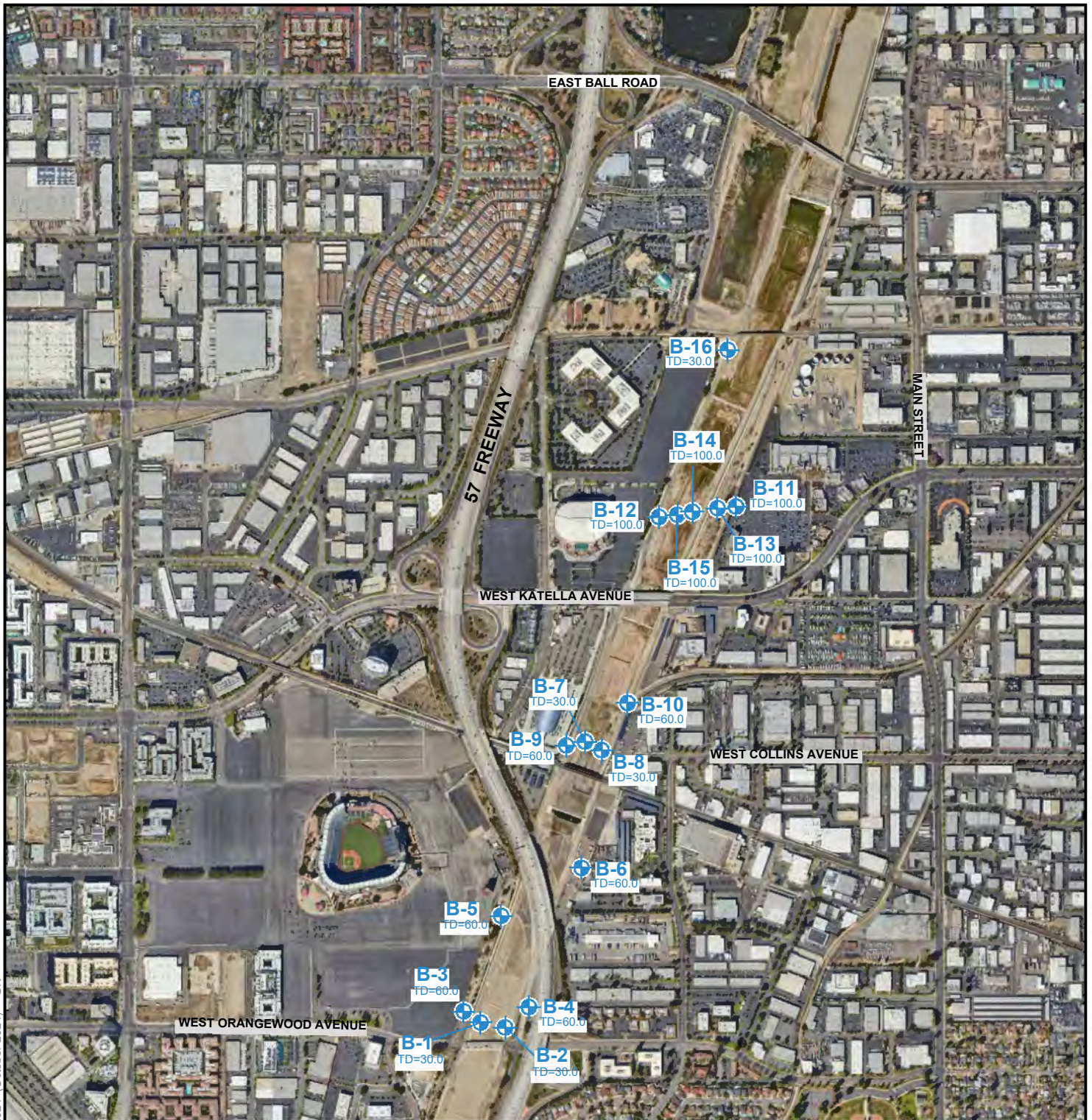


FIGURE 1

SITE LOCATION

OC RIVER WALK
ANAHEIM AND ORANGE, CALIFORNIA

2: 212076001 BL.dwg 10/09/2024 (October 2024) GK



LEGEND

B-16
TD=30.0

PROPOSED BORING (NINYO & MOORE);
TD=TOTAL DEPTH IN FEET

NOTE: DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE. | REFERENCE: GOOGLE EARTH, 2023.

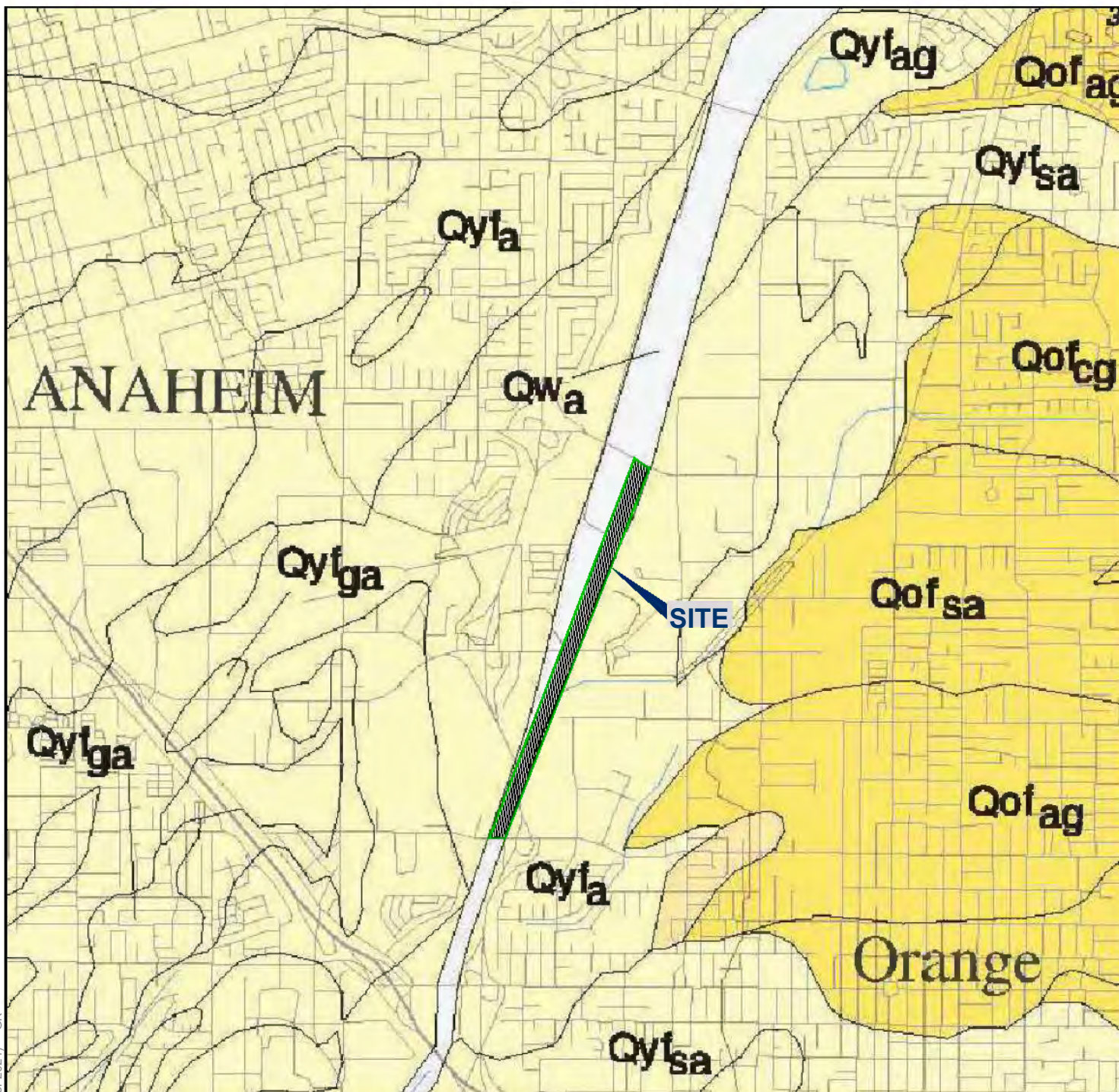


FIGURE 2

PROPOSED BORING LOCATIONS

OC RIVER WALK
ANAHEIM AND ORANGE, CALIFORNIA

4 212076001 RG.dwg 10/09/2024 (October 2024) GK



LEGEND

Qw	WASH DEPOSITS (LATE HOLOCENE)	Qof	OLD ALLUVIAL FAN DEPOSITS (LATE TO MIDDLE PLEISTOCENE)
Qyf	YOUNG ALLUVIAL FAN DEPOSITS (HOLOCENE AND LATE PLEISTOCENE)		GEOLOGIC CONTACT

NOTE: DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE. | REFERENCE: MORTON AND MILLER, 2006.

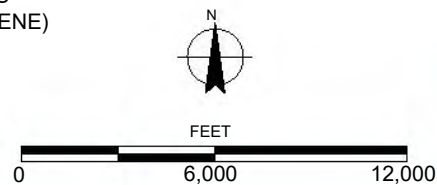
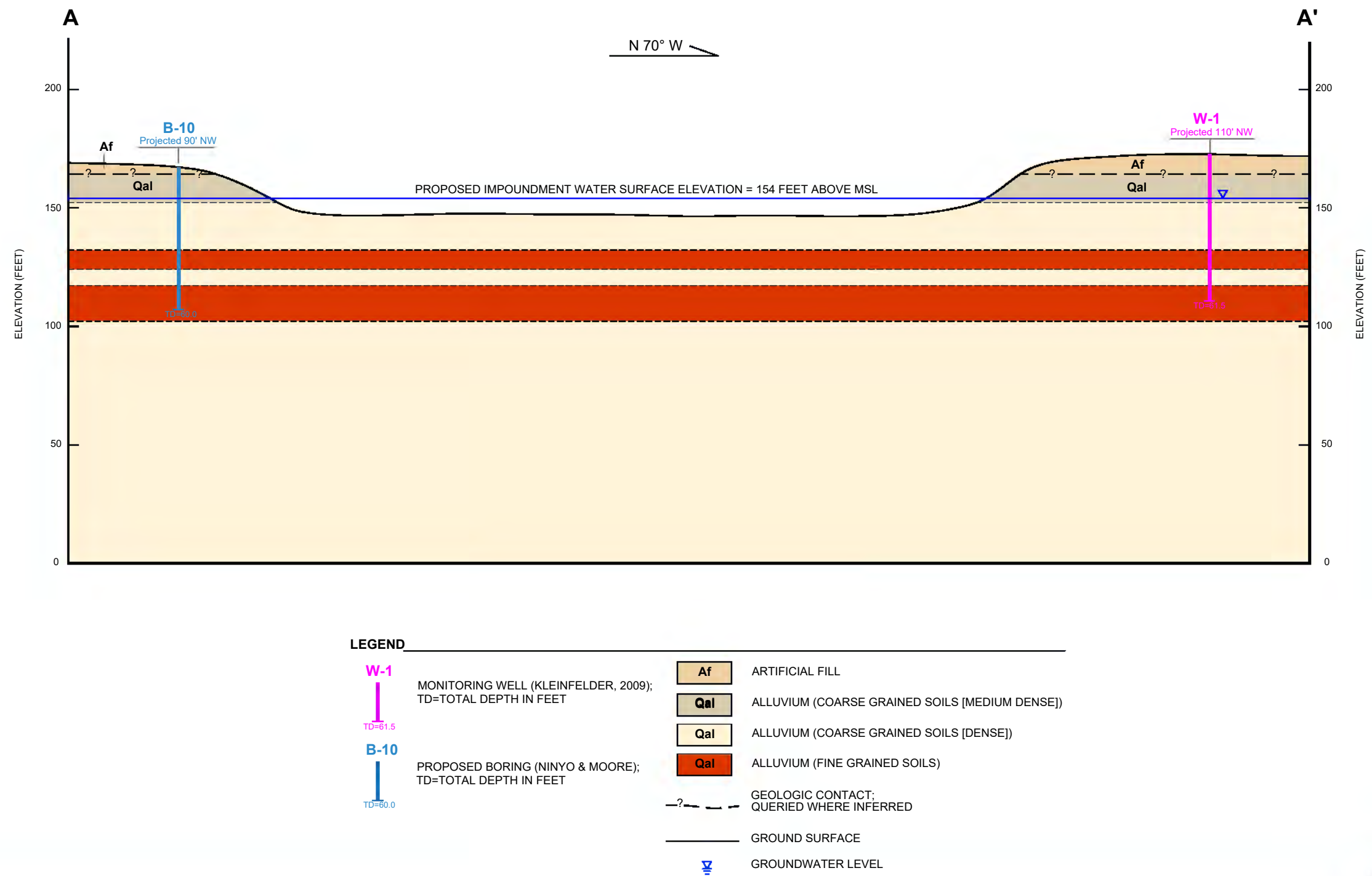
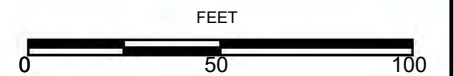


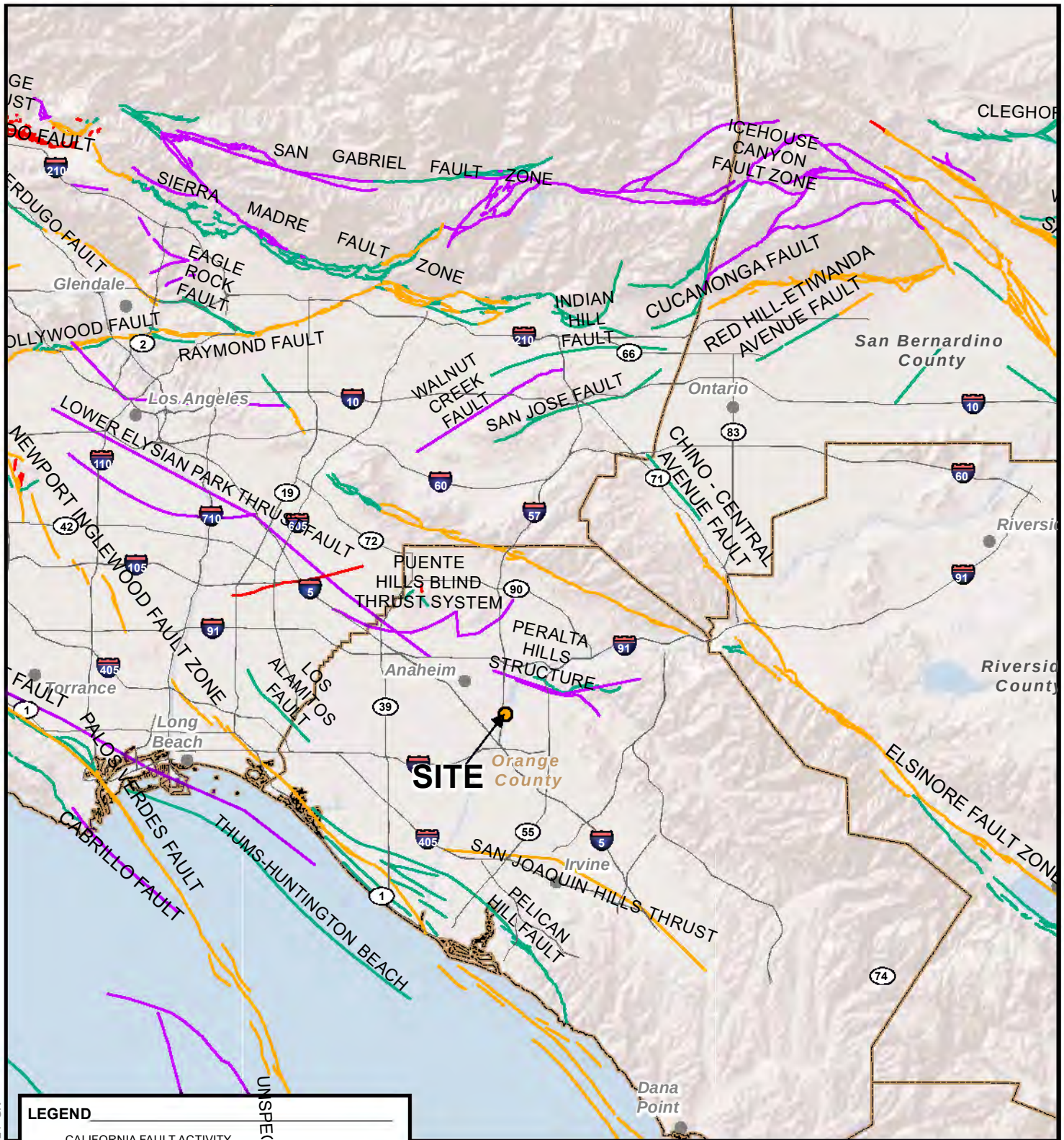
FIGURE 4

5_212076001_CSA.dwg 10/09/2024 (October 2024) GK



NOTE: DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE.





LEGEND

CALIFORNIA FAULT ACTIVITY

HISTORICALLY ACTIVE

HOLOCENE ACTIVE

LATE QUATERNARY (POTENTIALLY ACTIVE)

QUATERNARY (POTENTIALLY ACTIVE)

STATE/COUNTY BOUNDARY

SOURCES: QUATERNARY FAULTS DATABASE - U.S. GEOLOGICAL SURVEY AND CALIFORNIA GEOLOGICAL SURVEY, QUATERNARY FAULT AND FOLD DATABASE FOR THE UNITED STATES, ACCESSED FEBRUARY 27, 2024, AT: <https://www.usgs.gov/programs/earthquake-hazards/faults>, ESRI, 2023.

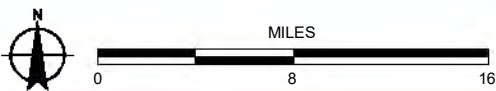
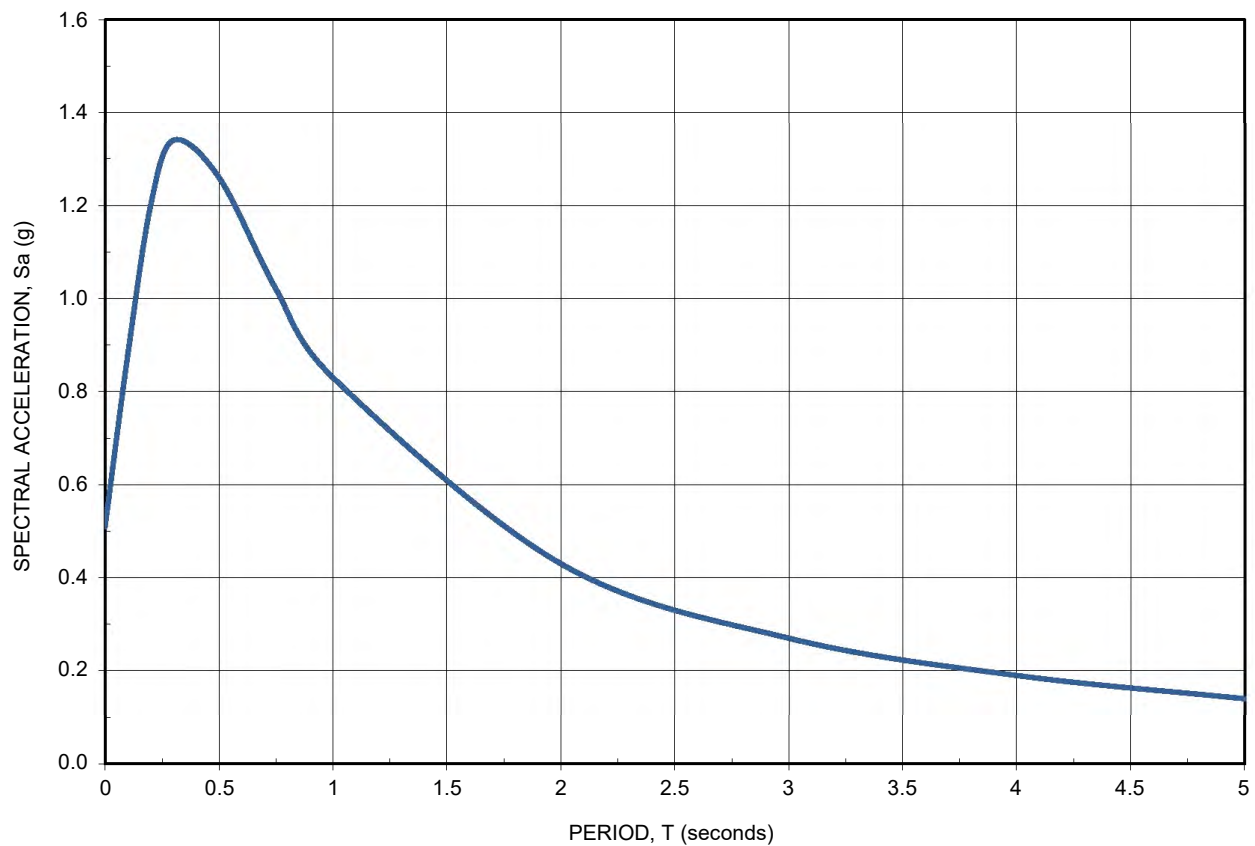


FIGURE 6

FAULT LOCATIONS

OC RIVER WALK
ANAHEIM AND ORANGE, CALIFORNIA

PERIOD (seconds)	DESIGN SPECTRAL ACCELERATION Sa (g)
PGA	0.51
0.10	0.88
0.20	1.20
0.30	1.34
0.50	1.26
0.75	1.02
1.00	0.83
2.00	0.43
3.00	0.27
4.00	0.19
5.00	0.14

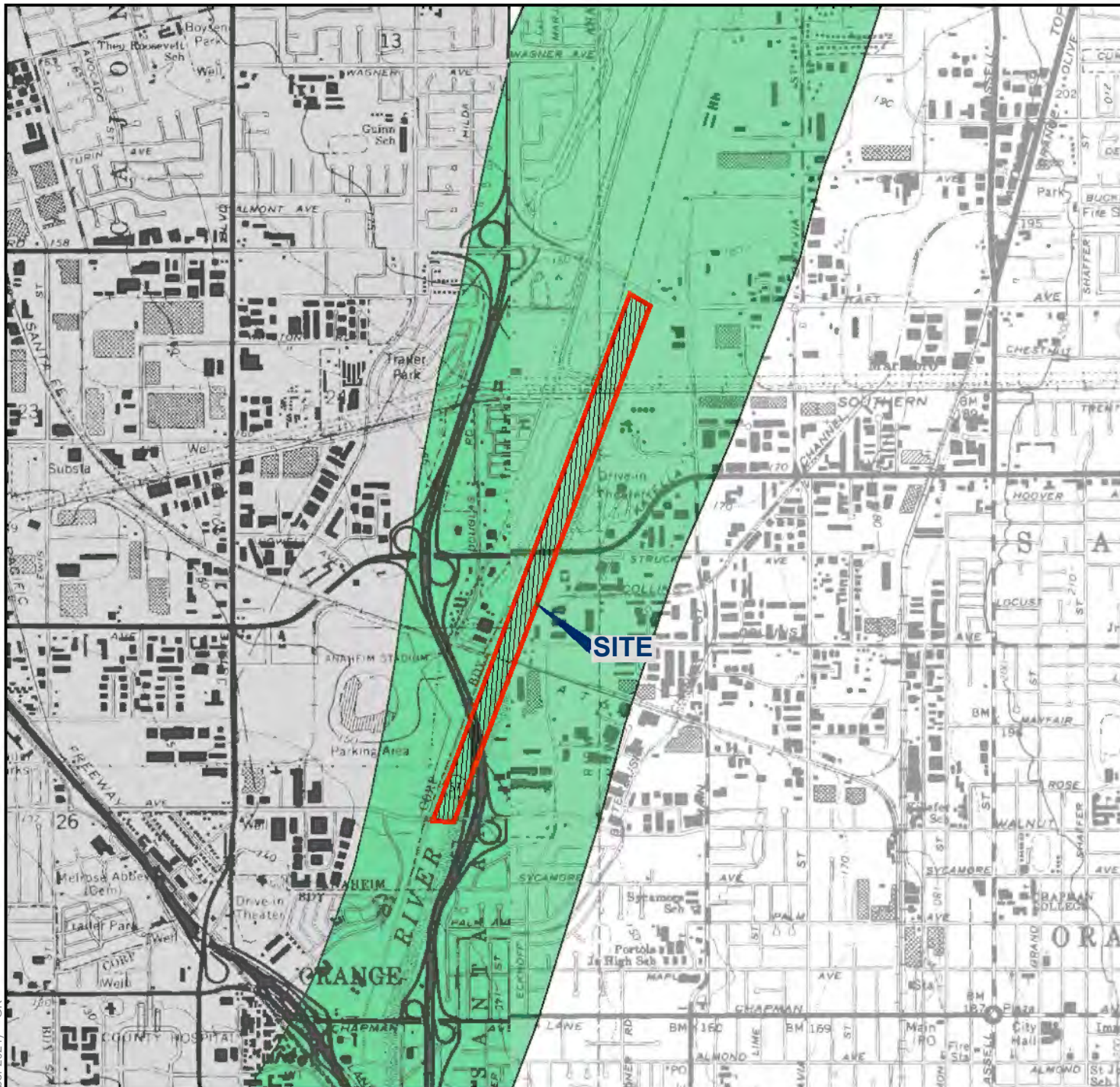


NOTES:

- 1 SITE LATITUDE = 33.80732 DEGREES
SITE LONGITUDE = -117.87417 DEGREES
- 2 AVERAGE SHEAR WAVE VELOCITY IN THE UPPER 30 METERS (ASSUMED) = 228 METERS/SECOND
- 3 THE ACCELERATION RESPONSE SPECTRUM REPRESENTS THE 2014 USGS 5% IN 50 YEARS (975 YEAR RETURN PERIOD) HAZARD AT 5% DAMPING.
- 4 THE ACCELERATION RESPONSE SPECTRUM INCLUDES NEAR-FAULT EFFECTS AND BASIN AMPLIFICATION EFFECTS.
- 5 PEAK GROUND ACCELERATION (PGA) = 0.51g
- 6 MEAN MOMENT MAGNITUDE (M) = 6.58

FIGURE 7

CALTRANS ACCELERATION RESPONSE SPECTRUM



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.

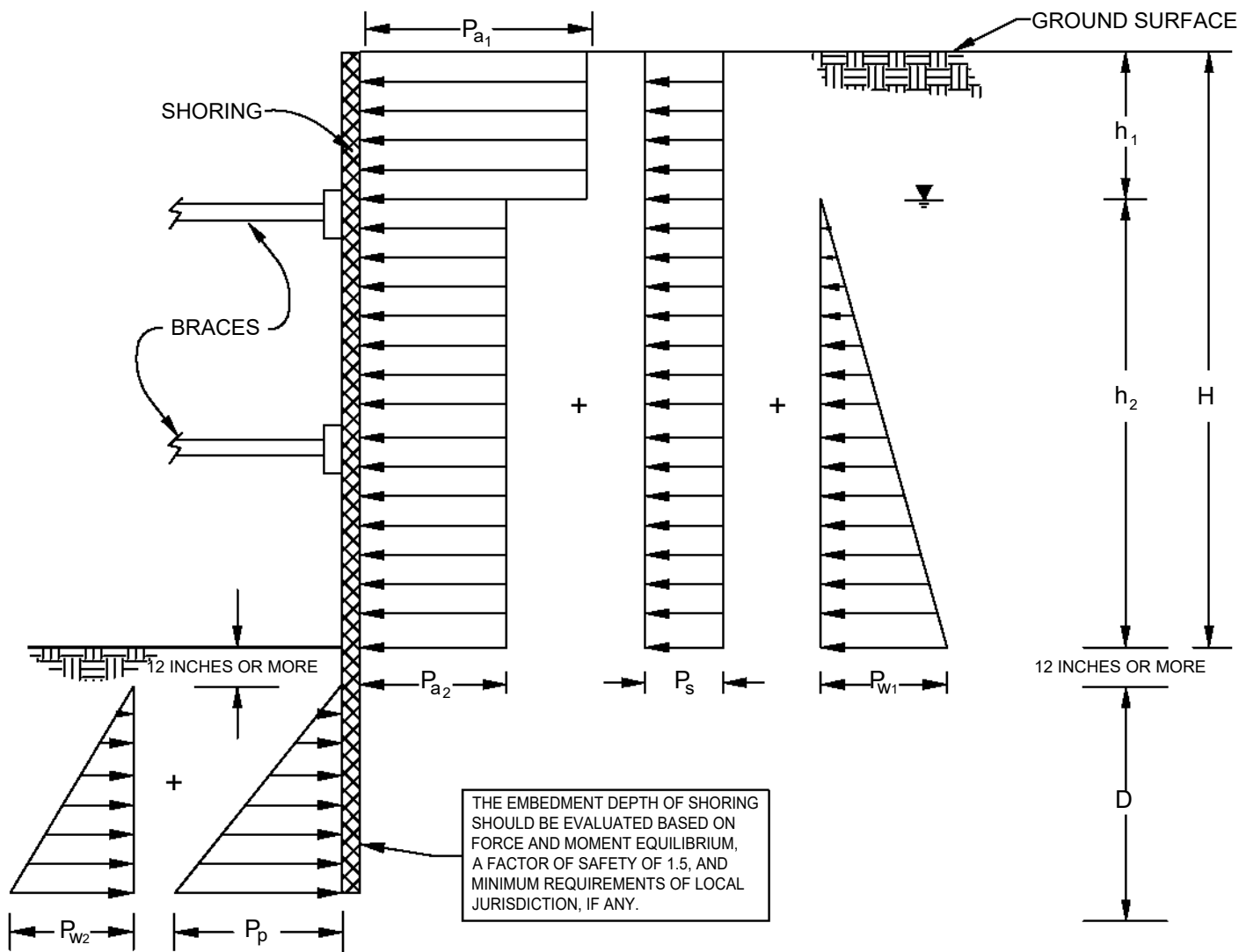
NOTE: DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE. | REFERENCE: CDMG, 1998a and b.



FIGURE 8

SEISMIC HAZARD ZONES

OC RIVER WALK
ANAHEIM AND ORANGE, CALIFORNIA



NOTES:

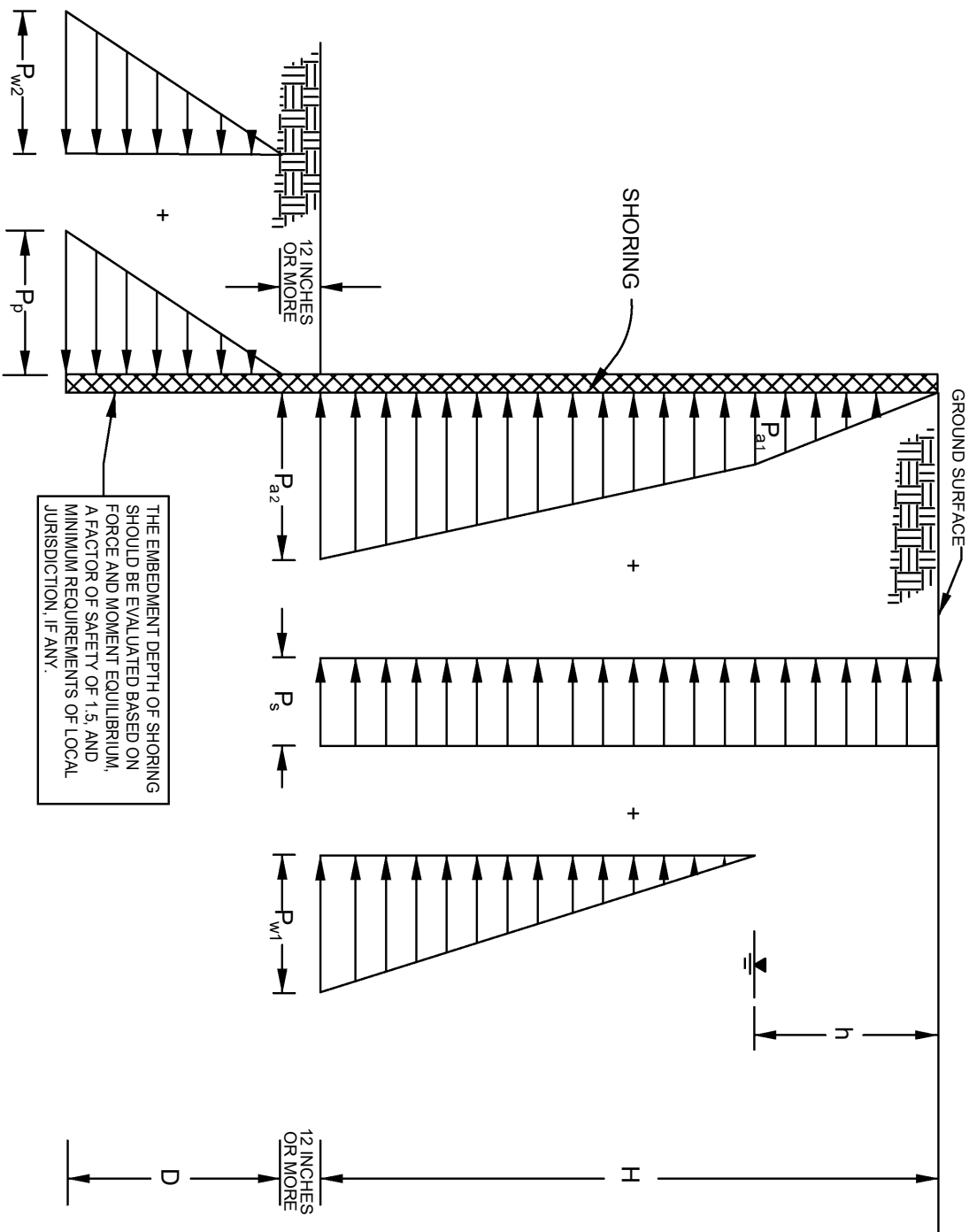
1. APPARENT LATERAL EARTH PRESSURES, P_{a1} AND P_{a2}
 $P_{a1} = 26h_1$ psf
 $P_{a2} = 13h_2$ psf
2. CONSTRUCTION TRAFFIC INDUCED SURCHARGE PRESSURE, P_s
 $P_s = 120$ psf
3. HYDROSTATIC PRESSURE, P_{w1} & P_{w2}
 $P_{w1} = 62.4(H - h)$ psf
 $P_{w2} = 62.4D$ psf
4. PASSIVE PRESSURE, P_p
 $P_p = 170D$ psf
5. SURCHARGES FROM EXCAVATED SOIL OR CONSTRUCTION MATERIALS ARE NOT INCLUDED
6. H , h_1 , h_2 AND D ARE IN FEET
7. GROUNDWATER TABLE
8. P_{w2} IS APPLICABLE WHEN DEWATERING IS TO BE PERFORMED FROM INSIDE OR OUTSIDE OF THE EXCAVATION

NOT TO SCALE

FIGURE 9

LATERAL EARTH PRESSURES FOR BRACED EXCAVATION BELOW GROUNDWATER

OC RIVER WALK
ANAHEIM AND ORANGE, CALIFORNIA



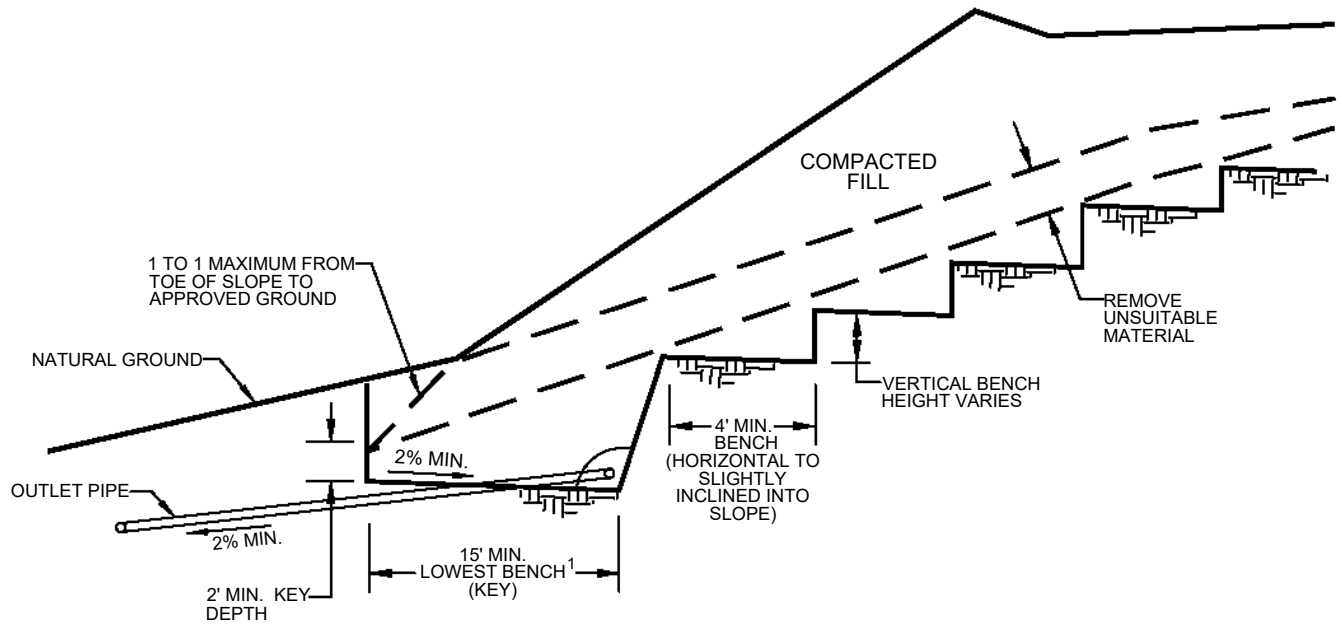
NOTES:

1. ACTIVE LATERAL EARTH PRESSURE, P_a
 $P_{a1} = 40h \text{ psf}$ $P_{a2} = P_{a1} + 20(h - h) \text{ psf}$
2. CONSTRUCTION TRAFFIC INDUCED SURCHARGE PRESSURE, P_s
 $P_s = 72 \text{ psf}$
3. HYDROSTATIC PRESSURE, P_{w1} & P_{w2}
 $P_{w1} = 62.4(h - h) \text{ psf}$
 $P_{w2} = 62.4D \text{ psf}$
4. PASSIVE LATERAL EARTH PRESSURE, P_p
 $P_p = 170D \text{ psf}$
5. SURCHARGES FROM EXCAVATED SOIL OR CONSTRUCTION MATERIALS ARE NOT INCLUDED
6. h , h AND D ARE IN FEET
7.  GROUNDWATER TABLE
8. P_{w2} IS APPLICABLE WHEN DEWATERING IS TO BE PERFORMED FROM INSIDE OR OUTSIDE OF THE EXCAVATION

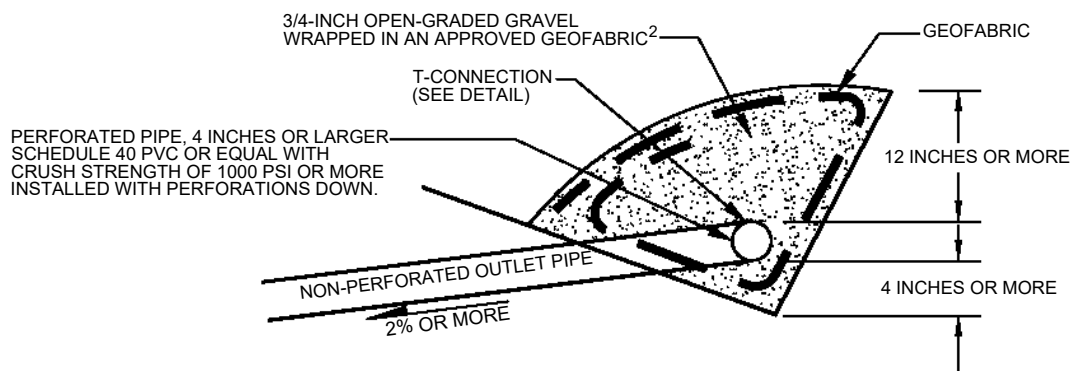
NOT TO SCALE

FIGURE 10

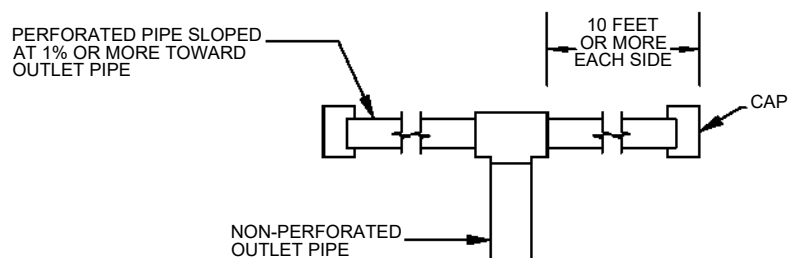
LATERAL EARTH PRESSURES FOR TEMPORARY CANTILEVERED SHORING BELOW GROUNDWATER



SUBDRAIN DETAIL



T-CONNECTION DETAIL



NOTES: ¹IN ACCORDANCE WITH CALIFORNIA BUILDING CODE 2022 FIGURE J107.3.
²AS AN ALTERNATIVE, AN APPROVED GEOCOMPOSITE DRAIN SYSTEM MAY BE USED.

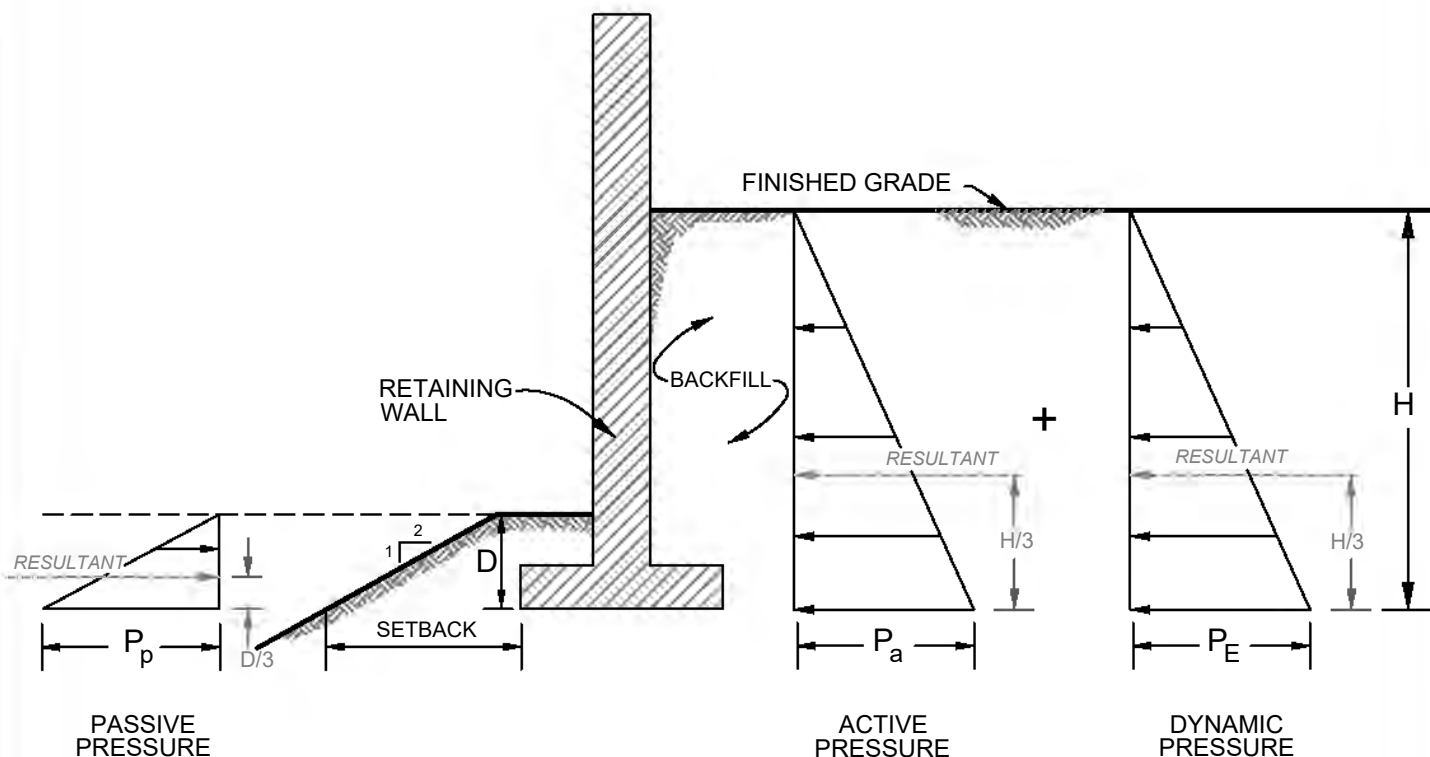
NOT TO SCALE

FIGURE 11

KEYING AND BENCHING DETAIL

OC RIVER WALK
 ANAHEIM AND ORANGE, CALIFORNIA

212076001 | 10/24



NOTES:

1. ASSUMES NO HYDROSTATIC PRESSURE BUILD-UP BEHIND THE RETAINING WALL
2. STRUCTURAL, GRANULAR BACKFILL MATERIALS AS SPECIFIED IN GREENBOOK SHOULD BE USED FOR RETAINING WALL BACKFILL
3. DRAINS AS RECOMMENDED IN THE RETAINING WALL DRAINAGE DETAIL SHOULD BE INSTALLED BEHIND THE RETAINING WALL
4. DYNAMIC LATERAL EARTH PRESURE IS BASED ON A MAPPED DESIGN PEAK GROUND ACCELERATION OF 0.67g
5. P_E IS CALCULATED IN ACCORDANCE WITH THE RECOMMENDATIONS OF MONONOBES AND MATSUO (1929), AND ATIK AND SITAR (2010)
6. SURCHARGE PRESSURES CAUSED BY VEHICLES OR NEARBY STRUCTURES ARE NOT INCLUDED
7. H AND D ARE IN FEET
8. SETBACK SHOULD BE IN ACCORDANCE WITH THE CURRENT VERSION OF THE APPLICABLE BUILDING CODE

RECOMMENDED GEOTECHNICAL DESIGN PARAMETERS

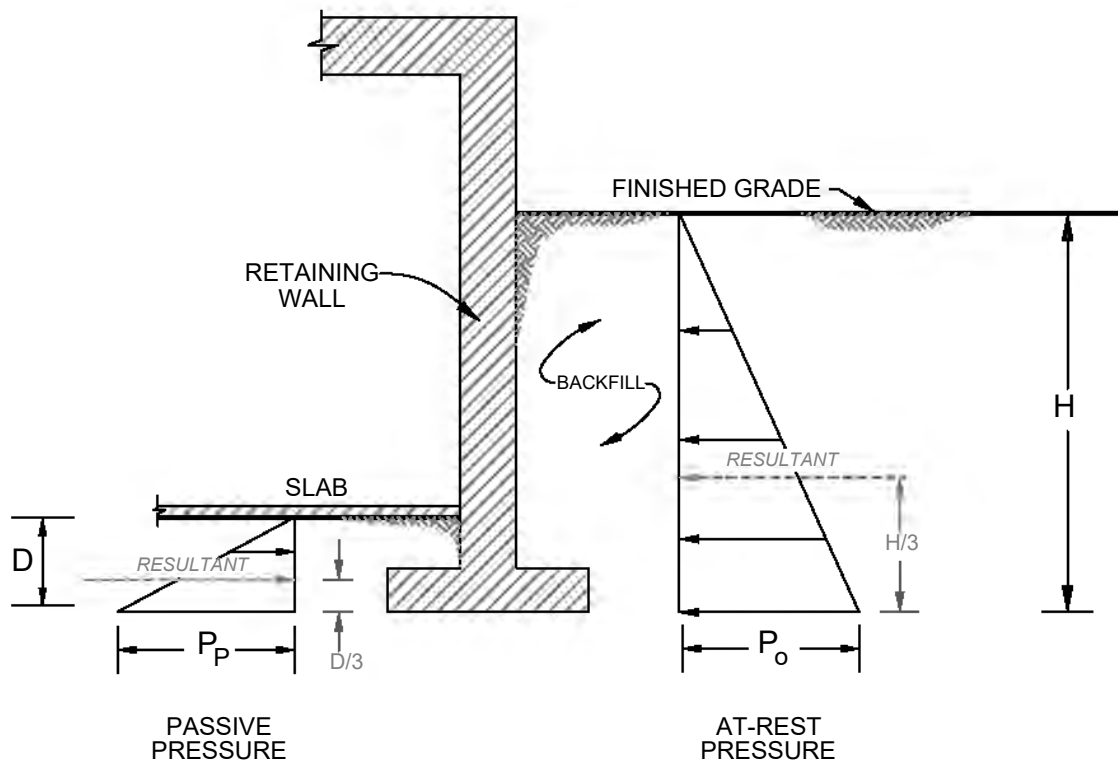
Lateral Earth Pressure	Equivalent Fluid Pressure (lb/ft ² /ft) ⁽¹⁾	
P_a	Level Backfill with Granular Soils ⁽²⁾	2H:1V Sloping Backfill with Granular Soils ⁽²⁾
	37H	57H
P_E	20H	26H
P_p	Level Ground	2H:1V Descending Ground
	350D	130D

NOT TO SCALE

FIGURE 12

LATERAL EARTH PRESSURES FOR YIELDING RETAINING WALLS

OC RIVER WALK
ANAHEIM AND ORANGE, CALIFORNIA



NOTES:

1. ASSUMES NO HYDROSTATIC PRESSURE BUILD-UP BEHIND THE RETAINING WALL
2. STRUCTURAL, GRANULAR BACKFILL MATERIALS AS SPECIFIED IN GREENBOOK SHOULD BE USED FOR RETAINING WALL BACKFILL
3. DRAINS AS RECOMMENDED IN THE RETAINING WALL DRAINAGE DETAIL SHOULD BE INSTALLED BEHIND THE RETAINING WALL
4. DYNAMIC LATERAL EARTH PRESSURE IS IGNORED AND DEEMED INAPPLICABLE DUE TO THE AT-REST CONDITION OF THE RETAINING WALL
5. SURCHARGE PRESSURES CAUSED BY VEHICLES OR NEARBY STRUCTURES ARE NOT INCLUDED
6. H AND D ARE IN FEET

RECOMMENDED GEOTECHNICAL DESIGN PARAMETERS

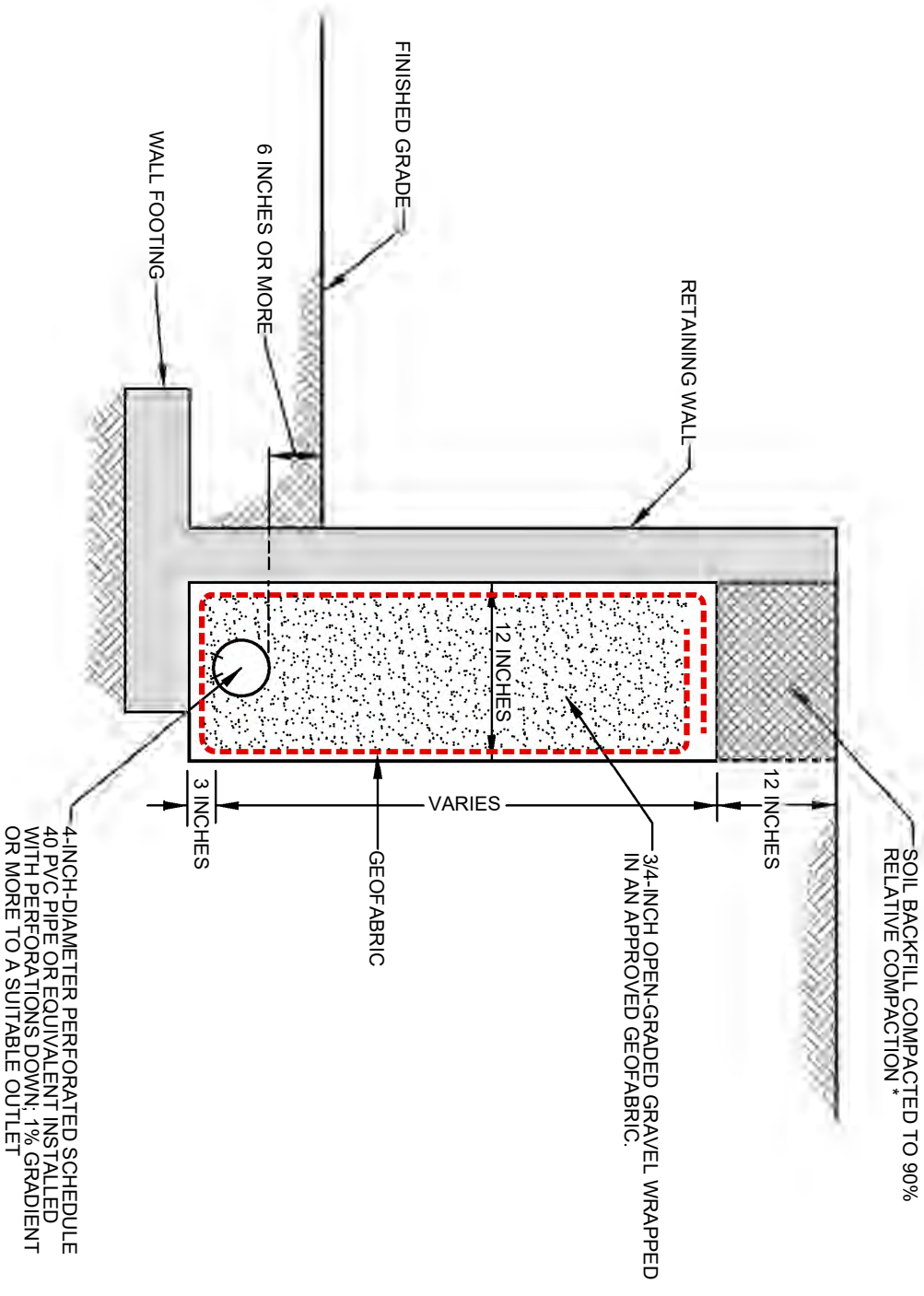
Lateral Earth Pressure	Equivalent Fluid Pressure ($\text{lb/ft}^2/\text{ft}^{(1)}$)	
P_o	Level Backfill with Granular Soils ⁽²⁾	2H:1V Sloping Backfill with Granular Soils ⁽²⁾
	57H	82H
P_p	Level Ground	2H:1V Descending Ground
	350D	130D

NOT TO SCALE

FIGURE 13

LATERAL EARTH PRESSURES FOR RESTRAINED RETAINING WALLS

OC RIVER WALK
ANAHEIM AND ORANGE, CALIFORNIA



*BASED ON ASTM D1557

NOT TO SCALE

FIGURE 14

RETAINING WALL DRAINAGE DETAIL

OC RIVER WALK
ANAHEIM AND ORANGE, CALIFORNIA

212076001 | 10/24

APPENDIX A

Previous Boring Logs and CPT Soundings

Date(s) Drilled	1/30/23	Logged By	TD/DDK	GW-1 Sheet 1 of 2
Drilling Company	BC2 Environmental	Drill Bit Size/Type	8"	
Drill Rig Type	CME 95 Hollow Stem	Hammer Data	140 lbs. @ 30-inch drop	
Sampling Method(s)	Modified California, Bulk			
Approximate Groundwater Depth: Groundwater at 26.6 Feet.				Total Depth Drilled (ft)51.5
Comments				Approximate Ground Surface Elevation (ft)175.0 msl

Elevation (ft)	Depth (ft)	SAMPLES		Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
		Type	Number						
0						Surface: Parking lot, 4" of asphaltic concrete over base.			
					SP	Artificial Fill (Af) @ 1': Olive brown fine to medium SAND, moist, medium dense to dense, micaceous, trace silt, scattered cobbles, friable.			
-170	5	D-1	95/10"		SW	@ 5': Olive brown SAND with few to little silt, moist to wet, very dense, micaceous, scattered cobble, slightly friable.	11.7	124.0	
					SM	Alluvium (Qal) @ 9': Olive brown silty SAND, moist, micaceous.			
	10	D-2	10		SP	@ 10': Light olive brown SAND, moist, loose, scattered subrounded pebbles, uppers contain laminated sandy SILT with pebbles.	6.9	114.8	
					GP	@ 13': Large cobbles in cuttings.			
-160	15					@ 15': No Recovery, abundant cobbles and pebbles.			
		D-3	57		SP	@ 16': Dark yellowish brown coarse SAND, moist, dense, micaceous, trace silt, scattered pebbles, friable.	5.0	110.7	
	20	D-4	62		SP	@ 20': Dark yellowish brown medium to coarse SAND, moist, very dense, micaceous, 2"-diameter pebbles, friable.	4.4	115.7	
		SB-1							SB-1 @ 20-25'
-150	25								

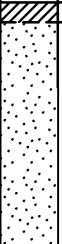
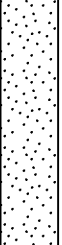
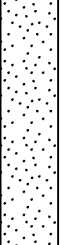
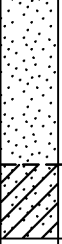
LOG OF BORING
 AREP/OC Vibe
 Anaheim, CA
 PROJECT NO. 20065-01



AREP/OC Vibe Anaheim, CA

GW-1

Sheet 2 of 2

Elevation (ft)	Depth (ft)	SAMPLES		Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
		Type	Number						
-150	25	D-5	38		CL SP	@ 25': Pale brown medium to coarse SAND, moist, medium dense, friable, blebs of dark gray plastic silty CLAY in top rings.	4.5	102.2	
	30	D-6	10		CH	@ 30': Very dark gray to dark olive brown CLAY, wet to saturated, medium stiff, micaceous, highly plastic.	46.7	73.8	
-140	35	D-7	13		SP	@ 35': Grayish brown coarse SAND with some silt, saturated, loose, micaceous, 1/4"-diameter pebbles, friable.	22.8		Sample disturbed.
	40	D-8	4?			@ 40': No Recovery. Medium to coarse SAND, saturated, disturbed.			Sample disturbed.
-130	45	D-9	26		SP	@ 45': Olive brown medium SAND with trace silt, saturated, medium dense, micaceous, scattered pebbles, friable.	20.6	106.8	
	50	D-10	42		SC/CL	@ 50': Reddish brown clayey fine to medium SAND/sandy CLAY, saturated, medium dense/very stiff, scattered pebbles, 2"-diameter pebble in tip.	14.7	116.9	
						Notes: Total Depth: 51.5 Feet. Groundwater at 26.6 Feet on 2/3/2023. Installed 30 Feet of Screen and 20 Feet of Solid Well Casing. Backfilled Annular Space with 32 Feet of #3 Sand, 3.5 Feet of Bentonite, and 14.5 Feet of Cement Slurry. Installed a Traffic Rated Well Cover.			
-120	55								

LOG OF BORING

AREP/OC Vibe
Anaheim, CA

PROJECT NO. 20065-01



Date(s) Drilled	1/31/23	Logged By	TD/DDK	GW-2 Sheet 1 of 2	
Drilling Company	BC2 Environmental	Drill Bit Size/Type	8"		
Drill Rig Type	CME 95 Hollow Stem	Hammer Data	140 lbs. @ 30-inch drop		
Sampling Method(s)	Modified California, Bulk				
Approximate Groundwater Depth: Groundwater at 15 Feet.					
Comments				Total Depth Drilled (ft)	41.5
				Approximate Ground Surface Elevation (ft)	162.2 msl

Elevation (ft)	SAMPLES			Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	Type	Number	Blows per foot						
0						Surface: Parking lot, 5" of asphaltic concrete over 4-6" of aggregate base.			
-160	B-1				SP	Artificial Fill (Af) @ 1.5': Olive brown medium SAND with gravel, moist, friable.			B-1 @ 1-5'
5	D-1	14			SP-SM	Alluvium (Qal) @ 5': Olive brown to dark olive brown SAND with silt, moist, loose, scattered gravel, friable, upper rings contain brown sandy SILT with gravel, shell fragments.	9.9	113.6	
10	D-2	66			SP-SM	@ 10': Olive brown to grayish brown medium to coarse SAND, moist, dense, scattered rounded pebbles, friable.	5.2	118.1	
-150									
15	D-3	24			SP	@ 15': Light gray coarse SAND, saturated, medium dense, micaceous, scattered gravel, medium grained sand in upper rings, free water at tip.	17.9	103.4	
20	D-4	12			SP	@ 20': Light olive gray medium to coarse SAND, saturated, loose, trace pebbles, friable.	15.3	109.9	
-140									
25									

LOG OF BORING
AREP/OC Vibe
Anaheim, CA
PROJECT NO. 20065-01



AREP/OC Vibe Anaheim, CA				GW-2		Sheet 2 of 2			
Elevation (ft)	SAMPLES			Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	Type	Number	Blows per foot						
25	D-5	10		SP	@ 25': Light olive gray medium to coarse SAND, saturated, loose, micaceous, layered, friable.	18.7	103.5		
30	D-6	11		SP	@ 30': Olive gray medium SAND, saturated, loose, micaceous, friable.	19.4	102.4		
35	D-7	23		MH	@ 35': Olive brown very fine sandy SILT with clay, saturated, very stiff, micaceous.	25.3	100.9		
40	D-8	15		CL-CH	@ 40': Strong brown silty CLAY, saturated, stiff, plastic, micaceous.	20.8	106.0		
45					Notes: Total Depth: 41.5 Feet. Groundwater at 15 Feet on 2/3/2023. Installed 20 Feet of Screen and 20 Feet of Solid Well Casing. Backfilled Annular Space with 20 Feet of #3 Sand, 6 Feet of Bentonite, and 14 Feet of Cement Slurry. Installed a Traffic Rated Well Cover.				
50									
55									

LOG OF BORING

AREP/OC Vibe
Anaheim, CA

PROJECT NO. 20065-01



LOG OF BORING
 AREP/OC Vibe
 Anaheim, CA
 PROJECT NO. 20065-01



Date(s) Drilled	1/31/23	Logged By	TD/DDK	GW-3 Sheet 1 of 2
Drilling Company	BC2 Environmental	Drill Bit Size/Type	8"	
Drill Rig Type	CME 95 Hollow Stem	Hammer Data	140 lbs. @ 30-inch drop	
Sampling Method(s)	Modified California, Bulk			
Approximate Groundwater Depth: Groundwater at 35.5 Feet.				
Comments				Total Depth Drilled (ft) 46.5 Approximate Ground Surface Elevation (ft) 168.3 msl

[illegible]

LOG OF BORING
AREP/OC Vibe
Anaheim, CA
PROJECT NO. 20065-01

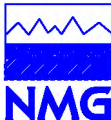


AREP/OC Vibe Anaheim, CA				GW-3		Sheet 2 of 2			
Elevation (ft)	Depth (ft)	SAMPLES		Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
		Type	Number						
25		D-5	15		SM	@ 25': Olive brown silty fine to medium SAND, moist, loose to medium dense, micaceous, trace pinhole pores (<1%), friable.	6.9	108.4	
140									
30		D-6	18		SM-ML	@ 30': Light olive brown to dark grayish brown silty very fine to fine SAND to sandy SILT, moist, medium dense/stiff, micaceous.	14.7	98.3	
35		D-7	33		SP	@ 35': Light gray medium SAND with trace silt, saturated, medium dense, micaceous, highly friable.	18.1	104.9	
130									
40		D-8	19		SP-SM	@ 40': Olive gray fine SAND to silty fine SAND, saturated, medium dense, micaceous, highly friable.	23.7		Sample disturbed.
45		D-9	12		ML/CL	@ 45': Olive brown very fine sandy clayey SILT/silty CLAY, saturated, medium stiff, micaceous, thinly laminated, slightly plastic.	33.7	89.8	
120						Notes: Total Depth: 46.5 Feet. Groundwater at 35 Feet on 2/3/2023. Installed 20 Feet of Screen and 26 Feet of Solid Well Casing. Backfilled Annular Space with 23.5 Feet of #3 Sand, 3.5 Feet of Bentonite, and 18.5 Feet of Cement Slurry. Installed a Traffic Rated Well Cover with 1 Foot of Concrete Backfill.			
50									
55									

LOG OF BORING

AREP/OC Vibe
Anaheim, CA

PROJECT NO. 20065-01



LOG OF BORING
AREP/OC Vibe
Anaheim, CA
PROJECT NO. 20065-01



GROUP SYMBOLS AND NAMES

Graphic / Symbol	Group Names	Graphic / Symbol	Group Names
	Well-graded GRAVEL		Lean CLAY
	Well-graded GRAVEL with SAND		Lean CLAY with SAND
	Poorly graded GRAVEL		Lean CLAY with GRAVEL
	Poorly graded GRAVEL with SAND		SANDY lean CLAY
	Well-graded GRAVEL with SILT		SANDY lean CLAY with GRAVEL
	Well-graded GRAVEL with SILT and SAND		GRAVELLY lean CLAY
	Well-graded GRAVEL with CLAY (or SILTY CLAY)		GRAVELLY lean CLAY with SAND
	Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		SILTY CLAY
	Poorly graded GRAVEL with SILT		SILTY CLAY with SAND
	Poorly graded GRAVEL with SILT and SAND		SILTY CLAY with GRAVEL
	Poorly graded GRAVEL with CLAY (or SILTY CLAY)		SANDY SILTY CLAY
	Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		SANDY SILTY CLAY with GRAVEL
	SILTY GRAVEL		GRAVELLY SILTY CLAY
	SILTY GRAVEL with SAND		GRAVELLY SILTY CLAY with SAND
	CLAYEY GRAVEL		SILT
	CLAYEY GRAVEL with SAND		SILT with SAND
	SILTY, CLAYEY GRAVEL		SILT with GRAVEL
	SILTY, CLAYEY GRAVEL with SAND		SANDY SILT
	Well-graded SAND		SANDY SILT with GRAVEL
	Well-graded SAND with GRAVEL		GRAVELLY SILT
	Poorly graded SAND		GRAVELLY SILT with SAND
	Poorly graded SAND with GRAVEL		ORGANIC lean CLAY
	Well-graded SAND with SILT		ORGANIC lean CLAY with SAND
	Well-graded SAND with SILT and GRAVEL		ORGANIC lean CLAY with GRAVEL
	Well-graded SAND with CLAY (or SILTY CLAY)		SANDY ORGANIC lean CLAY
	Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)		SANDY ORGANIC lean CLAY with GRAVEL
	Poorly graded SAND with SILT		GRAVELLY ORGANIC lean CLAY
	Poorly graded SAND with SILT and GRAVEL		GRAVELLY ORGANIC lean CLAY with SAND
	Poorly graded SAND with CLAY (or SILTY CLAY)		ORGANIC SILT
	Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)		ORGANIC SILT with SAND
	SILTY SAND		ORGANIC SILT with GRAVEL
	SILTY SAND with GRAVEL		SANDY ORGANIC SILT
	CLAYEY SAND		SANDY ORGANIC SILT with GRAVEL
	CLAYEY SAND with GRAVEL		GRAVELLY ORGANIC SILT
	SILTY, CLAYEY SAND		GRAVELLY ORGANIC SILT with SAND
	SILTY, CLAYEY SAND with GRAVEL		ORGANIC fat CLAY
	PEAT		ORGANIC fat CLAY with SAND
	COBBLES		ORGANIC fat CLAY with GRAVEL
	COBBLES and BOULDERS		SANDY ORGANIC fat CLAY
	BOULDERS		GRAVELLY ORGANIC fat CLAY
			GRAVELLY ORGANIC fat CLAY with SAND
			ORGANIC elastic SILT
			ORGANIC elastic SILT with SAND
			ORGANIC elastic SILT with GRAVEL
			SANDY elastic SILT
			SANDY elastic SILT with GRAVEL
			GRAVELLY elastic SILT
			GRAVELLY elastic SILT with SAND
			ORGANIC fat CLAY
			ORGANIC fat CLAY with SAND
			ORGANIC fat CLAY with GRAVEL
			SANDY ORGANIC fat CLAY
			SANDY ORGANIC fat CLAY with GRAVEL
			GRAVELLY ORGANIC fat CLAY
			GRAVELLY ORGANIC fat CLAY with SAND
			ORGANIC elastic SILT
			ORGANIC elastic SILT with SAND
			ORGANIC elastic SILT with GRAVEL
			SANDY ORGANIC elastic SILT
			SANDY ORGANIC elastic SILT with GRAVEL
			GRAVELLY ORGANIC elastic SILT
			GRAVELLY ORGANIC elastic SILT with SAND
			ORGANIC SOIL
			ORGANIC SOIL with SAND
			ORGANIC SOIL with GRAVEL
			SANDY ORGANIC SOIL
			SANDY ORGANIC SOIL with GRAVEL
			GRAVELLY ORGANIC SOIL
			GRAVELLY ORGANIC SOIL with SAND

FIELD AND LABORATORY TESTS

C	Consolidation (ASTM D 2435-04)
CL	Collapse Potential (ASTM D 5333-03)
CP	Compaction Curve (CTM 216 - 06)
CR	Corrosion, Sulfates, Chlorides (CTM 643 - 99; CTM 417 - 06; CTM 422 - 06)
CU	Consolidated Undrained Triaxial (ASTM D 4767-02)
DS	Direct Shear (ASTM D 3080-04)
EI	Expansion Index (ASTM D 4829-03)
M	Moisture Content (ASTM D 2216-05)
OC	Organic Content (ASTM D 2974-07)
P	Permeability (CTM 220 - 05)
PA	Particle Size Analysis (ASTM D 422-63 [2002])
PI	Liquid Limit, Plastic Limit, Plasticity Index (AASHTO T 89-02, AASHTO T 90-00)
PL	Point Load Index (ASTM D 5731-05)
PM	Pressure Meter
PP	Pocket Penetrometer
R	R-Value (CTM 301 - 00)
SE	Sand Equivalent (CTM 217 - 99)
SG	Specific Gravity (AASHTO T 100-06)
SL	Shrinkage Limit (ASTM D 427-04)
SW	Swell Potential (ASTM D 4546-03)
TV	Pocket Torvane
UC	Unconfined Compression - Soil (ASTM D 2166-06)
UU	Unconsolidated Undrained Triaxial (ASTM D 2850-03)
UW	Unit Weight (ASTM D 4767-04)
VS	Vane Shear (AASHTO T 223-96 [2004])
WA	Wash Analysis (ASTM D 1140-97)

SAMPLER GRAPHIC SYMBOLS

	Standard Penetration Test (SPT)
	Standard California Sampler
	Modified California Sampler
	Piston Sampler
	HQ Rock Core
	Other (see remarks)

DRILLING METHOD SYMBOLS

	Auger Drilling		Rotary Drilling		Dynamic Cone or Hand Driven		Diamond Core
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WATER LEVEL SYMBOLS

	First Water Level Reading (during drilling)
	Static Water Level Reading (short-term)
	Static Water Level Reading (long-term)

BORING RECORD LEGEND

MBI, Orangewood Avenue Bridge Over Santa Ana River

Project Number: 17-126

Date: 2-1-19

SHEET
1 of 2



Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

CONSISTENCY OF COHESIVE SOILS				
Descriptor	Unconfined Compressive Strength (tsf)	Pocket Penetrometer (tsf)	Torvane (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 - 0.50	0.25 - 0.50	0.12 - 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 - 1.0	0.50 - 1.0	0.25 - 0.50	Can be penetrated several inches by thumb with moderate effort
Stiff	1.0 - 2.0	1.0 - 2.0	0.50 - 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2.0 - 4.0	2.0 - 4.0	1.0 - 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

APPARENT DENSITY OF COHESIONLESS SOILS	
Descriptor	SPT N_{60} - Value (blows / foot)
Very Loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

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

PERCENT OR PROPORTION OF SOILS	
Descriptor	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

SOIL PARTICLE SIZE		
Descriptor		Size
Boulder		> 12 inches
Cobble		3 to 12 inches
Gravel	Coarse	3/4 inch to 3 inches
	Fine	No. 4 Sieve to 3/4 inch
Sand	Coarse	No. 10 Sieve to No. 4 Sieve
	Medium	No. 40 Sieve to No. 10 Sieve
	Fine	No. 200 Sieve to No. 40 Sieve
Silt and Clay		Passing No. 200 Sieve

PLASTICITY OF FINE-GRAINED SOILS	
Descriptor	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled, and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll, and not much time is required to reach the plastic limit; it cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

CEMENTATION	
Descriptor	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

NOTE:

This legend sheet provides descriptors and associated criteria for required soil description components only. Refer to Caltrans Soil and Rock Logging, Classification, and Presentation Manual (2010 Edition), Section 2, for tables of additional soil description components and discussion of soil description and identification.

REF = Refusal; During drilling seating interval (first 6-inch interval) is not achieved.



Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

BORING RECORD LEGEND

MBI, Orangewood Avenue Bridge Over Santa Ana River

Project Number: 17-126

Date: 2-1-19

SHEET
2 of 2

Date(s) Drilled	1/30/23	Logged By	TD/DDK	GW-1 Sheet 1 of 2
Drilling Company	BC2 Environmental	Drill Bit Size/Type	8"	
Drill Rig Type	CME 95 Hollow Stem	Hammer Data	140 lbs. @ 30-inch drop	
Sampling Method(s)	Modified California, Bulk			
Approximate Groundwater Depth: Groundwater at 26.6 Feet.				Total Depth Drilled (ft)51.5
Comments				Approximate Ground Surface Elevation (ft)175.0 msl

Elevation (ft)	Depth (ft)	SAMPLES		Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
		Type	Number						
	0					Surface: Parking lot, 4" of asphaltic concrete over base.			
					SP	Artificial Fill (Af) @ 1': Olive brown fine to medium SAND, moist, medium dense to dense, micaceous, trace silt, scattered cobbles, friable.			
-170	5	D-1	95/10"		SW	@ 5': Olive brown SAND with few to little silt, moist to wet, very dense, micaceous, scattered cobble, slightly friable.	11.7	124.0	
					SM	Alluvium (Qal) @ 9': Olive brown silty SAND, moist, micaceous.			
	10	D-2	10		SP	@ 10': Light olive brown SAND, moist, loose, scattered subrounded pebbles, uppers contain laminated sandy SILT with pebbles.	6.9	114.8	
					GP	@ 13': Large cobbles in cuttings.			
-160	15					@ 15': No Recovery, abundant cobbles and pebbles.			
		D-3	57		SP	@ 16': Dark yellowish brown coarse SAND, moist, dense, micaceous, trace silt, scattered pebbles, friable.	5.0	110.7	
	20	D-4	62		SP	@ 20': Dark yellowish brown medium to coarse SAND, moist, very dense, micaceous, 2"-diameter pebbles, friable.	4.4	115.7	
		SB-1							SB-1 @ 20-25'
-150	25								

LOG OF BORING
 AREP/OC Vibe
 Anaheim, CA
 PROJECT NO. 20065-01

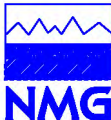


AREP/OC Vibe				Anaheim, CA		GW-1		Sheet 2 of 2	
Elevation (ft)	Depth (ft)	SAMPLES		Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
		Type	Number						
-150	25	D-5	38		CL SP	@ 25': Pale brown medium to coarse SAND, moist, medium dense, friable, blebs of dark gray plastic silty CLAY in top rings.	4.5	102.2	
	30	D-6	10		CH	@ 30': Very dark gray to dark olive brown CLAY, wet to saturated, medium stiff, micaceous, highly plastic.	46.7	73.8	
-140	35	D-7	13		SP	@ 35': Grayish brown coarse SAND with some silt, saturated, loose, micaceous, 1/4"-diameter pebbles, friable.	22.8		Sample disturbed.
	40	D-8	4?			@ 40': No Recovery. Medium to coarse SAND, saturated, disturbed.			Sample disturbed.
-130	45	D-9	26		SP	@ 45': Olive brown medium SAND with trace silt, saturated, medium dense, micaceous, scattered pebbles, friable.	20.6	106.8	
	50	D-10	42		SC/CL	@ 50': Reddish brown clayey fine to medium SAND/sandy CLAY, saturated, medium dense/very stiff, scattered pebbles, 2"-diameter pebble in tip.	14.7	116.9	
						Notes: Total Depth: 51.5 Feet. Groundwater at 26.6 Feet on 2/3/2023. Installed 30 Feet of Screen and 20 Feet of Solid Well Casing. Backfilled Annular Space with 32 Feet of #3 Sand, 3.5 Feet of Bentonite, and 14.5 Feet of Cement Slurry. Installed a Traffic Rated Well Cover.			
-120	55								

LOG OF BORING

AREP/OC Vibe
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Date(s) Drilled	1/31/23	Logged By	TD/DDK	GW-2 Sheet 1 of 2
Drilling Company	BC2 Environmental	Drill Bit Size/Type	8"	
Drill Rig Type	CME 95 Hollow Stem	Hammer Data	140 lbs. @ 30-inch drop	
Sampling Method(s)	Modified California, Bulk			
Approximate Groundwater Depth: Groundwater at 15 Feet.				
Comments				Total Depth Drilled (ft)41.5
				Approximate Ground Surface Elevation (ft)162.2 msl

Elevation (ft)	SAMPLES			Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	Type	Number	Blows per foot						
0						Surface: Parking lot, 5" of asphaltic concrete over 4-6" of aggregate base.			
-160	B-1				SP	Artificial Fill (Af) @ 1.5': Olive brown medium SAND with gravel, moist, friable.			B-1 @ 1-5'
5	D-1	14			SP-SM	Alluvium (Qal) @ 5': Olive brown to dark olive brown SAND with silt, moist, loose, scattered gravel, friable, upper rings contain brown sandy SILT with gravel, shell fragments.	9.9	113.6	
10	D-2	66			SP-SM	@ 10': Olive brown to grayish brown medium to coarse SAND, moist, dense, scattered rounded pebbles, friable.	5.2	118.1	
-150									
15	D-3	24			SP	@ 15': Light gray coarse SAND, saturated, medium dense, micaceous, scattered gravel, medium grained sand in upper rings, free water at tip.	17.9	103.4	
20	D-4	12			SP	@ 20': Light olive gray medium to coarse SAND, saturated, loose, trace pebbles, friable.	15.3	109.9	
-140									
25									

LOG OF BORING
 AREP/OC Vibe
 Anaheim, CA
 PROJECT NO. 20065-01



AREP/OC Vibe Anaheim, CA				GW-2		Sheet 2 of 2			
Elevation (ft)	SAMPLES			Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	Type	Number	Blows per foot						
25	D-5	10		SP	@ 25': Light olive gray medium to coarse SAND, saturated, loose, micaceous, layered, friable.	18.7	103.5		
30	D-6	11		SP	@ 30': Olive gray medium SAND, saturated, loose, micaceous, friable.	19.4	102.4		
35	D-7	23		MH	@ 35': Olive brown very fine sandy SILT with clay, saturated, very stiff, micaceous.	25.3	100.9		
40	D-8	15		CL-CH	@ 40': Strong brown silty CLAY, saturated, stiff, plastic, micaceous.	20.8	106.0		
45					Notes: Total Depth: 41.5 Feet. Groundwater at 15 Feet on 2/3/2023. Installed 20 Feet of Screen and 20 Feet of Solid Well Casing. Backfilled Annular Space with 20 Feet of #3 Sand, 6 Feet of Bentonite, and 14 Feet of Cement Slurry. Installed a Traffic Rated Well Cover.				
50									
55									

LOG OF BORING

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 AREP/OC Vibe
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 PROJECT NO. 20065-01



Date(s) Drilled	1/31/23	Logged By	TD/DDK	GW-3 Sheet 1 of 2
Drilling Company	BC2 Environmental	Drill Bit Size/Type	8"	
Drill Rig Type	CME 95 Hollow Stem	Hammer Data	140 lbs. @ 30-inch drop	
Sampling Method(s)	Modified California, Bulk			
Approximate Groundwater Depth: Groundwater at 35.5 Feet.				
Comments				Total Depth Drilled (ft) 46.5 Approximate Ground Surface Elevation (ft) 168.3 msl

Elevation (ft)	Depth (ft)	SAMPLES		Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
		Type	Number	Blows per foot					
	0					Surface: Parking lot, 4" of asphaltic concrete over 6" of aggregate base.			
	B-1				SM	Alluvium (Qal) @ 1': Olive brown silty very fine SAND, moist, micaceous.			B-1 @ 1-5'
	5	D-1	11		SP	@ 4': Olive brown SILT, moist, plastic, micaceous. @ 5': Light gray medium SAND, wet, loose to medium dense, micaceous, friable, more silty in upper rings.	9.1	101.4	
-160	10	D-2	20		SM	@ 10': Light olive brown silty fine to medium SAND, moist to wet, medium dense, micaceous, trace pinhole pores ($\pm 1\%$), scattered gravel.	8.9	115.4	
	15	D-3	10		ML	@ 15': Light olive brown SILT, moist to wet, medium stiff, micaceous, trace pinhole pores ($\pm 1\%$), silty sand in upper rings, friable.	8.6	98.7	
-150	20	D-4	14		SM	@ 20': Light olive brown silty SAND, moist, loose to medium dense, micaceous, trace pinhole pores (<1%), scattered pebbles, friable.	4.6	104.8	
	25								

LOG OF BORING
AREP/OC Vibe
Anaheim, CA
PROJECT NO. 20065-01



AREP/OC Vibe Anaheim, CA

GW-3

Sheet 2 of 2

Elevation (ft)	Depth (ft)	SAMPLES		Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
		Type	Number						
25		D-5	15		SM	@ 25': Olive brown silty fine to medium SAND, moist, loose to medium dense, micaceous, trace pinhole pores (<1%), friable.	6.9	108.4	
140									
30		D-6	18		SM-ML	@ 30': Light olive brown to dark grayish brown silty very fine to fine SAND to sandy SILT, moist, medium dense/stiff, micaceous.	14.7	98.3	
35		D-7	33		SP	@ 35': Light gray medium SAND with trace silt, saturated, medium dense, micaceous, highly friable.	18.1	104.9	
130									
40		D-8	19		SP-SM	@ 40': Olive gray fine SAND to silty fine SAND, saturated, medium dense, micaceous, highly friable.	23.7		Sample disturbed.
45		D-9	12		ML/CL	@ 45': Olive brown very fine sandy clayey SILT/silty CLAY, saturated, medium stiff, micaceous, thinly laminated, slightly plastic.	33.7	89.8	
120									
50						Notes: Total Depth: 46.5 Feet. Groundwater at 35 Feet on 2/3/2023. Installed 20 Feet of Screen and 26 Feet of Solid Well Casing. Backfilled Annular Space with 23.5 Feet of #3 Sand, 3.5 Feet of Bentonite, and 18.5 Feet of Cement Slurry. Installed a Traffic Rated Well Cover with 1 Foot of Concrete Backfill.			
55									

LOG OF BORING

AREP/OC Vibe
Anaheim, CA

PROJECT NO. 20065-01



LOGGED BY RA	BEGIN DATE 12-10-18	COMPLETION DATE 12-10-18	BOREHOLE LOCATION (Lat/Long or Station/Offset and Line) Latitude: 33.47° 45.1"		HOLE ID R-18-001
DRILLING CONTRACTOR Socal Drilling			Longitude: -117.52° 47.7"		SURFACE ELEVATION 149.0 ft
DRILLING METHOD Rotary Wash			DRILL RIG Mayhew 1000	BOREHOLE DIAMETER 4"	
SAMPLER TYPE(S) AND SIZE(S) (ID) Mod Cal (2.4"), SPT (1.4")			SPT HAMMER TYPE Automatic Hammer, 140lbs, 30inch drop	HAMMER EFFICIENCY, ERI 80%	
BOREHOLE BACKFILL AND COMPLETION Neat cement slurry			GROUNDWATER DEPTH/DURING DRILLING 23.0 ft	TOTAL DEPTH OF BORING 120.3 ft	

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
147.00	1		ASPHALT CONCRETE - 4" / AGGREGATE BASE - 6".												
147.00	2		SILTY SAND (SM); very dark brown; moist; coarse to fine SAND; little nonplastic fines; weak cementation.												
145.00	3														
145.00	4														
143.00	5														
143.00	6														
141.00	7														
141.00	8														
139.00	9														
139.00	10														
137.00	11		Medium dense; few coarse to fine GRAVEL, max. 3/4 in. dia.; weak cementation.												
137.00	12														
135.00	13														
135.00	14														
133.00	15		Dark olive brown; weak cementation.												
133.00	16														
133.00	17														
131.00	18														
131.00	19														
129.00	20														
129.00	21		Poorly graded SAND with SILT (SP-SM); medium dense; very dark grayish brown; moist; medium to fine SAND; few nonplastic fines; weak cementation.												
127.00	22														
125.00	23														
125.00	24														
125.00	25														

(continued)

 Earth Mechanics, Inc. Geotechnical and Earthquake Engineering		REPORT TITLE BORING RECORD		HOLE ID R-18-001	
PROJECT NAME MBI, Orangewood Avenue Bridge Over Santa Ana River		PREPARED BY DN		DATE 5-1-19	
				SHEET 1 of 5	

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
123.00	26		Dark brown; about 95% SAND; about 5% fines; weak cementation. Poorly graded SAND with SILT (SP-SM) (continued).		5	11 16 12	28	56		16.2	103.9			PL, PA	
121.00	28														
119.00	30		SANDY lean CLAY (CL); dark grayish brown; moist; some fine SAND; low plasticity fines.		6	2 2 2	4	67		27.1					
117.00	32														
115.00	34														
113.00	36		SANDY SILT (ML); very stiff; very dark brown; moist; some fine SAND; low plasticity fines.		7	5 11 15	26	67		20.8	109.1	PP = 2.0			
111.00	38														
109.00	40		CLAYEY GRAVEL with SAND (GC); very dense; very dark brown; moist; fine GRAVEL; max. 1/2 in. dia.; some coarse to fine SAND; little low plasticity fines; weak cementation.		8	18 20 21	41	44		11.2					CR
107.00	42														
105.00	44														
103.00	46		Poorly graded SAND with SILT and GRAVEL (SP-SM); very dark brown; moist; some coarse GRAVEL; max. 3/4 in. dia.; coarse to fine SAND; few nonplastic fines; weak cementation.		9	26 57	42			12.2	130.4				
101.00	48														
99.00	50														
97.00	52		CLAYEY GRAVEL with SAND (GC); very dense; dark yellowish brown; moist; fine GRAVEL; max. 1/2 in. dia.; some coarse to fine SAND; little low plasticity fines; weak cementation.		10	21 33 18	51	44		11.6					
96.00	54														
	56														

(continued)



Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

REPORT TITLE
BORING RECORD

HOLE ID
R-18-001

PROJECT NAME
MBI, Orangetown Avenue Bridge Over Santa Ana River
PREPARED BY
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ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
93.00	55		SANDY lean CLAY (CL); dark yellowish brown; moist; some fine SAND; low plasticity fines.	X	11	9 10 10	20	50		19.7	104.0	UU = 0.85		UU	
	56														
	57														
91.00	58														
	59														
89.00	60			X	12	3 3 4	7	100		22.1					
	61														
87.00	62														
	63														
85.00	64														
	65														
83.00	66		SILTY SAND with GRAVEL (SM); dark yellowish brown; moist; some fine GRAVEL, max. 1/2 in. dia.; coarse to fine SAND; little nonplastic fines; weak cementation.	X	13	28 36 39	75	56		9.8	128.2				
	67														
81.00	68														
	69														
79.00	70		SANDY lean CLAY (CL); dark brown; moist; trace fine GRAVEL, max. 1/5 in. dia.; little fine SAND; low plasticity fines.	X	14	2 4 5	9	89		19.1					
	71														
77.00	72														
	73														
75.00	74														
	75														
73.00	76		SANDY SILT (ML); very stiff; dark brown; moist; some fine SAND; low plasticity fines.	X	15	9 11 11	22	61		21.3	103.7	PP = 2.25		C	
	77														
71.00	78														
	79														
69.00	80														
	81		SILTY SAND (SM); dense; dark brown; moist; fine SAND; some nonplastic fines; weak cementation.	X	16	18 15 12	27	67		17.7					
	82														
67.00	83														
	84														
65.00	85														

(continued)



Earth Mechanics, Inc.

Geotechnical and Earthquake Engineering

REPORT TITLE
BORING RECORD

HOLE ID
R-18-001

PROJECT NAME
MBI, Orangewood Avenue Bridge Over Santa Ana River

PREPARED BY
DN

DATE
5-1-19

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ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
63.00	86		SANDY lean CLAY (CL); dark brown; moist; some fine SAND; low plasticity fines.		17	3	8	67							
						5									
61.00	88														
59.00	90		SILTY SAND (SM); dark brown; moist; fine SAND; some nonplastic fines; weak cementation.			18	4	100		27.4					
						2									
57.00	92					2									
						2									
55.00	94		SANDY SILT (ML); dark brown; moist; some fine SAND; low plasticity fines.												
53.00	96					19	7	19	67	19.1	111.7				
						9	10								
51.00	98		SANDY SILT (ML); dark brown; moist; some fine SAND; low plasticity fines.												
49.00	100					20	9	27	78	21.1					
						11	16								
47.00	102		Trace fine GRAVEL; max. 1/5 in. dia.; some fine SAND; low plasticity fines.												
45.00	104														
43.00	106					21	8	25	67	20.6	107.1				
						11	14								
41.00	108														
39.00	110					22	8	28	100	21.8					
37.00	112														
36.00	114														
	115														

(continued)

REPORT TITLE

BORING RECORD

HOLE ID

R-18-001

Earth Mechanics, Inc.

Geotechnical and Earthquake Engineering



PROJECT NAME

MBI, Orangetown Avenue Bridge Over Santa Ana River

PREPARED BY

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ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
33.00	116		Poorly graded SAND with SILT and GRAVEL (SP-SM); dark brown; moist; some coarse GRAVEL, max. 3/4 in. dia.; coarse to fine SAND; few nonplastic fines; weak cementation.												
31.00	118														
29.00	120														
27.00	122														
25.00	124		Very dense; dark olive brown; weak cementation. Bottom of borehole at 120.3 ft bgs. Notes:												
23.00	126														
21.00	128														
19.00	130														
17.00	132														
15.00	134														
13.00	136														
11.00	138														
9.00	140														
7.00	142														
5.00	144														
	145														

 Earth Mechanics, Inc. Geotechnical and Earthquake Engineering		REPORT TITLE BORING RECORD		HOLE ID R-18-001	
PROJECT NAME MBI, Orangewood Avenue Bridge Over Santa Ana River					
PREPARED BY DN	DATE 5-1-19	SHEET 5 of 5			

LOGGED BY			BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or Station/Offset and Line) Latitude: 33.47 45.2" Longitude: -117.52 46.4"	HOLE ID
RA			12-19-18	12-19-18		A-18-002
DRILLING CONTRACTOR						SURFACE ELEVATION
2R Drilling						133.0 ft
DRILLING METHOD						BOREHOLE DIAMETER
Hollow-Stem Auger			DRILL RIG		CME 75	8"
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE		HAMMER EFFICIENCY, ERI	
Bulk, Mod Cal (2.4"), SPT (1.4")			Automatic Hammer, 140lbs, 30inch drop		80%	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER DEPTH/DURING DRILLING		TOTAL DEPTH OF BORING	
Neat cement slurry			6.3 ft		100.5 ft	

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
131.00	2		Poorly graded SAND (SP); brown; moist; few coarse to fine GRAVEL, max. 3/4 in. dia.; coarse to fine SAND; trace nonplastic fines; weak cementation.		0			100	2.3						PA
129.00	4														
127.00	6				1	4	16	100	17.2						
125.00	8														
123.00	10				2	3	10	67	27.3	95.5	PP = 0.25				
121.00	12		SIL T with SAND (ML); soft; dark olive brown; moist; little fine SAND; low plasticity fines.												CR
119.00	14														
117.00	16				3	5	12	78	20.4						
115.00	18		SANDY SILT (ML); dark olive brown; moist; some fine SAND; low plasticity fines.												
113.00	20														
111.00	22				4	14	56	67	6.9	127.7					
109.00	24		CLAYEY GRAVEL with SAND (GC); dark brown; moist; coarse GRAVEL, max. 3/4 in. dia.; some coarse to fine SAND; little low plasticity fines; weak cementation.												
107.00	26														

(continued)

 Earth Mechanics, Inc. Geotechnical and Earthquake Engineering			REPORT TITLE BORING RECORD		HOLE ID A-18-002	
PROJECT NAME MBI, Orangewood Avenue Bridge Over Santa Ana River			PREPARED BY DN		DATE 5-1-19	
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ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
107.00	26		SILTY GRAVEL with SAND (GM); very dense; dark olive brown; moist; coarse GRAVEL, max. 3/4 in. dia.; some coarse to fine SAND; little nonplastic fines; weak cementation.		5	12	75	67		6.5					
105.00	28					27									
103.00	30				6	46	31	67		18.5	109.9				
101.00	32					15									
99.00	34		Lean CLAY with SAND (CL); dark brown; moist; fine GRAVEL, max. 1/2 in. dia.; little medium to fine SAND; nonplastic to low plasticity fines; weak cementation.												
97.00	36				7	2	5	100		24.5					
95.00	38														
93.00	40														
91.00	42		SILTY SAND (SM); dark yellowish brown; moist; few fine GRAVEL, max. 3/8 in. dia.; medium to fine SAND; little nonplastic fines; weak cementation.		8	15	50	67		14.4	113.8				DS
89.00	44					24									
87.00	46					26									
85.00	48														
83.00	50		SANDY lean CLAY (CL); dark brown; moist; some fine SAND; low plasticity fines.		9	3	19	78		15.6					
81.00	52					7									
79.00	54					12									
	55														
			SILTY SAND (SM); dark brown; moist; few coarse to fine GRAVEL, max. 3/4 in. dia.; coarse to fine SAND; some nonplastic fines; weak cementation.		10	12	64	72		12.0	120.7				
	51					31									
	53					33									

(continued)

 Earth Mechanics, Inc. Geotechnical and Earthquake Engineering		REPORT TITLE BORING RECORD		HOLE ID A-18-002	
PROJECT NAME MBI, Orangewood Avenue Bridge Over Santa Ana River		PREPARED BY DN		DATE 5-1-19	
				SHEET 2 of 4	

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
77.00	55		Very dense; weak cementation. SILTY SAND (SM) (continued).	X	11	16 29 38	67	78		6.9					
75.00	56														
	57														
	58														
	59														
73.00	60		SANDY SILT (ML); soft; dark brown; moist; some fine SAND; low plasticity fines.	X	12	8 12 14	26	67		24.7	100.8	PP = 0.25			
	61														
71.00	62														
	63														
	64														
69.00	65		SANDY lean CLAY (CL); dark brown; moist; some fine SAND; low plasticity fines.	X	13	5 7 11	18	100		24.0					
	66														
	67														
65.00	68														
	69														
63.00	70		SILTY SAND (SM); dark brown; moist; about 3% fine GRAVEL, max. 1/5 in. dia.; about 71% medium to fine SAND; about 26% nonplastic fines; weak cementation.	X	14	7 7 14	21	78		15.2	112.3				PI, PA
	71														
61.00	72														
	73														
	74														
59.00	75		SANDY SILT (ML); dark brown; moist; trace coarse GRAVEL, max. 3/4 in. dia.; some fine SAND; low plasticity fines.	X	15	3 5 8	13	100		15.6					
	76														
	77														
55.00	78														
	79														
53.00	80		SILTY SAND (SM); dark brown; moist; fine SAND; some nonplastic fines; weak cementation.	X	16	13 36 50/4.5"		73		18.9	112.1				
	81														
51.00	82														
	83														
49.00	84														
	85														

(continued)



Earth Mechanics, Inc.

Geotechnical and Earthquake Engineering

REPORT TITLE
BORING RECORD

HOLE ID
A-18-002

PROJECT NAME
MBI, Orangewood Avenue Bridge Over Santa Ana River

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ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
47.00	86		SANDY SILT (ML); dark olive brown; moist; some fine SAND; low plasticity fines.		17	9	37	100		22.2					
						15									
						22									
45.00	88		Strong brown.												
	89														
	90														
43.00	90		Strong brown.		18	29	66	67		20.2	109.6				
	91					44									
	92					22									
41.00	92														
	93														
	94														
39.00	94		SILTY SAND (SM); very dense; very dark brown; moist; few fine GRAVEL; max. 1/2 in. dia.; coarse to fine SAND; little nonplastic fines; weak cementation.												
	95				19	12	76	100		13.7					
	96					26									
37.00	96					50									
	97														
	98														
35.00	98														
	99														
	100														
33.00	100		Poorly graded SAND with SILT and GRAVEL (SP-SM); very dark brown; moist; some fine GRAVEL; max. 1/2 in. dia.; coarse to fine SAND; few nonplastic fines; weak cementation. Notes: Bottom of borehole at 100.5 ft bgs.		20	50.4"		100		7.4					
	101														
	102														
31.00	102														
	103														
	104														
29.00	104														
	105														
	106														
27.00	106														
	107														
	108														
25.00	108														
	109														
	110														
23.00	110														
	111														
	112														
21.00	112														
	113														
	114														
19.00	114														
	115														
	115														



Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

REPORT TITLE
BORING RECORD

HOLE ID
A-18-002

PROJECT NAME
MBI, Orangewood Avenue Bridge Over Santa Ana River
PREPARED BY
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LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or Station/Offset and Line)	HOLE ID
RA	1-23-19	1-23-19	Latitude: 33.47° 45.2"	A-18-003
DRILLING CONTRACTOR				SURFACE ELEVATION
2R Drilling				133.0 ft
DRILLING METHOD				BOREHOLE DIAMETER
Hollow-Stem Auger				8"
SAMPLER TYPE(S) AND SIZE(S) (ID)				HAMMER EFFICIENCY, ERI
Bulk, Mod Cal (2.4"), SPT (1.4")				80%
BOREHOLE BACKFILL AND COMPLETION				TOTAL DEPTH OF BORING
Neat cement slurry				100.8 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
131.00	2		Poorly graded SAND (SP); brown; moist; fine GRAVEL, max. 1/2 in. dia.; coarse to fine SAND; nonplastic fines.		0			100							P1, PA
129.00	4														
127.00	6		About 4% GRAVEL; about 92% SAND; about 4% fines; weak cementation.		1	5	17	67		11.3	111.7				
125.00	8														
123.00	10														
121.00	12														
119.00	14														
117.00	16					3	1	3	0						
115.00	18														
113.00	20														
111.00	22		CLAYEY SAND (SC); dense; dark brown; moist; some coarse GRAVEL; max. 3/4 in. dia.; coarse to fine SAND; little low plasticity fines; weak cementation.		4	7	28	39		9.4					
109.00	24														
107.00	26														

(continued)



Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

REPORT TITLE		HOLE ID	
BORING RECORD		A-18-003	
PROJECT NAME			
MBI, Orangewood Avenue Bridge Over Santa Ana River			
PREPARED BY		DATE	SHEET
DN		5-1-19	1 of 4

ELEVATION (ft)	DEPTH (ft)	MATERIAL GRAPHICS	DESCRIPTION	SAMPLE LOCATION	SAMPLE NUMBER	BLOWS PER 6 IN.	BLOWS PER FOOT	RECOVERY (%)	RQD (%)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	SHEAR STRENGTH (tsf)	DRILLING METHOD	CASING DEPTH	REMARKS
107.00	25		Poorty graded GRAVEL with SILT and SAND (GP-GM); dark olive brown; moist; coarse GRAVEL, max. 1.5 in. dia.; some coarse to fine SAND; few nonplastic fines; weak cementation.		5	29	66	61		6.6	125.6				
105.00	26					33									
103.00	27					33									
101.00	28														
99.00	29														
97.00	30		SANDY lean CLAY (CL); dark brown; moist; some fine SAND; low plasticity fines.		6	4	8	100		20.2					
95.00	31					4									
93.00	32														
91.00	33														
89.00	34														
87.00	35		Lean CLAY with SAND (CL); medium stiff; dark brown; moist; little fine SAND; nonplastic fines.		7	6	15	67		25.3	95.6	PP = 0.5		C	
85.00	36					6									
83.00	37					9									
81.00	38														
79.00	39														
	40		SILT with SAND (ML); dark brown; moist; little fine SAND; low plasticity fines.		8	6	19	89		17.3				CR	
	41					8									
	42					11									
	43														
	44														
	45		SANDY lean CLAY (CL); very stiff; dark brown; moist; trace fine GRAVEL, max. 1/5 in. dia.; some fine SAND; nonplastic fines.		9	14	36	67		13.3	121.0	PP = 2.5			
	46					18									
	47					18									
	48														
	49														
	50		Lean CLAY with SAND (CL); dark yellowish brown; moist; little fine SAND; low plasticity fines.		10	4	11	100		18.7					
	51					5									
	52					6									
	53														
	54														
	55														

(continued)

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
77.00	56		SANDY lean CLAY (CL); dark yellowish brown; moist; trace fine GRAVEL, max. 1/5 in. dia.; little fine SAND; nonplastic fines.		11	50/2.5'	100		20.6	104.1					
75.00	58														
73.00	60		Poorly graded GRAVEL with SILTY CLAY (GP-GC); very dense; dark olive gray; moist; coarse GRAVEL, max. 3/4 in. dia.; some coarse to fine SAND; few nonplastic fines; weak cementation.		12	47	28	42	6	5.7					
71.00	62														
69.00	64														
67.00	66		Lean CLAY with SAND (CL); stiff; dark brown; moist; trace fine GRAVEL, max. 1/5 in. dia.; little fine SAND; low plasticity fines.		13	30	17	12	67	28.1	94.8	PP = 1.0			
65.00	68														
63.00	70		Poorly graded SAND with SILT (SP-SM); dense; very dark brown; moist; trace fine GRAVEL, max. 1/5 in. dia.; coarse to fine SAND; few low plasticity fines; weak cementation.		14	19	13	17	94	25.3					
61.00	72														
59.00	74														
57.00	76		SANDY SILT (ML); very dark brown; moist; trace fine GRAVEL, max. 1/5 in. dia.; some fine SAND; nonplastic fines.		15	10	14	24	67	19.6	111.3				
55.00	78														
53.00	80					16	8	21	100	16.9					
51.00	82						9								
49.00	84						12								
	85														

(continued)

 Earth Mechanics, Inc. Geotechnical and Earthquake Engineering		REPORT TITLE BORING RECORD		HOLE ID A-18-003	
PROJECT NAME MBI, Orangetown Avenue Bridge Over Santa Ana River		PREPARED BY DN		DATE 5-1-19	
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ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
47.00	86		Dark brown, SANDY SILT (ML) (continued).		17	12	72	28		19.8	105.7				
						36									
						36									
45.00	88														
43.00	90		SANDY lean CLAY (CL); dark brown; moist; some fine SAND; low plasticity fines.		18	6	23	100		19.6					
						9									
						14									
41.00	92														
39.00	94														
37.00	96		SILT Y SAND with GRAVEL (SM); dark brown; moist; little coarse GRAVEL; max. 3/4 in. dia.; coarse to fine SAND; little nonplastic fines; weak cementation.		19	50.4"		75		11.9	129.8				
35.00	98														
33.00	100		Poorly graded SAND with GRAVEL (SP); very dense; moist; some coarse GRAVEL; max. 3/4 in. dia.; coarse to fine SAND; trace nonplastic fines; weak cementation. Notes: Bottom of borehole at 100.8 ft bgs.		20	38		100		9.4					
						50.4"									
31.00	102														
29.00	104														
27.00	106														
25.00	108														
23.00	110														
21.00	112														
19.00	114														
	115														



Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

REPORT TITLE
BORING RECORD

HOLE ID
A-18-003

PROJECT NAME
MBI, Oranewood Avenue Bridge Over Santa Ana River
PREPARED BY
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LOGGED BY		BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or Station/Offset and Line)							HOLE ID				
RA		1-24-19	1-24-19	Latitude: 33.47 45.2"							A-18-004				
DRILLING CONTRACTOR		Longitude: -117.52' 44"							SURFACE ELEVATION						
2R Drilling									133.0 ft						
DRILLING METHOD		DRILL RIG							BOREHOLE DIAMETER						
Hollow-Stem Auger		CME 75							8"						
SAMPLER TYPE(S) AND SIZE(S) (ID)		SPT HAMMER TYPE							HAMMER EFFICIENCY, ERI						
Bulk, Mod Cal (2.4"), SPT (1.4")		Automatic Hammer, 140lbs, 30inch drop							80%						
BOREHOLE BACKFILL AND COMPLETION		GROUNDWATER DEPTH/DURING DRILLING							TOTAL DEPTH OF BORING						
Neat cement slurry		4.9 ft							100.3 ft						
ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		SILTY SAND (SM); dark olive brown; moist; few fine GRAVEL, max. 1/2 in. dia.; coarse to fine SAND; little nonplastic fines; weak cementation.		0			100							
131.00	2														
129.00	4														
	5														
	6		Medium dense.		1	5	13	83		20.9					
127.00	6					7									
	7					6									
125.00	8														
	9														
123.00	10														
	11		SANDY SILT (ML); soft; dark olive brown; moist; some fine SAND; low plasticity fines.		2	4	8	67		27.2	93.8	PP = 0.25			
121.00	12					4									
	13					4									
119.00	14														
	15														
	16		SILTY SAND (SM); medium dense; dark olive brown; moist; few fine GRAVEL, max. 1/5 in. dia.; medium to fine SAND; little nonplastic fines; weak cementation.		3	2	15	83		17.9					CR
117.00	16					6									
	17					9									
115.00	18														
	19														
113.00	20														
	21		SILTY SAND with GRAVEL (SM); dark olive brown; moist; little fine GRAVEL, max. 1/2 in. dia.; coarse to fine SAND; little nonplastic fines; weak cementation.		4	49		47		14.8					
111.00	22					50/2.5"									
	23														
109.00	24														
	25														

(continued)



Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

REPORT TITLE
BORING RECORD

HOLE ID
A-18-004

PROJECT NAME
MBI, Orangewood Avenue Bridge Over Santa Ana River
PREPARED BY
DN
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ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
107.00	25		Poorly graded SAND with SILT and GRAVEL (SP-SM); dense; dark brown; moist; little coarse GRAVEL, max. 3/4 in. dia.; coarse to fine SAND; few nonplastic fines; weak cementation.	X	5	19 16 9	25	83		10.7					
105.00	26														
	27														
	28														
103.00	29														
	30		SANDY lean CLAY (CL); dark yellowish brown; moist; some fine SAND; low plasticity fines.	X	6	4 6 7	13	67		25.4	95.9	UU = 0.38			PI, UU
101.00	31														
	32														
	33														
99.00	34														
	35		Lean CLAY (CL); dark yellowish brown; moist; few fine SAND; medium plasticity fines.	X	7	3 4 6	10	100		24.9					
97.00	36														
	37														
95.00	38														
	39														
93.00	40		Poorly graded SAND with SILT (SP-SM); dark brown; moist; trace fine GRAVEL, max. 1/5 in. dia.; coarse to fine SAND; few nonplastic fines; weak cementation.	X	8	21 31 33	64	67		4.3	104.5				
91.00	41														
	42														
	43														
89.00	44														
	45		Lean CLAY with SAND (CL); dark brown; moist; little fine SAND; low plasticity fines.	X	9	4 4 5	9	100		18.9					
87.00	46														
	47														
85.00	48														
	49														
83.00	50			X	10	10 16 18	34	67		22.4	98.4				
81.00	51														
	52														
	53														
79.00	54														
	55														

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A-18-004

 PROJECT NAME
MBI, Orangewood Avenue Bridge Over Santa Ana River

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ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
77.00	55		Poorly graded SAND with SILT and GRAVEL (SP-SM); very dense; dark brown; moist; some coarse GRAVEL, max. 3/4 in. dia.; coarse to fine SAND; little nonplastic fines; weak cementation.	X	11	23 46 50/4.5"		97		11.6					
	56														
	57														
75.00	58														
	59														
73.00	60		Poorly graded SAND (SP); dark brown; moist; few fine GRAVEL, max. 1/2 in. dia.; coarse to fine SAND; trace nonplastic fines; weak cementation.	X	12	37 50/4.5"		86		7.1	111.1				
	61														
71.00	62														
	63														
69.00	64														
	65		Very dense; very dark brown; about 4% fine GRAVEL, max. 1/2 in. dia.; about 90% coarse to fine SAND; about 6% fines; weak cementation.	X	13	8 20 21	41	100		16.1					
67.00	66														
	67														
65.00	68														
	69														
63.00	70		SANDY lean CLAY (CL); dark brown; moist; few fine GRAVEL, max. 3/8 in. dia.; some fine SAND; medium plasticity fines.	X	14	10 19 50	69	67		18.3	111.0				
	71														
61.00	72														
	73														
59.00	74														
	75		Poorly graded SAND with SILT and GRAVEL (SP-SM); dense; dark brown; moist; few fine GRAVEL, max. 1/2 in. dia.; coarse to fine SAND; few nonplastic fines; weak cementation.	X	15	10 11 13	24	100		15.9 14.2					
57.00	76		SANDY SILT (ML); dark brown; moist; few fine GRAVEL, max. 3/8 in. dia.; some fine SAND; low plasticity fines.												
	77														
55.00	78														
	79														
53.00	80		SILTY SAND (SM); dark yellowish brown; moist; few fine GRAVEL, max. 1/5 in. dia.; fine SAND; some nonplastic fines; weak cementation.	X	16	23 26 28	54	22		21.1	103.7				
	81														
51.00	82														
	83														
49.00	84														
	85														

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ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
47.00	86		Medium dense; weak cementation. SILTY SAND (SM) (continued).		17	5	22	100		20.4					
						8									
						14									
45.00	88		Coarse to fine SAND; little fines; weak cementation.												
	89														
43.00	90				18	50/4.5"	67			9.7	120.4				
	91														
41.00	92														
	93														
39.00	94		Poorly graded SAND with GRAVEL (SP); very dense; olive brown with black; moist; little fine GRAVEL; max. 1/2 in. dia.; coarse to fine SAND; trace nonplastic fines; weak cementation.												
	95				19	50/5"	100			8.9					
37.00	96														
	97														
35.00	98														
	99														
33.00	100		Poorly graded SAND with SILT and GRAVEL (SP-SM); dark olive brown; moist; little fine GRAVEL; max. 1/2 in. dia.; coarse to fine SAND; few nonplastic fines; weak cementation. Notes: Bottom of borehole at 100.3 ft bgs.		20	50/3"	67			7.9	137.4				
	101														
31.00	102														
	103														
29.00	104														
	105														
27.00	106														
	107														
25.00	108														
	109														
23.00	110														
	111														
21.00	112														
	113														
19.00	114														
	115														



Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

REPORT TITLE
BORING RECORD

HOLE ID
A-18-004

PROJECT NAME
MBI, Orangetown Avenue Bridge Over Santa Ana River
PREPARED BY
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LOGGED BY RA	BEGIN DATE 12-7-18	COMPLETION DATE 12-7-18	BOREHOLE LOCATION (Lat/Long or Station/Offset and Line) Latitude: 33.47° 45.1"		HOLE ID R-18-005
DRILLING CONTRACTOR Socal Drilling			Longitude: -117.52° 43.2"		SURFACE ELEVATION 149.0 ft
DRILLING METHOD Rotary Wash			DRILL RIG Mayhew 1000	BOREHOLE DIAMETER 4"	
SAMPLER TYPE(S) AND SIZE(S) (ID) Mod Cal (2.4"), SPT (1.4")			SPT HAMMER TYPE Automatic Hammer, 140lbs, 30inch drop	HAMMER EFFICIENCY, ERI 80%	
BOREHOLE BACKFILL AND COMPLETION Neat cement slurry			GROUNDWATER DEPTH/DURING DRILLING 22.0 ft	TOTAL DEPTH OF BORING 110.5 ft	

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
0	0		ASPHALT CONCRETE - 3"AGGREGATE BASE - 6".												
1	1		SILTY SAND (SM); dark olive brown; moist; medium to fine SAND; little nonplastic fines; stratified.												
147.00	2														
146.00	3														
145.00	4														
143.00	6		Medium dense; weak cementation.		1	7 9	18 39		9.9						
142.00	7														
141.00	8														
140.00	9														
139.00	10		Poorly graded SAND with SILT (SP-SM); olive brown; moist; trace fine GRAVEL; max. 1/5 in. dia.; coarse to fine SAND; few nonplastic fines; weak cementation.		2	13 15 19	34 44		10.3	107.0					DS
138.00	11														
137.00	12														
136.00	13														
135.00	14		Medium dense; weak cementation.												
134.00	15														
133.00	16				3	7 9 12	21 39		10.7						
132.00	17														
131.00	18														
130.00	19														
129.00	20														
128.00	21														
127.00	22		SILTY SAND (SM); olive brown; moist; about 2% fine GRAVEL; max. 1/5 in. dia.; about 84% coarse to fine SAND; about 14% nonplastic fines; weak cementation.		4	15 15 12	27 22		16.7	103.3					PI, PA
126.00	23														
125.00	24														
124.00	25														

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 Earth Mechanics, Inc. Geotechnical and Earthquake Engineering		REPORT TITLE BORING RECORD		HOLE ID R-18-005	
PROJECT NAME MBI, Orangewood Avenue Bridge Over Santa Ana River		PREPARED BY DN		DATE 5-1-19	
				SHEET 1 of 4	

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
123.00	25		Poorly graded SAND with SILT (SP-SM); dense; olive brown; moist; trace fine GRAVEL, max. 1/5 in. dia.; coarse to fine SAND; few nonplastic fines; weak cementation.	X	5	12 14 11	25	33		24.6					
121.00	26														
	27														
119.00	28														
	29														
117.00	30		SANDY SILT (ML); medium stiff; dark brown; moist; some fine SAND; low plasticity fines.	X	6	7 5 2	7	67		27.3	95.7	PP = 0.5 UU = 0.25		UU	
	31														
115.00	32														
	33														
113.00	34														
	35														
111.00	36		CLAYEY SAND (SC); dense; dark brown; moist; few fine GRAVEL, max. 1/2 in. dia.; medium to fine SAND; little low plasticity fines; weak cementation.	X	7	8 12 12	24	56		14.0					
	37														
109.00	38														
	39														
107.00	40		SILTY SAND with GRAVEL (SM); very dense; olive brown; moist; some coarse GRAVEL, max. 3/4 in. dia.; coarse to fine SAND; little nonplastic fines; weak cementation.	X	8	38 32 27	59	44		20.3		PP = 2.5			
	41														
105.00	42														
	43														
103.00	44														
	45														
101.00	46		SANDY lean CLAY (CL); strong brown; moist; trace fine GRAVEL, max. 1/5 in. dia.; little fine SAND; low plasticity fines.	X	9	16 11 10	21	56		19.0	108.6			CR	
	47														
99.00	48														
	49														
97.00	50														
	51														
95.00	52														
	53														
	54														
	55														

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Earth Mechanics, Inc.

Geotechnical and Earthquake Engineering

REPORT TITLE
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HOLE ID
R-18-005

PROJECT NAME
MBI, Orangewood Avenue Bridge Over Santa Ana River

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ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
93.00	55		Lean CLAY with SAND (CL); dark brown; moist; little fine SAND; low plasticity fines.	X	11	5 6 6	12	100		21.3					
89.00	60		SILTY SAND (SM); dark brown; moist; medium to fine SAND; little nonplastic fines; weak cementation.	X	12	14 21 16	37	56		17.4	105.8	PP = 1.0			
83.00	66		Lean CLAY with SAND (CL); stiff; dark brown; moist; little fine SAND; low plasticity fines.	X	13	4 5 5	10	78		21.0					
79.00	70		Poorly graded GRAVEL with CLAY and SAND (GP-GC); dark brown; moist; coarse GRAVEL, max. 3/4 in. dia.; some coarse to fine SAND; few low plasticity fines; weak cementation.	X	14	60/6"		67		7.1					
73.00	76		SILTY SAND with GRAVEL (SM); very dense; dark yellowish brown; moist; some coarse GRAVEL, max. 3/4 in. dia.; coarse to fine SAND; little nonplastic fines; weak cementation.	X	15	44 50/4.5"		30		10.1					
69.00	80		Poorly graded SAND with SILT and GRAVEL (SP-SM); dark yellowish brown; moist; little coarse GRAVEL, max. 3/4 in. dia.; coarse to fine SAND; few nonplastic fines; weak cementation.	X	16	38 50/5"		55		11.0	121.5				

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Geotechnical and Earthquake Engineering

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HOLE ID
R-18-005

PROJECT NAME
MBI, Orangewood Avenue Bridge Over Santa Ana River

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ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
63.00	86		Lean CLAY with SAND (CL); dark yellowish brown; moist; little fine SAND; medium plasticity fines.		17	3	20	100		21.5					
61.00	88					9									
59.00	90		SILT Y SAND (SM); dark yellowish brown; moist; few coarse to fine GRAVEL, max. 1 in. dia.; medium to fine SAND; little nonplastic fines; weak cementation.		18	19	27	56		13.6	119.1				
57.00	92					12									
55.00	94					15									
53.00	96					14	45	67							
51.00	98					18									
49.00	100		SANDY SILT (ML); very stiff; dark yellowish brown; moist; some fine SAND; low plasticity fines.		20	18	54	67		19.6	111.0	PP = 3.5			
47.00	102					23									
45.00	104					31									
43.00	106		SILT Y SAND (SM); very dense; dark yellowish brown; moist; few fine GRAVEL, max. 1/5 in. dia.; medium to fine SAND; some nonplastic fines; weak cementation.		21	17	54	100		21.1					
41.00	108					26									
39.00	110					28									
37.00	112		Poorly graded SAND with SILT and GRAVEL (SP-SM); dark olive brown; moist; some coarse GRAVEL, max. 3/4 in. dia.; coarse to fine SAND; few nonplastic fines; weak cementation.		22	77/6"		50		10.1	111.5				
36.00	114		Notes: Bottom of borehole at 110.5 ft bgs.												
	115														



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MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS	
			GRAPH	LETTER		
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES	
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	
		SAND AND SANDY SOILS	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
			SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SAND, SAND - SILT MIXTURES
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)			SC	CLAYEY SANDS, SAND - CLAY MIXTURES	
			SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS	
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY	
SAND AND SANDY SOILS	CLEAN SANDS (LITTLE OR NO FINES)			SW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES	
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SAND, SAND - SILT MIXTURES		
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES		
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY	
SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS		
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY		
SAND AND SANDY SOILS		CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES	
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SAND, SAND - SILT MIXTURES		
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES		
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY	
SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS		
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY		
SAND AND SANDY SOILS		CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES	
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SAND, SAND - SILT MIXTURES		
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES		
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY	
SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS		
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY		
SAND AND SANDY SOILS		CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES	
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SAND, SAND - SILT MIXTURES		
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES		
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY	
SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS		
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY		
SAND AND SANDY SOILS		CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES	
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SAND, SAND - SILT MIXTURES		
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES		
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY	
SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS		
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY		
SAND AND SANDY SOILS		CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES	
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SAND, SAND - SILT MIXTURES		
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES		
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY	
SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS		
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY		
SAND AND SANDY SOILS		CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES	
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SAND, SAND - SILT MIXTURES		
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES		
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY	
SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS		
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY		
SAND AND SANDY SOILS		CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES	
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SAND, SAND - SILT MIXTURES		
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES		
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY	
SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS		
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY		
SAND AND SANDY SOILS		CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES	
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SAND, SAND - SILT MIXTURES		
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES		
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY	
SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS		
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY		
SAND AND SANDY SOILS		CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES	
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SAND, SAND - SILT MIXTURES		
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES		
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY	
SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS		
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY		
SAND AND SANDY SOILS		CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES	
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SAND, SAND - SILT MIXTURES		
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES		
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY	
SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS		
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY		
SAND AND SANDY SOILS		CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES	
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SAND, SAND - SILT MIXTURES		
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES		
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY	
SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS		
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY		
SAND AND SANDY SOILS		CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES	
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SAND, SAND - SILT MIXTURES		
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES		
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY	
SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS		
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY		
SAND AND SANDY SOILS		CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES	
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SAND, SAND - SILT MIXTURES		
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES		
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY	
SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS		
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY		
SAND AND SANDY SOILS		CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES	
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SAND, SAND - SILT MIXTURES		
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES		
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY	
SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS		
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY		
SAND AND SANDY SOILS		CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES	
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SAND, SAND - SILT MIXTURES		
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES		
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY	
SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS		
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY		
SAND AND SANDY SOILS		CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES	
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SAND, SAND - SILT MIXTURES		
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES		
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY	
SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS		
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY		
SAND AND SANDY SOILS		CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES	
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SAND, SAND - SILT MIXTURES		
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES		
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY	
SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS		
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY		
SAND AND SANDY SOILS		CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES	
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SAND, SAND - SILT MIXTURES		
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES		
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY	
SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS		
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY		
SAND AND SANDY SOILS		CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES	
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SAND, SAND - SILT MIXTURES		
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES		
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY	
SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS		
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY		
SAND AND SANDY SOILS		CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES	
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SAND, SAND - SILT MIXTURES		
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES		
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY	
SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS		
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY		
SAND AND SANDY SOILS		CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES	
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SAND, SAND - SILT MIXTURES		
	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SC			

LOG OF BORING B-4

Project: Angels Stadium Master Plan
Job No.: 20-01-3950
Location: Anaheim, CA
Coordinates:

Surface Elev.: 140.0
Top of Casing Elev.: N.A.
Drilling Method: Hollow Stem Auger
Sampling Method: Cal-Mod and SPT

Elevation, feet	Depth, feet	Sample No.	Sampler Graphics Symbol / USCS	Recovery %	MATERIAL DESCRIPTION	Blow Counts	Dry Unit Weight, lb/cu ft.	Water Content %
	0				5" ASPHALT CONCRETE PAVEMENT			
					<u>ALLUVIUM (Qal):</u> SILTY SAND (SM), medium black brown, moist, medium dense	19	94	8
135.0	5				SAND (SP), light-medium brown, moist, medium dense, trace silt	15	96	6
					@7.5' medium to coarse grained, loose	14	98	3
130.0	10				@10' medium dense	20	97	3
						20	91	3
125.0	15				@17.5' dense	28	99	3
						53	98	3
120.0	20				SAND (SP), light-medium brown, moist, medium dense	46	99	4
					SILTY SAND (SM), medium brown, moist, medium dense	22	106	13
115.0	25				@27.5' loose	23	101	12
					@29' wet, perched water	11	97	25
110.0	30				SANDY SILT (ML), medium brown, moist to very moist, medium dense	17	105	20
105.0	35				SANDY GRAVEL (GW), gray brown gravel, little to no fines, fracturing, moist, very dense	38 50/5"	125	6
	40							

Completion Depth: 51.0
Date Boring Started: 2/24/20
Date Boring Completed: 2/24/20
Logged By: BC
Drilling Contractor: OWD

Remarks:
Groundwater was not encountered. Type of auger used prevented caving.
Backfilled with auger cuttings. Pavement patch with cold-mix asphalt concrete.

The stratification lines represent approximate boundaries. The transition may be gradual.

LOG OF BORING B-4

Project: Angels Stadium Master Plan
 Job No.: 20-01-3950
 Location: Anaheim, CA
 Coordinates:

Surface Elev.: 140.0
 Top of Casing Elev.: N.A.
 Drilling Method: Hollow Stem Auger
 Sampling Method: Cal-Mod and SPT

Elevation, feet	Depth, feet	Sample No.	Sampler Graphics Symbol / USCS	Recovery %	MATERIAL DESCRIPTION	Blow Counts	Dry Unit Weight, lb/cu ft.	Water Content %
	40				SANDY GRAVEL (GW), gray brown gravel, little to no fines, fracturing, moist, very dense	50/5"		4
95.0	45				SILTY GRAVEL (GM), medium brown, moist, very dense	50/6"		4
90.0	50						101	4

Completion Depth: 51.0
 Date Boring Started: 2/24/20
 Date Boring Completed: 2/24/20
 Logged By: BC
 Drilling Contractor: OWD

Remarks:
 Groundwater was not encountered. Type of auger used prevented caving.
 Backfilled with auger cuttings. Pavement patch with cold-mix asphalt concrete.

The stratification lines represent approximate boundaries. The transition may be gradual.

LOG OF BORING B-5

Project: Angels Stadium Master Plan
 Job No.: 20-01-3950
 Location: Anaheim, CA
 Coordinates:

Surface Elev.: 140.0
 Top of Casing Elev.: N.A.
 Drilling Method: Hollow Stem Auger
 Sampling Method: Cal-Mod and SPT

Elevation, feet	Depth, feet	Sample No.	Sampler Graphics Symbol / USCS	Recovery %	MATERIAL DESCRIPTION	Blow Counts	Dry Unit Weight, lb/cu ft.	Water Content %
0	0				5" ASPHALT CONCRETE PAVEMENT			
					<u>ALLUVIUM (Qal):</u> SILTY SAND (SM), light-medium brown, moist, medium dense, trace gravel	48	116	11
135.0	5					41	102	5
					SAND (SP) with silt, light-medium brown, moist, medium dense	14	94	5
130.0	10					14	97	3
						16	93	3
125.0	15				SAND (SW), light-medium brown, moist, medium dense, trace silt	26	101	3
120.0	20					34	96	3
						42	97	3
115.0	25				SAND (SP), light brown, moist, medium dense	40		8
					CLAYEY SILT (ML), 6-inch lens, moist, very stiff	43		26
110.0	30				SAND (SP), light brown, moist, medium dense	36	102	17
105.0	35				SAND (SW), light-medium brown, moist, dense, trace silt	50/4"		11
	40							

Completion Depth: 101.0
 Date Boring Started: 2/20/20
 Date Boring Completed: 2/20/20
 Logged By: BC
 Drilling Contractor: OWD

Remarks:
 Groundwater was not encountered. Type of auger used prevented caving.
 Backfilled with auger cuttings. Pavement patch with cold-mix asphalt concrete.

The stratification lines represent approximate boundaries. The transition may be gradual.

LOG OF BORING B-5

Project: Angels Stadium Master Plan
 Job No.: 20-01-3950
 Location: Anaheim, CA
 Coordinates:

Surface Elev.: 140.0
 Top of Casing Elev.: N.A.
 Drilling Method: Hollow Stem Auger
 Sampling Method: Cal-Mod and SPT

Elevation, feet	Depth, feet	Sample No.	Sampler Graphics Symbol / USCS	Recovery %	MATERIAL DESCRIPTION	Blow Counts	Dry Unit Weight, lb/cu ft.	Water Content %
40					SANDY GRAVEL (GW), gray brown gravel, moist, very dense, little to no fines	86		6
95.0	45				SAND (SW) with gravel, medium brown/gray, wet, very dense	86		18
90.0	50				CLAYEY SILT (ML), medium brown, wet, very stiff	18		23
85.0	55				SILTY SAND (SM) with gravel, medium brown, wet, very dense	50/6"		14
80.0	60				SILTY SAND (SM) with gravel, medium brown, wet, medium dense	12		17
75.0	65				CLAYEY SILT (ML), medium brown, wet, medium stiff	6		19
70.0	70					6		23
65.0	75				@75' stiff	11		27
80								

Completion Depth: 101.0
 Date Boring Started: 2/20/20
 Date Boring Completed: 2/20/20
 Logged By: BC
 Drilling Contractor: OWD

Remarks:
 Groundwater was not encountered. Type of auger used prevented caving.
 Backfilled with auger cuttings. Pavement patch with cold-mix asphalt concrete.

The stratification lines represent approximate boundaries. The transition may be gradual.

Harrison
 Geotechnical
 Engineering, Inc. _____

PLATE A-5b

LOG OF BORING B-5

Project: Angels Stadium Master Plan
 Job No.: 20-01-3950
 Location: Anaheim, CA
 Coordinates:

Surface Elev.: 140.0
 Top of Casing Elev.: N.A.
 Drilling Method: Hollow Stem Auger
 Sampling Method: Cal-Mod and SPT

Elevation, feet	Depth, feet	Sample No.	Sampler Graphics Symbol / USCS	Recovery %	MATERIAL DESCRIPTION	Blow Counts	Dry Unit Weight, lb/cu ft.	Water Content %
80					CLAYEY SILT (ML), medium brown, very moist to wet, stiff, trace sand	13		19
55.0	85					14		22
50.0	90				SILTY SAND (SM), medium brown, very moist, medium dense	13		16
45.0	95				CLAYEY SILT (ML), 6" lens, very moist, very stiff SILTY SAND (SM), with gravel, medium brown, very moist, dense	36		19
40.0	100				SILTY SAND (SW), medium brown, very moist to wet, dense	50/4"		11

Completion Depth: 101.0
 Date Boring Started: 2/20/20
 Date Boring Completed: 2/20/20
 Logged By: BC
 Drilling Contractor: OWD

Remarks:
 Groundwater was not encountered. Type of auger used prevented caving.
 Backfilled with auger cuttings. Pavement patch with cold-mix asphalt concrete.

The stratification lines represent approximate boundaries. The transition may be gradual.

LOG OF BORING B-1

Project: Anaheim Riverwalk
 Job No.: Ana-0491
 Location: Anaheim
 Coordinates:

Surface Elev.:
 Top of Casing Elev.:
 Drilling Method: Hollow Stem Auger
 Sampling Method: Ring

Elevation, feet	Depth, feet	Sample No.	Sampler Graphics Symbol / USCS	Recovery %	MATERIAL DESCRIPTION	Blow Counts	Dry Unit Weight, lb/cu ft.	Water Content %
	0				ALLUVIUM (Qal): Gravelly Sand (SW) , tan/brown, moist, loose to medium dense, coarse grained, angular			
	5					14	103	4
						13	102	1
	10					16	100	2
					@ 12.5' increased grain size	26	104	2
	15				Sand (SP) , tan, moist, medium dense, medium to very fine grained	21	98	2
						21	105	8
	20					22	101	3

Completion Depth: 21.5
 Date Boring Started: 6/2/21
 Date Boring Completed: 6/2/21
 Logged By: SBM
 Drilling Contractor: OWD

Remarks:
 Groundwater was not encountered. No caving due to type of auger used.

The stratification lines represent approximate boundaries. The transition may be gradual.

LOG OF BORING B-2

Project: Anaheim Riverwalk
 Job No.: Ana-0491
 Location: Anaheim
 Coordinates:

Surface Elev.:
 Top of Casing Elev.:
 Drilling Method: Hollow Stem Auger
 Sampling Method: Ring

Elevation, feet	Depth, feet	Sample No.	Sampler Graphics Symbol / USCS	Recovery %	MATERIAL DESCRIPTION	Blow Counts	Dry Unit Weight, lb/cu ft.	Water Content %
0	0				ALLUVIUM (Qal): Sand (SW) , brown/tan, moist, loose to medium dense, coarse to fine grained, angular			
	5				@ 5' decreased moisture	10	102	3
						15	99	3
						24	102	3
	10					17	101	2
					Silty Sand (SM) , olive/brown/gray, moist to wet, medium dense, minor oxidation	17	88	26
	15				Sand (SW) , tan/light brown, damp to moist, medium dense, medium grained, angular	27	111	4
						38	99	1
	20					31	102	5
					Sand (SW) , brown/olive, saturated, medium dense, medium to fine grained	26	102	21
	25				Sand (SW) , brown/olive, saturated, loose, very fine grained, minor oxidation	13	102	24
	30					11	102	24
	35				Clayey Sand (SC) with gravel, olive/brown, saturated, dense, large well round gravel and cobbles	50/6"	115	19
	40							

Completion Depth: 51.5
 Date Boring Started: 6/2/21
 Date Boring Completed: 6/2/21
 Logged By: SBM
 Drilling Contractor: OWD

Remarks:
 Perched water at 22.5'. No caving due to type of auger used.

The stratification lines represent approximate boundaries. The transition may be gradual.

LOG OF BORING B-2

Project: Anaheim Riverwalk
 Job No.: Ana-0491
 Location: Anaheim
 Coordinates:

Surface Elev.:
 Top of Casing Elev.:
 Drilling Method: Hollow Stem Auger
 Sampling Method: Ring

Elevation, feet	Depth, feet	Sample No.	Sampler Graphics Symbol / USCS	Recovery %	MATERIAL DESCRIPTION	Blow Counts	Dry Unit Weight, lb/cu ft.	Water Content %
	40				Sandy Silt (ML) , olive/brown, saturated, stiff	50/2"	93	39
	45				Silty Sand (SM) , olive/brown, moist dense	50/3"	114	13
	50					50/5"	125	10

Completion Depth: 51.5
 Date Boring Started: 6/2/21
 Date Boring Completed: 6/2/21
 Logged By: SBM
 Drilling Contractor: OWD

Remarks:
 Perched water at 22.5'. No caving due to type of auger used.

The stratification lines represent approximate boundaries. The transition may be gradual.

Harrington
 Geotechnical
 Engineering, Inc. _____

PLATE A-2b

LOG OF BORING B-3

Project: Anaheim Riverwalk
 Job No.: Ana-0491
 Location: Anaheim
 Coordinates:

Surface Elev.:
 Top of Casing Elev.:
 Drilling Method: Hollow Stem Auger
 Sampling Method: Ring

Elevation, feet	Depth, feet	Sample No.	Sampler Graphics Symbol / USCS	Recovery %	MATERIAL DESCRIPTION	Blow Counts	Dry Unit Weight, lb/cu ft.	Water Content %
0	0				ALLUVIUM (Qal): Silty Sand (SM) , tan/brown/black, moist, medium dense, fine to very fine grained, angular			
	5					32	98	16
						28	88	2
	10				Gravelly Sand (SW) , tan/brown, damp, medium dense, coarse grained, large angular gravel	30	98	2
						27	111	2
	15				@ 12.5' Clayey Sand (SC) lenses	24	94	11
					Clayey Sand (SC) , brown/light brown, wet medium dense, very fine grained	23	93	21
	20				Silty Sand (SM) , tan/light brown, moist, medium dense, fine grained, angular	39	99	2
						34	100	10
	25				Clayey Sand (SC) , light brown/olive, wet, medium dense, very fine grained, minor oxidation	16	95	24
						15	102	23
	30					16	94	25
	35				Clayey Sand (SC) , red/orange, moist, dense, angular gravel, well oxidized	52	128	7
	40							

Completion Depth: 51.5
 Date Boring Started: 6/2/21
 Date Boring Completed: 6/2/21
 Logged By: SBM
 Drilling Contractor: OWD

Remarks:
 Perched water at 22.5'. No caving due to type of auger used.

The stratification lines represent approximate boundaries. The transition may be gradual.

LOG OF BORING B-3

Project: Anaheim Riverwalk
 Job No.: Ana-0491
 Location: Anaheim
 Coordinates:

Surface Elev.:
 Top of Casing Elev.:
 Drilling Method: Hollow Stem Auger
 Sampling Method: Ring

Elevation, feet	Depth, feet	Sample No.	Sampler Graphics Symbol / USCS	Recovery %	MATERIAL DESCRIPTION	Blow Counts	Dry Unit Weight, lb/cu ft.	Water Content %
	40				Silty Sand (SM), red/orange, moist, dense	44	121	8
	45					50/4"	131	5
	50					50/4"	113	6

Completion Depth: 51.5
 Date Boring Started: 6/2/21
 Date Boring Completed: 6/2/21
 Logged By: SBM
 Drilling Contractor: OWD

Remarks:
 Perched water at 22.5'. No caving due to type of auger used.

The stratification lines represent approximate boundaries. The transition may be gradual.

LOG OF BORING B-4

Project: Anaheim Riverwalk
 Job No.: Ana-0491
 Location: Anaheim
 Coordinates:

Surface Elev.:
 Top of Casing Elev.:
 Drilling Method: Hollow Stem Auger
 Sampling Method: Ring

Elevation, feet	Depth, feet	Sample No.	Sampler Graphics Symbol / USCS	Recovery %	MATERIAL DESCRIPTION	Blow Counts	Dry Unit Weight, lb/cu ft.	Water Content %
	0				ALLUVIUM: (Qal) Sand (SW) , tan/light brown, damp, medium dense, medium to fine grained, angular			
	5				@ 5' less dense	24	103	5
						11	97	2
						15	99	2
	10					17	101	2
					Clayey Sand (SC) , olive/brown, wet, loose, very fine grained, minor oxidation	11	82	33
	15				Sand (SW) , tan/light brown, damp, medium dense, medium to fine grained, angular, minor oxidation	35	103	3
						21	94	2
	20					28	101	3

Completion Depth: 21.5
 Date Boring Started: 6/2/21
 Date Boring Completed: 6/2/21
 Logged By: SBM
 Drilling Contractor: OWD

Remarks:
 Groundwater was not encountered. No caving due to type of auger used.

The stratification lines represent approximate boundaries. The transition may be gradual.

SOIL CLASSIFICATION SYSTEM-ASTM D2487

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE-GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES APPRECIABLE AMOUNT OF FINES		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES APPRECIABLE AMOUNT OF FINES		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE-GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY	
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS	
			OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY	
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS	
			CH	INORGANIC CLAYS OF HIGH PLASTICITY	
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS	
HIGHLY ORGANIC SOILS			PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS	

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

- "Push" Sampler
- Split Barrel "Drive" Sampler With Liner
- Standard Penetration Test (SPT) Sampler
- Hand Auger
- Concrete/Rock Core
- Groundwater Surface

SPT "N" = 0.65 x modified California blows per foot

- NP = Nonplastic
- EI = Expansion Index Test
- SG = Specific Gravity
- SE = Sand Equivalent
- UC = Unconfined Comp.
- CD = Consol. Drained Triaxial.
- CU = Consol. Undrained Triaxial.
- UU = Undrained, Unconsol. Triaxial.
- RV = R-Value
- CA = Chemical Analysis
- DS = Direct Shear
- CN = Consolidation
- CP = Collapse Potential
- SA = Grain size; HD = Hydrometer
- MD = Compaction Test
- HC = Hydraulic Conductivity Test
- CBR = California Bearing Ratio
- [PID] Reading in ppm above background

Anaheim Regional Transportation Intermodal Center
Project No. 2009-021

PLATE
B1



BORING LOCATION: See Figure 2							ELEVATION AND DATUM (feet): 164 MSL						
LATITUDE: 33° 48' 20.4" N							LONGITUDE: 117° 52' 33.4" W						
DRILLING EQUIPMENT: CME-75							DRILLING METHOD: Hollow Stem Auger						
BORING DIAMETER (inches): 8							BORING DEPTH (feet): 5						
DATE STARTED: 2-24-10 COMPLETED: 2-24-10							HAMMER TYPE: Automatic Efficiency: 75%						
DRILLING CONTRACTOR: 2R Drilling, Inc							HAMMER DROP: 30 inches WT: 140 lbs						
LOGGED BY: SS CHECKED BY: KV							DRIVE SAMPLER DIAMETER (inches) ID: 2.4 OD: 3						
Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
160	5			22	44		ASPHALT CONCRETE (AC): 4 inches	119	13				
				28			POORLY GRADED SAND with SILT and GRAVEL						
				40			(SP-SM): dark brown, moist, medium dense, fine- to medium-grained sand, fine gravel, BASE: 4 inches						
				28			SILTY SAND (SM): gray, moist, dense, fine-grained sand, FILL						
				38			POORLY GRADED SAND with SILT (SP-SM): light brown, moist, dense, fine- to medium-grained sand, trace coarse-grained sand						
				35			Bottom of boring at 5 feet. Groundwater not encountered during drilling. Boring backfilled with pea gravel. Surface patched with cold patch asphalt.						
													</

LOG OF BORING DYB10-01

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Project No. 2009-021

PLATE

B2

BORING LOCATION: See Figure 2				ELEVATION AND DATUM (feet): 163 MSL									
LATITUDE: 33° 48' 19.2" N				LONGITUDE: 117° 52' 33.7" W									
DRILLING EQUIPMENT: CME-75				DRILLING METHOD: Hollow Stem Auger									
BORING DIAMETER (inches): 8				BORING DEPTH (feet): 5.5									
DATE STARTED: 2-24-10		COMPLETED: 2-24-10		HAMMER TYPE: Automatic		Efficiency: 75%							
DRILLING CONTRACTOR: 2R Drilling, Inc				HAMMER DROP: 30 inches		WT: 140 lbs							
LOGGED BY: SS		CHECKED BY: KV		DRIVE SAMPLER DIAMETER (inches) ID: 2.4 OD: 3									
Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
160				16 50/6"	65	4	ASPHALT CONCRETE (AC): 3 inches SILTY SAND with GRAVEL (SM): brown, moist, medium dense, fine- to medium-grained sand, fine gravel, BASE: 3 inches	127	7	NP	NP		
				40 40 50	58		SANDY SILT (ML): grayish brown, moist, hard, nonplastic, fine-grained sand, trace roots, FILL POORLY GRADED SAND with SILT (SP-SM): brown, moist, very dense, fine- to medium-grained sand, trace coarse-grained sand	114	3				
	5						Bottom of boring at 5.5 feet. Groundwater not encountered during drilling. Boring backfilled with pea gravel. Surface patched with cold patch asphalt.						
155													
	10												
150													
	15												
145													
	20												
140													
	25												
135													

LOG OF BORING DYB10-02

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PLATE

B3



BORING LOCATION: See Figure 2				ELEVATION AND DATUM (feet): 159 MSL										
LATITUDE: 33° 48' 17.3" N				LONGITUDE: 117° 52' 34.9" W										
DRILLING EQUIPMENT: CME-75				DRILLING METHOD: Hollow Stem Auger										
BORING DIAMETER (inches): 8				BORING DEPTH (feet): 15										
DATE STARTED: 2-24-10		COMPLETED: 2-24-10		HAMMER TYPE: Automatic		Efficiency: 75%								
DRILLING CONTRACTOR: 2R Drilling, Inc				HAMMER DROP: 30 inches		WT: 140 lbs								
LOGGED BY: SS		CHECKED BY: RA		DRIVE SAMPLER DIAMETER (inches) ID: 2.4 OD: 3										
Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 inches	SPT N	Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests (PID)
155	5			13	31			ASPHALT CONCRETE (AC): 4 inches	123	10				
				23				POORLY GRADED SAND with SILT and GRAVEL	126	11			13	RV
				25				(SP-SM): brown, moist, medium dense, fine- to						SA
				15	44			coarse-grained sand, fine gravel, BASE: 3 inches	127	7			17	SA
				27				SILTY SAND (SM): light brownish gray, moist, dense, fine-						MD
				40				to medium-grained sand, FILL						
				18	57			SILTY SAND (SM): light brownish gray, moist, dense, fine-						
				38				to medium-grained sand	128	9			18	
				49				very dense, trace fine gravel, trace shell fragments						
150	10			21	41			brown, dense, no gravel, no shell fragments					24	
				26										
				37				POORLY GRADED SAND with SILT (SP-SM): brown, moist,	115	4				
				12	21			medium dense, fine- to medium-grained sand, trace						
145	15			15				coarse-grained sand						
								POORLY GRADED SAND (SP): light yellowish brown,	102	2			1	
				5	9			moist, loose, fine- to medium-grained sand, few						
140	20			6				coarse-grained sand						
				8										
135	25							Bottom of boring at 15 feet.						
								Groundwater not encountered during drilling.						
								Boring setup for percolation tests at 10 feet and 15 feet.						
								Surface patched with cold patch asphalt.						
130														

LOG OF BORING DYB10-04

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Anaheim Regional Transportation Intermodal Center

Project No. 2009-021

PLATE

B5



BORING LOCATION: See Figure 2							ELEVATION AND DATUM (feet): 156 MSL						
LATITUDE: 33° 48' 13.9" N							LONGITUDE: 117° 52' 35.9" W						
DRILLING EQUIPMENT: CME-75							DRILLING METHOD: Hollow Stem Auger						
BORING DIAMETER (inches): 8							BORING DEPTH (feet): 5.5						
DATE STARTED: 2-24-10 COMPLETED: 2-24-10							HAMMER TYPE: Automatic Efficiency: 75%						
DRILLING CONTRACTOR: 2R Drilling, Inc							HAMMER DROP: 30 inches WT: 140 lbs						
LOGGED BY: SS CHECKED BY: KV							DRIVE SAMPLER DIAMETER (inches) ID: 2.4 OD: 3						
Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [P/D]
155				8	10		ASPHALT CONCRETE (AC): 3 inches						
				9			POORLY GRADED GRAVEL with SILT and SAND	110	5				
				6			(GP-GM): brown, moist, medium dense, fine to coarse						
				3	8		gravel, fine- to medium-grained sand, BASE: 3 inches						
	5			6			POORLY GRADED SAND with SILT (SP-SM): brown, moist,	109	7				
				6			loose, fine- to medium-grained sand						
							trace fine gravel						
150							Bottom of boring at 5.5 feet.						
							Groundwater not encountered during drilling.						
							Boring backfilled with pea gravel.						
							Surface patched with cold patch asphalt.						
145	10												
140	15												
135	20												
130	25												

LOG OF BORING DYB10-08

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PLATE**B9**

BORING LOCATION:	See Figure 2	ELEVATION AND DATUM (feet):	156 MSL
LATITUDE:	33° 48' 13.2" N	LONGITUDE:	117° 52' 36.8" W
DRILLING EQUIPMENT:	CME-75/Mayhew 1000	DRILLING METHOD:	Hollow Stem Auger/ Rotary Wash
BORING DIAMETER (inches):	8	BORING DEPTH (feet):	83.5
DATE STARTED:	2-26-10	COMPLETED:	3-4-10
DRILLING CONTRACTOR:	2R Drilling/ Socal Drilling	HAMMER TYPE:	Automatic
		Efficiency:	75%
LOGGED BY:	WD/SS	CHECKED BY:	KV
		DRIVE SAMPLER DIAMETER (inches)	ID: 2.4 OD: 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
155							ASPHALT CONCRETE (AC): 3 inches						
				9	14		POORLY GRADED GRAVEL with SILT and SAND (GP-GM): strong brown, moist, medium dense, fine to coarse gravel, fine- to medium-grained sand, BASE: 5 inches	105	4				
				10									
				11	12								
				8									
	5			9	10		POORLY GRADED SAND (SP): light brown, moist, medium dense, medium-grained sand, trace coarse-grained sand, trace fine gravel, FILL	109	3				
				10			few fine gravel						
150				4			loose, fine-grained sand						
				4									
				6									
				4	6		POORLY GRADED SAND with GRAVEL (SP): grayish brown, moist, loose, coarse-grained sand, fine to coarse gravel	97	23				
				5									
	10			5									
145				9	13		POORLY GRADED SAND (SP): light yellowish brown, moist, medium dense, fine-grained sand					3	SA
				6									
				7									
140				11	18		fine- to medium-grained sand	107	5				CA
				13									
				15									
135				5	9		loose, fine-grained sand						
				6									
				3									
	25						SILTY SAND (SM): strong brown, moist, loose, fine-grained sand						
130				5	9	2.5	SANDY SILT (ML): olive brown, moist, very stiff, nonplastic, fine-grained sand, slightly micaceous	111	16	NP	NP	51	
				7									
				7									

LOG OF BORING DYB10-09

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PLATE

B10



Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
125				12 12 22	34		POORLY GRADED SAND with SILT and GRAVEL (SP-SM): reddish brown, moist, dense, fine- to coarse-grained sand, fine to coarse gravel					9	
120	35			23 50/4"	97		SILTY GRAVEL with SAND (GM): strong brown, moist, very dense, fine to coarse gravel, fine-grained sand	120	5				
115	40			22 25 32	57		WELL-GRADED GRAVEL with SILT and SAND (GW-GM): dark grayish brown, moist, very dense, fine to coarse gravel, fine- to coarse-grained sand					7	SA
110	45			5 5 7	8	0.75	LEAN CLAY with SAND (CL): strong brown, moist, medium stiff, medium plasticity, fine-grained sand	102	23	29	12		
105	50			4 4 4	8	0.5	▽ wet						
100	55						no recovery						
95	60			2 2 4	6	0.75							
90	65												

LOG OF BORING DYB10-09

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PLATE

B11



[illegible]

LOG OF BORING DYB10-09

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**Anaheim Regional Transportation Intermodal Center
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PLATE

B12

BORING LOCATION: See Figure 2				ELEVATION AND DATUM (feet): 156 MSL										
LATITUDE: 33° 48' 11.2" N				LONGITUDE: 117° 52' 37.3" W										
DRILLING EQUIPMENT: Mayhew 1000				DRILLING METHOD: Rotary Wash										
BORING DIAMETER (inches): 5				BORING DEPTH (feet): 101.5										
DATE STARTED: 3-5-10		COMPLETED: 3-5-10		HAMMER TYPE: Automatic		Efficiency: 75%								
DRILLING CONTRACTOR: Socal Drilling, Inc.				HAMMER DROP: 30 inches		WT: 140 lbs								
LOGGED BY: SS		CHECKED BY: KV		DRIVE SAMPLER DIAMETER (inches) ID: 2.4 OD: 3										
Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N	Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
155				26 50/6"	65			ASPHALT CONCRETE (AC): 3 inches						
				22	36			POORLY GRADED GRAVEL with SILT and SAND (GP-GM): brown, moist, medium dense, fine to coarse gravel, fine- to medium-grained sand, BASE: 3 inches	115	2				
				26				POORLY GRADED SAND (SP): light brown, moist, very dense, fine- to medium-grained sand, trace fine gravel, FILL	110	3				MD RV
	5			30										
150				14	42									
				20										
				22										
				12	34			SILTY SAND (SM): grayish brown, moist, dense, fine- to medium-grained sand, FILL	108	8			13	
	10			23										
				30										
145														
				4	8			POORLY GRADED SAND with SILT (SP-SM): light brown, moist, loose, fine- to medium-grained sand						
				4										
	15			4										
140														
				17	47			POORLY GRADED SAND (SP): light brown, moist, dense, fine-grained sand	107	4				
	20			33										
				40										
135														
				6	15			POORLY GRADED SAND (SP): grayish brown, moist, medium dense, fine-grained sand, trace medium-grained sand						
				8										
	25			7										
130								SANDY SILT (ML): grayish brown, moist, medium stiff, nonplastic, fine-grained sand	93	26	NP	NP	56	CN
						0.75								

LOG OF BORING DYB10-12

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PLATE

B19



Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N	Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
125														
				5 8 9	11	2		SANDY LEAN CLAY (CL): reddish brown, moist, stiff, medium plasticity, fine-grained sand, trace fine gravel	114	17	25	11	51	
120	35			19 31 33	64			POORLY GRADED GRAVEL with SILT and SAND (GP-GM): grayish brown, moist, very dense, fine to coarse gravel, fine- to coarse-grained sand						
115	40			24 50/5"	100			▽ wet						
110	45			8 9 10	12	1		SANDY LEAN CLAY (CL): olive brown, wet, stiff, medium plasticity, fine-grained sand	101	23	29	11		UU
105	50			20 24 28	52			POORLY GRADED GRAVEL with SILT and SAND (GP-GM): grayish brown, wet, very dense, fine to coarse gravel, fine- to coarse-grained sand	96	31	27	10	56	
100	55			6 7 8	10	1.5		LEAN CLAY (CL): strong brown, wet, stiff, medium plasticity						
95	60			2 2 3	5	0.5		LEAN CLAY with SAND (CL): strong brown, wet, medium stiff, medium plasticity, fine-grained sand						
90	65			7 9 10	12			stiff, no recovery						

LOG OF BORING DYB10-12

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PLATE

B20



Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
85				3 6 8	9		no recovery						
				5 7 7	14	1.25	SANDY SILT (ML): strong brown, wet, stiff, nonplastic, fine-grained sand, micaceous						
75				6 9 14	23	1							
80				24 15 15	19	2	POORLY GRADED SAND (SP): dark grayish brown, wet, medium dense, fine- to medium-grained sand	118	13				
75							SANDY LEAN CLAY (CL): olive brown, wet, very stiff, medium plasticity, fine-grained sand						
85				32 40 46	86		POORLY GRADED GRAVEL with SILT and SAND (GP-GM): grayish brown, wet, very dense, fine to coarse gravel, fine- to coarse-grained sand						
70				29 50/6"	100							10	
65				35 40 48	88								
90							Bottom of boring at 101.5 feet. Groundwater measured at 41 feet after drilling. Boring backfilled with cement/bentonite grout. Surface patched with cold patch asphalt.						
95													
100													
105													

LOG OF BORING DYB10-12

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Anaheim Regional Transportation Intermodal Center

Project No. 2009-021

PLATE

B21



Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
125				3 3 4	5	0.5		93	28				
						0.75		104	22	NP	NP	61	CN
35				1 1 4	3	0.25	LEAN CLAY (CL): brown, wet, soft, medium plasticity, trace fine gravel	108	20				
120													
40													
115				2 5 6	11	1.75	SANDY SILTY CLAY (CL-ML): brown, wet, stiff, low plasticity, fine-grained sand, trace fine gravel		20	24	6		
45				4 6 7	8		SANDY LEAN CLAY (CL): brown, wet, medium stiff, medium plasticity, fine-grained sand, trace fine gravel no recovery						
110													
50				2 2 2	4	0.25	soft no recovery						
105													
55				55/6"	71		POORLY GRADED GRAVEL with SAND (GP): brown, wet, very dense, fine to coarse gravel, fine- to coarse-grained sand	129	9				
100													
60				2 2 3	5	1	LEAN CLAY with SAND (CL): reddish brown, wet, medium stiff, medium plasticity, fine-grained sand		25	32	16		
95													
65				8 11 14	16	2	very stiff, few fine to coarse gravel						
90													

LOG OF BORING DYB10-13

Page 2 of 4

Anaheim Regional Transportation Intermodal Center
Project No. 2009-021

PLATE

B23



Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N	Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
85				2 2 2	4		0.5	soft, no gravel						
75				11 12 17	19		3	SANDY LEAN CLAY (CL): dark brown, wet, very stiff, medium plasticity, fine-grained sand	108	20	27	8	69	SA
80								SILTY SAND (SM): brown, wet, very dense, fine-grained sand						
80				18 24 27	51									
75								POORLY GRADED SAND (SP): grayish brown, wet, medium dense, fine-grained sand, slightly micaceous	99	21				
85				25 22 17	25									
70								POORLY GRADED GRAVEL with SAND (GP): grayish brown, wet, very dense, fine to coarse gravel, fine- to coarse-grained sand						
90				28 56/6"	100									
65														
95				55/6"	100									
60														
100				59/6"	100									
55														
105														
50								POORLY GRADED SAND with SILT and GRAVEL (SP-SM): olive brown, wet, very dense, fine- to medium-grained sand, fine to coarse gravel						

LOG OF BORING DYB10-13

Page 3 of 4

Anaheim Regional Transportation Intermodal Center
Project No. 2009-021

PLATE

B24



Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
45		X		29 38 50/5"	98								
115													
40													
							POORLY GRADED GRAVEL with SAND (GP): light olive brown, wet, very dense, fine to coarse gravel, fine- to coarse-grained sand						
120		X		58/6"	100		Bottom of boring at 120.5 feet. Groundwater measured at 24.5 feet after drilling. Boring backfilled with cement/bentonite grout. Surface patched with cold patch asphalt.						
35													
125													
30													
130													
25													
135													
20													
140													
15													
145													
10													

LOG OF BORING DYB10-13

Page 4 of 4

Anaheim Regional Transportation Intermodal Center
Project No. 2009-021

PLATE

B25



BORING LOCATION: See Figure 2						ELEVATION AND DATUM (feet): 155 MSL							
LATITUDE: 33° 48' 8.1" N						LONGITUDE: 117° 52' 39.3" W							
DRILLING EQUIPMENT: Mayhew 1000						DRILLING METHOD: Rotary Wash							
BORING DIAMETER (inches): 5						BORING DEPTH (feet): 99							
DATE STARTED: 2-24-10			COMPLETED: 2-24-10			HAMMER TYPE: Automatic		Efficiency: 75%					
DRILLING CONTRACTOR: Socal Drilling, Inc.						HAMMER DROP: 30 inches		WT: 140 lbs					
LOGGED BY: KV			CHECKED BY: WD			DRIVE SAMPLER DIAMETER (inches) ID: 2.4 OD: 3							
Elevation (feet)	Depth (feet)	Sampler Symbol	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
150	5			3	7	0.5	SANDY SILT (ML): grayish brown, moist, medium stiff, nonplastic, fine-grained sand, FILL	94	20				
				5	5		POORLY GRADED SAND (SP): olive brown, moist, loose, fine-grained sand, FILL	102	23				
				5			POORLY GRADED SAND with SILT (SP-SM): olive brown, moist, medium dense, fine-grained sand, FILL						
145	10			3	13								
				6			gray, trace medium- to coarse-grained sand	106	8				
140	15			5	18		POORLY GRADED SAND (SP): olive brown, moist, medium dense, fine- to medium-grained sand, trace fine gravel					4	
				8									
135	20			11	28		light brown, no gravel	106	3				
				19									
130	25			2	4	0.5	SANDY SILTY CLAY (CL-ML): olive brown, moist, soft, low plasticity, fine-grained sand, trace coarse gravel						
				2									
				2		0.5		101	23	24	6	62	CN

LOG OF BORING DYB10-15

Page 1 of 3

Anaheim Regional Transportation Intermodal Center

Project No. 2009-021

PLATE

B29

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
120	35			3 7 9	10	1	SANDY LEAN CLAY (CL): reddish brown, moist, stiff, medium plasticity, trace fine to coarse gravel	109	18	25	10	70	
115	40			1 1 1	2	0.25	very soft						
110	45			2 3 3	4	0.5	SANDY SILTY CLAY (CL-ML): reddish brown, moist, soft, low plasticity, fine-grained sand ▽ wet	102	21	25	5		
105	50			1 3 4	7	0.75	SANDY LEAN CLAY (CL): reddish brown, wet, medium stiff, medium plasticity, fine- to medium-grained sand		17	28	12		
100	55			4 5 5	6	0.5	LEAN CLAY with SAND (CL): reddish brown, wet, medium stiff, medium plasticity, fine-grained sand	98	25	31	11	83	UU
95	60			23 50/5"	100		POORLY GRADED GRAVEL with SAND (GP): dark reddish gray, wet, very dense, fine to coarse gravel, fine- to coarse-grained sand						
90	65			4 4 7	11	1.25	SANDY LEAN CLAY (CL): light olive brown, wet, stiff, medium plasticity, fine-grained sand						
				5 7 10	11	1.5		102	22	28	11		

LOG OF BORING DYB10-15

Page 2 of 3

Anaheim Regional Transportation Intermodal Center
Project No. 2009-021

PLATE

B30



Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
80	75			2 3 6	9	1	SANDY SILT (ML): brown, wet, stiff, low plasticity, fine-grained sand	101	23				
				4 8 17	16	2	very stiff						
75	80			29 53/6"	100		POORLY GRADED SAND with GRAVEL (SP): dark grayish brown, wet, very dense, fine- to coarse-grained sand, fine to coarse gravel						
70	85			18 50/4"	100		POORLY GRADED GRAVEL with SAND (GP): grayish brown, wet, very dense, fine to coarse gravel, fine- to coarse-grained sand						
65	90			35 55/6"	100								
60	95			60/6"	100								
55	100						Bottom of boring at 99 feet. Groundwater measured at 44 feet after drilling. Boring backfilled with cement/bentonite grout. Surface patched with cold patch asphalt.						
50	105												

LOG OF BORING DYB10-15

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Anaheim Regional Transportation Intermodal Center

Project No. 2009-021

PLATE

B31



BORING LOCATION: See Figure 2							ELEVATION AND DATUM (feet): 157 MSL						
LATITUDE: 33° 48' 6.2" N							LONGITUDE: 117° 52' 39.5" W						
DRILLING EQUIPMENT: CME-75							DRILLING METHOD: Hollow Stem Auger						
BORING DIAMETER (inches): 8							BORING DEPTH (feet): 5						
DATE STARTED: 2-25-10				COMPLETED: 2-25-10			HAMMER TYPE: Automatic			Efficiency: 75%			
DRILLING CONTRACTOR: 2R Drilling, Inc							HAMMER DROP: 30 inches			WT: 140 lbs			
LOGGED BY: SS				CHECKED BY: KV			DRIVE SAMPLER DIAMETER (inches) ID: 2.4 OD: 3						
Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
155		AS	AS	15 13 14	18		ASPHALT CONCRETE (AC): 4 inches SILTY SAND with GRAVEL (SM): greenish brown, moist, medium dense, fine- to medium-grained sand, fine to coarse gravel, BASE: 5 inches	103	2				
		AS	AS	5 6 7	8		POORLY GRADED SAND (SP): light yellowish brown, moist, medium dense, fine-grained sand loose	90	7				MD RV
150							Bottom of boring at 5 feet. Groundwater not encountered during drilling. Boring backfilled with pea gravel. Surface patched with cold patch asphalt.						
	10												
145													
	15												
140													
	20												
135													
	25												
130													

LOG OF BORING DYB10-17

Page 1 of 1

Anaheim Regional Transportation Intermodal Center

Project No. 2009-021

PLATE

B35



Date Drilled:
 Drilled By:
 Drilling Method:
 Logged By:

Water Depth:
 Date Measured:
 Reference Elevation:
 Datum:

Elevation (feet) Depth	Sample	Sample No.	Blow Count (Blows/ft.)	Graphic Log	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Density (pcf)	Moisture Content (%)	Additional Tests
		1	6			108	10	DS, SE
		2	12					GS
5								
	(1)	(2)	(3)	(4)	(5)	(6)	(6)	(7)

NOTES ON FIELD INVESTIGATION

- SAMPLE** - Graphical representation of sample type as shown below.
 Split Spoon - Standard Penetration Test Sample (SPT) 
 Drive Sample - California Sample (Cal) 
 Bulk Sample - Obtained by collecting cuttings in a plastic bag 
 Tube Sample - Shelby/Pitcher Tube Sample 
- SAMPLE NO.** - Sample Number
- BLOWS/FT** - Number of blows required to advance sampler 1 foot (unless a lesser distance is specified).
 Samplers in general were driven into the soil at the bottom of the hole with a standard (140 lb) hammer dropping a standard 30 inches.
 Drive samples collected in bucket auger borings may be obtained by dropping non-standard weight from variable heights.
 When a SPT sampler is used the blow count conforms to ASTM D-1586.
SCR/RQD - Sample Core Recovery (SCR) in percent (%) and Rock Quality Designation (RQD) in percent (%). RQD is defined as the percentage of core in each run which the spacing between natural fractures is greater than 4 inches. Mechanical breaks of the core are not considered.
- GRAPHIC LOG** - Standard symbols for soil and rock types, as shown on plate A-1b.
- GEOTECHNICAL DESCRIPTION**
Soil - Soil classifications are based on the United Soil Classification System per ASTM D-2987, and designations include consistency, moisture, color and other modifiers. Field descriptions have been modified to reflect results of laboratory analyses where deemed appropriate.
Rock - Rock classifications generally include a rock type, color, moisture, mineral constituents, degree of weathering, alteration, and the mechanical properties of the rock. Fabric, lineations, bedding spacing, foliations, and degree of cementation are also presented where appropriate.
 Description of soil origin or rock formation is placed in brackets at the beginning of the description where applicable, for example, Residual Soil.
- DRY DENSITY, MOISTURE CONTENT:** As estimated by laboratory or field testing.
- ADDITIONAL TESTS** - (Indicates sample tested for properties other than the above):
 MAX - Maximum Dry Density SG - Specific Gravity PP - Pocket Penetrometer
 GS - Grain Size Distribution HA - Hydrometer Analysis WA - Wash Analysis
 SE - Sand Equivalent AL - Atterberg Limits DS - Direct Shear
 EI - Expansion Index RV - R-Value CP - Collapse Potential
 CHEM - Sulfate and Chloride Content, pH, Resistivity CN - Consolidation UC - Unconfined Compression
 PM - Permeability CU - Consolidation Undrained Triaxial T - Torvane
 UU - Unconsolidated Undrained Triaxial CD - Consolidated Drained Triaxial
- ATTITUDES** - Orientation of rock discontinuity observed in bucket auger boring or rock core, expressed in strike/dip and dip angle, respectively, preceded by a one-letter symbol denoting nature of discontinuity as shown below.
 B: Bedding Plane J: Jointing C: Contact F: Fault S: Shear



EXPLANATION OF LOGS

PLATE

A-1a

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D-2487)

PRIMARY DIVISIONS			GROUP SYMBOLS	SECONDARY DIVISIONS	
COURSE GRAINED SOILS MORE THAN HALF OF MATERIALS IS LARGER THAN #200 SIEVE SIZE	GRAVELS MORE THAN HALF OF COURSE FRACTION IS LARGER THAN #4 SIEVE	CLEAN GRAVELS (LESS THAN) 5% FINES	GW		WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
			GP		POORLY GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		GRAVEL WITH FINES	GM		SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
			GC		CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SANDS MORE THAN HALF OF COURSE FRACTION IS SMALLER THAN #4 SIEVE	CLEAN SANDS (LESS THAN) 5% FINES	SW		WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
			SP		POORLY GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES
		SANDS WITH FINES	SM		SILTY SANDS, SAND-SILT MIXTURES
			SC		CLAYEY SANDS, SAND-CLAY MIXTURES
FINE GRAINED SOILS MORE THAN HALF OF MATERIALS IS SMALLER THAN #200 SIEVE SIZE	SILTS AND CLAYS LIQUID LIMIT IS LESS THAN 50		ML		INORGANIC SILTS, VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS
			CL		INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL		ORGANIC SILTS AND ORGANIC SILT-CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS LIQUID LIMIT IS GREATER THAN 50		MH		INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDS OR SILTS, ELASTIC SILTS
			CH		INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH		ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
	HIGHLY ORGANIC SOILS		PT		PEAT, MUCK AND OTHER HIGHLY ORGANIC SOILS
TYPICAL FORMATIONAL MATERIALS	SANDSTONES		SS		
	SILTSTONES		SH		
	CLAYSTONES		CS		
	LIMESTONES		LS		
	SHALES		SL		

CONSISTENCY CRITERIA BASED ON FIELD TESTS

RELATIVE DENSITY - COARSE - GRAIN SOIL			CONSISTENCY-FINE-GRAIN SOIL		TORVANE	POCKET ** PENETROMETER
RELATIVE DENSITY	SPT * (# blows/ft)	RELATIVE DENSITY (%)	CONSISTENCY	(# SPT blows/ft)	UNDRAINED SHEAR STRENGTH (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)
Very Loose	<4	0 - 15	Very Soft	<2	<0.13	<0.25
Loose	4 - 10	15 - 35	Soft	2 - 4	0.13 - 0.25	0.25 - 0.5
Medium Dense	10 - 30	35 - 65	Medium Stiff	4 - 8	0.25 - 0.5	0.5 - 1.0
Dense	30 - 50	65 - 85	Stiff	8 - 15	0.5 - 1.0	1.0 - 2.0
Very Dense	>50	85 - 100	Very Stiff	15 - 30	1.0 - 2.0	2.0 - 4.0
			Hard	>30	>2.0	>4.0

* NUMBER OF BLOWS OF 140 POUND HAMMER FALLING 30 INCHES TO DRIVE A 2 INCH O.D. (1 3/8 INCH I.D.) SPLIT BARREL SAMPLER (ASTM-1586 STANDARD PENETRATION TEST)

** UNCONFINED COMPRESSIVE STRENGTH IN TONS/SQ.FT. READ FROM POCKET PENETROMETER

MOISTURE CONTENT

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

CEMENTATION

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



EXPLANATION OF LOGS

PLATE

A-1b

Date Drilled:	9/22/09	Water Depth:	58 feet
Drilled By:	Cal Pac Drilling	Date Measured:	9/22/2009
Drilling Method:	Hollow Stem Auger	Elevation:	156 feet (approx.)
Logged By:	K. S. and F. J.	Datum:	NAVD 88

Elevation (feet) Depth	Sample Type Sample Number	Blows per Foot	Graphic Log	SOIL DESCRIPTION AND CLASSIFICATION	Dry Density (pcf)	Moisture Content (%)	Additional Tests
155				Artificial Fill: Pavement: approx 2.75 inches of asphalt over 6.5 inches of base			
	1			Poorly Graded Sand (SP): olive brown, dense, slightly moist, trace fine to coarse gravel, layers of sand with silt.		2.0	
	2						
	3						
	4					4.8	
5	5						
150	6	36		— brown, moist, small clay pockets.	118	4.6	
	7	50 / 5"		—brown with light brown inclusions, moist, fine to medium grained.	118	4.5	
10							
145	8	70			123	7.3	
	9	16		Silty Sand (SM): olive brown, medium dense, fine to coarse grained.		10.1	
15							
140	10	12		Alluvium: Sand with Silt (SP-SM): light brownish gray, medium dense, slightly moist, moderate iron oxide staining, lumps of clay.		6.0	
				Poorly Graded Sand (SP): pink, medium dense, moist, micaceous, fine to medium grained.			
20							
135	11	28			105	2.2	
25							
130	12	7		Silty Sand (SM): olive brown to yellowish brown, loose, very moist, fine grained.		11.3	WA (30% fines)
				Sandy Silt (ML)			
				Silty Sand (SM): olive brown to yellowish brown, loose, moist, fine grained.			
30							
125	13	6			101	22.3	WA (39% fines)
				Sandy Lean Clay (CL): yellowish brown, very stiff, moist, layers of clayey sand.			
				ARTIC S. Douglass Road and Katella Avenue Anaheim, California			PLATE
PROJECT NO. 103567				LOG OF BORING B-3			A-4a

Drafted By: _____ Reviewed By: _____ Legend To Logs On Plate A-1

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

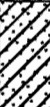
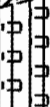
Elevation (feet) Depth	Sample Type Sample Number	Blows per Foot	Graphic Log	SOIL DESCRIPTION AND CLASSIFICATION (Continued From Previous Page)	Dry Density (pcf)	Moisture Content (%)	Additional Tests	
120	14	15		Sandy Lean Clay (CL): yellowish brown, very stiff, moist, layers of clayey sand. (continued)		16.7	WA (72% fines) AL LL = 30 PL = 15	
40								
115	15	11		-- lense of yellowish brown silty sand, trace fine gravel, very moist.	105	21.9	WA (63 % fines)	
45								
110	16	9				19.9	WA (73% fines)	
				Lean Clay (CL): yellowish brown, stiff, moist.				
50								
105	17	9				101	25.5	WA (89% fines)
55							31.6	
100	18	33		Silty Sand with Gravel (SM): yellowish brown, medium dense, fine to coarse grained gravel.		10.8		
			Poorly Graded Sand with Gravel (SP): gray, medium dense, wet, fine to coarse sand.					
60								
95	19	36			121	13.8		
			Lean Clay with Sand (CL): yellowish brown, stiff, moist.					
65								
90	20	11				24.7		
70								
85	21	16			103	23.6		
						22.2		
				ARTIC S. Douglass Road and Katella Avenue Anaheim, California			PLATE	
PROJECT NO. 103567				LOG OF BORING B-3			A-4b	

GROTECH DB 103567 ARTIC BORINGS, WELLS, CPTS.GPJ KA RD.LND.GDT 10/25/09

Legend To Logs On Plate A-1

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH DB 103567 ARTIC BORINGS, WELLS, CPTS.GPJ KA RD.LND.GDT 10/25/09

Elevation (feet) Depth	Sample Type	Sample Number	Blows per Foot	Graphic Log	SOIL DESCRIPTION AND CLASSIFICATION <i>(Continued From Previous Page)</i>	Dry Density (pcf)	Moisture Content (%)	Additional Tests
80		22	13		Clayey Sand (SC): yellowish brown, medium dense, very moist, fine grained.		16.2	
80					Silty Sand (SM): yellowish brown, medium dense, moist to very moist, trace gravel.			
75		23	30		Total depth: 81.5 feet. Groundwater encountered at approximately 58 feet. Boring backfilled with bentonite slurry and capped with quickset concrete.		16.8	
					ARTIC S. Douglass Road and Katella Avenue Anaheim, California			PLATE A-4c
PROJECT NO. 103567					LOG OF BORING B-3			

Legend To Logs On Plate A-1

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled:	9/25/09	Water Depth:	25 feet
Drilled By:	Cal Pac Drilling	Date Measured:	9/25/09
Drilling Method:	Hollow Stem Auger	Elevation:	159 feet (approx.)
Logged By:	F. J.	Datum:	NAVD 88

Elevation (feet) Depth	Sample Type Sample Number	Blows per Foot	Graphic Log	SOIL DESCRIPTION AND CLASSIFICATION	Dry Density (pcf)	Moisture Content (%)	Additional Tests
155	1			Artificial Fill:			
	2			Pavement: approx 2.75 inches of asphalt over 5 inches of base		2.6	
	3			Poorly Graded Sand (SP): pink, dry, fine to coarse grained.			
5	4						
	5	8		-- layer of sand with silt, mottled brown, lumps of lean clay. -- loose, yellowish brown, moist.	101	9.2	
150	6	7		Alluvium:		4.5	
10				Poorly Graded Sand (SP): pink, loose to medium dense, dry, fine to medium grained.			
	7	31		-- layer of lean clay with sand -- layer of sand with silt, mottled brown, moist, fine to coarse sand.	118	7.2	
145	8	19			108	2.5	
15	9	8		-- loose		7.0	
140				Silty Sand (SM): brown, medium dense, moist, fine to medium sand.			
20	10	27		-- coarse gravel -- darker, silty sand inclusions.	117	11.7	WA (20%)
135				Sandy Silt (ML): olive brown, soft, wet, layers of lean clay.		26.0	
25	11	5					
130				Clayey Sand (SC): yellowish brown, medium dense, moist, fine to coarse sand, lenses and layers of lean clay.			
30	12	14		-- layer of gravel	124	14.0	WA (38%)
125				Poorly Graded Gravel with Sand (GP): olive brown, very dense, moist.			



ARTIC
S. Douglass Road and Katella Avenue
Anaheim, California

PLATE

PROJECT NO. 103567

LOG OF BORING W-1

A-7a

Drafted By: Reviewed By: Legend To Logs On Plate A-1
Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH DB 103567 ARTIC WELLS.GPJ KA RD.LND.GDT 10/25/09

Elevation (feet) Depth	Sample Type	Sample Number	Blows per Foot	Graphic Log	SOIL DESCRIPTION AND CLASSIFICATION (Continued From Previous Page)	Dry Density (pcf)	Moisture Content (%)	Additional Tests
120		13	72		Poorly Graded Gravel with Sand (GP): olive brown, very dense, moist. (continued)		4.3	
40		14	56		Poorly Graded Sand (SP): olive brown, dense, moist, trace iron oxide staining.		5.3	
115		15	13		Lean Clay with Sand (CL): yellowish brown, stiff, moist.		19.2	
45		15	13		-- layer of silty sand, gray to olive gray, moist, fine to coarse grained.		8.6	
110		16	14		Sandy Silt (ML): yellowish brown, stiff, moist.	106	19.8	
50		16	14					
105		17	15		-- wet, trace gravel.		21.6	
55		17	15					
100		18	17		-- moist, some fine sand.	105	21.9	
60		18	17					
Total depth: 61.5 feet. Seepage at approximately 25 feet. Two inch well constructed.								
					ARTIC S. Douglass Road and Katella Avenue Anaheim, California			PLATE
PROJECT NO. 103567					LOG OF BORING W-1			A-7b

Legend To Logs On Plate A-1

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled:	9/23/09	Water Depth:	None
Drilled By:	Cal Pac Drilling	Date Measured:	9/23/09
Drilling Method:	Hollow Stem Auger	Elevation:	156 feet (approx.)
Logged By:	F. J.	Datum:	NAVD 88

Elevation (feet) Depth	Sample Type Sample Number	Blows per Foot	Graphic Log	SOIL DESCRIPTION AND CLASSIFICATION	Dry Density (pcf)	Moisture Content (%)	Additional Tests
155	1			Artificial Fill: Pavement: approx 3 inches of asphalt over 6.25 inches of base			
	2			Poorly Graded Sand with Silt (SP-SM): brown, moist -- lumps of sandy clay		8.4	
	3						
5	4						
150	5	47		-- olive gray to olive brown, dense, fine to medium grained.	121	7.2	
	6	28		-- medium dense, iron oxide staining, trace clay nodules,			
10							
145	7	24		-- layer of sand with silt, sandy lean clay, olive brown.	114	7.2	
	8	13		Alluvium: Poorly Graded Sand (SP): gray to pink, medium dense, dry, fine to medium grained.		2.8	
15							
140	9	12			92	3.4	
20							
135	10	20		-- layer of silty sand, moist. -- olive brown, sandy clay intrusions.	113	12.5	
				Silty Sand (SM): olive gray, loose, moist, fine to medium grained.			
25							
130	11	7				12.1	WA (33%)
				Sandy Silt (ML): yellowish brown, medium stiff, moist.			
30							
125	12	10		Lean Clay with Sand (CL): yellowish brown, stiff, moist.	99	26.0	WA (64%)
				ARTIC S. Douglass Road and Katella Avenue Anaheim, California			PLATE A-8a
PROJECT NO. 103567				LOG OF BORING W-2			

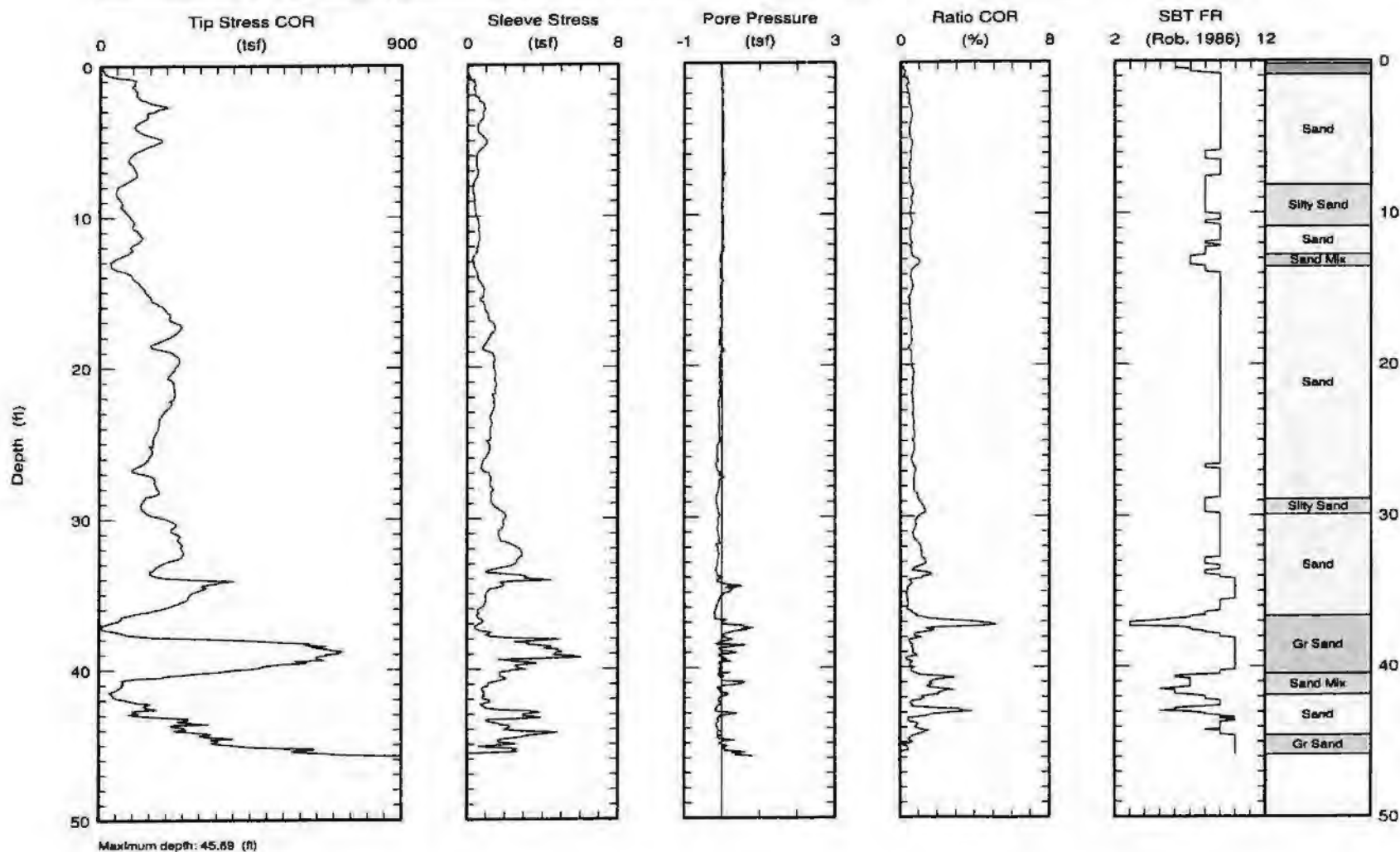
Drafted By: _____ Reviewed By: _____ Legend To Logs On Plate A-1
 Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Elevation (feet) Depth	Sample Type Sample Number	Blows per Foot	Graphic Log	SOIL DESCRIPTION AND CLASSIFICATION <i>(Continued From Previous Page)</i>	Dry Density (pcf)	Moisture Content (%)	Additional Tests
120	13	10		Lean Clay with Sand (CL): yellowish brown, stiff, moist. <i>(continued)</i>		16.5	
40	14	42		Well Graded Sand with Gravel (SW): mottled olive brown and olive gray, medium dense, moist, fine to coarse grained, fine to coarse gravel.	120	7.2	
45	15	8		Lean Clay with Sand (CL): yellowish brown, medium stiff, moist, layers of clayey sand and sandy silt.		19.5	
50	16	11		Poorly Graded Gravel with Sand (GP): olive brown, loose, fine to coarse sand.			
105				Lean Clay with Sand (CL): yellowish brown, medium stiff, moist.	101	24.7	
Total depth: 51.5 feet. Groundwater not encountered. Two inch well constructed.							
				ARTIC S. Douglass Road and Katella Avenue Anaheim, California			PLATE
PROJECT NO. 103567				LOG OF BORING W-2			A-8b

GEOTECH DB 103567 ARTIC WELLS.GPJ KA_RDLND.GDT 10725/09

Legend To Logs On Plate A-1
 Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

 Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com skehoe@msn.com	CPT Data 30 ton rig	Date: 23/Sep/2009 Test ID: CPT-1 Project: Anaheim
	Customer: Kleinfelder Job Site: E. Katella Ave & Douglass Rd	



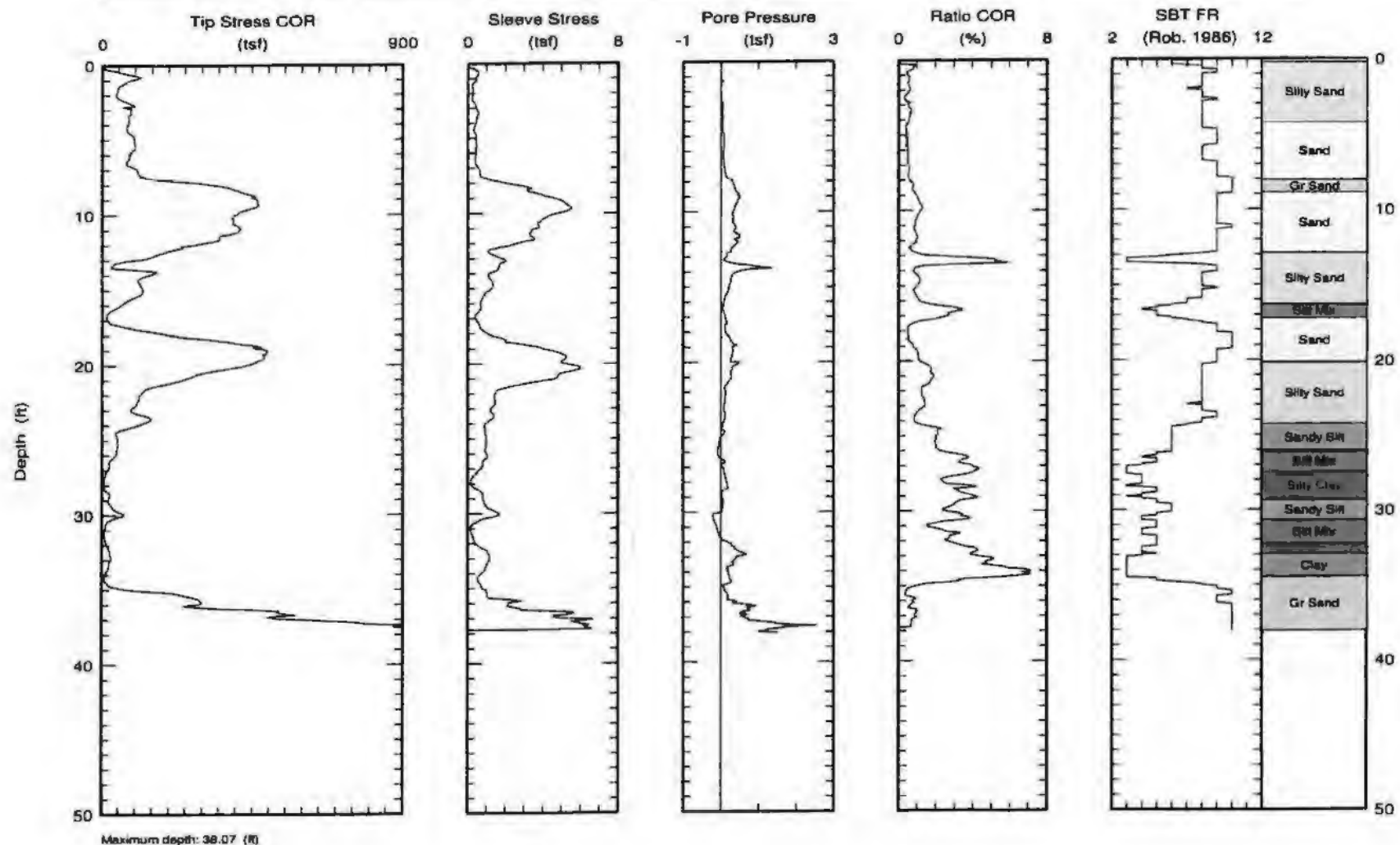


Kehoe Testing & Engineering
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rich@kehoetesting.com
skehoe@msn.com

CPT Data
30 ton rig

Date: 23/Sep/2009
Test ID: CPT-3
Project: Anaheim

Customer: Kleinfelder
Job Site: E. Katella Ave & Douglass Rd



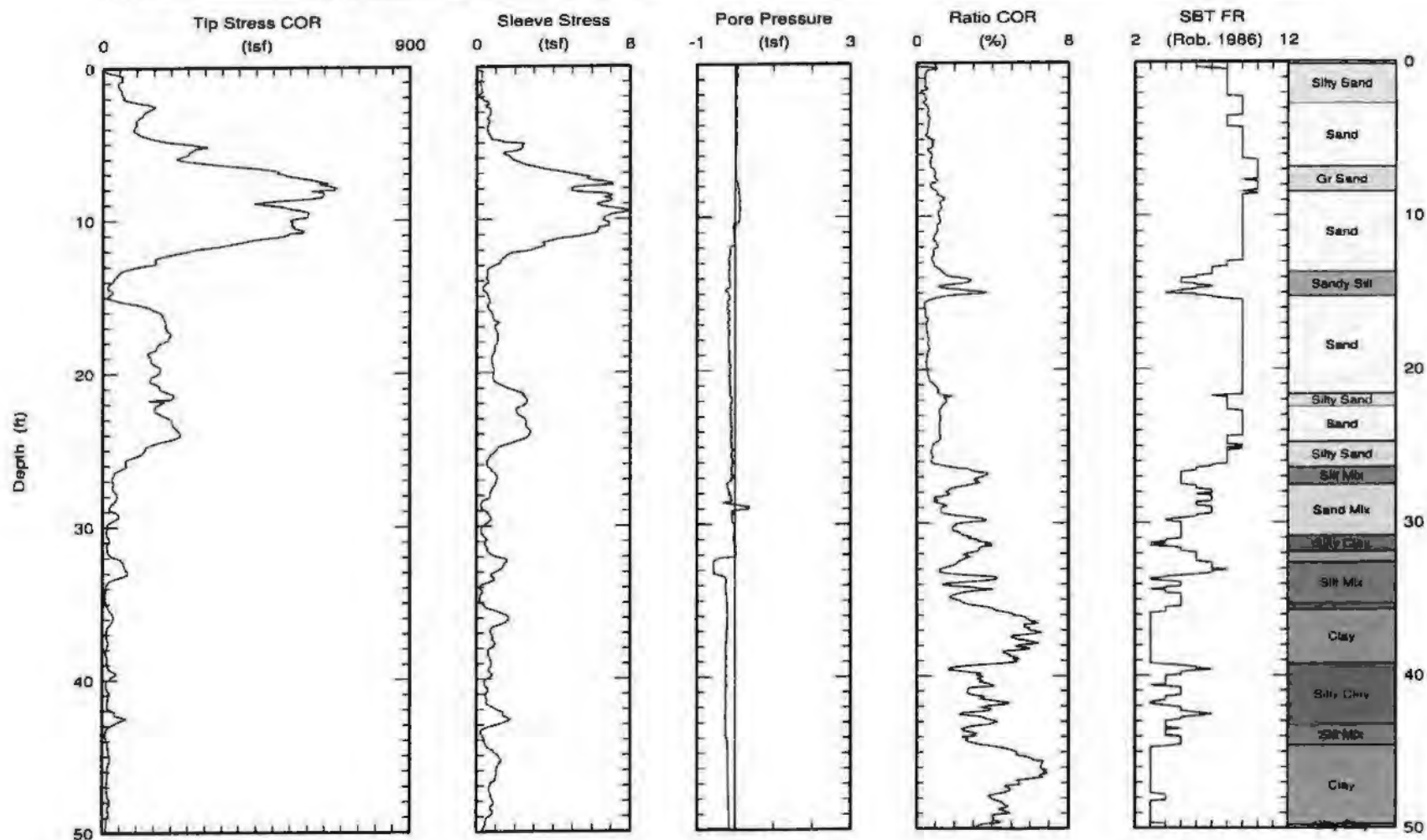


Kehoe Testing & Engineering
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skhoe@msn.com

CPT Data
30 ton rig

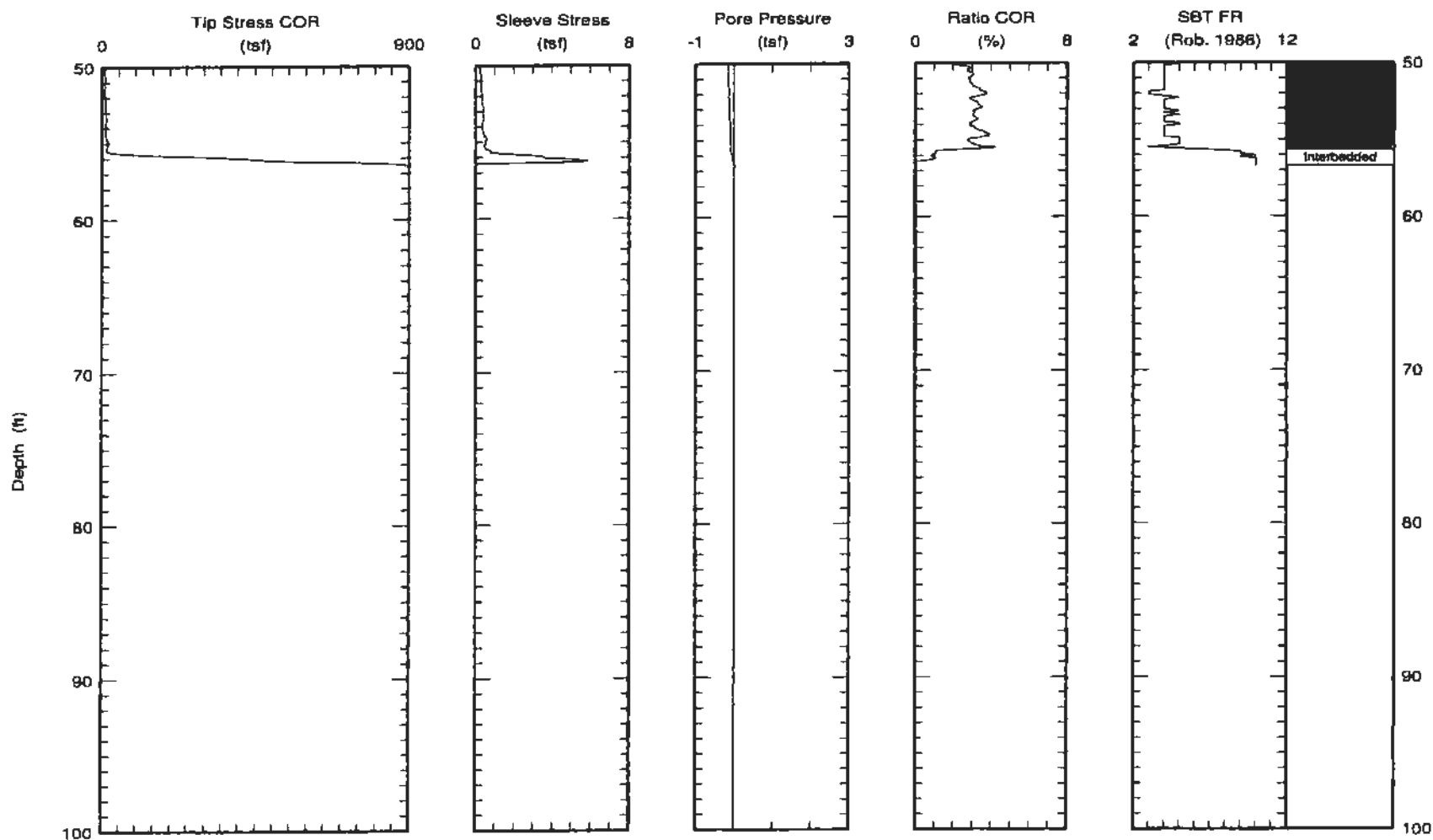
Date: 23/Sep/2009
Test ID: CPT-7
Project: Anaheim

Customer: Kleinfelder
Job Site: E. Katella Ave & Douglass Rd



Maximum depth: 58.72 (ft)
Page 1 of 2

 Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com skehoe@msn.com	CPT Data 30 ton rig	Date: 23/Sep/2009 Test ID: CPT-7 Project: Anaheim
	Customer: Kleinfelder Job Site: E. Katella Ave & Douglass Rd	



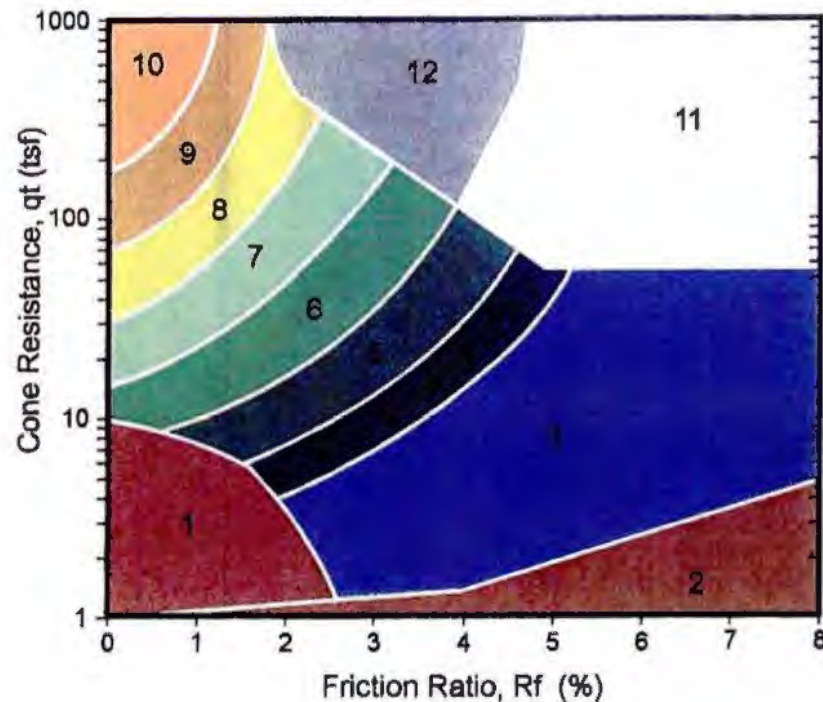
Maximum depth: 56.72 (ft)

Page 2 of 2



CPT Classification Chart

(after Robertson and Campanella, 1988)



Zone	q_t / N	Soil Behavior Type	UCSCS
1	2	sensitive fine grained	OL-OH
2	1	organic material	Pt-OH
3	1	clay	CH
4	1.5	silty clay to clay	CL-CH
5	2	clayey silt to silty clay	ML-CL
6	2.5	sandy silt to clayey silt	MH-ML
7	3	silty sand to sandy silt	SM-ML
8	4	sand to silty sand	SP-SM
9	5	sand	SP
10	6	gravelly sand to sand	SW-SP
11	1	very stiff fine grained *	CL-MH
12	2	sand to clayey sand *	SP-SC

* overconsolidated or cemented

Date(s) Drilled	7/30/20	Logged By	ZKH	H- 5 Sheet 1 of 2
Drilling Company	2R Drilling, Inc.	Drill Bit Size/Type	11"	
Drill Rig Type	CME 75 Hollow Stem	Hammer Data	140 lbs. @ 30-inch drop	
Sampling Method(s)	Modified California			
Approximate Groundwater Depth: 49.5 Feet				Total Depth Drilled (ft) 51.5
Comments				Approximate Ground Surface Elevation (ft) 167.0 msl

Elevation (ft)	SAMPLES			Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	Type	Number	Blows per foot						
0						Surface: Parking Lot, 3" AC over 4" AB. Artificial Fill, Undocumented (Afu)			
	D-1	58			ML	@ 2.5' SAMPLE: Olive SILT, very moist to wet, medium stiff, micaceous, asphalt in lower rings.	15.3	117.3	
5	D-2	90/10.5			SM	Alluvium (Qal) @ 5' SAMPLE: Olive gray silty fine to medium SAND, moist, very dense, gravel in tip (granitic).	4.9	118.5	
	D-3	31				@ 7.5' SAMPLE: Olive gray silty fine to medium SAND, moist, medium dense.	5.8	108.8	
10	D-4	17			SP	@ 10' SAMPLE: Light gray fine to coarse SAND, damp, medium dense, friable.	3.5	99.2	
	D-5	11				@ 15' SAMPLE: Light gray fine to coarse SAND, damp, loose, highly friable.	2.0		
15									
20	D-6	34			SP-SM	@ 20' SAMPLE: Light gray silty to clean fine SAND, damp, medium dense, micaceous.	5.7	99.6	
25									

LOG OF BORING
 AREP/OC Vibe
 Anaheim, CA
 PROJECT NO. 20065-01



AREP/OC Vibe Anaheim, CA					H- 5	Sheet 2 of 2			
Elevation (ft)	Depth (ft)	SAMPLES		Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
		Type	Number						
-140	25	D-7	36		SP	@ 25' SAMPLE: Light gray fine to medium SAND, damp, medium dense, friable, micaceous.	3.1	104.4	
	30	D-8	37		SM	@ 30' SAMPLE: Light gray silty fine SAND, damp, medium dense, friable, micaceous.	3.0	101.7	
	35	D-9	32		SP	@ 35' SAMPLE: Upper: Light gray fine to medium SAND, damp, medium dense, friable, micaceous. Lower: Light gray silty fine SAND, moist, medium dense, friable, micaceous.	2.5	104.0	
-130	40	D-10	10		CH	@ 40' SAMPLE: Yellowish brown silty plastic CLAY, saturated, medium stiff, trace pinhole pores.	22.3	104.0	
	45	D-11	16		GC-CH	@ 45' SAMPLE: Yellowish brown clayey GRAVEL/gravelly CLAY, saturated, stiff, clay is highly plastic.	8.4	126.7	
	50	D-12	20		CH	@ 50' SAMPLE: Strong brown plastic CLAY, saturated, stiff.	17.2	113.4	
-120					GC	@ 48': Driller noted gravel, 1'-2" thick.			
						Notes: Total Depth: 51.5 Feet. Groundwater First Encountered at 50.9 Feet. Static Groundwater Measured at 49.5 Feet After 10 Minutes. Backfilled with Bentonite Cement Grout. Patched with Cold Patch AC.			
55									

LOG OF BORING

AREP/OC Vibe
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Date(s) Drilled	8/4/20	Logged By	ZKH	H-12 Sheet 1 of 2
Drilling Company	2R Drilling, Inc.	Drill Bit Size/Type	11"	
Drill Rig Type	CME 75 Hollow Stem	Hammer Data	140 lbs. @ 30-inch drop	
Sampling Method(s)	Modified California			
Approximate Groundwater Depth: 30.4 Feet				Total Depth Drilled (ft)51.5
Comments				Approximate Ground Surface Elevation (ft)162.2 msl

Elevation (ft)	Depth (ft)	SAMPLES			USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
		Type	Number	Blows per foot					
0						Surface: Parking Lot, 4" AC over 13" AB.			
					SM	Artificial Fill, Undocumented (Afu) @ 2': Rip-rap fragment within silty fine to medium SAND. @ 2.5' SAMPLE: Dark grayish brown silty fine to coarse SAND, moist, medium dense, friable, trace asphalt and gravel.	8.9	120.5	
-160		D-1	35						
	5	D-2	25			@ 5' SAMPLE: Dark grayish brown silty fine to medium SAND, moist, medium dense, 2" diameter concrete fragment.	12.3	121.1	
					SM/GP	Alluvium (Qal) @ 7.5' SAMPLE: Upper: Brown silty fine to medium SAND, moist, medium dense, abundant angular gravel.	2.9	109.8	
		D-3	24		SM	Lower: Pale brown silty fine to medium SAND, damp, medium dense.			
	10	D-4	45			@ 10' SAMPLE: Upper: Pale brown to brown silty fine to medium SAND, damp, medium dense, friable, micaceous.	2.1	107.7	
						Lower: Pale brown fine to medium SAND, damp, medium dense, friable, micaceous.			
-150					CL	@ 15' SAMPLE: Upper: brown silty CLAY, moist, stiff, pinhole pores, micaceous, FeO stained.	16.8	101.6	
	15	D-5	8		SM	Lower: Brown silty very fine SAND, moist, loose, micaceous.			
	20	D-6	8			@ 20' SAMPLE: Brown silty fine SAND, wet, loose, FeO stained, micaceous.	17.1	114.6	
-140									
	25								

LOG OF BORING
 AREP/OC Vibe
 Anaheim, CA
 PROJECT NO. 20065-01



Report: HOLLOW STEM; Project: 20065-01.GPJ; Data Template: NMG_GINT_2016.GDT; Printed: 10/6/20

AREP/OC Vibe Anaheim, CA					H-12	Sheet 2 of 2			
Elevation (ft)	Depth (ft)	SAMPLES		Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
		Type	Number						
-130	25	D-7	39		SP-SM	@ 25' SAMPLE: Light gray silty to clean fine to medium SAND, very moist, friable, micaceous.	33.3	88.8	
	30	D-8	31		SM	@ 30' SAMPLE: Gray silty fine SAND, saturated, medium dense, micaceous.	23.5	87.8	
	35	D-9	30			@ 35' SAMPLE: Gray silty fine to medium SAND, saturated, medium dense, friable, micaceous, trace coarse sand.	21.5	103.2	
	40	D-10	20		CL	@ 40' SAMPLE: Strong brown silty CLAY, very moist to wet, trace pinhole pores, micaceous.	16.9	114.7	
	45	D-11	50/6"		SC with Gravel	@ 45' SAMPLE: Brown clayey fine to medium SAND with gravel, saturated, very dense, micaceous.	6.0	136.4	
-120	50	D-12	50		GP	@ 50' SAMPLE: Olive brown silty/sandy GRAVEL, saturated, very dense, friable.	4.6	123.8	
	55					Notes: Total Depth: 51.5 Feet. Groundwater First Encountered at 31.2 Feet. Static Groundwater Measured at 30.4 Feet After 10 Minutes. Backfilled with Bentonite Cement Grout. Patched with Cold Patch AC.			

LOG OF BORING

AREP/OC Vibe
Anaheim, CA

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LOG OF BORING
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Anaheim, CA
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Date(s) Drilled	8/5/20	Logged By	ZKH	H-15 Sheet 1 of 2		
Drilling Company	2R Drilling, Inc.	Drill Bit Size/Type	11"			
Drill Rig Type	CME 75 Hollow Stem	Hammer Data	140 lbs. @ 30-inch drop			
Sampling Method(s)	Modified California, Bulk					
Approximate Groundwater Depth:				23.4 Feet	Total Depth Drilled (ft)	51.0
Comments					Approximate Ground Surface Elevation (ft)	161.8 msl

Elevation (ft)	Depth (ft)	SAMPLES			USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
		Type	Number	Blows per foot					
0						Surface: Parking Lot. Asphalt section not measured.			
-160					CL	Artificial Fill, Undocumented (Afu)			
		D-1	27			@ 2.5' SAMPLE: Dark brown sandy CLAY, moist, very stiff, filter fabric in sample, rock fragment, metal debris.	10.8	124.1	
5		D-2	8		SC with Gravel	@ 5' SAMPLE: Brown to dark brown clayey fine SAND with gravel, very moist, abundant gravel.	11.0	89.6	
		D-3	48		GC	@ 7': Driller notes hard drilling, abundant rip-rap fragments in cuttings. @ 7.5' SAMPLE: Brown clayey sandy GRAVEL, wet to saturated, very dense, asphalt fragments, abundant rock fragments.	9.2	108.8	
10		D-4	27			@ 10' SAMPLE: Brown clayey sandy GRAVEL, wet to saturated, very dense, asphalt fragments, abundant rock fragments.	12.9	110.7	@ 9.2': Perched groundwater within gravel layer.
-150		D-5	30		SP	Alluvium (Qal) @ 15' SAMPLE: Light gray fine to coarse SAND, moist, medium dense, highly friable, micaceous, some silty sand and gravel.	2.3	114.0	
		B-1							B-1 @ 15'-20' DS, MD, GS
20		D-6	23		SM	@ 20' SAMPLE: Light gray silty fine SAND, very moist, medium dense, friable, micaceous, FeO stained.	4.2	101.1	
-140									
25									

LOG OF BORING
 AREP/OC Vibe
 Anaheim, CA
 PROJECT NO. 20065-01



AREP/OC Vibe				Anaheim, CA		H-15		Sheet 2 of 2	
Elevation (ft)	Depth (ft)	SAMPLES		Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
		Type	Number						
-130	25	D-7	26		SM	@ 25' SAMPLE: Light gray silty fine to medium SAND, saturated, medium dense, friable, micaceous.	18.9	105.6	
	30	D-8	19			@ 30' SAMPLE: Light gray silty fine to medium SAND, saturated, medium dense, friable, micaceous.	19.7	107.3	
	35	D-9	22			@ 35' SAMPLE: Light gray silty fine to medium SAND, saturated, medium dense, friable, micaceous.	20.6	102.1	
-120	40	D-10	36		CL	@ 40' SAMPLE: Upper: Light gray silty fine to medium SAND, saturated, medium dense, friable, micaceous. Lower: Strong brown silty CLAY, saturated, very stiff, highly plastic.	15.9	117.1	
	45	D-11	85/11"		GP	@ 45' SAMPLE: Olive brown fine to medium sandy GRAVEL, saturated, very dense, angular gravel, micaceous, friable.	1.7		
-110	50	D-12	50/6"			@ 50' SAMPLE: Olive brown fine to medium sandy GRAVEL, saturated, very dense, angular gravel, micaceous, friable.	4.0		
	55					Notes: Total Depth: 51.0 Feet. Perched Groundwater Encountered at 9.2 Feet Within Gravelly Fill. True Groundwater First Encountered at 23.5 Feet. Static Groundwater Measured at 23.4 Feet After 10 Minutes. Backfilled with Bentonite Cement Grout. Patched with Cold Patch AC.			

LOG OF BORING

AREP/OC Vibe
Anaheim, CA

PROJECT NO. 20065-01



LOG OF BORING
AREP/OC Vibe
Anaheim, CA
PROJECT NO. 20065-01



Date(s) Drilled	8/3/20	Logged By	ZKH	H-17 Sheet 1 of 2
Drilling Company	2R Drilling, Inc.	Drill Bit Size/Type	11"	
Drill Rig Type	CME 75 Hollow Stem	Hammer Data	140 lbs. @ 30-inch drop	
Sampling Method(s)	Modified California, Bulk			
Approximate Groundwater Depth: 33.0 Feet				Total Depth Drilled (ft) 51.5
Comments				Approximate Ground Surface Elevation (ft) 175.0 msl

Elevation (ft)	Depth (ft)	SAMPLES			USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
		Type	Number	Blows per foot					
0					SM	Surface: Parking Lot, 3.5" AC over 2.5" AB. Artificial Fill, Undocumented (Afu)			
		D-1	77			@ 2.5' SAMPLE: Gray silty fine to medium SAND moist, very dense, trace asphalt fragments.	9.6	125.9	
-170	5	D-2	54			@ 5' SAMPLE: Gray silty fine to medium SAND moist, very dense, trace asphalt and glass fragments.	4.9	117.9	B-1 @ 5'-10'
		B-1							
		D-3	38		SC	@ 7.5' SAMPLE: Very dark gray to black clayey fine to medium SAND, moist, medium dense, organic odor, 2" diameter concrete and rock fragments, micaceous.	9.2	119.2	
	10	D-4	21			@ 10' SAMPLE: Dark brown clayey fine to medium SAND, very moist, medium dense, abundant rock fragments, slightly organic odor.	12.3	116.8	
		B-2							B-2 @ 10'-15'
-160	15	D-5	3"		SM-ML	@ 15' SAMPLE: Grayish brown to olive brown silty fine SAND/sandy SILT, moist, very dense, mottled, 2" diameter concrete fragment.	17.0	113.1	
					SM	Alluvium (Qal) Tip: Olive brown silty fine SAND, moist, micaceous, homogeneous color.			
	20	D-6	42		SP	@ 20' SAMPLE: Light gray to pale brown fine to coarse SAND, damp, medium dense, highly friable, trace gravel.	1.4	104.4	
-150	25								

LOG OF BORING
AREP/OC Vibe
Anaheim, CA
PROJECT NO. 20065-01



Report: HOLLOW STEM; Project: 20065-01.GPJ; Data Template: NMG_GINT_2016.GDT; Printed: 10/6/20

AREP/OC Vibe				Anaheim, CA		H-17		Sheet 2 of 2		
Elevation (ft)	Depth (ft)	SAMPLES			Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
		Type	Number	Blows per foot						
-150	25	D-7	23			SM	@ 25' SAMPLE: Olive brown silty fine SAND, very moist, micaceous.	12.0	113.8	
	30	D-8	11			SM-CH	@ 30' SAMPLE: Olive brown silty fine SAND and plastic CLAY, saturated, loose/stiff, interlayered, micaceous, root stained pores.	22.2	99.4	
-140	35	D-9	33			SM	@ 35' SAMPLE: Gray silty fine to medium SAND, saturated, medium dense, trace coarse sand lenses, micaceous/magnetite rich layer, 1/16" thick.	21.1	100.0	
	40	D-10	19			SP-SM	@ 40' SAMPLE: Light olive brown silty to clean fine to coarse SAND, saturated, medium dense, friable, micaceous.	15.9	106.2	
						SC-CL	Tip: Olive brown clayey fine SAND/sandy CLAY.			
-130	45	D-11	9			CH	@ 45' SAMPLE: Olive brown silty plastic CLAY, saturated, micaceous.	24.0	102.3	
	50	D-12	80			SC	@ 50' SAMPLE: Strong brown to brown clayey fine to coarse SAND, saturated, very dense, 2" diameter gravel.	7.5	120.5	
							Notes: Total Depth: 51.5 Feet. Groundwater First Encountered at 34.4 Feet. Static Groundwater Measured at 33.0 Feet After 15 Minutes. Backfilled with Bentonite Cement Grout. Patched with Cold Patch AC.			
-120	55									

LOG OF BORING

AREP/OC Vibe

Anaheim, CA

PROJECT NO. 20065-01



LOG OF BORING
AREP/OC Vibe
Anaheim, CA
PROJECT NO. 20065-01



Date(s) Drilled	8/5/20	Logged By	ZKH	H-18 Sheet 1 of 2
Drilling Company	2R Drilling, Inc.	Drill Bit Size/Type	11"	
Drill Rig Type	CME 75 Hollow Stem	Hammer Data	140 lbs. @ 30-inch drop	
Sampling Method(s)	Modified California, Bulk			
Approximate Groundwater Depth: 27.5 Feet				
Comments				Total Depth Drilled (ft) 51.0
				Approximate Ground Surface Elevation (ft) 163.3 msl

Elevation (ft)	Depth (ft)	SAMPLES			USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
		Type	Number	Blows per foot					
0						Surface: Parking Lot, 3" AC over 8" AB.			
					SM	Artificial Fill, Undocumented (Afu)			B-1 @ 1'-7.5'
-160		D-1	60			@ 2.5' SAMPLE: Brown silty fine SAND, moist, dense, slightly mottled with clayey fine sand in tip.	10.1	124.4	
	5	D-2	56		SM-SC	@ 5' SAMPLE: Gray clayey/silty fine to medium SAND, moist, dense, mottled, trace fine gravel, rock fragments.	10.9	125.7	
		D-3	50/4"		GC	@ 7.5' SAMPLE: No Recovery. Driller notes hard drilling, rip-rap fragments in cuttings.			
-150	10	D-4	30		SC-GC	@ 10' SAMPLE: Brown to dark gray clayey fine SAND/GRAVEL, wet to saturated (perched water), medium dense, abundant gravel.	8.4	128.2	
	15	D-5	15		SM	Alluvium (Qal) @ 15' SAMPLE: Gray to olive brown silty very fine SAND, very moist, medium dense, micaceous.	16.8	100.4	
	20	D-6	47		SP-SM	@ 20' SAMPLE: Gray silty to clean fine to coarse SAND, moist, dense, friable, micaceous.	2.9	108.1	
-140									
	25								

LOG OF BORING
 AREP/OC Vibe
 Anaheim, CA
 PROJECT NO. 20065-01



AREP/OC Vibe Anaheim, CA				H-18		Sheet 2 of 2			
Elevation (ft)	SAMPLES			Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	Type	Number	Blows per foot						
25	D-7	29		SP	@ 25' SAMPLE: Upper: Pale brown to light gray fine to coarse SAND, very moist, medium dense, friable.	4.2	111.7		
				SM	Lower: Light gray silty fine SAND, wet, medium dense, micaceous.				
30	D-8	23			@ 30' SAMPLE: Light gray silty fine to coarse SAND, saturated, medium dense, friable.	17.0	109.4		
35	D-9	65			@ 35' SAMPLE: Light gray silty fine to coarse SAND, saturated, medium dense, friable.	20.6	107.4		
40	D-10	31			@ 40' SAMPLE: Upper: Olive brown silty fine SAND, saturated, medium dense.	17.4	114.5		
				CL	Lower: Strong brown silty CLAY, very moist to saturated, stiff, micaceous.				
45	D-11	50/6"		SM with Gravel	@ 45' SAMPLE: Upper: Strong brown silty CLAY, very moist to saturated, hard, micaceous.	16.7	104.7		
					Lower: Olive brown silty fine SAND with gravel, saturated, very dense.				
50	D-12	50/6"		GP	@ 50' SAMPLE: Olive brown fine to medium sandy GRAVEL, saturated, very dense, friable, micaceous, 2" diameter gravel.	6.3	129.0		
					Notes: Total Depth: 51.0 Feet. Groundwater First Encountered at 27.7 Feet. Static Groundwater Measured at 27.5 Feet After 10 Minutes. Backfilled with Bentonite Cement Grout. Patched with Cold Patch AC.				
55									

LOG OF BORING

AREP/OC Vibe
Anaheim, CA

PROJECT NO. 20065-01



LOG OF BORING
AREP/OC Vibe
Anaheim, CA
PROJECT NO. 20065-01





Kehoe Testing and Engineering

714-901-7270

steve@kehoetesting.com

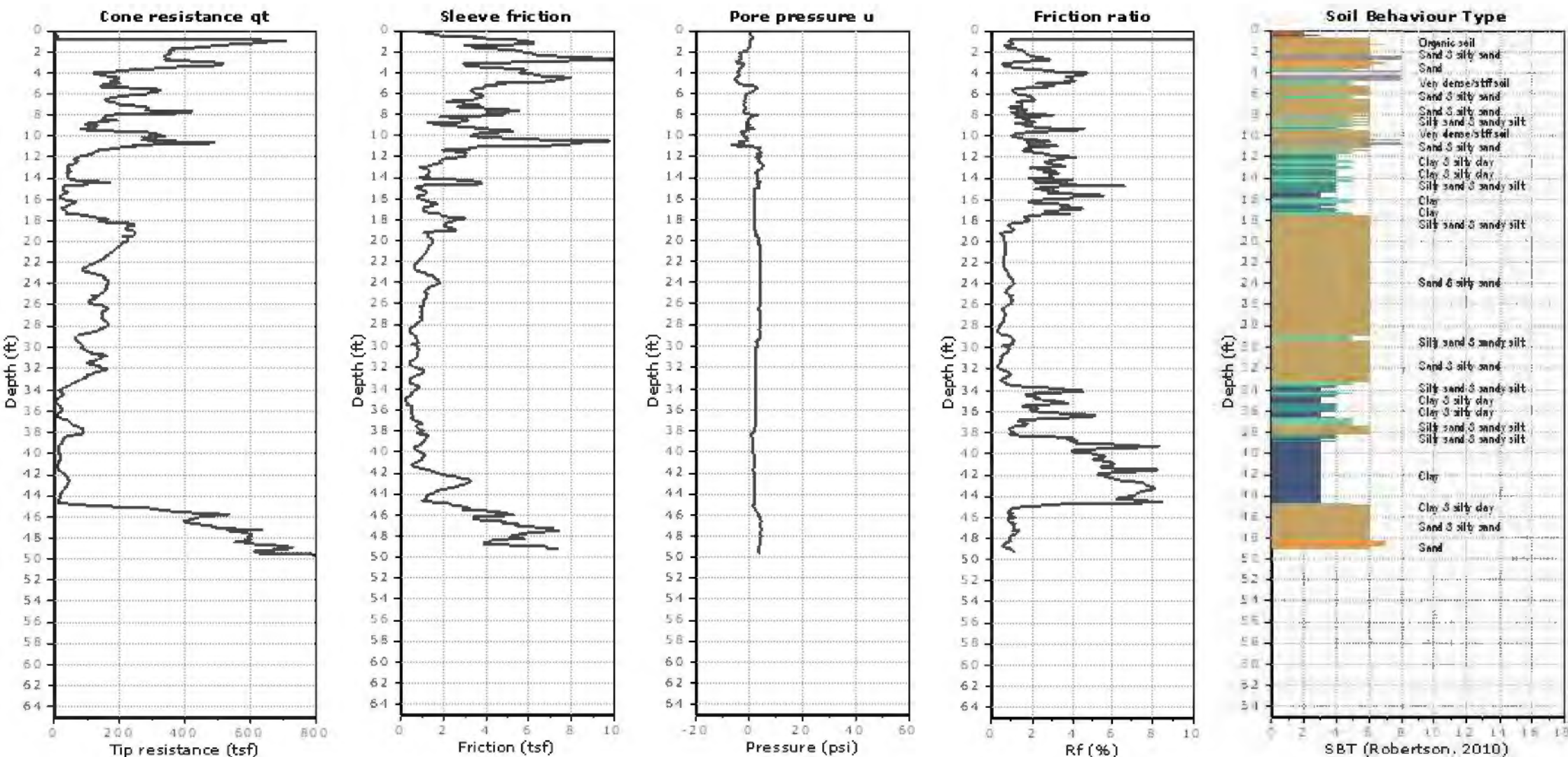
www.kehoetesting.com

Project: Langan Engr. & Env. Services

Location: E. Katella Ave & S. Douglass Rd, Anaheim, CA

CPT-D1-A

Total depth: 49.63 ft, Date: 8/22/2019





Kehoe Testing and Engineering

714-901-7270

steve@kehoetesting.com

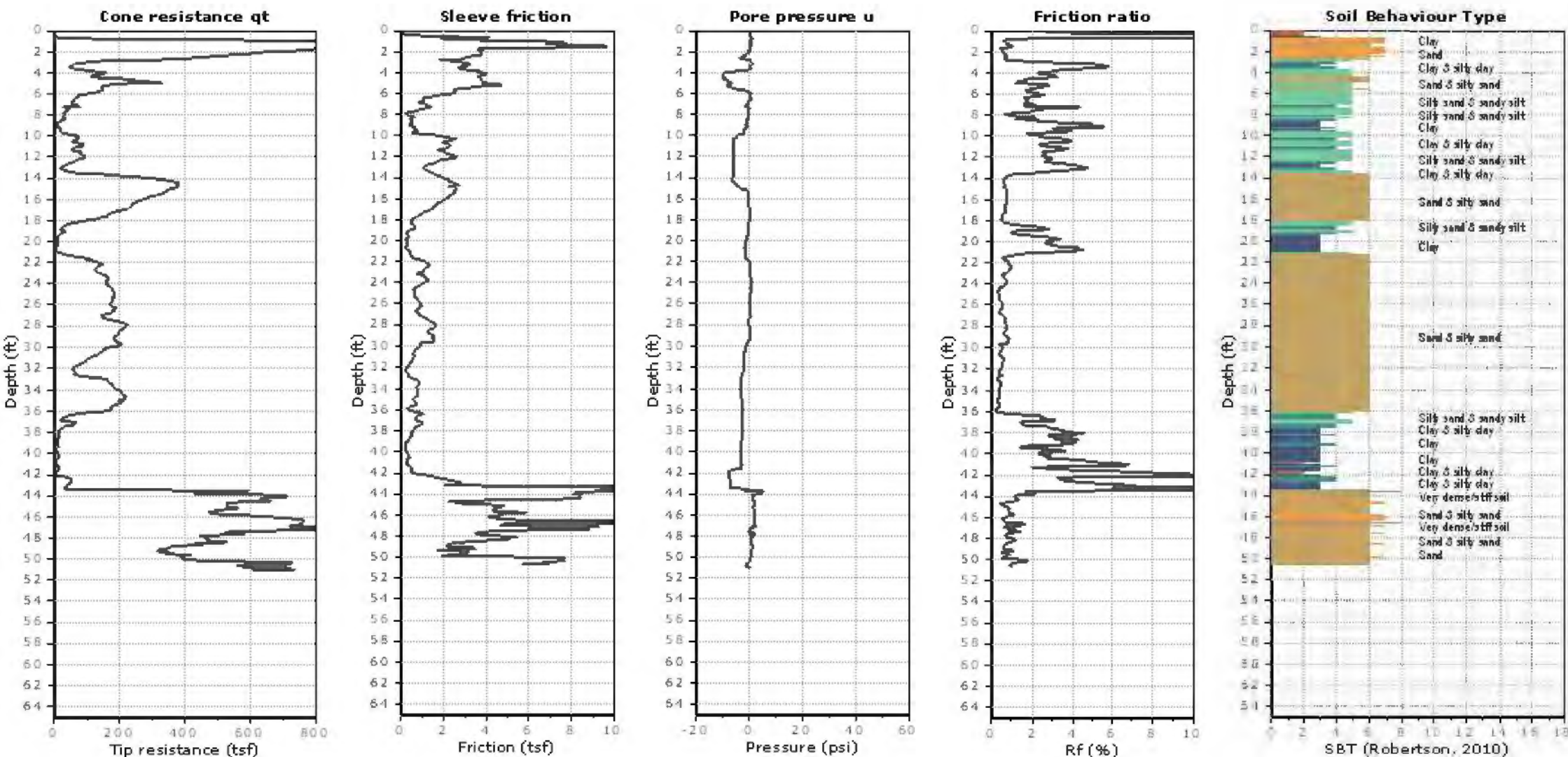
www.kehoetesting.com

Project: Langan Engr. & Env. Services

Location: E. Katella Ave & S. Douglass Rd, Anaheim, CA

CPT-D2

Total depth: 51.05 ft, Date: 8/22/2019



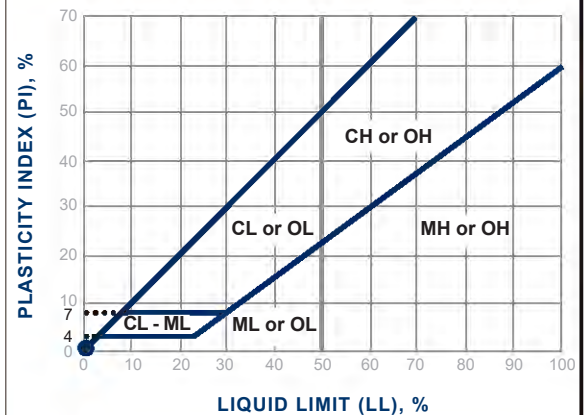
Soil Classification Chart Per ASTM D 2488

Primary Divisions		Secondary Divisions	
		Group Symbol	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
	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
		INORGANIC	CH fat CLAY
			MH elastic SILT
			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"	Thumb-sized to fist-sized
	Fine	#4 - 3/4"	Pea-sized to thumb-sized
Sand	Coarse	#10 - #4	Rock-salt-sized to pea-sized
	Medium	#40 - #10	Sugar-sized to rock-salt-sized
	Fine	#200 - #40	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		Automatic Trip Hammer	
	SPT (blows/foot)	Modified Split Barrel (blows/foot)	SPT (blows/foot)	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		Automatic Trip Hammer	
	SPT (blows/foot)	Modified Split Barrel (blows/foot)	SPT (blows/foot)	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)	Bulk Driven SAMPLES	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). No recovery with a SPT. Shelby tube sample. Distance pushed in inches/length of sample recovered in inches. No recovery with Shelby tube sampler. Continuous Push Sample. Seepage. Groundwater encountered during drilling. Groundwater measured after drilling.
5		XX/XX					
10							
15						SM	<u>MAJOR MATERIAL TYPE (SOIL):</u> Solid line denotes unit change.
20						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
20							The total depth line is a solid line that is drawn at the bottom of the boring.

DEPTH (feet)	SAMPLES		BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DATE DRILLED 9/27/21 BORING NO. B-1	
	Bulk	Driven						GROUND ELEVATION 182' ± (MSL)	SHEET 1 OF 2
METHOD OF DRILLING 8" Hollow-Stem Auger (ABC Liovin Drilling)									
DRIVE WEIGHT 140 lbs. (Auto. Trip Hammer) DROP 30"									
SAMPLED BY GM LOGGED BY GM REVIEWED BY MRM/MLP									
DESCRIPTION/INTERPRETATION									
0							SP-SM	FILL: Olive brown, moist, medium dense, poorly graded SAND with silt; few to little gravel; few gravel-sized concrete and asphalt fragments; trace clay.	
			24				SP	Olive brown, moist, medium dense, poorly graded SAND with gravel.	
							SM	Olive brown, moist, medium dense, silty SAND; trace gravel.	
10			16	5.3	100.7				
							SP	ALLUVIUM: Grayish brown, moist, very dense, poorly graded SAND with gravel.	
			88	5.1	115.8		SP-SM	Grayish brown, moist, very dense, poorly graded SAND with silt; trace gravel; gravel rounded to sub-rounded.	
20			34	17.5	106.2		SP	Grayish brown, moist, medium dense, poorly graded SAND with gravel.	
			20				SM	Olive brown, wet, medium dense, silty SAND. @ 24' Groundwater encountered during drilling.	
							SP-SM	Gray, wet, very dense, poorly graded SAND with silt.	
30			38						
							SM	Grayish brown, wet, medium dense, silty SAND.	
			12				CL	Reddish brown, wet, very stiff, lean CLAY.	
40									

FIGURE A- 1

DEPTH (feet)	SAMPLES		BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DATE DRILLED <u>9/27/21</u> BORING NO. <u>B-1</u> GROUND ELEVATION <u>182' ± (MSL)</u> SHEET <u>2</u> OF <u>2</u> METHOD OF DRILLING <u>8" Hollow-Stem Auger (ABC Liovin Drilling)</u> DRIVE WEIGHT <u>140 lbs. (Auto. Trip Hammer)</u> DROP <u>30"</u> SAMPLED BY <u>GM</u> LOGGED BY <u>GM</u> REVIEWED BY <u>MRM/MLP</u> DESCRIPTION/INTERPRETATION
	Bulk	Driven						
40			26				CL	ALLUVIUM: (Continued) Reddish brown, wet, hard, lean CLAY. Very stiff; sandy.
50			50/5"	10.8	126.4		SC	Reddish brown, wet, very dense, clayey SAND with gravel. Dense. Very dense.
60			50/6"					Total Depth = 61.0 feet. Groundwater was encountered during drilling at approximately 24 feet. Backfilled with cement-bentonite grout on 9/27/21. Notes: Groundwater may rise to a level higher than that measured in borehole 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.
70								
80								

FIGURE A- 2

FIELD STUDY	BY: M.C. COLE	DATE: 10-2-59
CHECKED	BY: J. L. HANSEN	DATE: 10-2-59
APPROVED	BY: J. L. HANSEN	DATE: 10-2-59

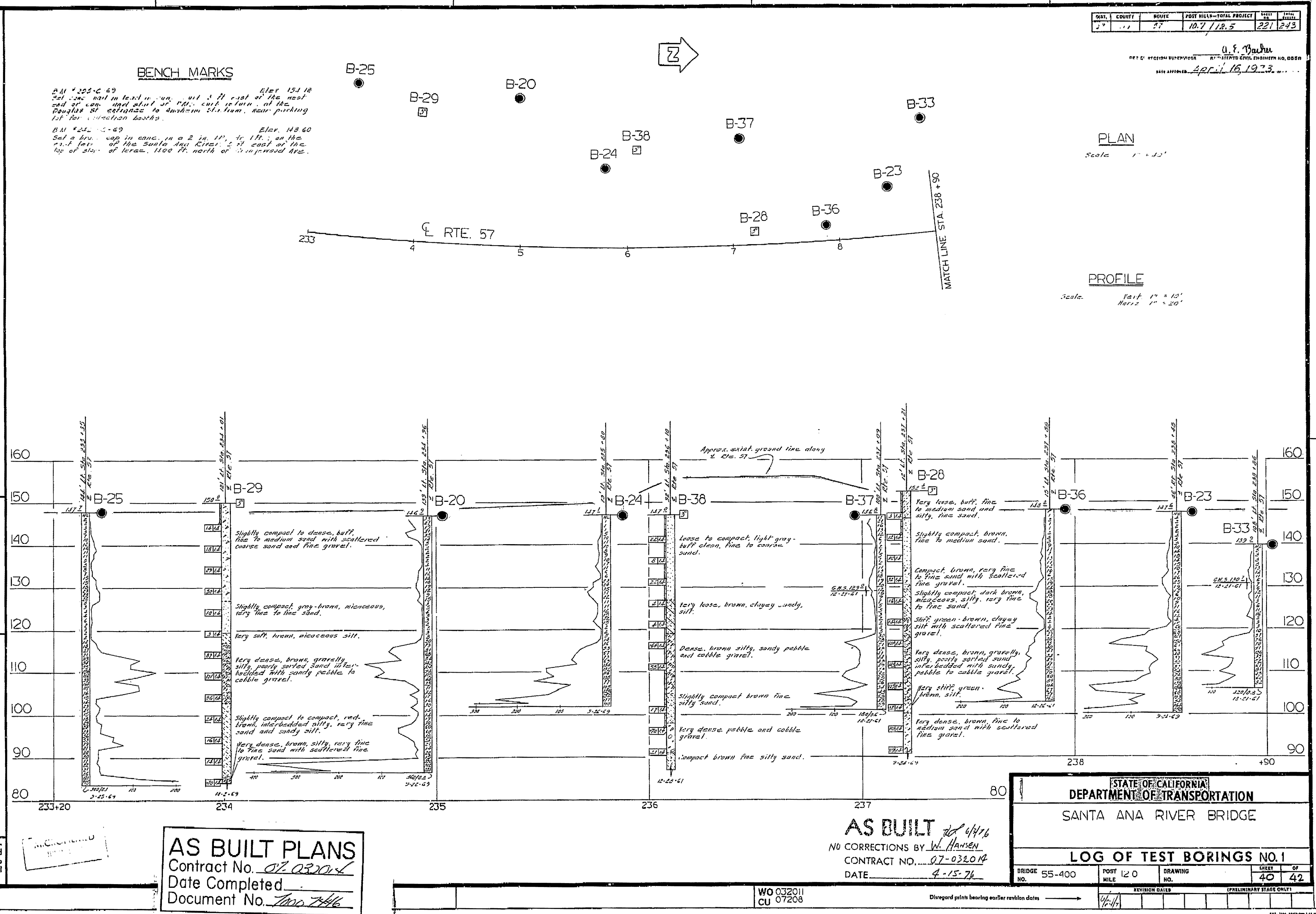
BRIDGE DEPARTMENT
ENGINEERING GEOLOGY SECTION

LEGEND OF BORING OPERATIONS

LEGEND OF EARTH MATERIALS

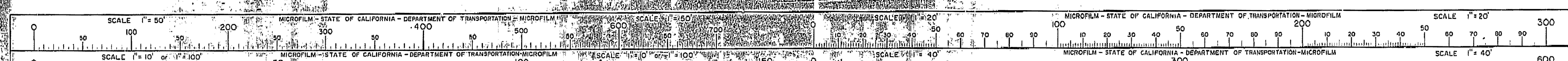
CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS

NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.



I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF TRANSPORTATION.

DATE: 10-2-59
BY: J. L. HANSEN
TITLE: J. L. HANSEN



APPENDIX B

Previous Laboratory Testing

[illegible][illegible]

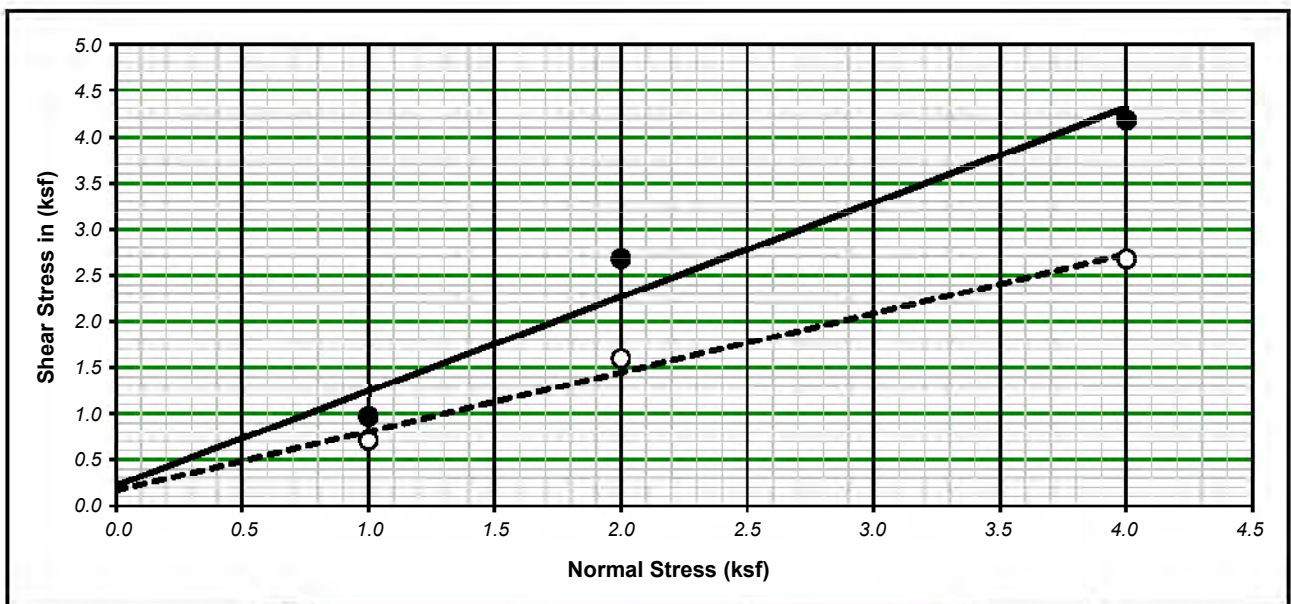
[illegible][illegible]

TABLE B-1 SUMMARY OF LABORATORY TEST RESULTS	
Project No. : 17-126	Project Name : MBI, Orangewood Avenue Improvement Project, Anaheim

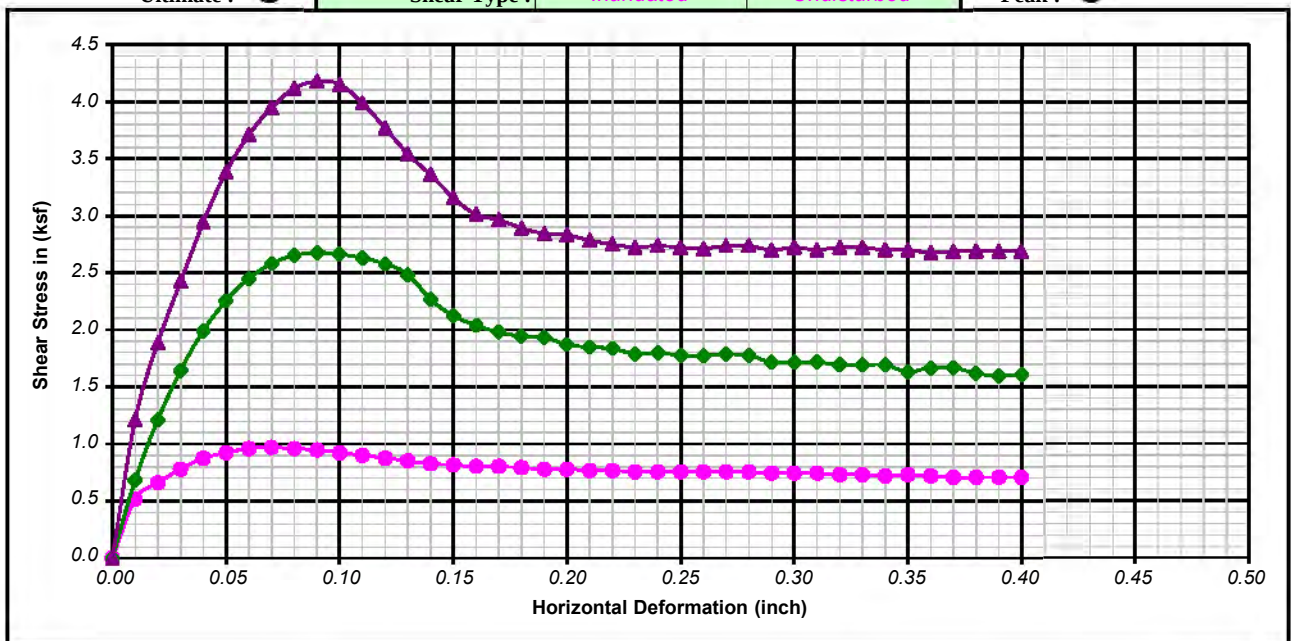
Project No. : 17-126 **Project Name :** _____

Project Name : MBI, Orangewood Avenue Improvement Project, Anaheim

[illegible]



Ultimate : ☐ Shear Type : ☒ Inundated ☐ Undisturbed Peak : ☒



Boring No. : R-18-001		Strength Intercept (C) :		0.22	(ksf)	Peak	0.17	(ksf)	Ultimate	
Sample No. : D-3				10.63	(kPa)		8.04	(kPa)		
Depth (ft/m) : 15.0	0.00	Friction Angle (ϕ) :		45.64	Degree		32.60	Degree		
Description : Dark olive brown, SILTY SAND (SM)							Shear Rate (inch/minute) : 0.02			
SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY		VOID RATIO	NORMAL STRESS		PEAK STRESS		ULTIMATE STRESS	
		(pcf)	(kN/m ³)		(ksf)	(kPa)	(ksf)	(kPa)	(ksf)	(kPa)
	9.68	117.12	18.43	0.44	1.00	47.88	0.97	46.54	0.71	33.90
	9.36	114.99	18.10	0.47	2.00	95.76	2.68	128.13	1.60	76.42
	10.31	116.75	18.38	0.44	4.00	191.52	4.18	199.95	2.68	128.13



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Geotechnical and Earthquake Engineering

MBI, Orangewood Avenue Improvement Project, Anaheim

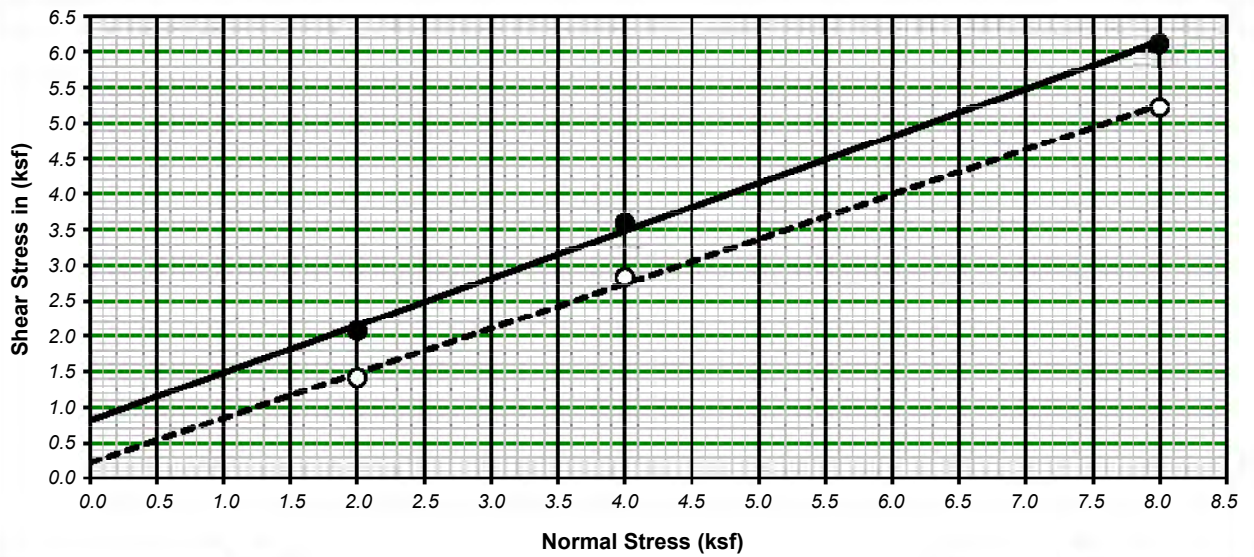
Project No. : 17-126

Date :

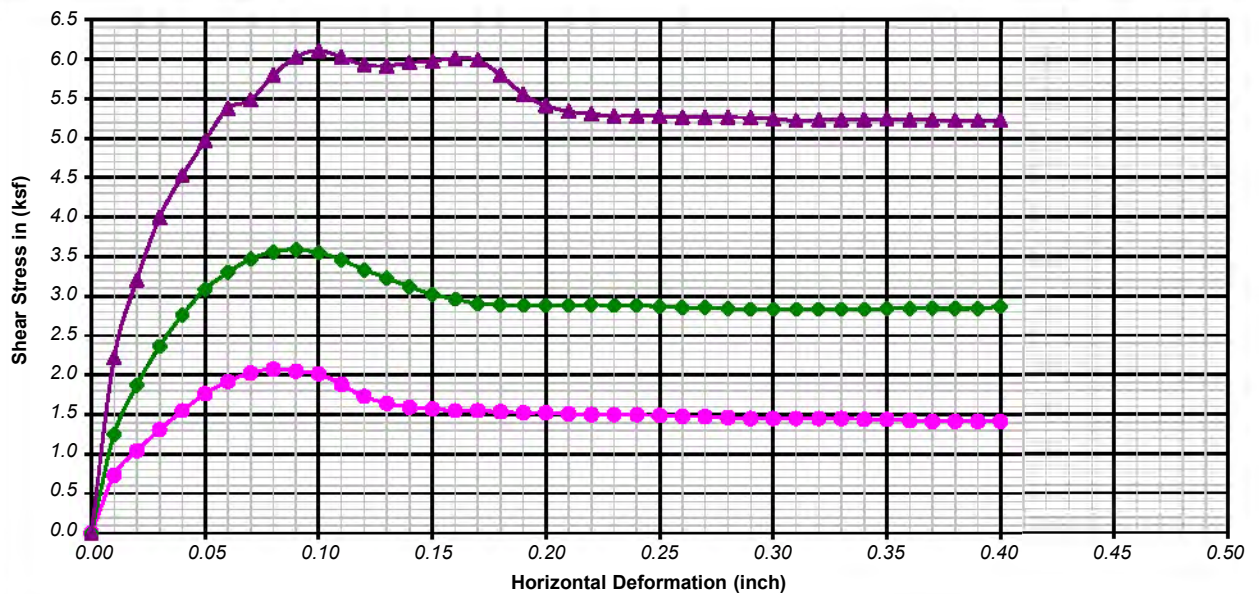
DIRECT SHEAR TEST
3080)

(ASTM D-

Figure No.



Ultimate : ☐ Shear Type : ☒ Inundated ☐ Undisturbed Peak : ☒



Boring No. : A-18-002		Strength Intercept (C) :		0.82	(ksf)	Peak	0.22	(ksf)	Ultimate	
Sample No. : D-8				39.07	(kPa)		10.63	(kPa)		
Depth (ft/m) :	40.0 0.00	Friction Angle (ϕ) :		33.66	Degree		32.16	Degree		
Description : Dark yellowish brown, SILTY SAND (SM)							Shear Rate (inch/minute) : 0.02			
SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY		VOID RATIO	NORMAL STRESS		PEAK STRESS		ULTIMATE STRESS	
		(pcf)	(kN/m ³)		(ksf)	(kPa)	(ksf)	(kPa)	(ksf)	(kPa)
	14.36	111.65	17.57	0.51	2.00	95.76	2.08	99.40	1.42	67.80
	13.19	112.32	17.68	0.50	4.00	191.52	3.59	171.79	2.83	135.60
	12.94	110.75	17.43	0.52	8.00	383.04	6.11	292.45	5.22	249.93



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MBI, Orangewood Avenue Improvement Project, Anaheim

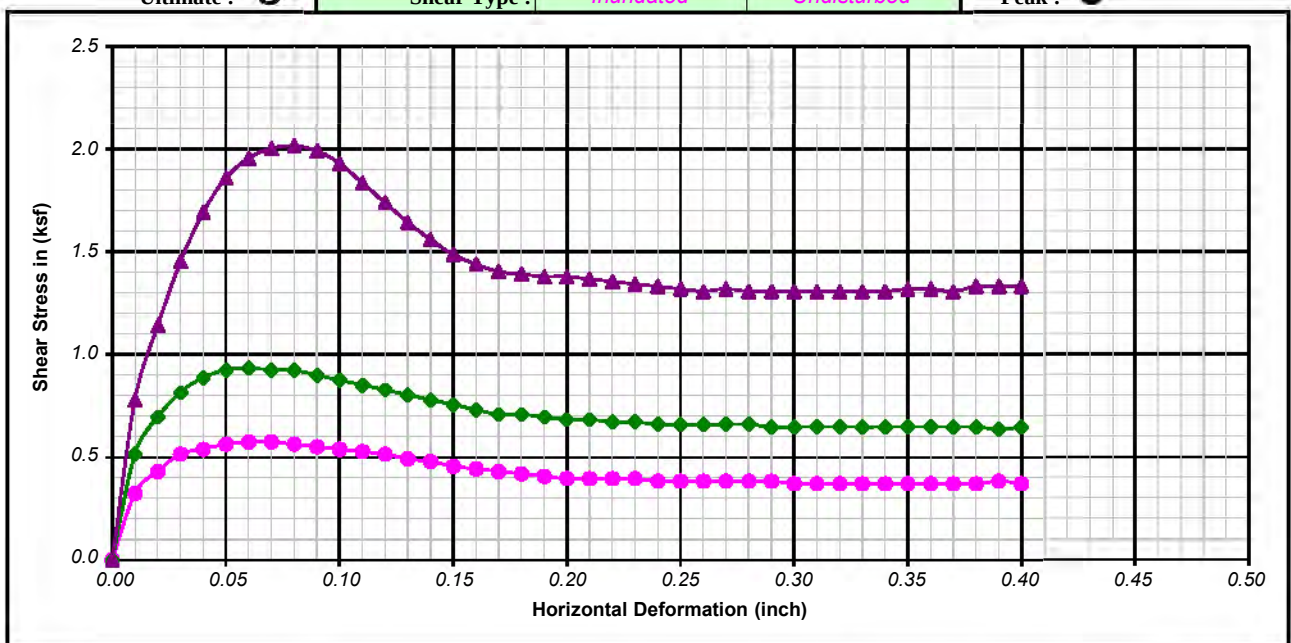
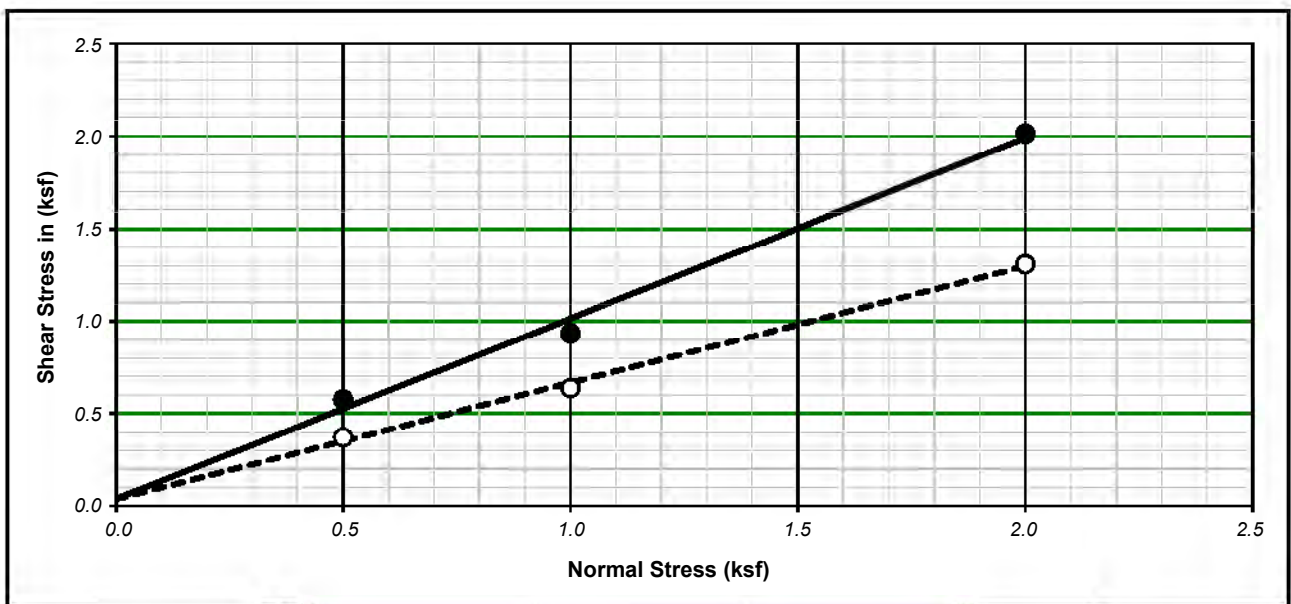
Project No. : 17-126

Date :

DIRECT SHEAR TEST
(ASTM D-3080)

(ASTM D-

Figure No.



Boring No. : R-18-005		Strength Intercept (C) :		0.04	(ksf)	Peak	0.04	(ksf)	Ultimate	
Sample No. : D-2				1.72	(kPa)		1.72	(kPa)		
Depth (ft/m) : 10.0 0.00		Friction Angle (ϕ) :		44.34	Degree	32.25	Degree			
Description : Olive brown, Poorly graded SAND with SILT (SP-SM)Shear Rate (inch/minute) : 0.02										
SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY		VOID RATIO	NORMAL STRESS		PEAK STRESS		ULTIMATE STRESS	
		(pcf)	(kN/m³)		(ksf)	(kPa)	(ksf)	(kPa)	(ksf)	(kPa)
	10.27	103.88	16.35	0.62	0.50	23.94	0.58	27.58	0.37	17.81
	9.51	102.08	16.07	0.65	1.00	47.88	0.94	44.82	0.64	30.45
	9.20	104.28	16.41	0.62	2.00	95.76	2.02	96.53	1.31	62.63



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Geotechnical and Earthquake Engineering

MBI, Orangewood Avenue Improvement Project, Anaheim

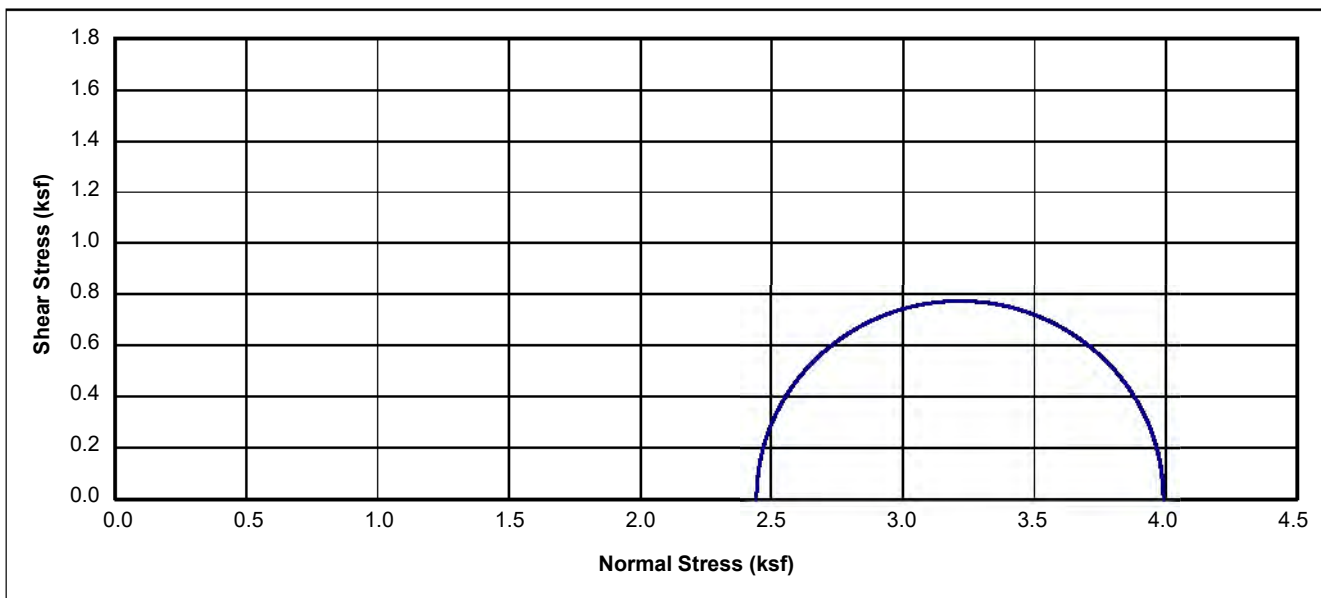
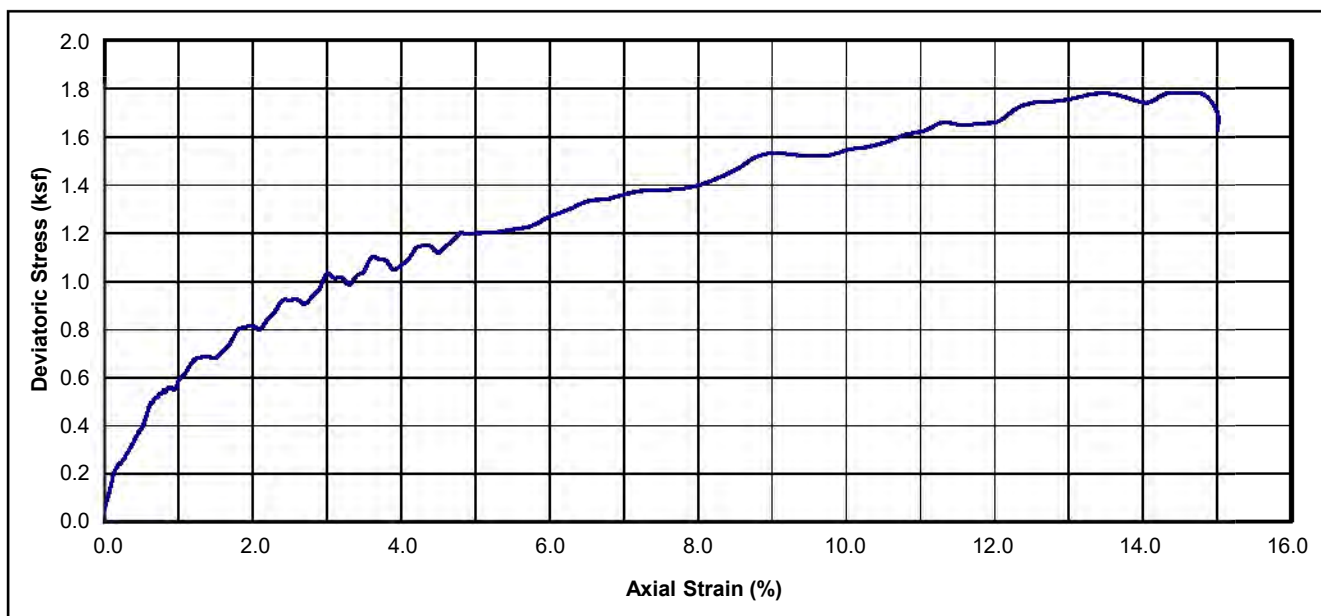
Project No. : 17-126

Date :

DIRECT SHEAR TEST
3080)

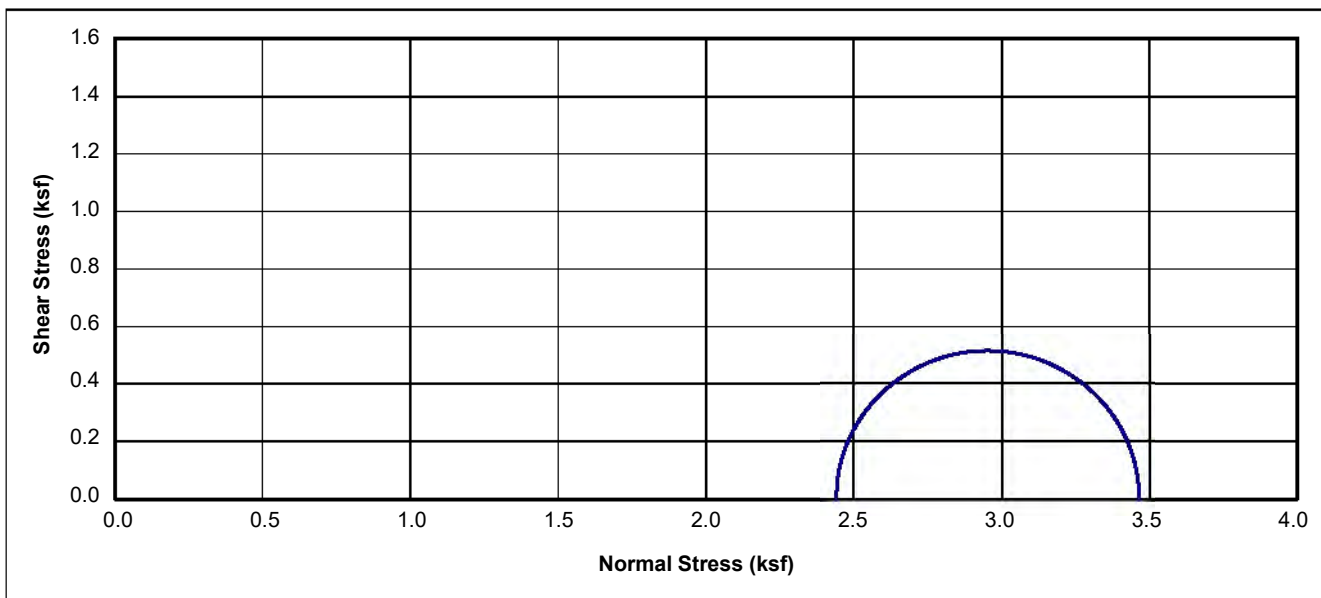
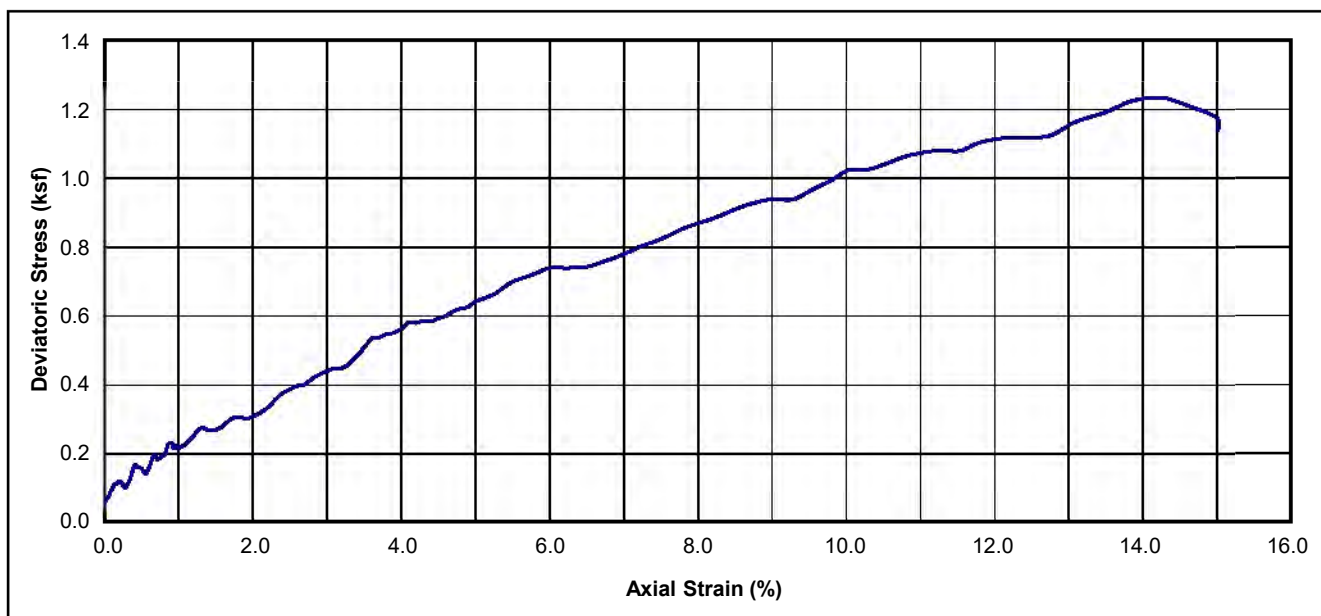
(ASTM D-

Figure No.



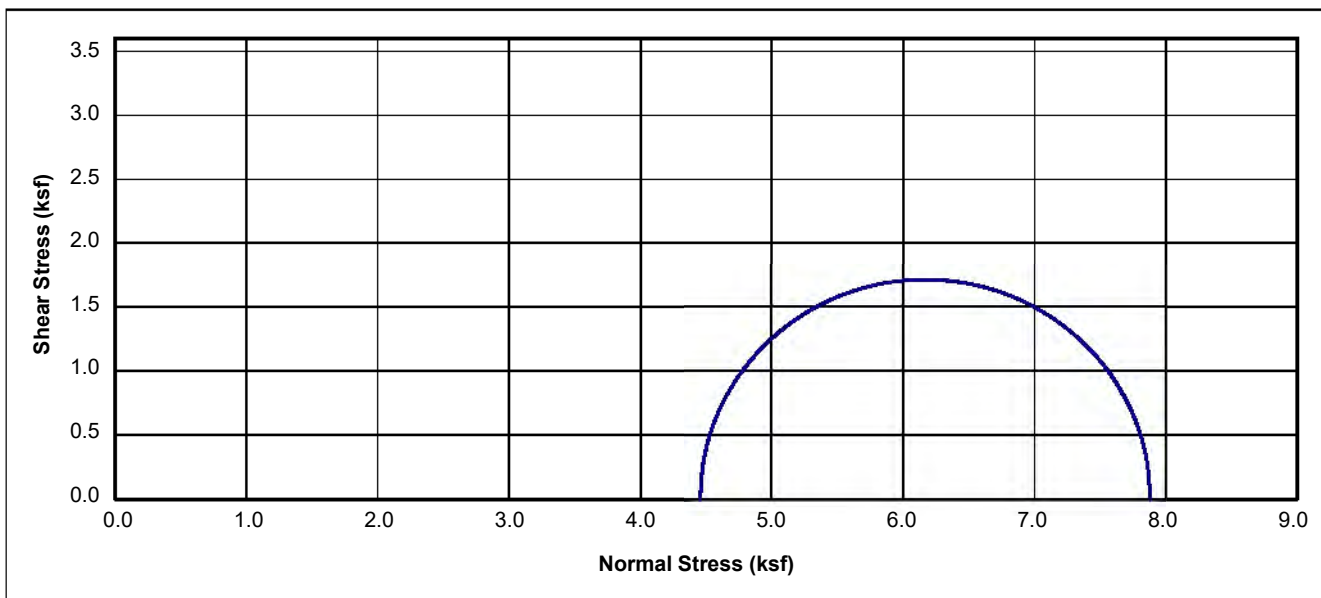
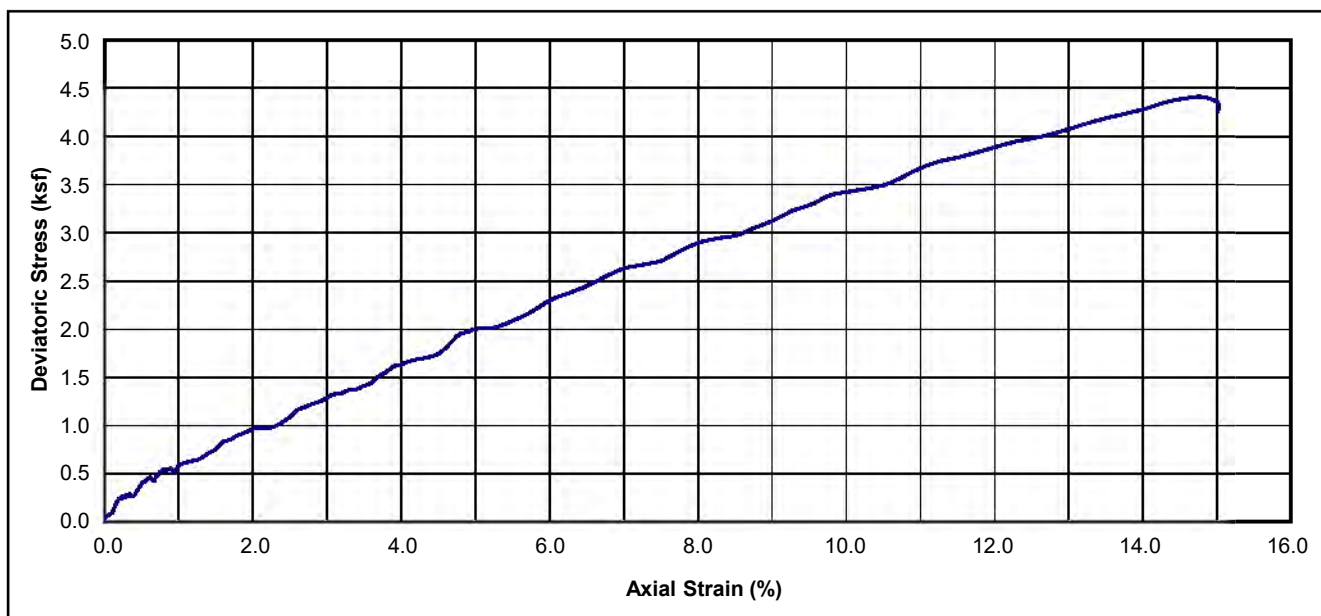
Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	10% Axial Strain Dev. Stress (ksf)	Initial Saturation (%)
A-18-004	D-6	30	Dark yellowish brown, SANY lean CLAY (CL)	96.4	25.38	2.44	1.55	91.7

 Earth Mechanics, Inc. Geotechnical and Earthquake Engineering			MBI, Orangewood Avenue Improvement Project, Anaheim		
			UNCONSOLIDATED UNDRAINED TEST (ASTM D2850)		
Project No. : 17-126		Date : 03/04/19		Figure No. :	



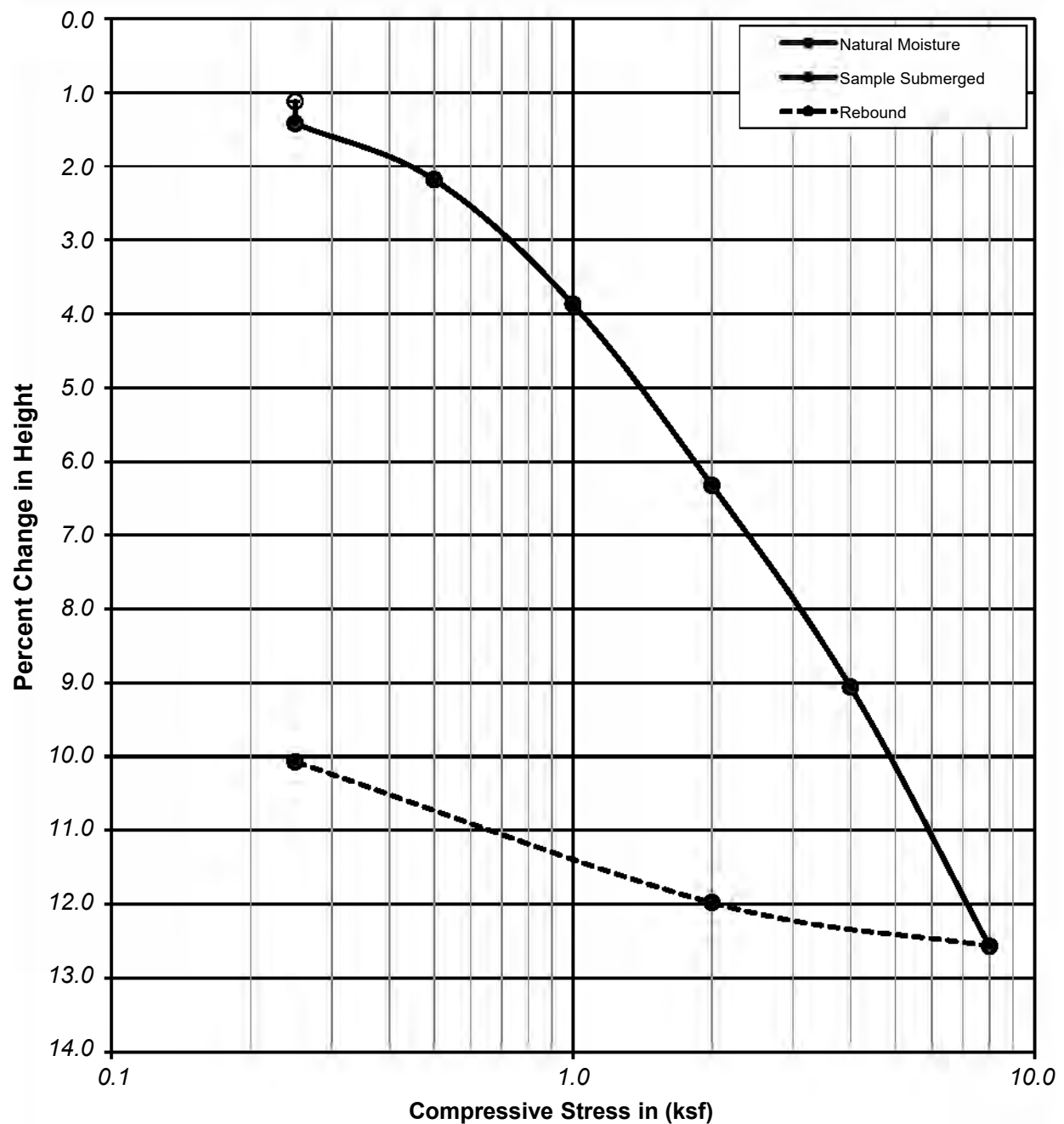
Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	10% Axial Strain Dev. Stress (ksf)	Initial Saturation (%)
A-18-005	D-6	30	Olive brown, SANY SILT (ML)	94.5	27.35	2.44	1.02	94.3

 Earth Mechanics, Inc. Geotechnical and Earthquake Engineering			MBI, Orangewood Avenue Improvement Project, Anaheim		
			UNCONSOLIDATED UNDRAINED TEST (ASTM D2850)		
Project No. : 17-126		Date : 03/04/19		Figure No. :	



Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	10% Axial Strain Dev. Stress (ksf)	Initial Saturation (%)
R-18-001	D-11	55	Dark yellowish brown, SANDY lean CLAY (CL)	104.9	19.72	4.46	3.42	87.8

 Earth Mechanics, Inc. Geotechnical and Earthquake Engineering			MBI, Orangewood Avenue Improvement Project, Anaheim		
			UNCONSOLIDATED UNDRAINED TEST (ASTM D2850)		
Project No. : 17-126		Date : 03/04/19		Figure No. :	



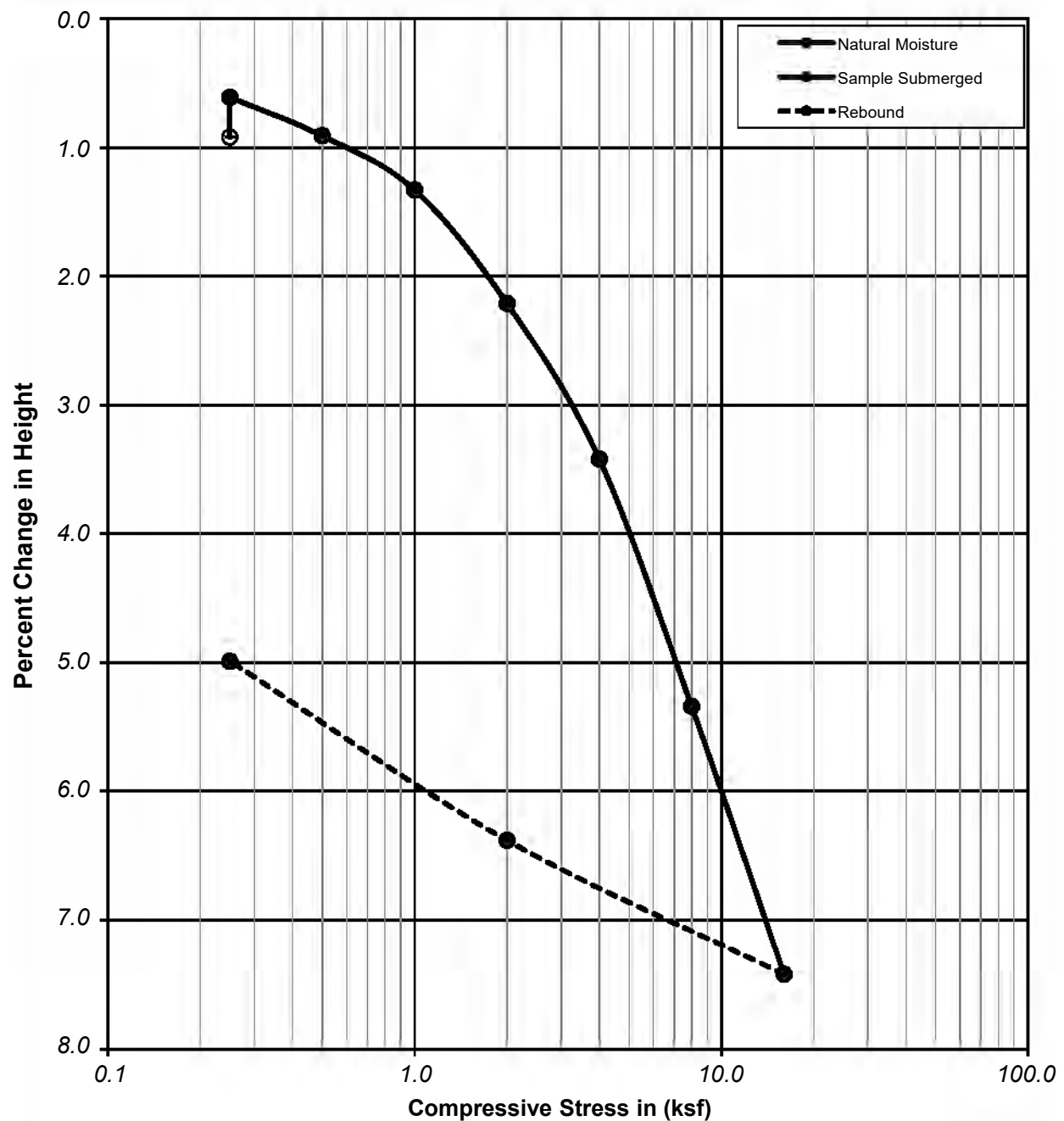
Boring No. : A-18-003	Liquid Limit : -		Moisture Content (%)	Dry Density		Percent Saturation	Void Ratio
Sample No. : D-7	Plastic Limit : -			(pcf)	(kN/m ³)		
Depth (ft) : 35.0 36.5	Plastic Index : -	Initial	24.25	93.17	14.66	80.91	0.81
(m) : 10.68 11.13	Specific Gravity : 2.70	Final	21.31	103.62	16.31	91.81	0.63
Description : Dark brown, Lean CLAY with SAND (CL)							



MBI, Orangewood Avenue Improvement Project, Anaheim

Project No. : **17-126** **03/15/19**

CONSOLIDATION TEST
(ASTM D-2435 / CT-219)



Boring No. :	R-18-001		Liquid Limit :	-		Moisture Content (%)	Dry Density		Percent Saturation	Void Ratio
Sample No. :	D-15		Plastic Limit :	-			(pcf)	(kN/m ³)		
Depth	(ft)	75.0 76.5	Plastic Index :	-	Initial	20.82	105.09	16.54	93.08	0.60
	(m)	22.88 23.33	Specific Gravity :	2.70	Final	18.92	110.62	17.41	97.50	0.52
Description : Dark brown, SANDY SILT										



MBI, Orangewood Avenue Improvement Project, Anaheim

Project No. : 17-126 03/15/19

CONSOLIDATION TEST
(ASTM D-2435 / CT-219)



Cobbles		Gravel				Sand			Silt or Clay	
		Coarse		Fine		Coarse	Medium	Fine		
Symbol	Boring Number	Sample Number	Depth				Soil Color	Soil Description	U.S.C.S.	
			(ft)		(m)					
●	R-18-001	D-5	25				dark brown	Poorly graded sand with silt	SP-SM	
Remark										



Cobbles		Gravel				Sand			Silt or Clay	
		Coarse		Fine		Coarse	Medium	Fine		
Symbol	Boring Number	Sample Number	Depth				Soil Color	Soil Description	U.S.C.S.	
			(ft)		(m)					
●	A-18-004	S-13	65				very dark brown	Poorly graded sand with silt	SP-SM	
Remark										



Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

**MBI, Orangewood Avenue Improvement
Project, Anaheim**

Project No. : **17-161**

Date : **02/21/19**

GRAIN SIZE ANALYSIS
(ASTM D-422)

Figure No. :

**AP Engineering and Testing, Inc.**

DBE|MBE|SBE

2607 Pomona Boulevard | Pomona, CA 91768

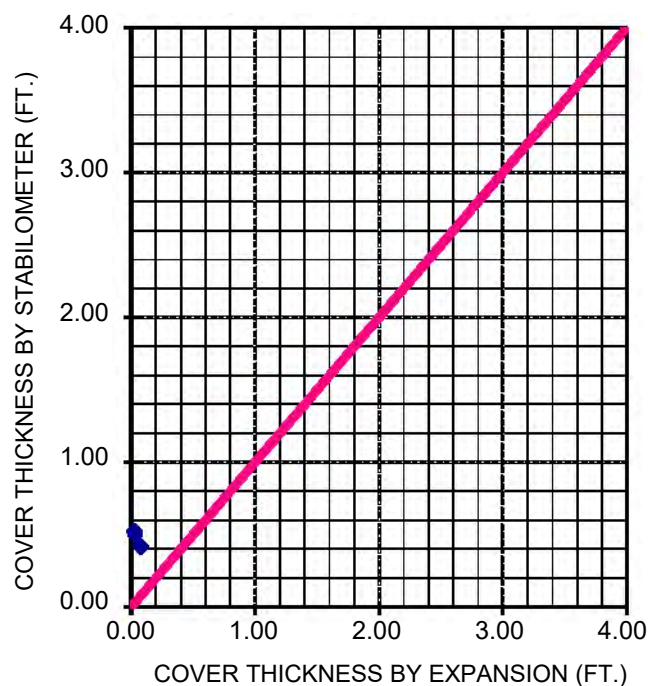
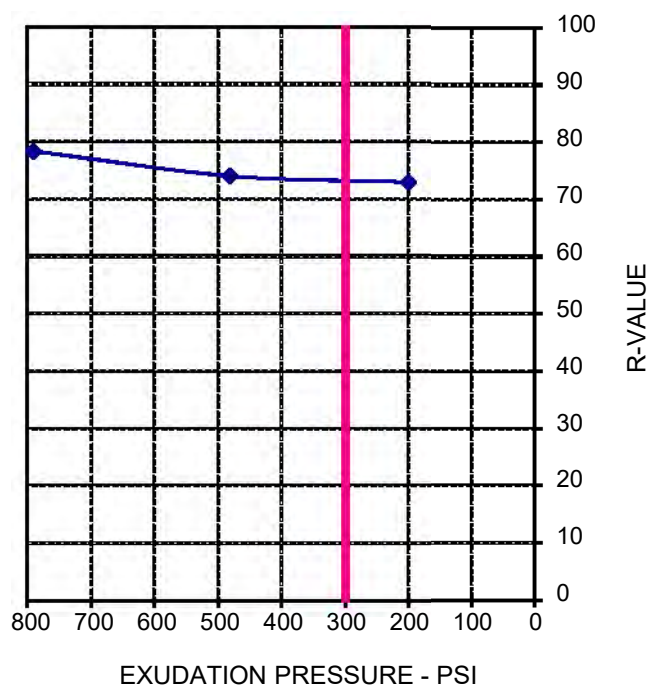
t. 909.869.6316 | f. 909.869.6318 | www.aplaboratory.com**R-VALUE TEST DATA**

ASTM D2844

Project Name: MBI, Orangewood Ave. Improvement P Tested By: ST Date: 03/11/19
 Project Number: 17-126 Computed By: KM Date: 03/12/19
 Boring No.: A-18-007 Checked By: AP Date: 03/15/19
 Sample No.: B-0 Depth (ft.): 0-5
 Location: N/A
 Soil Description: Silty Sand

Mold Number	D	F	E	
Water Added, g	77	74	61	
Compact Moisture(%)	12.2	11.9	10.5	
Compaction Gage Pressure, psi	290	290	350	
Exudation Pressure, psi	201	481	790	
Sample Height, Inches	2.6	2.5	2.6	
Gross Weight Mold, g	3033	3027	3008	
Tare Weight Mold, g	1964	1964	1954	
Net Sample Weight, g	1069	1062	1054	
Expansion, inches $\times 10^{-4}$	8	9	23	
Stability 2,000 (160 psi)	14/27	15/26	12/21	
Turns Displacement	5.11	4.53	5.00	
R-Value Uncorrected	71	74	77	
R-Value Corrected	73	74	78	
Dry Density, pcf	111.0	115.1	111.1	
Traffic Index	8.0	8.0	8.0	
G.E. by Stability	0.52	0.50	0.41	
G.E. by Expansion	0.03	0.03	0.08	

R-VALUE	By Exudation:	73
	By Expansion:	*N/A
	At Equilibrium: (by Exudation)	73
Remarks	Gf = 1.34, and 0.0 % Retained on the $\frac{3}{4}$ " *Not Applicable	



**AP Engineering and Testing, Inc.**

DBE | MBE | SBE

2607 Pomona Boulevard | Pomona, CA 91768

t. 909.869.6316 | f. 909.869.6318 | www.aplaboratory.com**COMPACTION TEST**

Client: Earth Mechanics Inc.
 Project Name: MBI, Orangewood Ave. Improvement Project
 Project No.: 17-126
 Boring No.: A-18-007
 Sample No.: B-0
 Visual Sample Description: Silty Sand

AP Number: 19-0312
 Tested By: AM Date: 03/13/19
 Calculated By: JP Date: 03/14/19
 Checked By: AP Date: 03/14/19
 Depth(ft.): 0-5

METHOD

MOLD VOLUME (CU.FT)

A
0.0333

Compaction Method

Preparation Method

☒ ASTM D1557
☐ ASTM D698
☐ Moist
☒ Dry

Wt. Comp. Soil + Mold (gm.)	3751	3830	3851	3820		
Wt. of Mold (gm.)	1837	1837	1837	1837		
Net Wt. of Soil (gm.)	1914	1993	2014	1983		
Container No.						
Wt. of Container (gm.)	139.27	150.12	142.59	147.31		
Wet Wt. of Soil + Cont. (gm.)	326.28	346.30	336.73	346.89		
Dry Wt. of Soil + Cont. (gm.)	311.87	327.27	314.45	320.84		
Moisture Content (%)	8.35	10.74	12.96	15.01		
Wet Density (pcf)	126.59	131.81	133.17	131.15		
Dry Density (pcf)	116.83	119.03	117.89	114.03		

Maximum Dry Density (pcf)

119.3

Optimum Moisture Content (%)

11.8

Maximum Dry Density w/ Rock Correction (pcf)

N/A

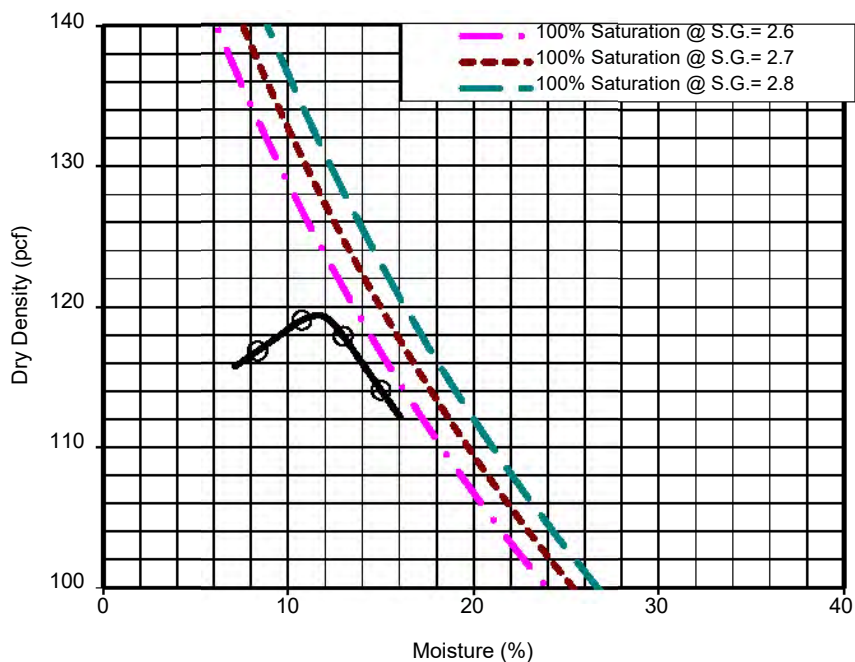
Optimum Moisture Content w/ Rock Correction (%)

N/A**PROCEDURE USED**

☒ **METHOD A: Percent of Oversize:** 0.2%
 Soil Passing No. 4 (4.75 mm) Sieve
 Mold: 4 in. (101.6 mm) diameter
 Layers: 5 (Five)
 Blows per layer: 25 (twenty-five)

☐ **METHOD B: Percent of Oversize:** N/A
 Soil Passing 3/8 in. (9.5 mm) Sieve
 Mold: 4 in. (101.6 mm) diameter
 Layers: 5 (Five)
 Blows per layer: 25 (twenty-five)

☐ **METHOD C: Percent of Oversize:** N/A
 Soil Passing 3/4 in. (19.0 mm) Sieve
 Mold: 6 in. (152.4 mm) diameter
 Layers: 5 (Five)
 Blows per layer: 56 (fifty-six)



Sieve Analysis (ASTM D6913/D6913M-17)

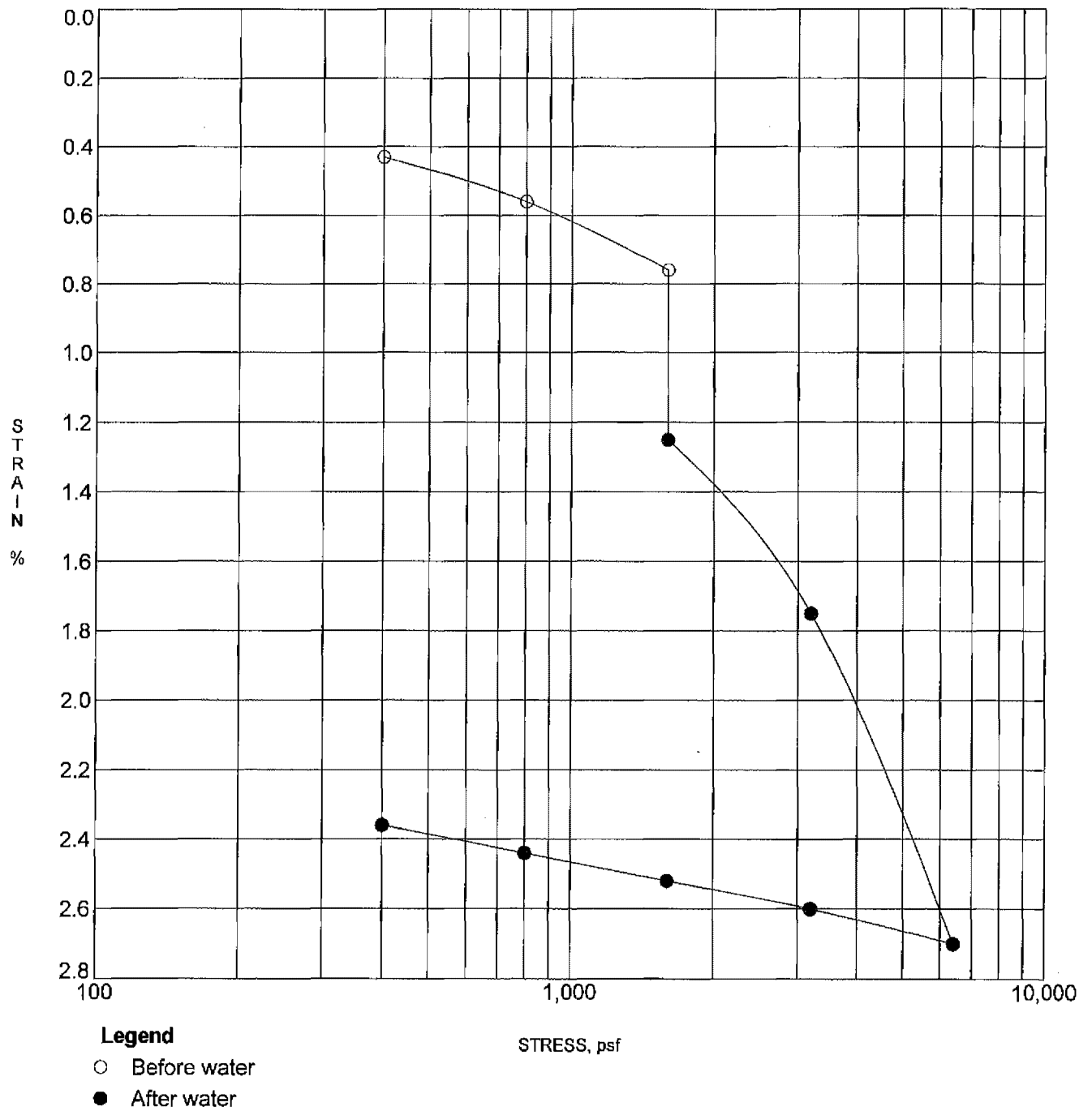
Sieve analyses were conducted on samples to confirm the visual-manual classification of the soils. Graphs of the results are presented on Plate B-67.

TABLE 1 Expansion Index Test Results (ASTM D4829)						
Sample Id.	Moisture Content (%)		Dry Unit Weight (pcf)		Calculated Expansion Index	Expansion Potential
	Initial	Final	Initial	Final		
B-3 @ 0'-3'	8.7	14.6	113.2	113.3	0	Very Low
B-13 @ 0'-3'	8.4	12.8	115.7	115.9	0	Very Low
B-17 @ 3'-6'	9.1	12.8	114.8	115.1	0	Very Low

TABLE 2 Corrosivity Test Results (EPA 300.0, 9045C/CT643)				
Sample ID	Water-Soluble Sulfate (%)	Chloride (%)	pH	Resistivity (ohm/cm)
B-3 @ 0'-3'	0.0011	ND	8.1	8873
B-7 @ 2'-4'	ND	ND	8.3	17,025
B-13 @ 0'-3'	ND	ND	8.4	13,530
B-17 @ 3'-6'	ND	ND	8.4	15,855

ND - non-detectable

TABLE 3 Compaction Test Results (ASTM D1557-12ε1)		
Sample ID	Maximum Dry Density, pcf	Optimum Moisture Content, %
B-4 @ 0'-3'	118.0	12.0
B-9 @ 2'-5'	124.0	8.5
B-17@3'-6'	125.5	8.5



Specimen Identification			Classification	DD	MC%
●	B-5	22.5	SAND (SW)	100	18
☒					
▲					
★					
○					
⊕					

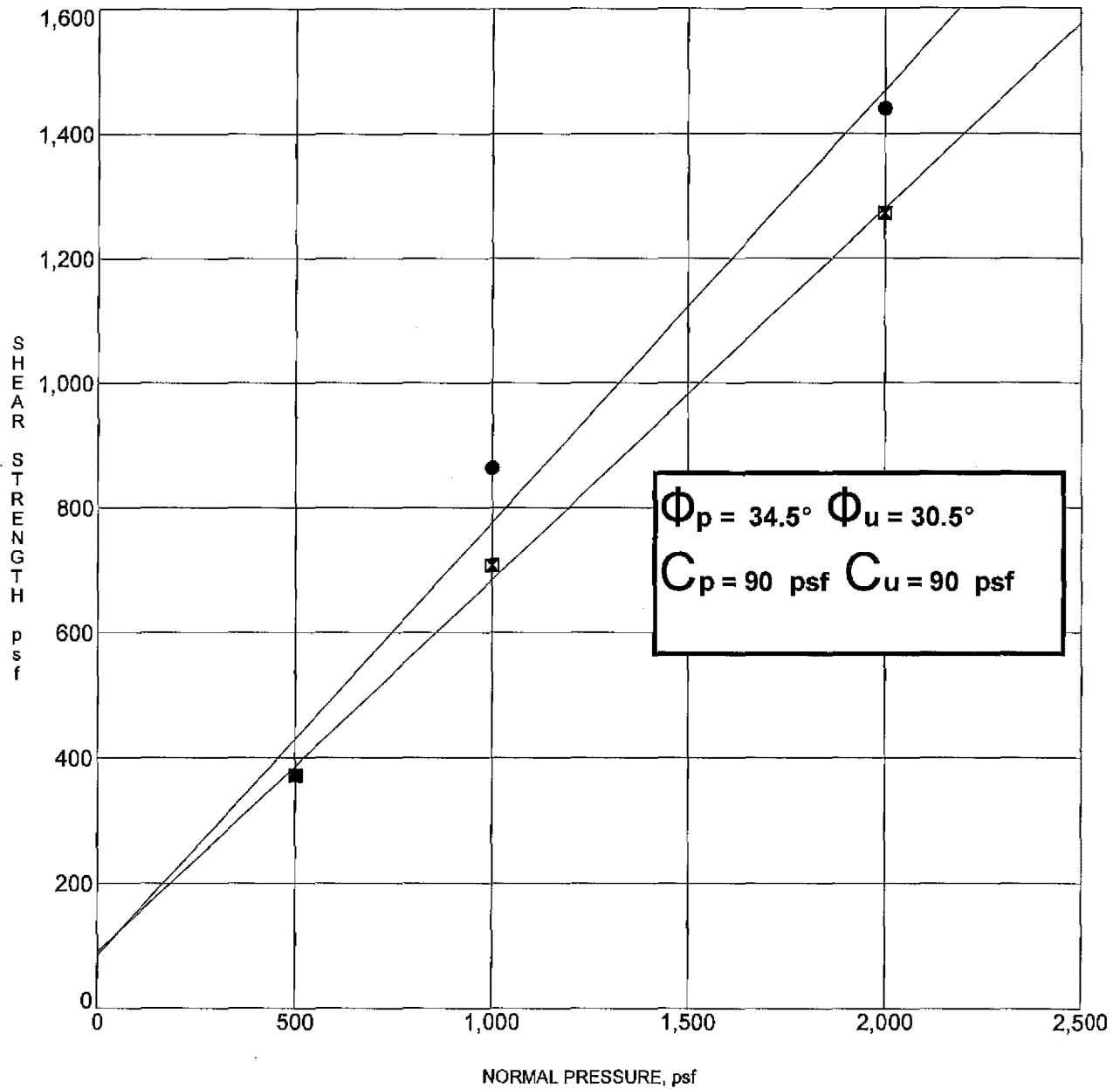
PROJECT Angel's Stadium Master Plan - Anaheim, CA

JOB NO. 20-01-3950
DATE 4/22/20

CONSOLIDATION TEST

Harrington
Geotechnical
Engineering, Inc. _____

PLATE B-10



Specimen Identification			Classification	DD	MC%
●	B-4	0.0	SILTY SAND (SM) (Peak) (Remolded)	104	18
☒	B-4	0.0	(Ultimate)		

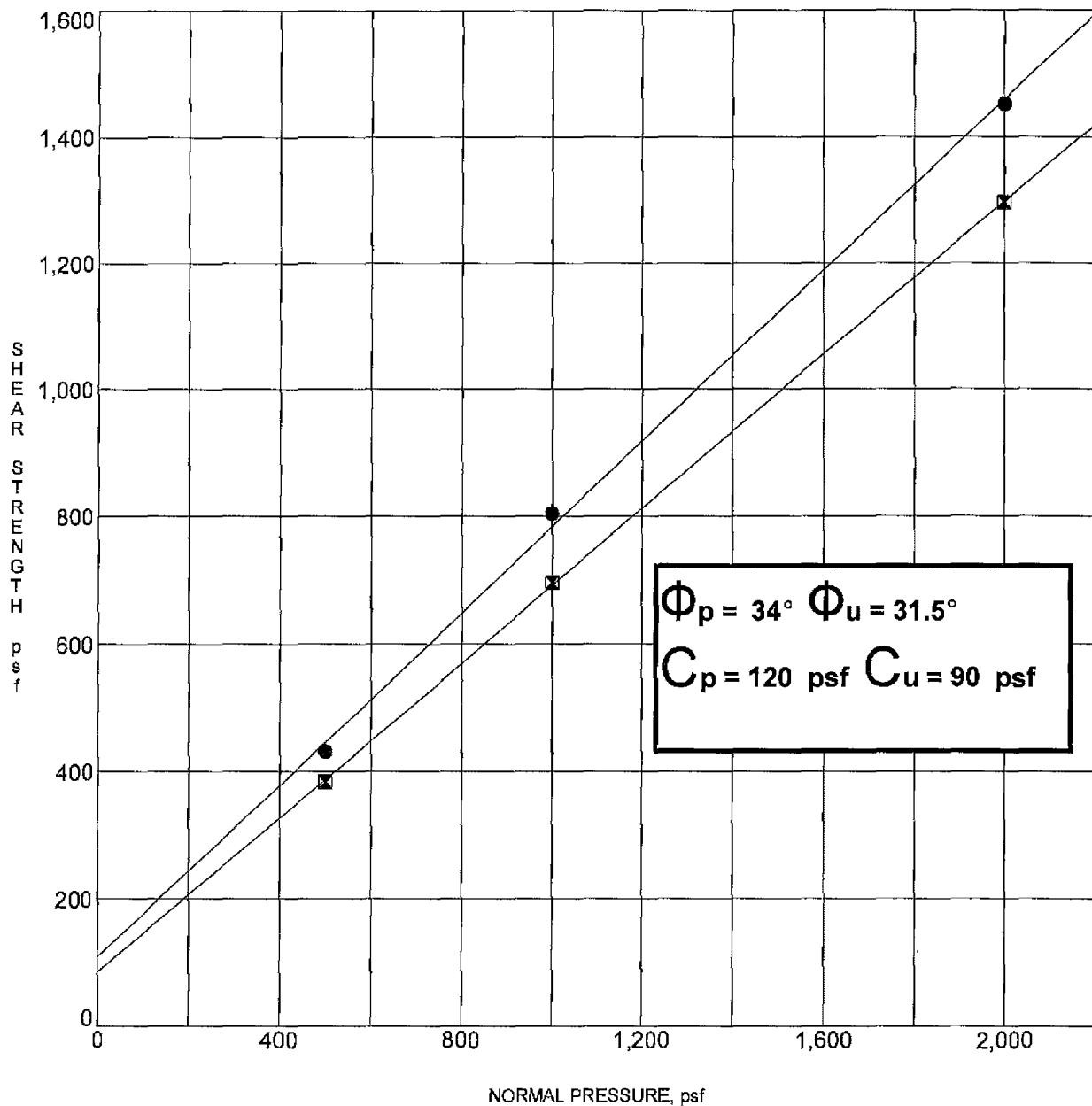
PROJECT Anaheim Ball Park - Anaheim, CA

JOB NO. 20-01-3950
DATE 4/22/20

SHEAR TEST DIAGRAM

Harrington
Geotechnical
Engineering, Inc.

PLATE B-41



Specimen Identification			Classification	DD	MC%
●	B-5	20.0	SAND (SP) (Peak)	91	25
⊠	B-5	20.0	(Ultimate)		

PROJECT Anaheim Ball Park - Anaheim, CA

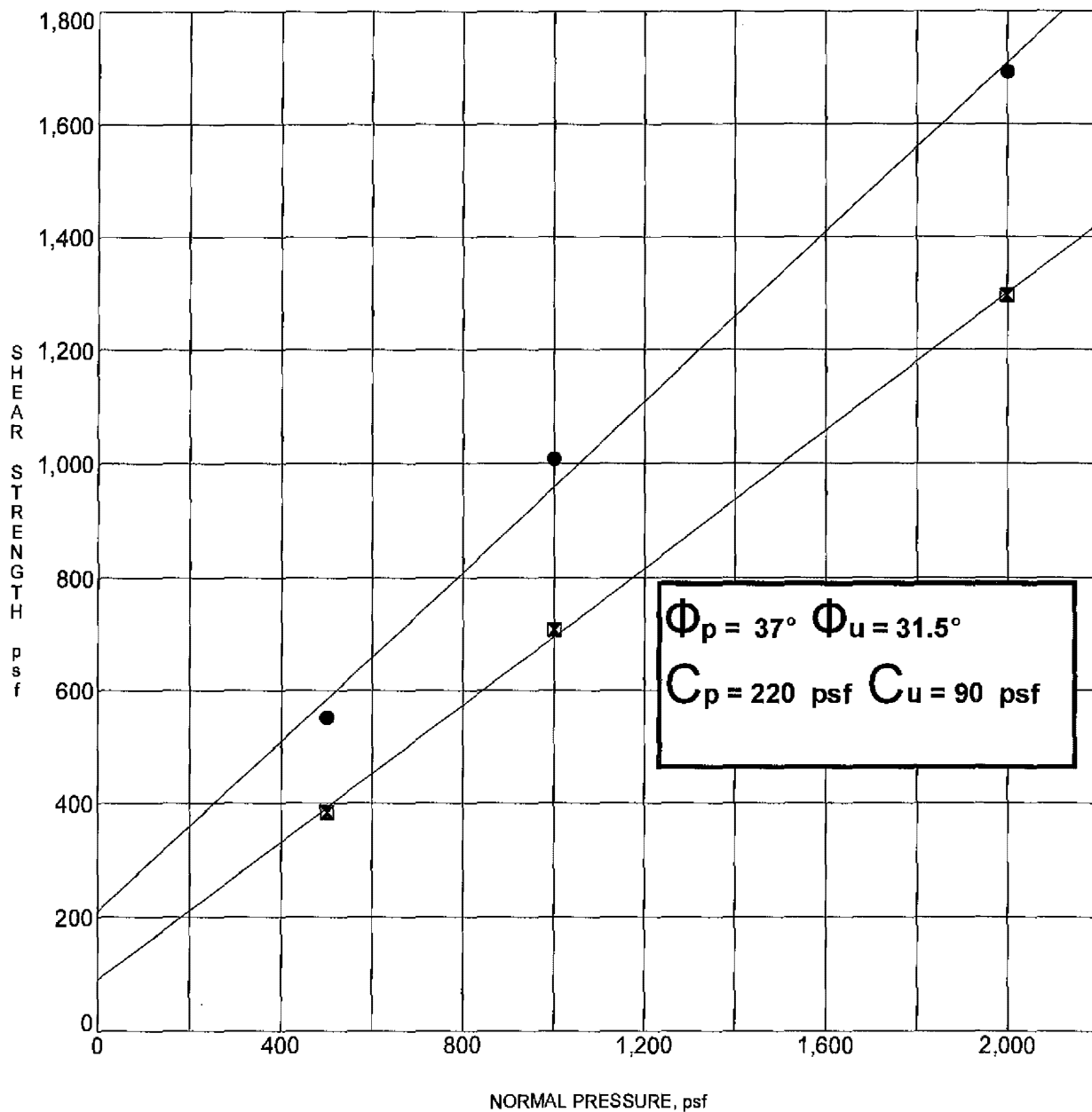
JOB NO.
DATE

20-01-3950
4/17/20

SHEAR TEST DIAGRAM

Harrington
Geotechnical
Engineering, Inc.

PLATE B-42



Specimen Identification			Classification	DD	MC%
●	B-5	30.0	SAND (SP) (Peak)	105	20
☒	B-5	30.0	(Ultimate)		

PROJECT Anaheim Ball Park - Anaheim, CA

JOB NO. 20-01-3950
DATE 4/17/20

SHEAR TEST DIAGRAM

Harrington
Geotechnical
Engineering, Inc.

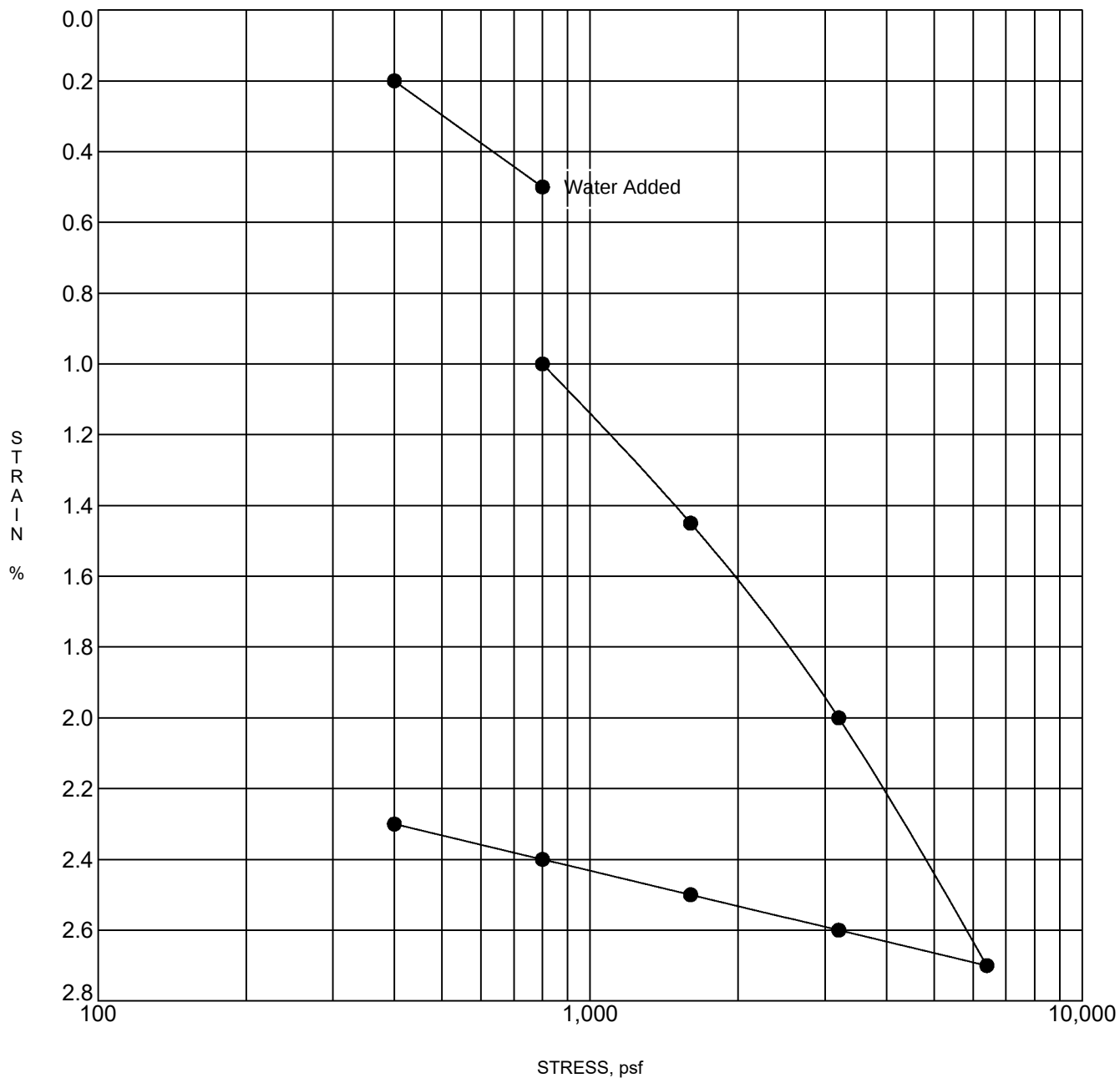
PLATE B-43

TABLE 1	
Water-Soluble Sulfate (EPA 300.0)	
Sample ID	Water-Soluble Sulfate (%)
B-2 @ 0'-2.5'	ND

ND non-detectable

SAMPLE STORAGE

Soil samples presently stored in our laboratory will be discarded 30 days after the date of this report unless this office receives a written request to retain the samples for a longer period. Note that prolonged storage will result in sample degradation and may render them unsuitable for testing.



Specimen Identification			Classification	DD	MC%
●	B-1	7.5	Gravelly Sand (SW)	97	5

PROJECT Anaheim Riverwalk - Anaheim

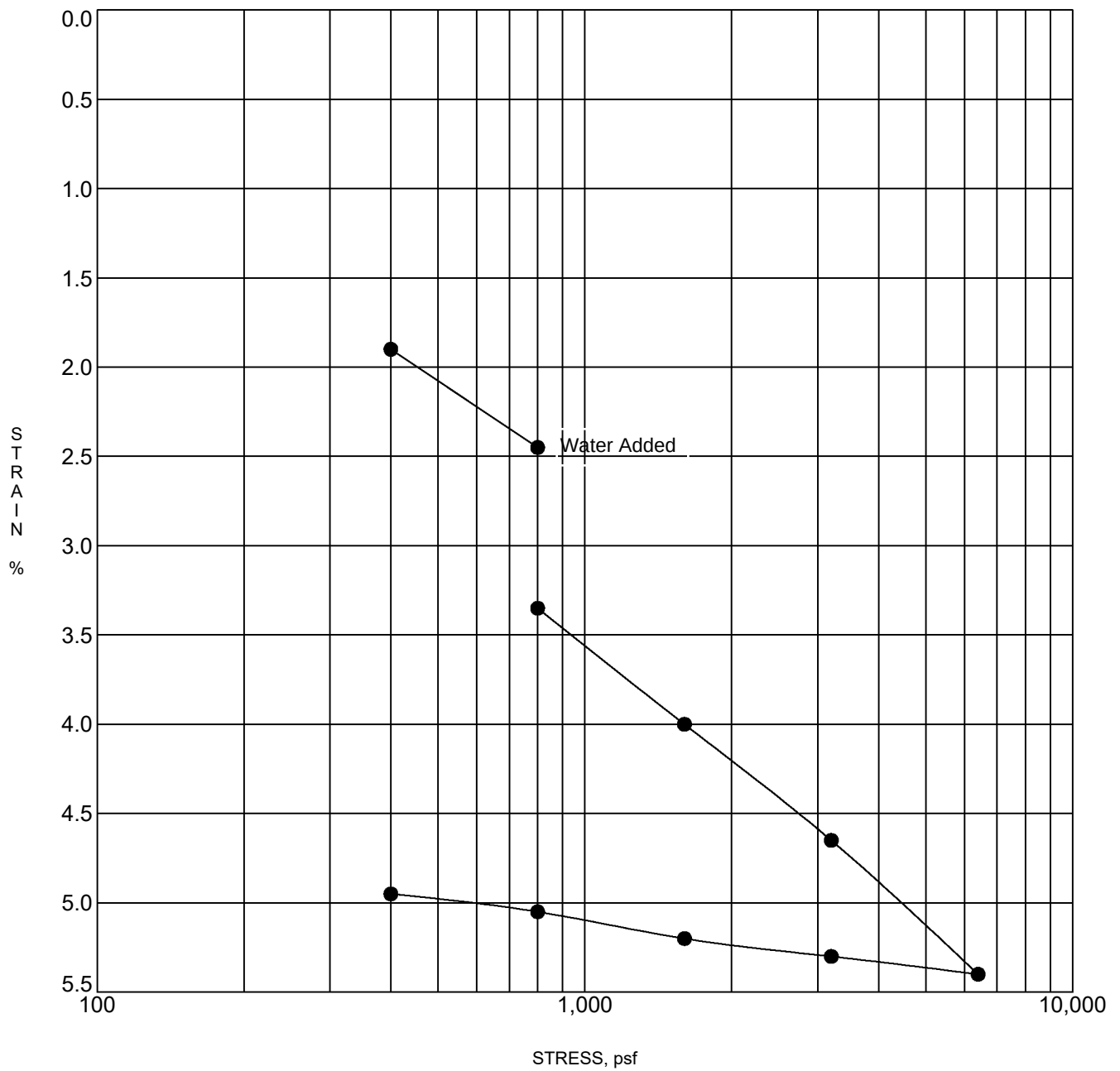
JOB NO. 0491-1

DATE 7/19/21

CONSOLIDATION TEST

Harrington
Geotechnical
Engineering, Inc. _____

PLATE B-1



Specimen Identification			Classification	DD	MC%
●	B-1	20.0	Medium Sand (SP)	96	5

PROJECT Anaheim Riverwalk - Anaheim

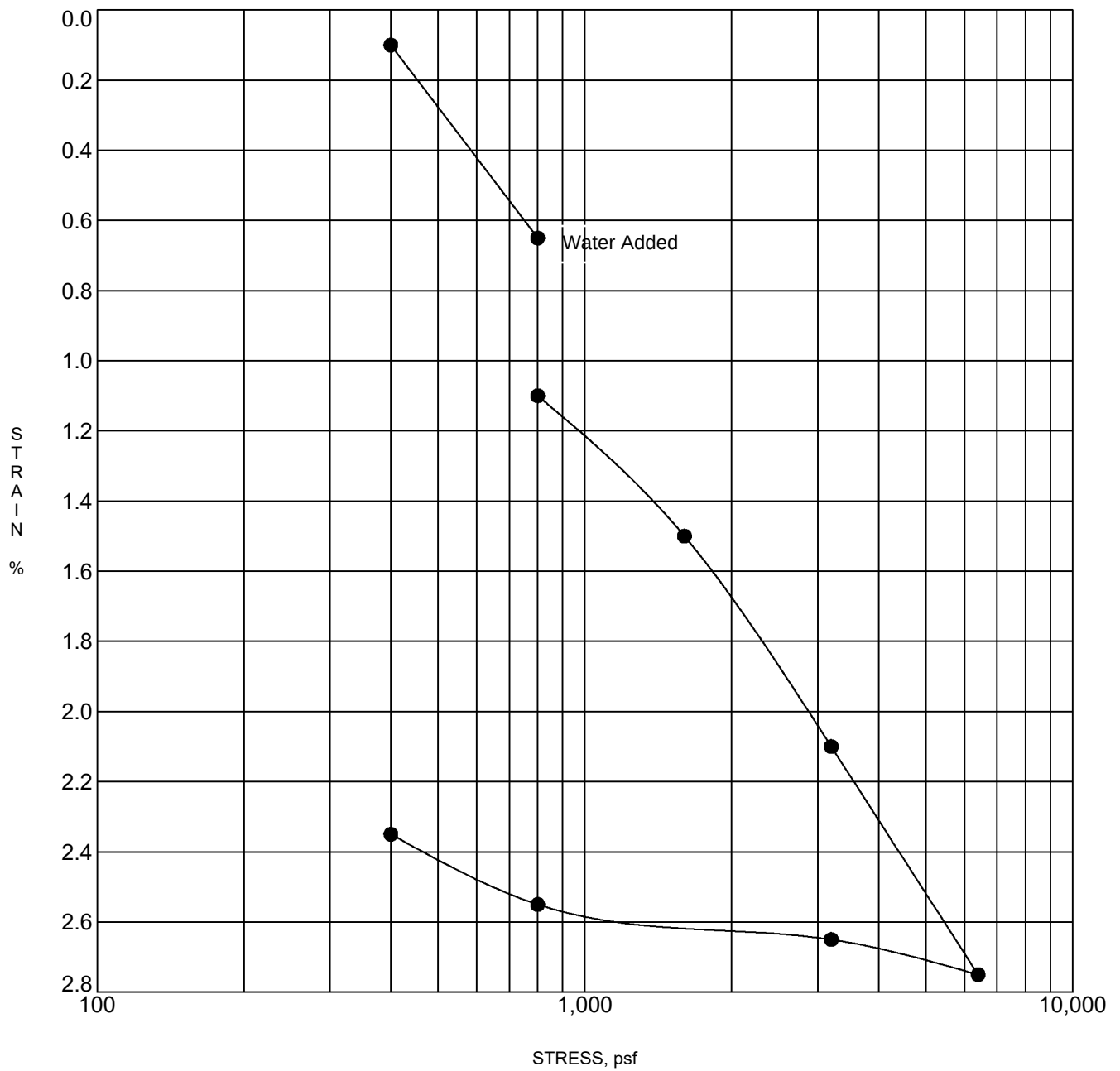
JOB NO. 0491-1

DATE 7/19/21

CONSOLIDATION TEST

Harrington
Geotechnical
Engineering, Inc. _____

PLATE B-2



Specimen Identification			Classification	DD	MC%
●	B-2	5.0	Fine to Coarse Sand (SW)	97	4

PROJECT Anaheim Riverwalk - Anaheim

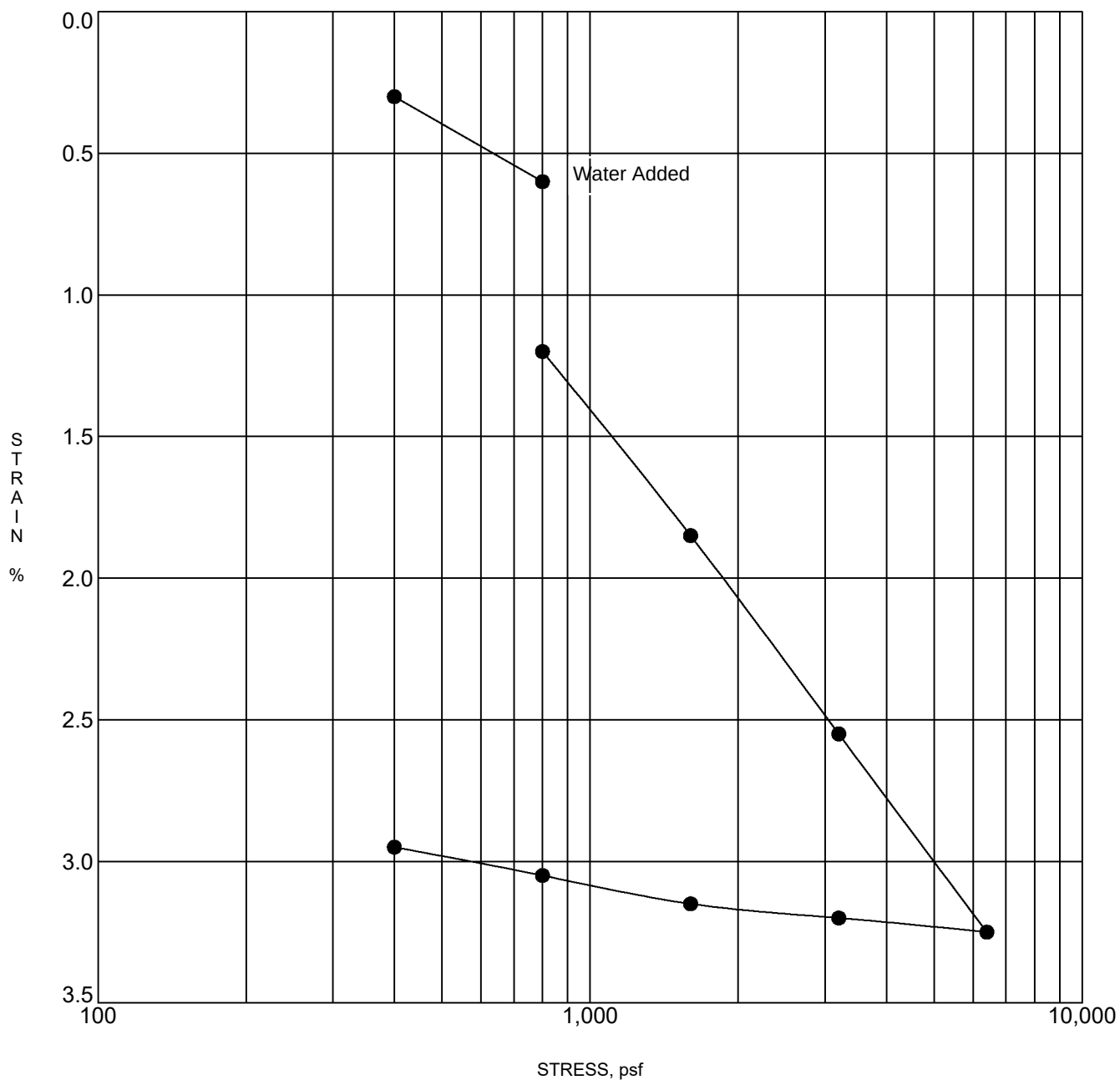
JOB NO. 0491-1

DATE 7/19/21

CONSOLIDATION TEST

Harrington
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Engineering, Inc. _____

PLATE B-3



Specimen Identification			Classification	DD	MC%
●	B-3	5.0	Silty Sand (SM)	94	4

PROJECT Anaheim Riverwalk - Anaheim

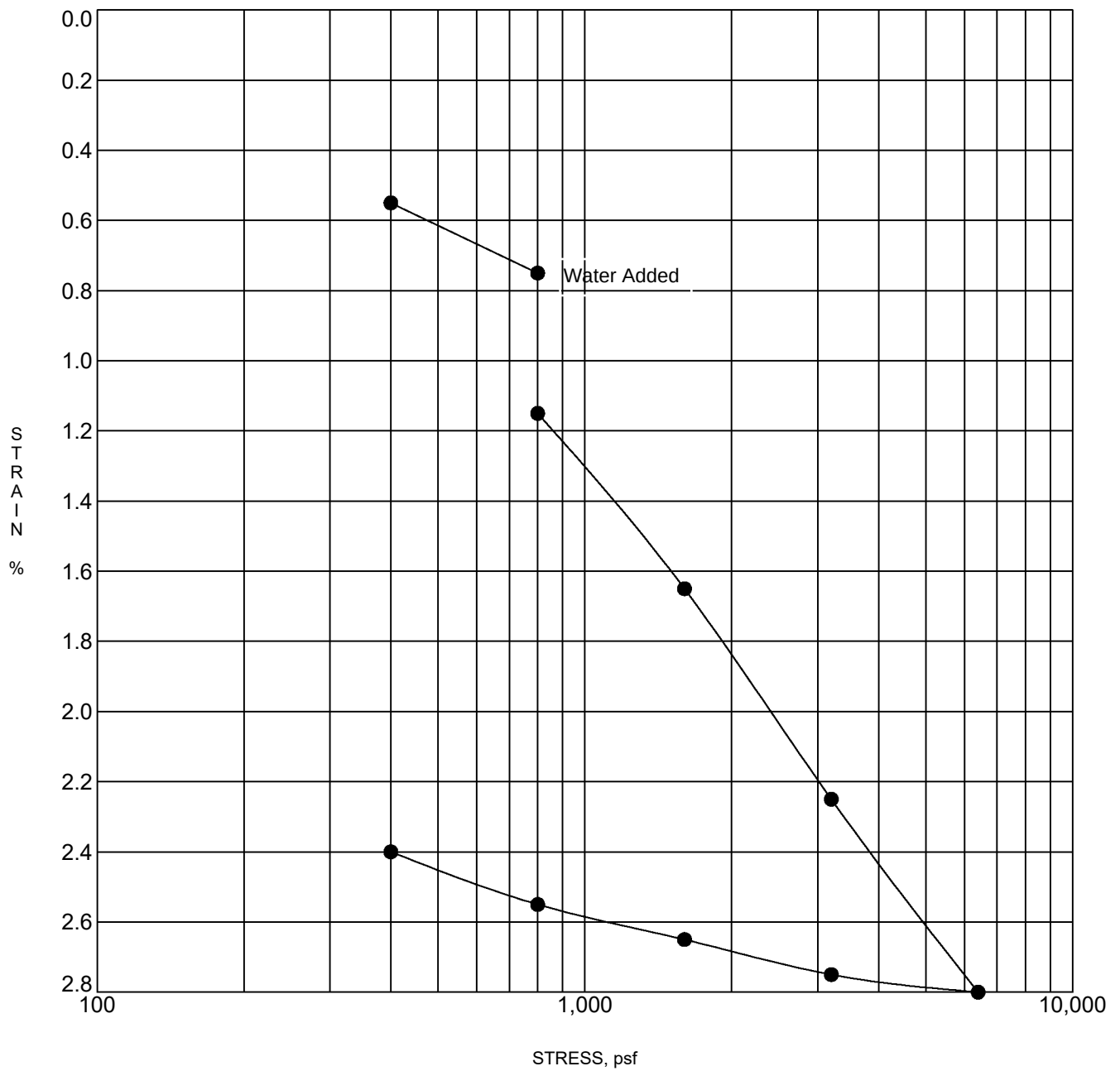
JOB NO. 0491-1

DATE 7/19/21

CONSOLIDATION TEST

Harrington
Geotechnical
Engineering, Inc. _____

PLATE B-4



Specimen Identification			Classification	DD	MC%
●	B-4	7.5	Fine to Medium Sand (SW)	99	5

PROJECT Anaheim Riverwalk - Anaheim

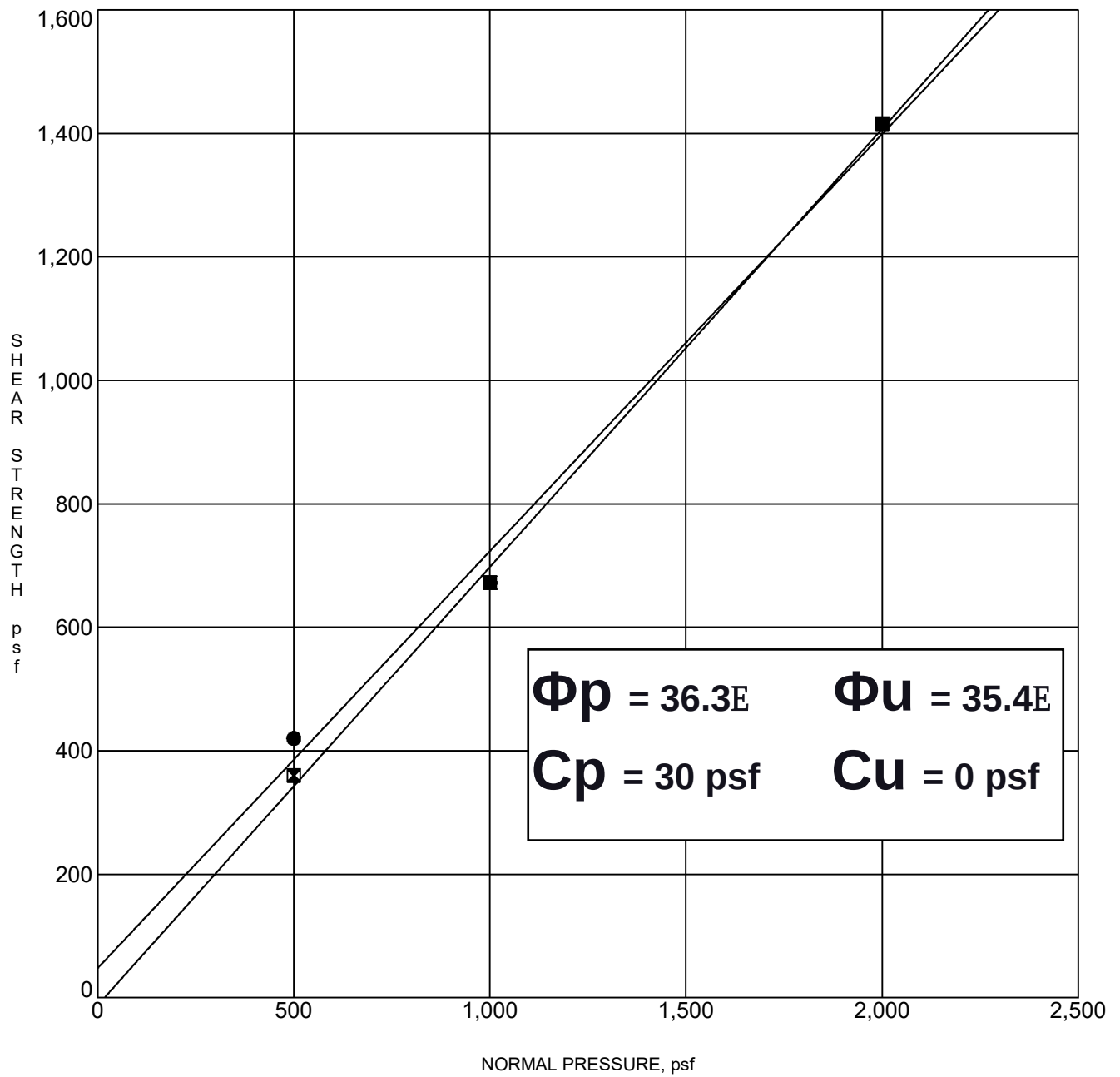
JOB NO. 0491-1

DATE 7/19/21

CONSOLIDATION TEST

Harrington
Geotechnical
Engineering, Inc. _____

PLATE B-5

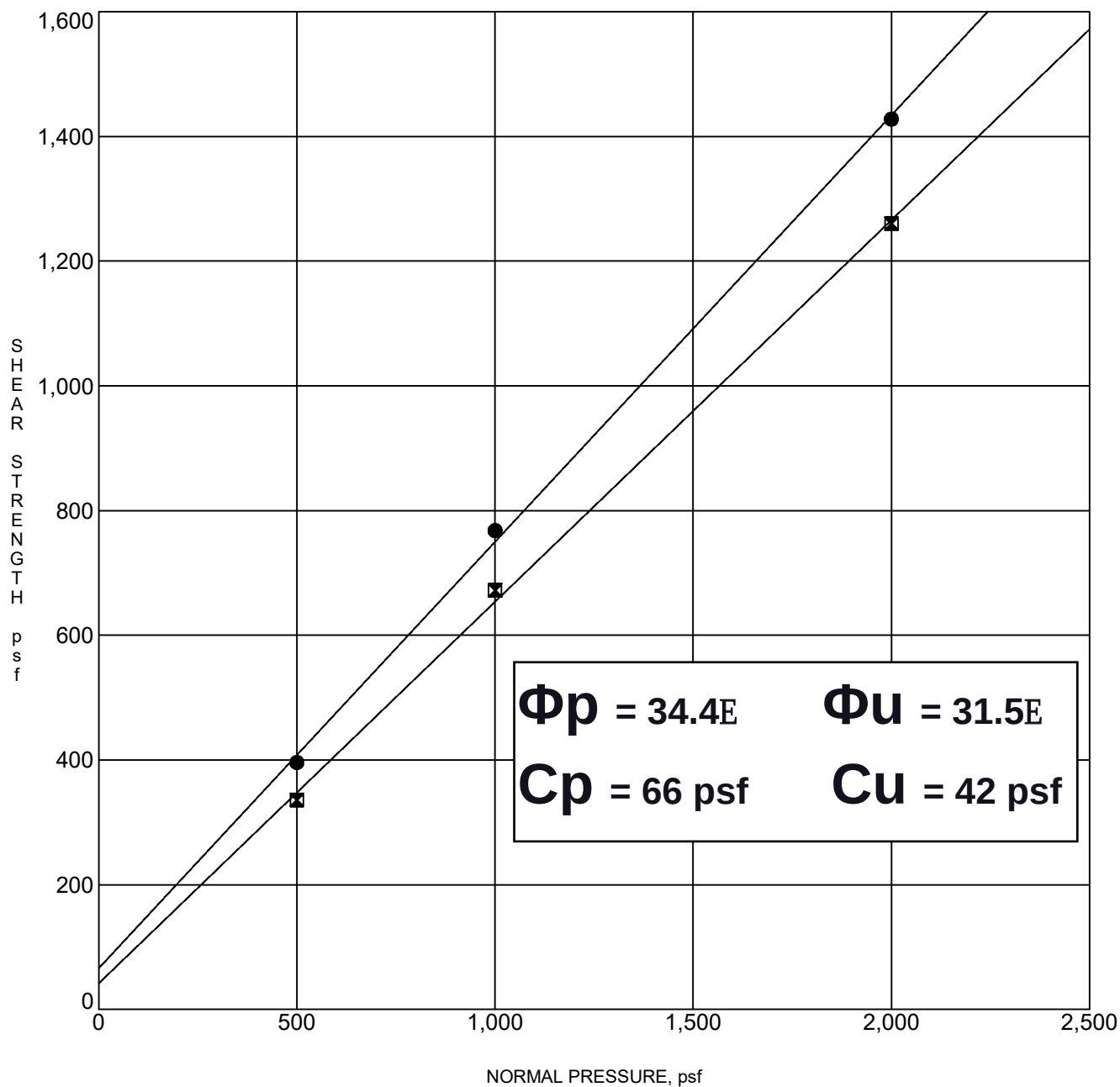


Specimen Identification			Classification	DD	MC%
●	B-1	5.0	Gravelly Sand (SW), (Peak)	95	10
☒	B-1	5.0	(Ultimate)		

PROJECT Anaheim Riverwalk - Anaheim JOB NO. 0491-1
DATE 7/21/21

SHEAR TEST DIAGRAM

Harrington
Geotechnical Engineering, Inc. _____



Specimen Identification			Classification	DD	MC%
●	B-1	17.5	Medium Sand (SP), (Peak)	97	19
☒	B-1	17.5	(Ultimate)		

PROJECT Anaheim Riverwalk - Anaheim

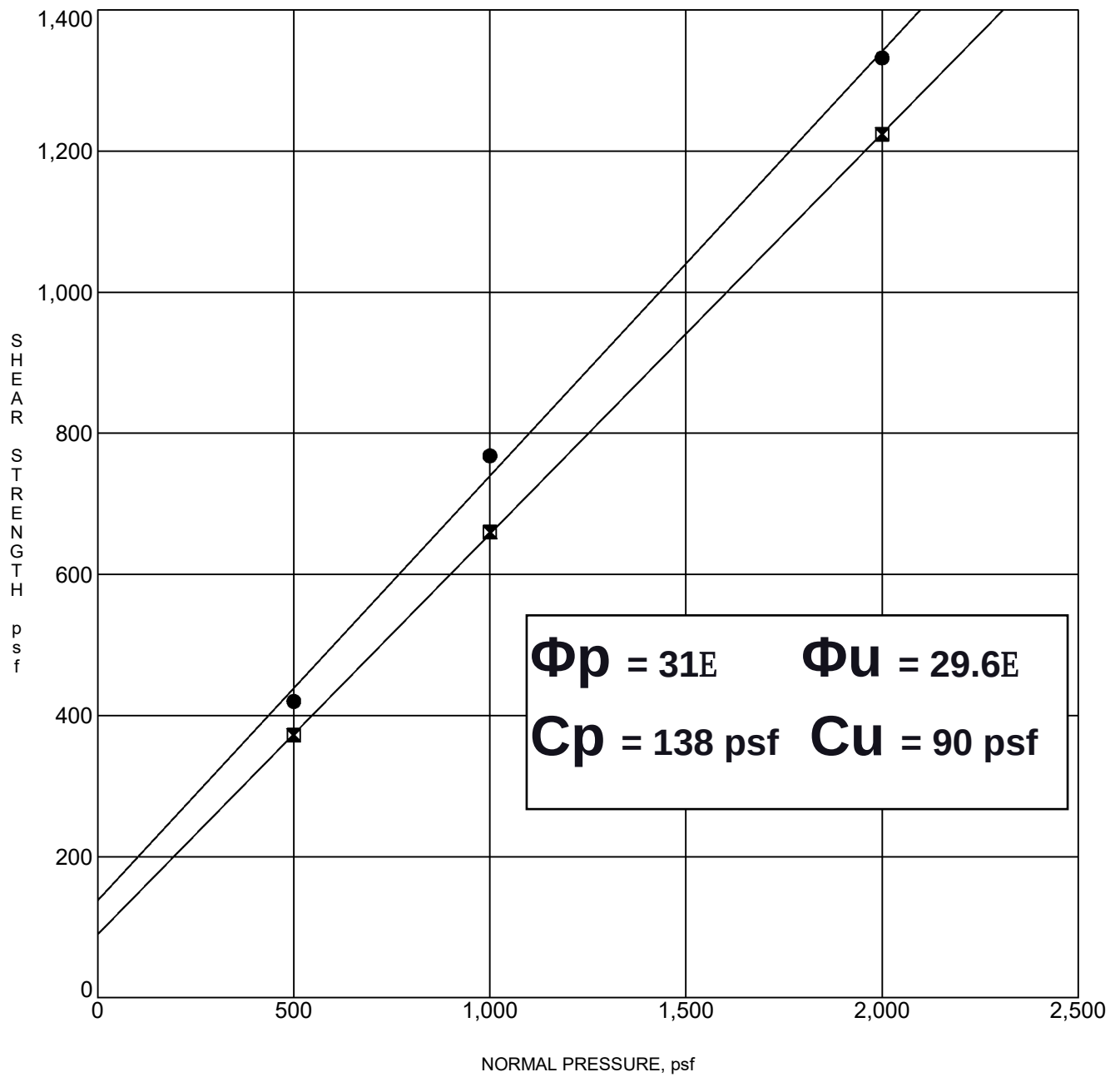
JOB NO. 0491-1

DATE 7/21/21

SHEAR TEST DIAGRAM

Harrington
Geotechnical
Engineering, Inc. _____

PLATE B-7



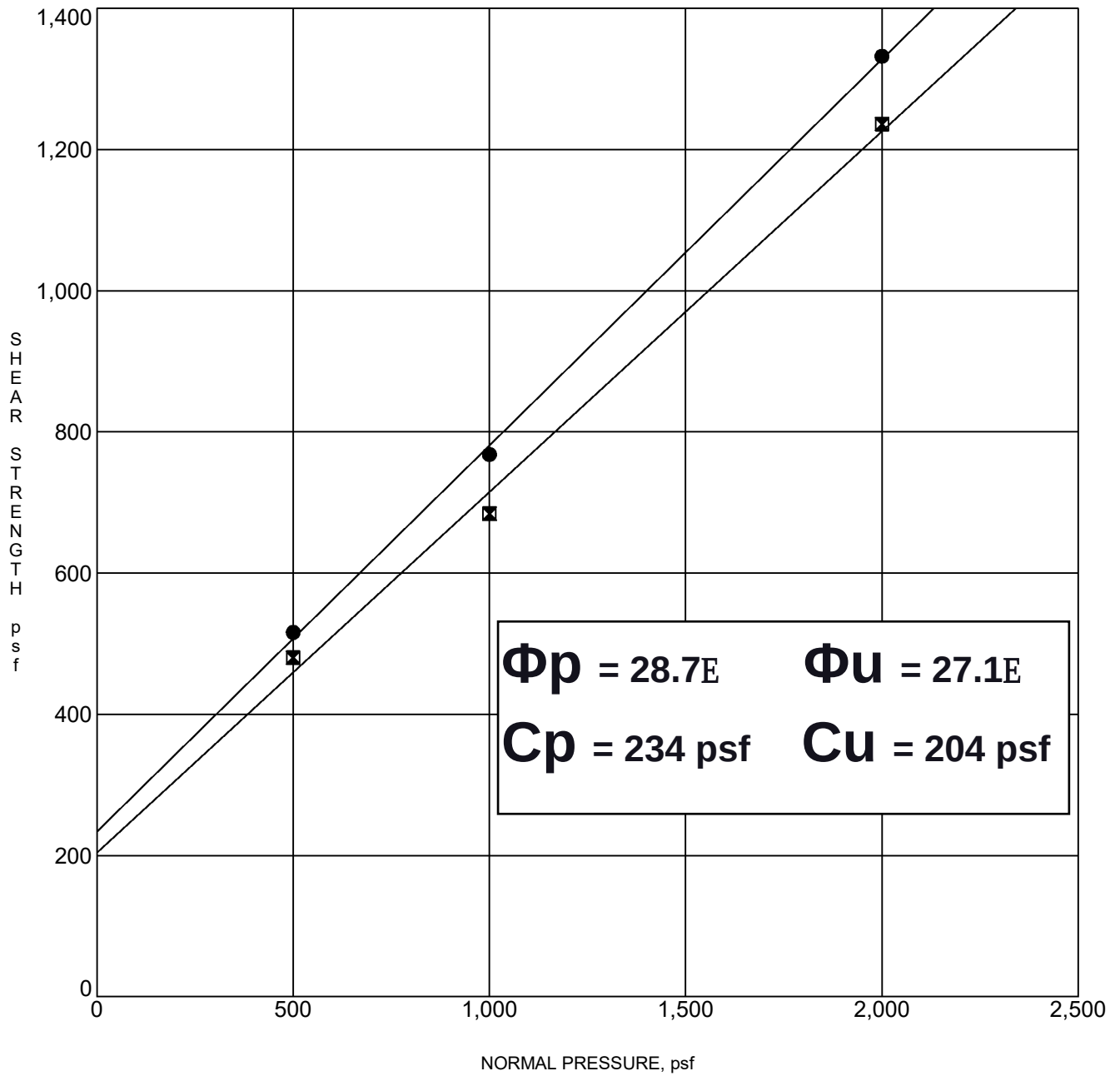
Specimen Identification			Classification	DD	MC%
●	B-2	2.5	Fine to Coarse Sand (SW), (Peak)	102	19
⊠	B-2	2.5	(Ultimate)		

PROJECT Anaheim Riverwalk - Anaheim JOB NO. 0491-1
DATE 7/21/21

SHEAR TEST DIAGRAM

Harrington
Geotechnical
Engineering, Inc. _____

PLATE B-8



Specimen Identification			Classification	DD	MC%
●	B-3	2.5	Silty Sand (SM), (Peak)	102	8
⊠	B-3	2.5	(Ultimate)		

PROJECT Anaheim Riverwalk - Anaheim

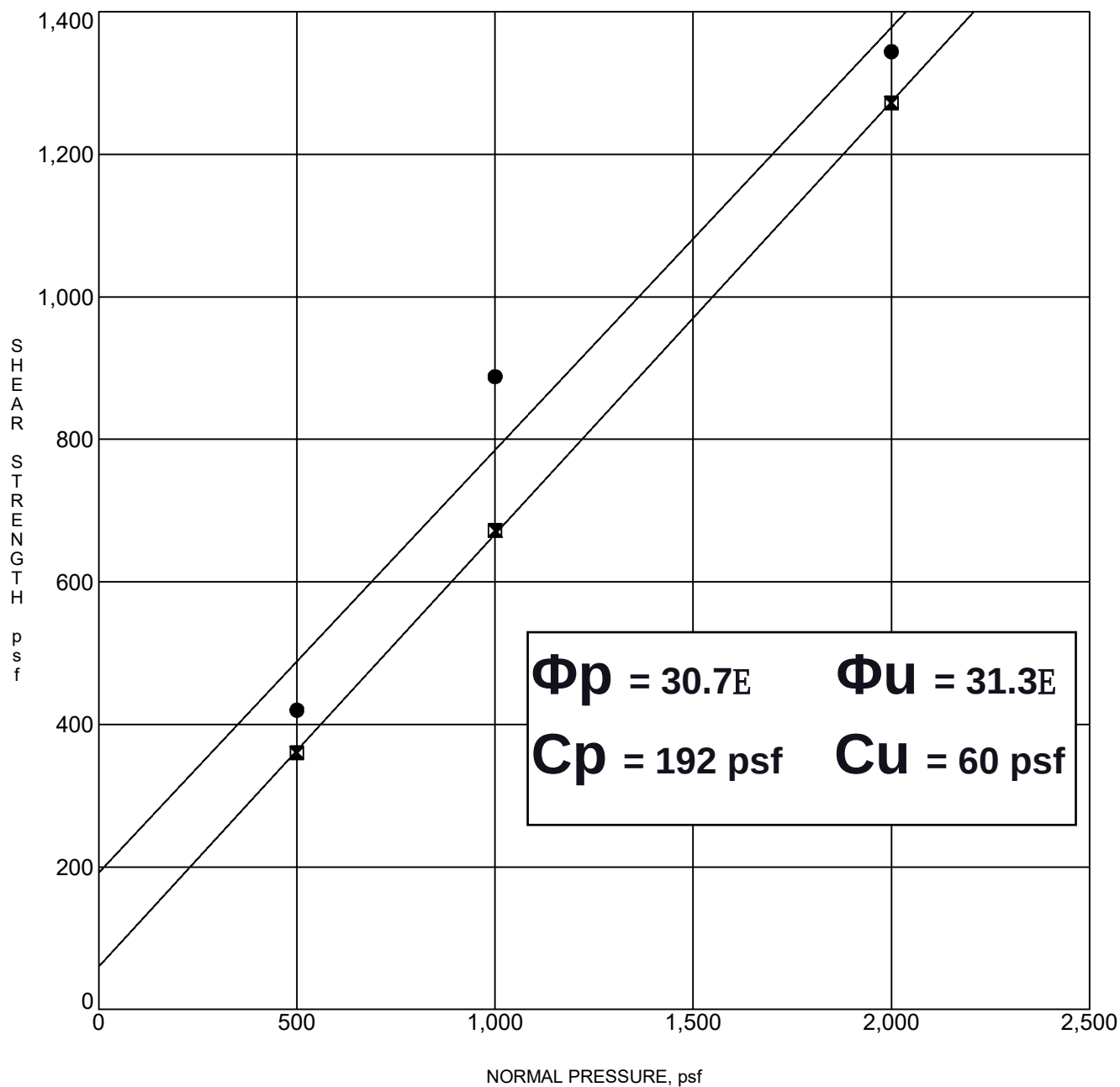
JOB NO. 0491-1

DATE 7/21/21

SHEAR TEST DIAGRAM

Harrington
Geotechnical
Engineering, Inc. _____

PLATE B-9



Specimen Identification			Classification	DD	MC%
●	B-4	5.0	Fine to Medium Sand (SW), (Peak)	93	7
☒	B-4	5.0	(Ultimate)		

PROJECT Anaheim Riverwalk - Anaheim

JOB NO. 0491-1

DATE 7/21/21

SHEAR TEST DIAGRAM

Harrington
Geotechnical
Engineering, Inc. _____

PLATE B-10

APPENDIX C - LABORATORY TESTING

Diaz•Yourman & Associates (DYA) selected soil samples to be tested and the tests to be performed on the selected samples. Laboratory testing was performed by AP Engineering and Testing, Inc., Hushmand Associates, Inc., and DYA. Laboratory data are summarized on the boring logs in Appendix B and presented on Plates C1 through C54. A summary of the geotechnical laboratory testing performed only for this Project is presented in Table C1. A summary of the corrosion test results is presented in Table C2.

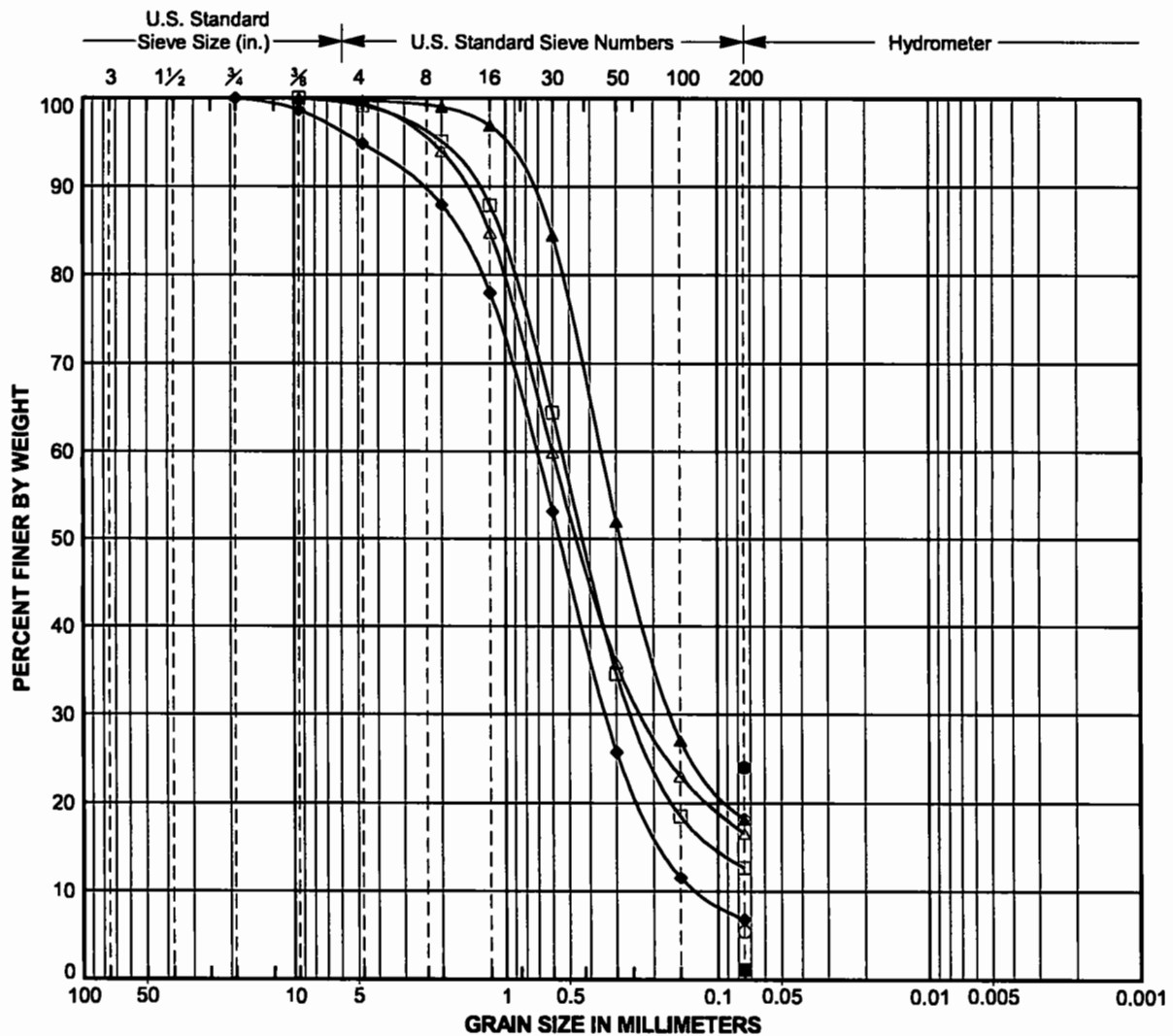
Table C1 - LABORATORY TESTING SUMMARY

TEST NAME	PROCEDURE	PURPOSE	LOCATION
Percent Passing the No. 200 Sieve	ASTM D1140	Classification, index properties	Boring Logs
Moisture Content, Dry Density	ASTM D2216	Classification, index properties	Boring Logs
Grain-Size Distribution	ASTM D422	Classification, index properties	Plates C1 through C6
Atterberg Limits	ASTM D-4318	Expansion potential, classification, index properties	Plates C7 through C10
Consolidation	ASTM D2435	Settlement	Plates C11 through C29
Direct Shear	ASTM D3080	Shear strength	Plates C30 through C34
Unconsolidated Undrained	ASTM D2850	Shear strength	Plates C35 through C39
Compaction	ASTM D1557	Earthwork	Plates C40 through C42
Resistance (R-) Value	ASTM D2844 CTM 301	Pavement thickness design	Plates C43 through C50
pH	CTM 532	Corrosion potential	Plates C51 through C54 and Table C2
Resistivity	CTM 532	Corrosion potential	Plates C51 through C54 and Table C2
Soluble Sulfates	CTM 417-B	Corrosion potential	Plates C51 through C54 and Table C2
Soluble Chlorides	CTM 422	Corrosion potential	Plates C51 through C54 and Table C2
Notes:			
• ASTM = American Society for Testing and Materials • CTM = Caltrans Test Method			

Table C2 - CORROSION POTENTIAL TEST RESULTS

Boring No.	DYB10-09	DYB10-10	DYB10-10	DYB10-16	DYB10-20	DYB10-20
Depth (feet)	1 to 36	40 to 60	57.5 to 100	18 to 48	1.5 to 14	19 to 49
pH	8.1	7.4	8	7.4	7.4	7.5
Water Soluble Sulfate Content (ppm)	47	49	142	68	74	67
Water Soluble Chloride Content (ppm)	128	199	215	151	213	140
Minimum Resistivity (ohms-cm)	13,000	2,700	3,300	1,800	3,800	3,400





COBBLES	Coarse	Fine	Coarse	Medium	Fine	SILT or CLAY
	GRAVEL		SAND			

Laboratory Testing by: AP Engineering and Testing, Inc., Hushmand Associates, Inc., and Diaz Yourman & Associates

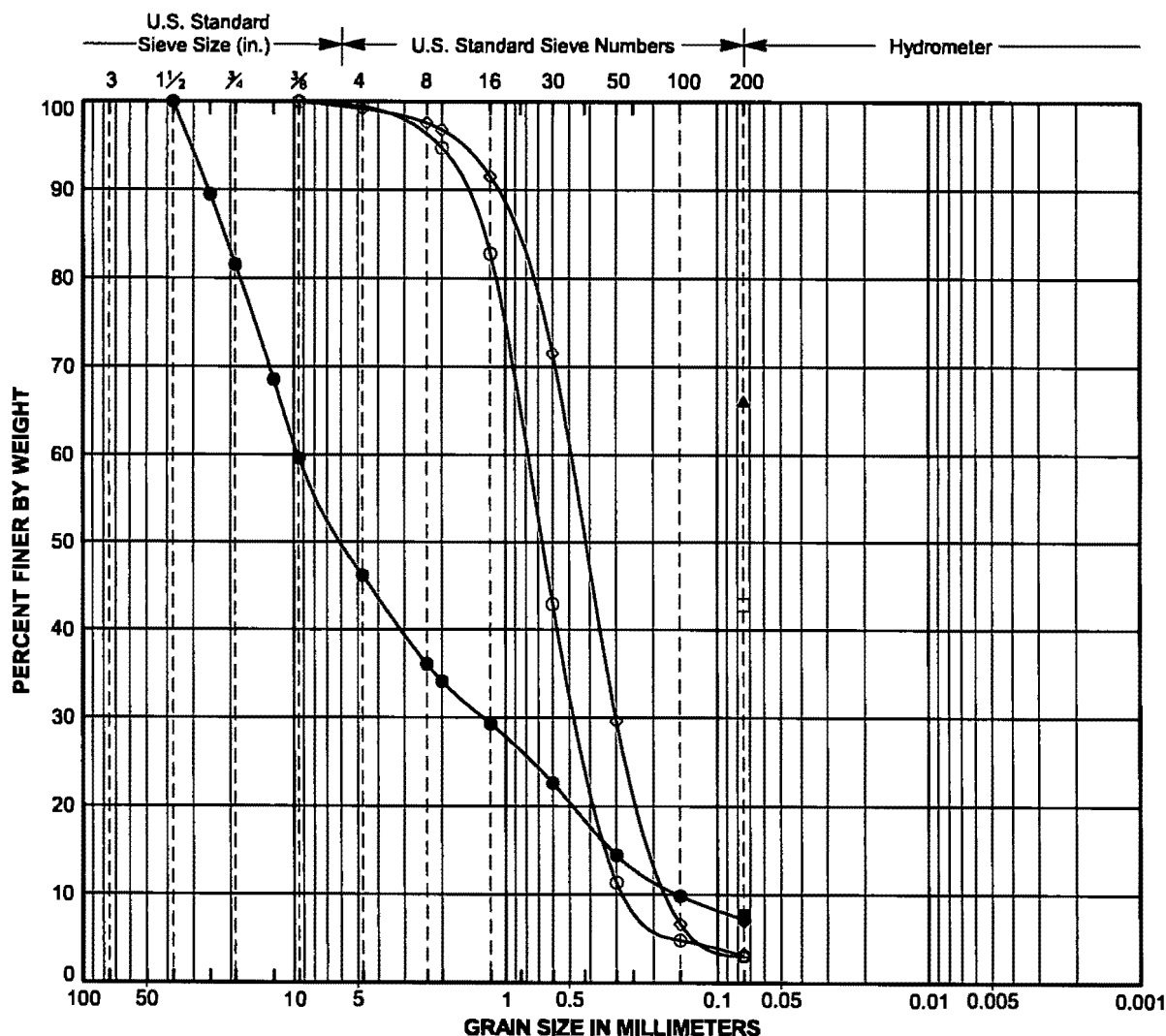
Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	DYB10-01	3.5	POORLY GRADED SAND WITH SILT (SP-SM)	2			5
□	DYB10-04	1.5	SILTY SAND (SM)	11			13
△	DYB10-04	2.5	SILTY SAND (SM)	7			17
◇	DYB10-04	5.5	SILTY SAND (SM)	9			18
●	DYB10-04	7.5	SILTY SAND (SM)				24
■	DYB10-04	13.5	POORLY GRADED SAND (SP)	2			1
▲	DYB10-05	2.5	SILTY SAND (SM)	7			18
◆	DYB10-05	6.5	POORLY GRADED SAND WITH SILT (SP-SM)				7

PARTICLE SIZE ANALYSIS

Anaheim Regional Transportation Intermodal Center
Project No. 2009-021

PLATE

C1



COBBLES	Coarse	Fine	Coarse	Medium	Fine	SILT or CLAY
	GRAVEL		SAND			

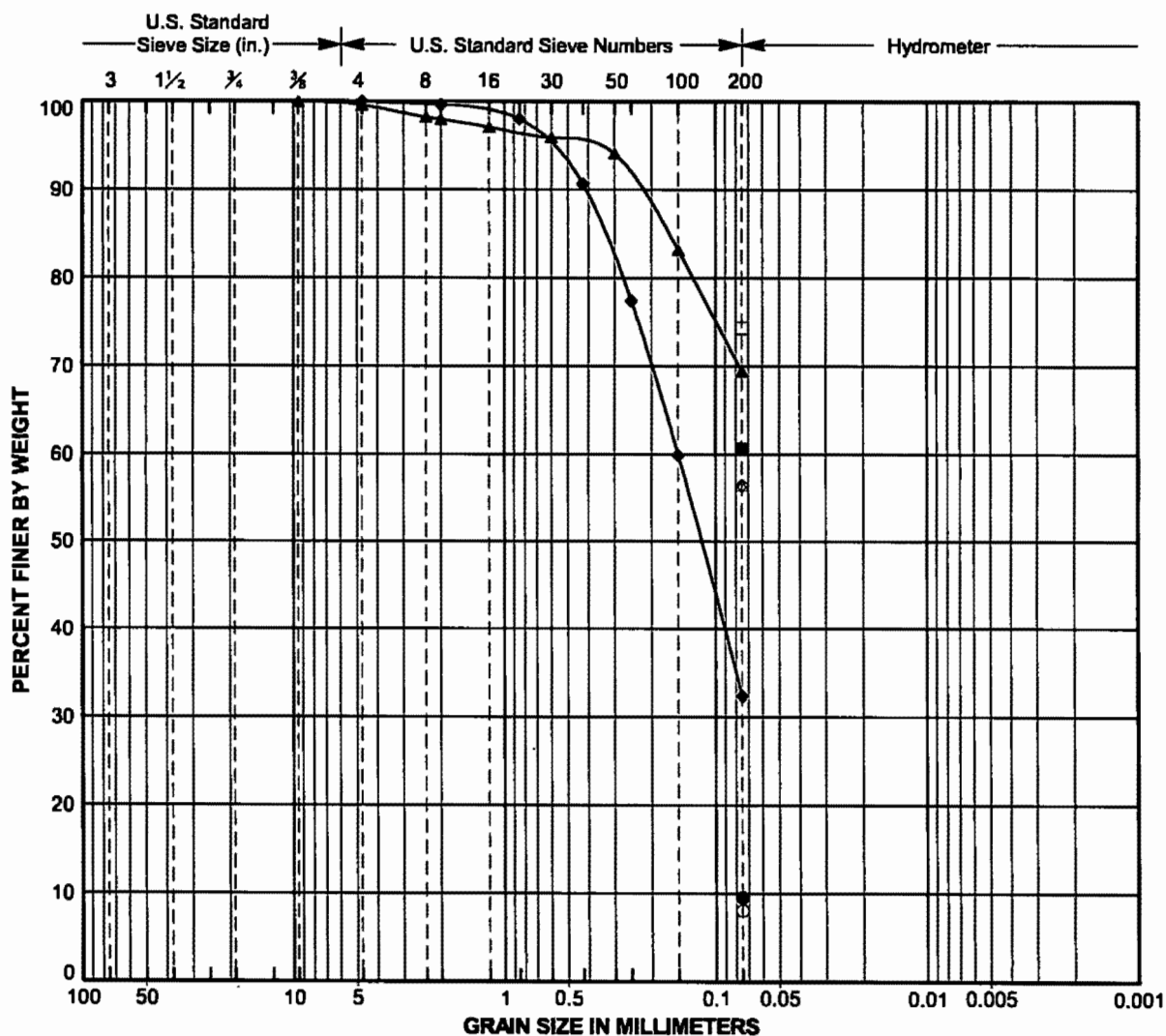
Laboratory Testing by: AP Engineering and Testing, Inc., Hushmand Associates, Inc., and Diaz Yourman & Associates

Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	DYB10-05	13.5	POORLY GRADED SAND (SP)	5			3
□	DYB10-06	1.0	SILTY SAND (SM)				43
△	DYB10-07	1.0	POORLY GRADED SAND (SP)	1			4
◇	DYB10-09	11.0	POORLY GRADED SAND (SP)				3
●	DYB10-09	41.0	WELL-GRADED GRAVEL WITH SILT AND SAND (GW-GM)				7
■	DYB10-10	25.0	POORLY GRADED SAND WITH SILT (SP-SM)				8
▲	DYB10-10	70.0	SANDY LEAN CLAY (CL)	23	30	10	66
◆	DYB10-11	4.0	POORLY GRADED SAND WITH SILT (SP-SM)				7

PARTICLE SIZE ANALYSIS

Anaheim Regional Transportation Intermodal Center
Project No. 2009-021

PLATE
C2



COBBLES	Coarse	Fine	Coarse	Medium	Fine	SILT or CLAY
	GRAVEL		SAND			

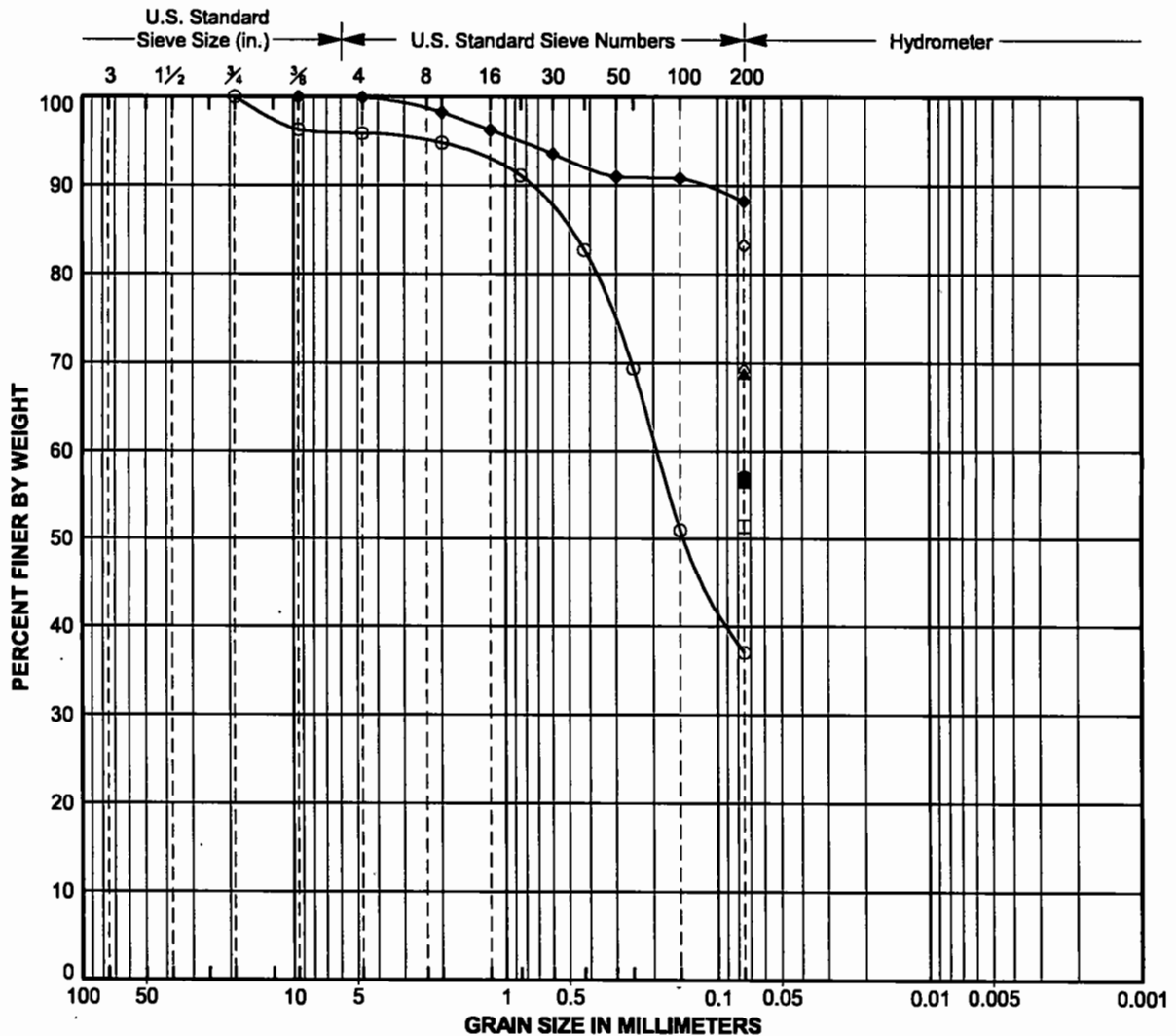
Laboratory Testing by: AP Engineering and Testing, Inc., Hushmand Associates, Inc., and Diaz Yourman & Associates

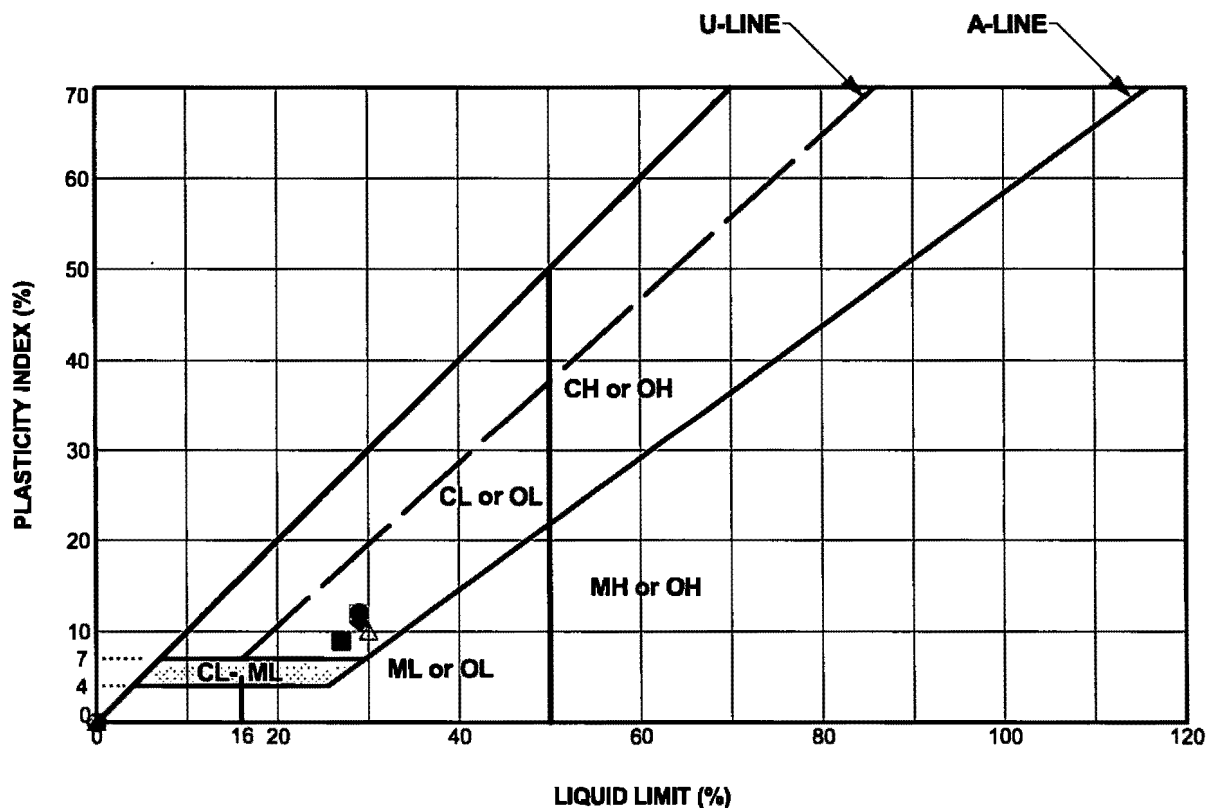
Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	DYB10-11	10.0	POORLY GRADED SAND WITH SILT (SP-SM)				8
□	DYB10-11	65.0	LEAN CLAY WITH SAND (CL)	20	27	9	74
△	DYB10-12	28.0	SANDY SILT (ML)	26	NP	NP	56
◇	DYB10-12	50.0	SANDY LEAN CLAY (CL)	31	27	10	56
●	DYB10-12	93.0	POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)				10
■	DYB10-13	31.5	SANDY SILT (ML)	22	NP	NP	61
▲	DYB10-13	75.0	SANDY LEAN CLAY (CL)	20	27	8	69
◆	DYB10-14	17.0	SILTY SAND (SM)	15			32

PARTICLE SIZE ANALYSIS

Anaheim Regional Transportation Intermodal Center
Project No. 2009-021

PLATE
C3





Laboratory Testing by: AP Engineering and Testing, Inc., Hushmand Associates, Inc., and Diaz Yelmar & Associates, Inc. Volume 8, ASTM D-15318-05

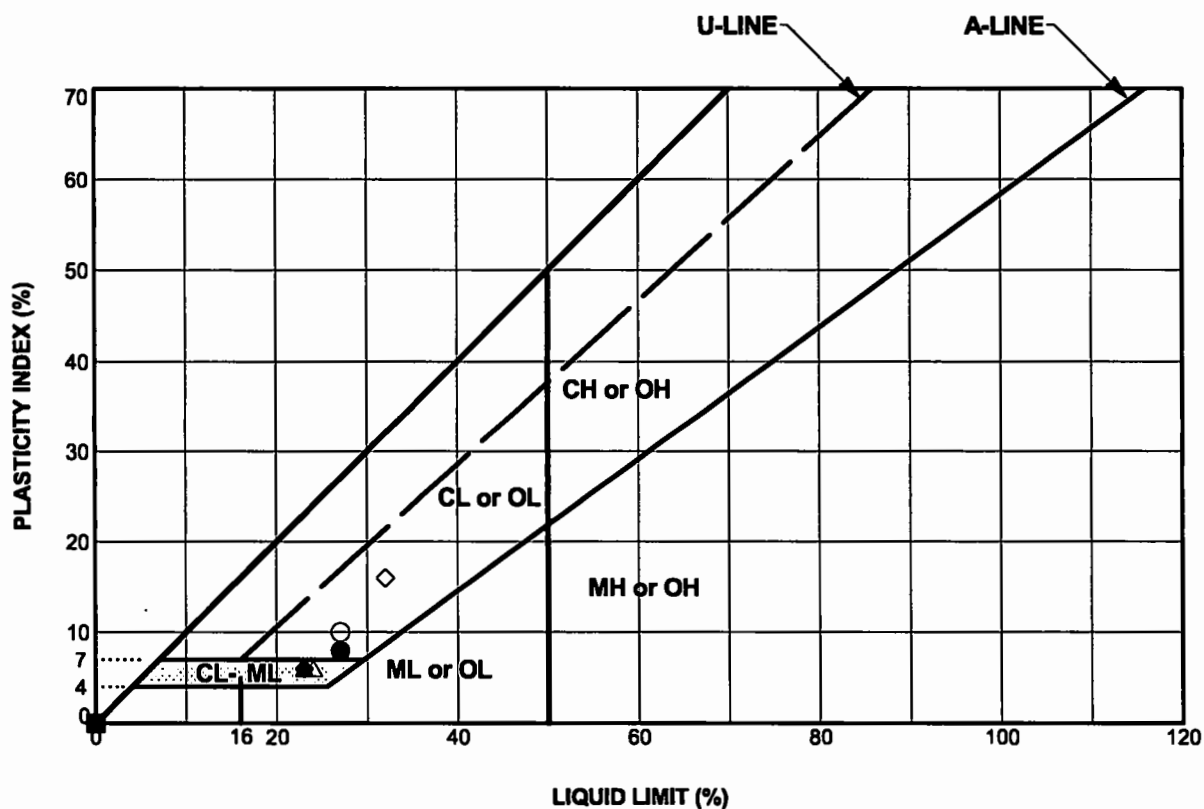
Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	DYB10-02	1.5	SANDY SILT (ML)	7	NP	NP	NP	
□	DYB10-09	46.0	LEAN CLAY WITH SAND (CL)	23	29	17	12	
△	DYB10-10	70.0	SANDY LEAN CLAY (CL)	23	30	20	10	66
◇	DYB10-11	25.0	SANDY SILT (ML)	22	NP	NP	NP	
●	DYB10-11	50.0	LEAN CLAY WITH SAND (CL)	25	29	17	12	
■	DYB10-11	65.0	LEAN CLAY WITH SAND (CL)	20	27	18	9	74
▲	DYB10-12	28.0	SANDY SILT (ML)	26	NP	NP	NP	56
◆	DYB10-12	48.0	SANDY LEAN CLAY (CL)	23	29	18	11	

PLASTICITY CHART

Anaheim Regional Transportation Intermodal Center
Project No. 2009-021

PLATE

C7



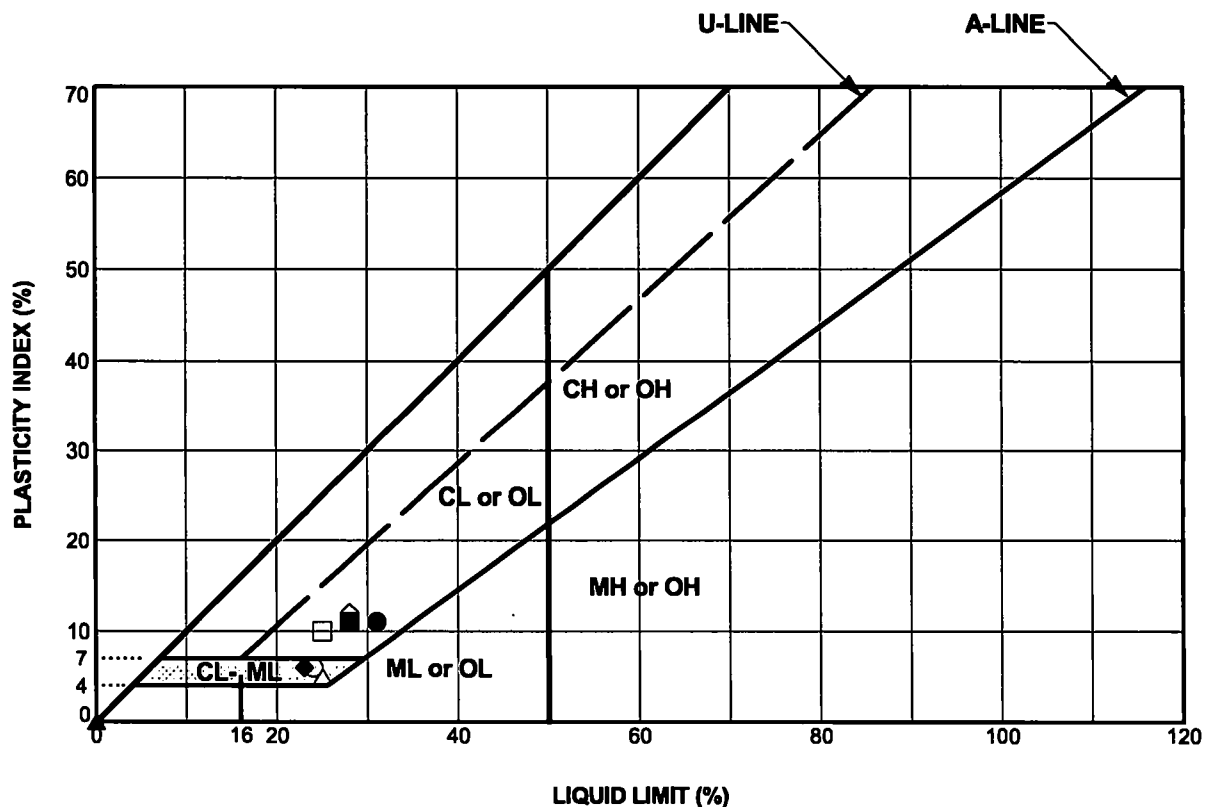
Laboratory Testing by: AP Engineering and Testing, Inc., Hushmand Associates, Inc., and Diaz Yehumenes Associates, Inc. Volume 8, ASTM D 318-05

Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	DYB10-12	50.0	SANDY LEAN CLAY (CL)	31	27	17	10	56
□	DYB10-13	31.5	SANDY SILT (ML)	22	NP	NP	NP	61
△	DYB10-13	41.0	SANDY SILTY CLAY (CL-ML)	20	24	18	6	
◇	DYB10-13	60.0	LEAN CLAY WITH SAND (CL)	25	32	16	16	
●	DYB10-13	75.0	SANDY LEAN CLAY (CL)	20	27	19	8	69
■	DYB10-14	34.0	SANDY SILT (ML)	24	NP	NP	NP	51
▲	DYB10-14	42.0	SILTY CLAY (CL-ML)	19	23	17	6	
◆	DYB10-14	77.0	SANDY SILTY CLAY (CL-ML)	17	23	17	6	

PLASTICITY CHART

Anaheim Regional Transportation Intermodal Center
Project No. 2009-021

PLATE
C8



Laboratory Testing by: AP Engineering and Testing, Inc., Hushmand Associates, Inc., and Diaz & Associates, Inc. Test Method: ASTM D 1586-05

Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	DYB10-15	29.0	SILTY CLAY WITH SAND (CL-ML)	23	24	18	6	
□	DYB10-15	32.5	SANDY LEAN CLAY (CL)	18	25	15	10	70
△	DYB10-15	42.5	SANDY SILTY CLAY (CL-ML)	21	25	20	5	
◇	DYB10-15	47.5	SANDY LEAN CLAY (CL)	17	28	16	12	
●	DYB10-15	52.5	LEAN CLAY WITH SAND (CL)	25	31	20	11	83
■	DYB10-15	67.5	SANDY LEAN CLAY (CL)	22	28	17	11	
▲	DYB10-16	23.0	SANDY SILT (ML)	16	NP	NP	NP	57
◆	DYB10-16	50.0	SILTY CLAY WITH SAND (CL-ML)	19	23	17	6	

PLASTICITY CHART

Anaheim Regional Transportation Intermodal Center
Project No. 2009-021

PLATE
C9



HUSHMAND ASSOCIATES, INC.
Geotechnical and Earthquake Engineers

CONSOLIDATION TEST (ASTM D2435)

Project Name: ARTIC
Boring No.: DYB10-12 **Sample No.:** 8 **Depth:** 28'
Soil Description: Grayish Brown Sandy Silt (ML)

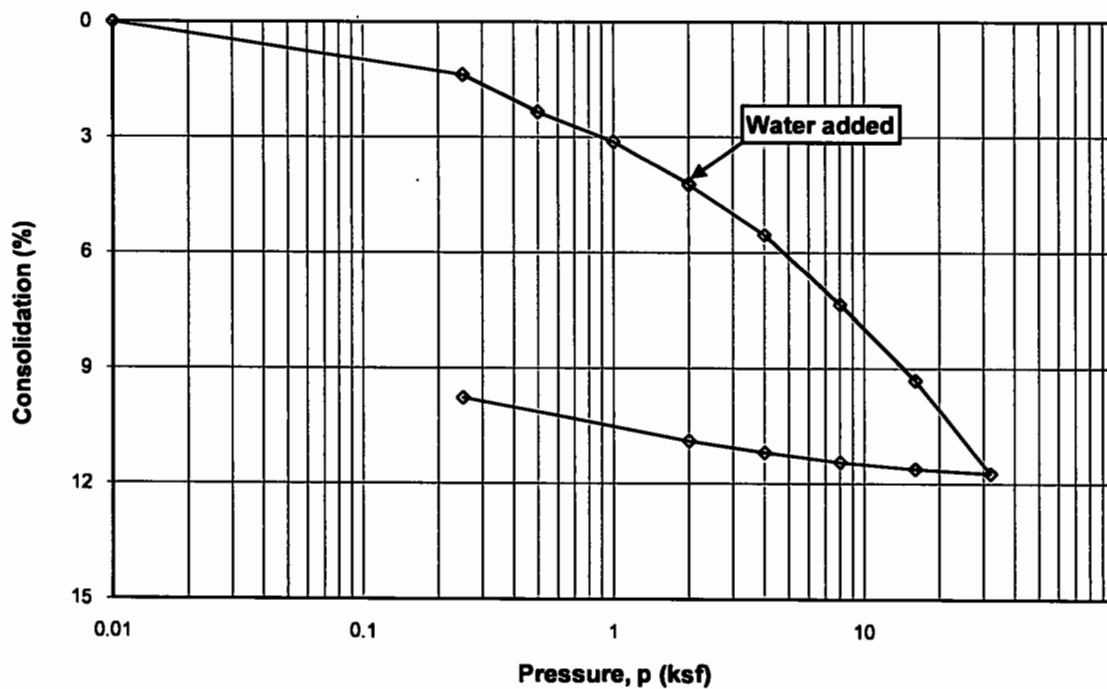
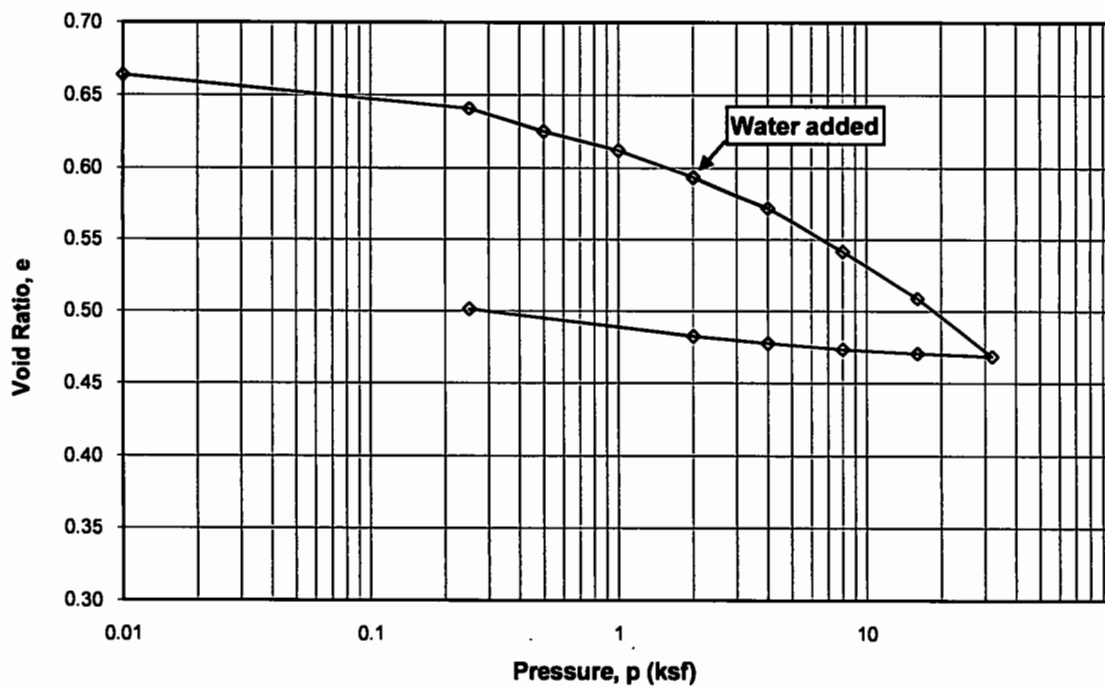
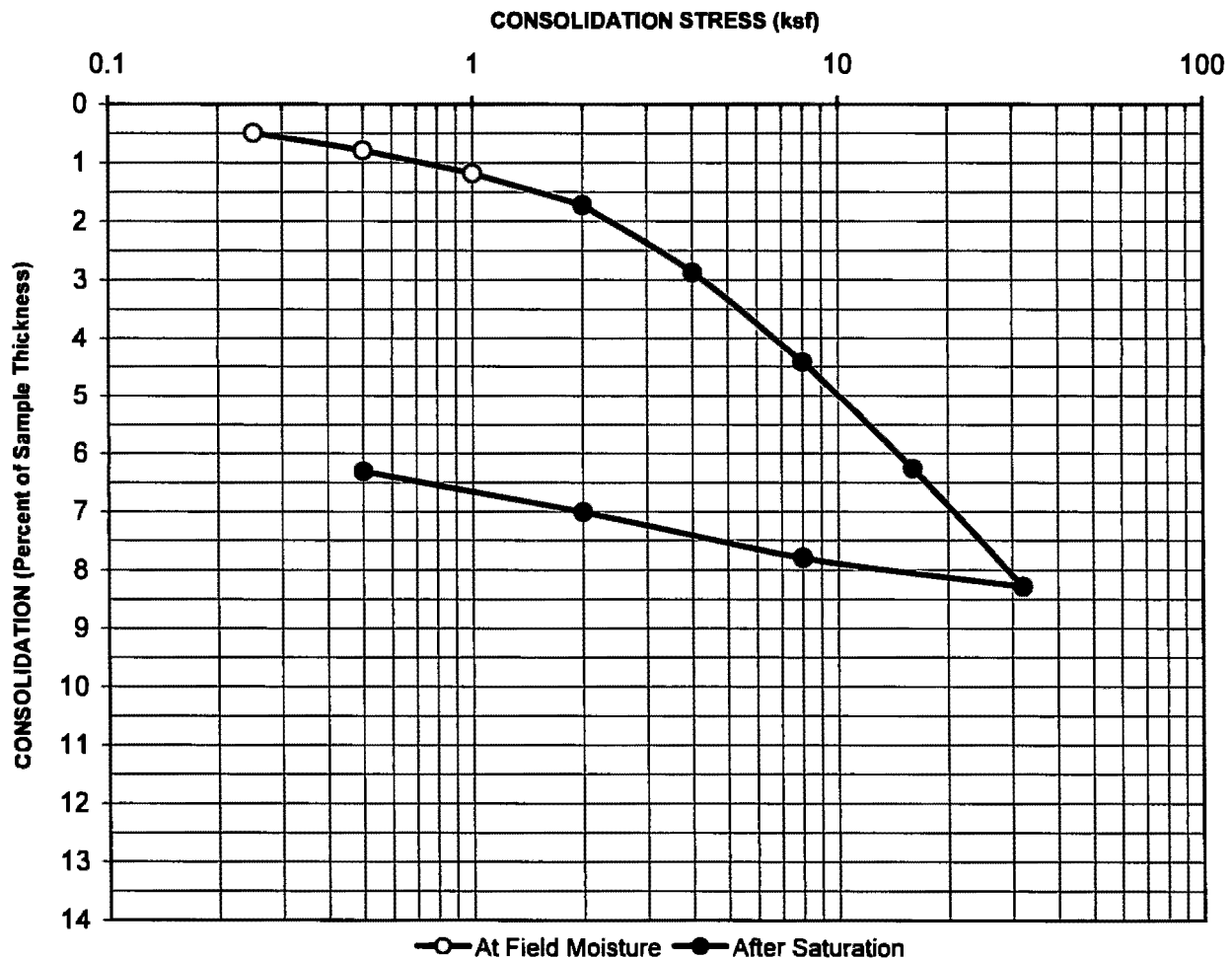


PLATE
C14



AP Engineering & Testing, Inc.



Boring No. : DYB10-13

Initial Dry Unit Weight (pcf): 106.0

Sample No.: 9

Initial Moisture Content (%): 22.1

Depth (feet): 31.5

Final Moisture Content (%): 19.8

Sample Type: Mod Cal

Assumed Specific Gravity: 2.7

Soil Description: Light Brown Sandy Silt (ML)

Initial Void Ratio: 0.59

Remarks: _____

CONSOLIDATION CURVE
ASTM D 2435

Project Name: ARTIC

Project No.: 2009-021

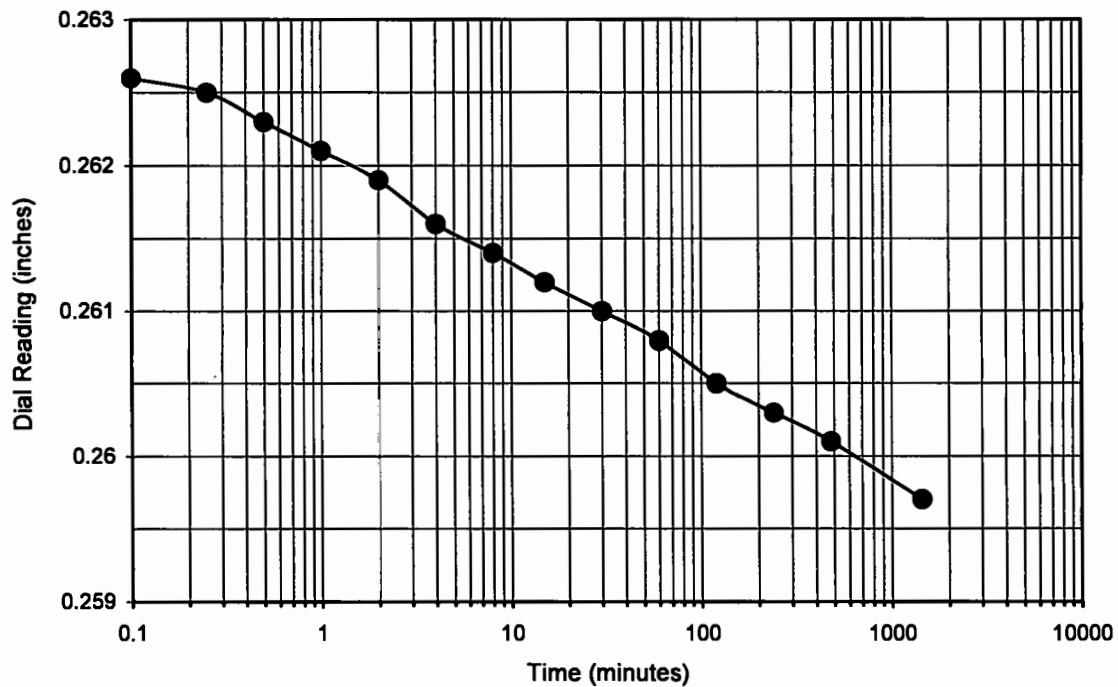
Date: 3/11/2010

AP No: 10-0313

PLATE
C15



AP Engineering & Testing, Inc.



Boring No. :	DYB10-13	Sample Type:	Undisturbed
Sample No.:	9	Soil Description:	Light Brown Sandy Silt (ML)
Depth (feet):	31.5	Vertical Pressure (ksf):	2
		Test Condition:	Saturated

Time (minutes)	Dial Reading (inches)
0.1	0.2626
0.25	0.2625
0.5	0.2623
1	0.2621
2	0.2619
4	0.2616
8	0.2614
15	0.2612
30	0.261
60	0.2608
120	0.2605
240	0.2603
480	0.2601
1440	0.2597

TIME RATE CONSOLIDATION CURVE
ASTM D 2435

Project Name: ARTIC

Project No.: 2009-021

Date: 03/11/10

AP No: 10-0313

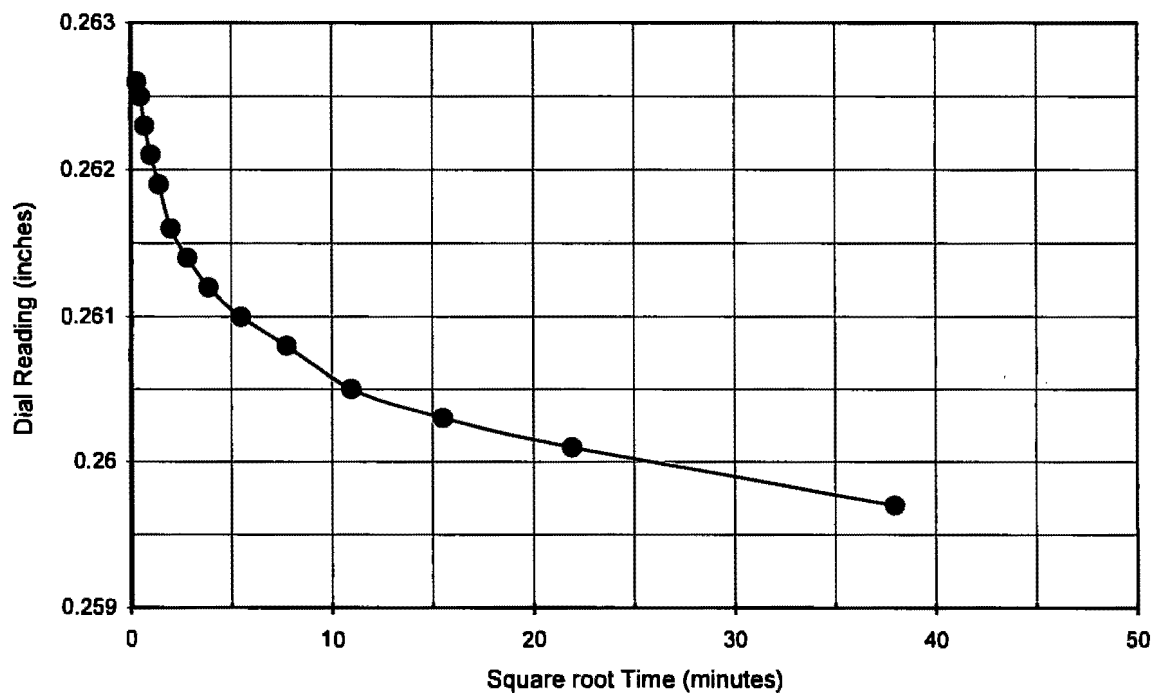
Figure No:

PLATE

C16



AP Engineering & Testing, Inc.



Boring No. :	DYB10-13	Sample Type:	Undisturbed
Sample No.:	9	Soil Description:	Light Brown Sandy Silt (ML)
Depth (feet):	31.5	Vertical Pressure (ksf):	2
		Test Condition:	Saturated

SQRT Time (minutes)	Dial Reading (inches)
0.3162	0.2626
0.5000	0.2625
0.7071	0.2623
1.0000	0.2621
1.4142	0.2619
2.0000	0.2616
2.8284	0.2614
3.8730	0.2612
5.4772	0.2610
7.7460	0.2608
10.9545	0.2605
15.4919	0.2603
21.9089	0.2601
37.9473	0.2597

TIME RATE CONSOLIDATION CURVE
ASTM D 2435

Project Name: ARTIC

Project No.: 2009-021

Date: 03/11/10

AP No: 10-0313

Figure No:

PLATE

C17

CONSOLIDATION TEST (ASTM D2435)

Project Name: ARTIC
Boring No.: DYB10-15 **Sample No.:** 8 **Depth:** 29'
Soil Description: Olive Brown Silty Clay with Sand (CL-ML)

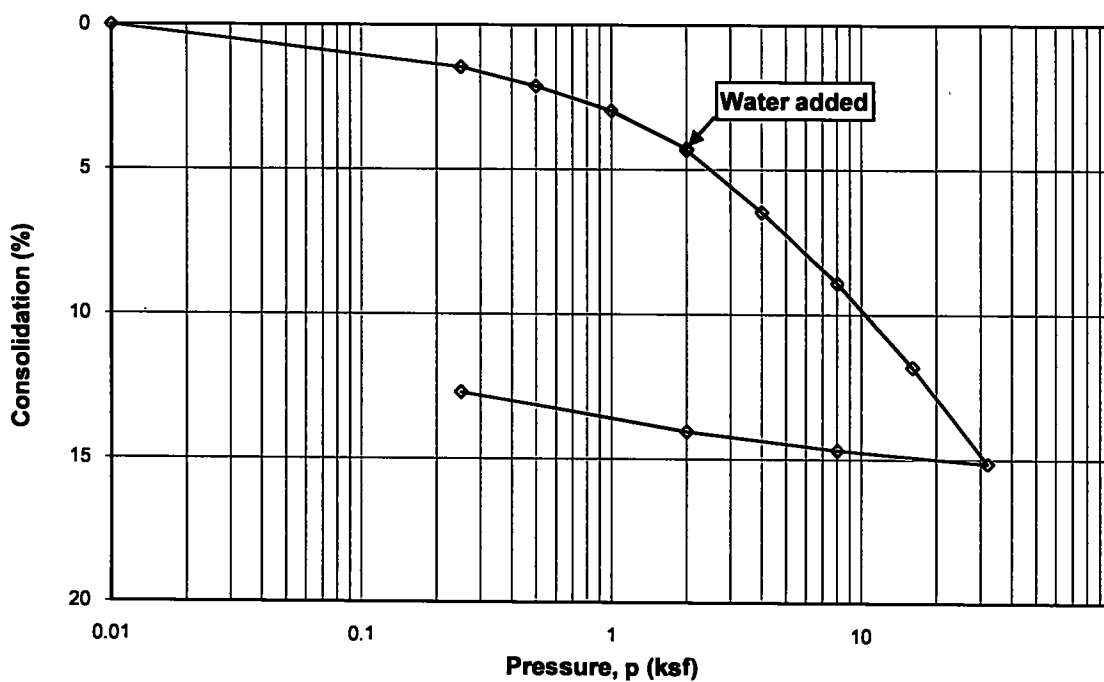
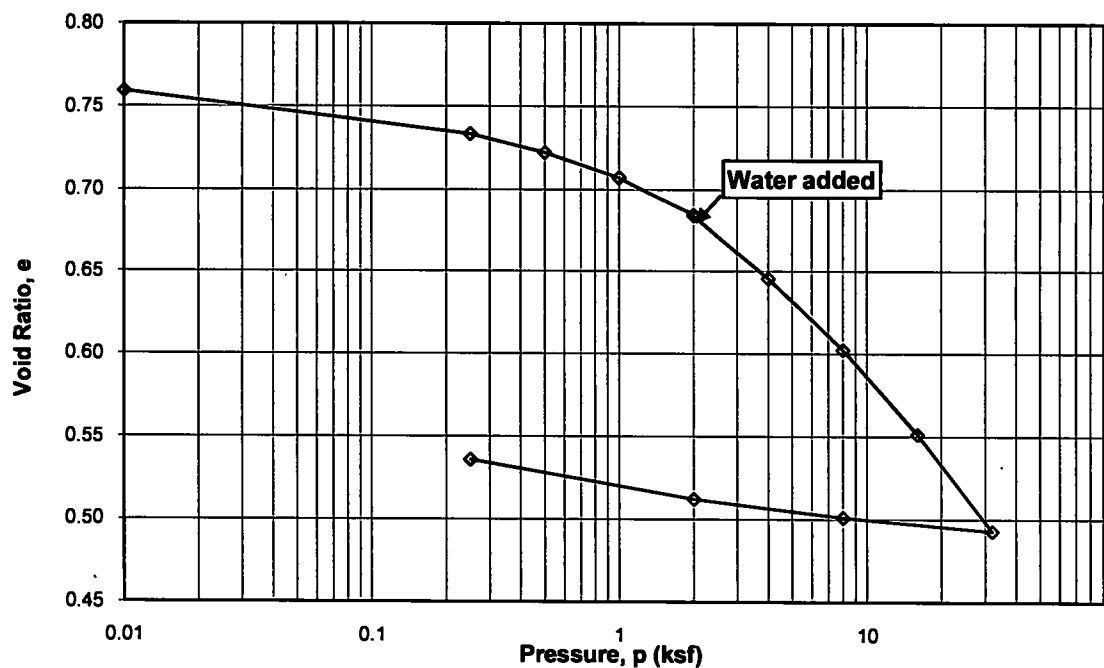


PLATE
C24

CONSOLIDATION TEST (ASTM D 2435)

Project Name: ARTIC

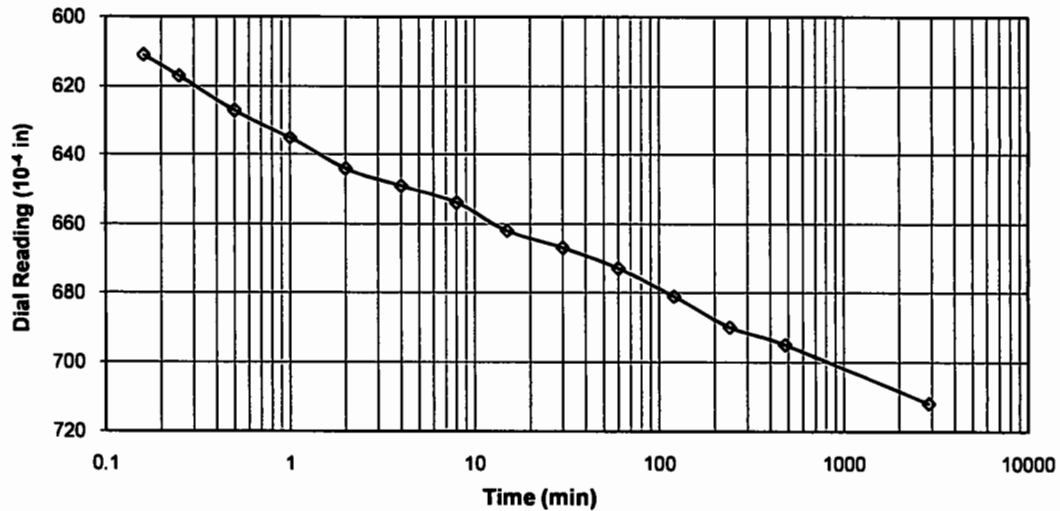
Boring No.: DYB10-15

Sample No.: 8

Depth: 29'

Soil Description: Olive Brown Silty Clay with Sand (CL-ML)

Time Reading @ 4.0 ksf



Time Readings @ 4.0 ksf

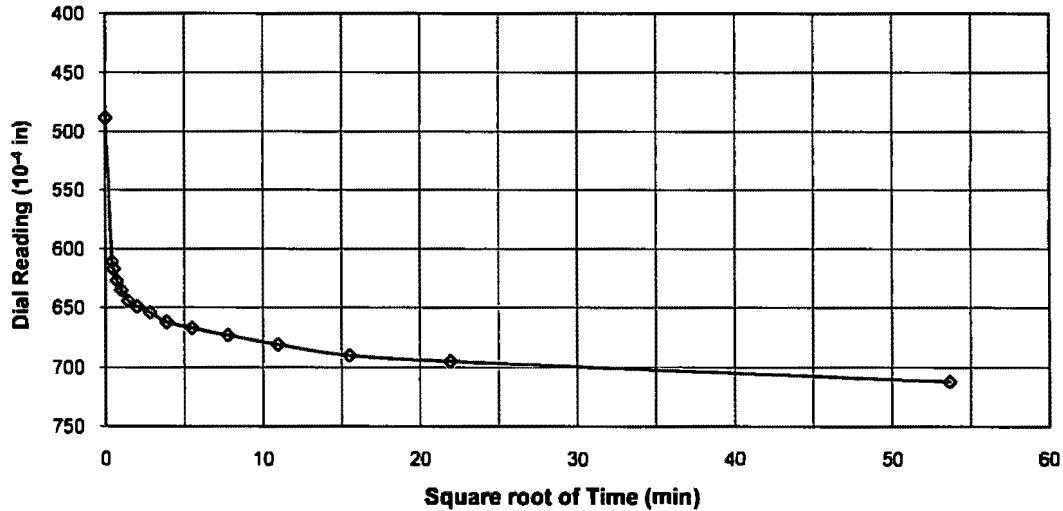
ELAPSED TIME (MIN)	DIAL READING (10 ⁻⁴ IN)
0.00	488
0.16	611
0.25	617
0.5	627
1	635
2	644
4	649
8	654
15	662
30	667
60	673
120	681
240	690
480	695
2880	712

PLATE
C25

CONSOLIDATION TEST (ASTM D 2435)

Project Name: ARTIC
Boring No.: DYB10-15 **Sample No.:** 8 **Depth:** 29'
Soil Description: Olive Brown Silty Clay with Sand (CL-ML)

Time Reading @ 4.0 ksf



Time Readings @ 4.0 ksf

Square root of time (min)	DIAL READING (10^{-4} IN)
0	488
0.40	611
0.50	617
0.71	627
1.00	635
1.41	644
2.00	649
2.83	654
3.87	662
5.48	667
7.75	673
10.95	681
15.49	690
21.91	695
53.67	712

CONSOLIDATION TEST

(ASTM D 2435)

Project Name: ARTIC

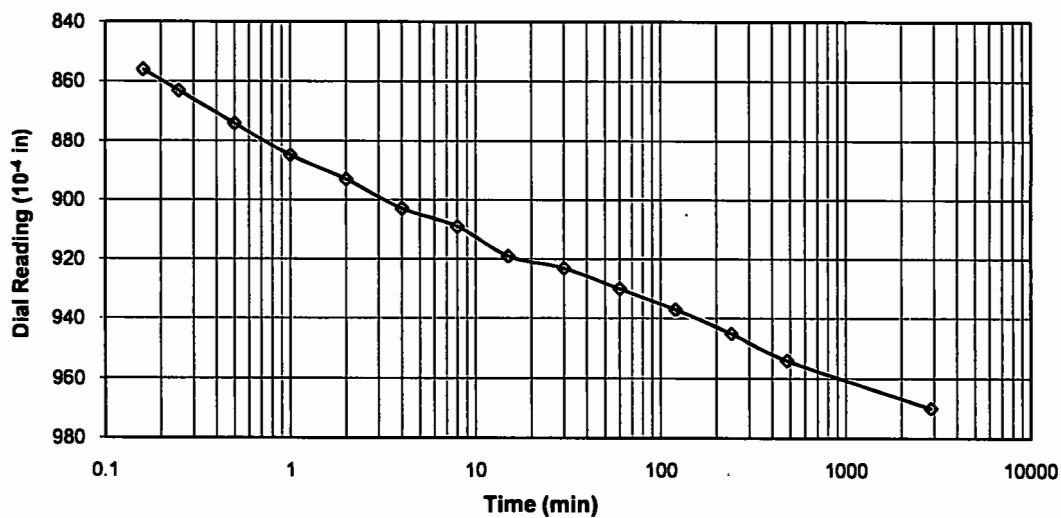
Boring No.: DYB10-15

Sample No.: 8

Depth: 29'

Soil Description: Olive Brown Silty Clay with Sand (CL-ML)

Time Reading @ 8.0 ksf



Time Readings @ 8.0 ksf

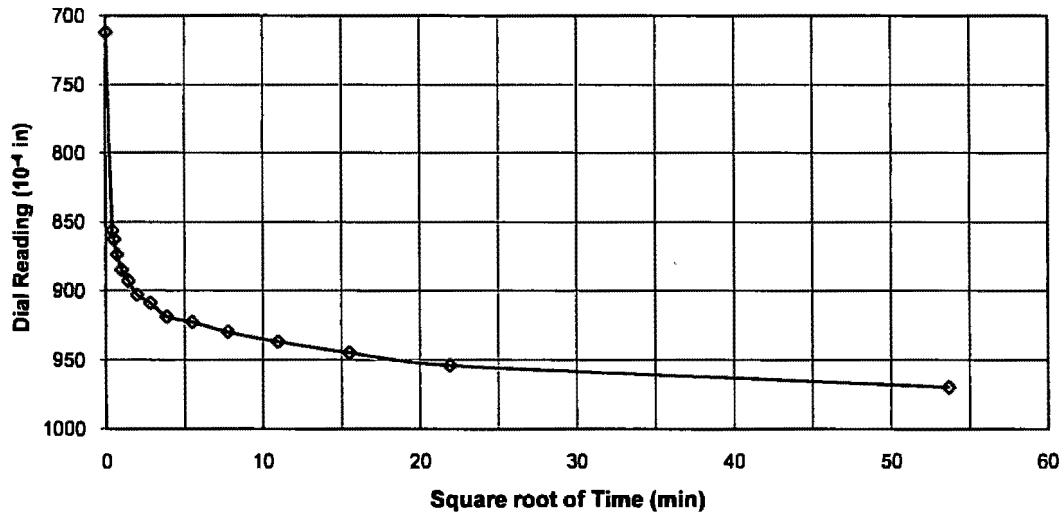
ELAPSED TIME (MIN)	DIAL READING (10 ⁻⁴ IN)
0.00	712
0.16	856
0.25	863
0.5	874
1	885
2	893
4	903
8	909
15	919
30	923
60	930
120	937
240	945
480	954
2880	970

PLATE
C27

CONSOLIDATION TEST (ASTM D 2435)

Project Name: ARTIC
Boring No.: DYB10-15 **Sample No.:** 8 **Depth:** 29'
Soil Description: Olive Brown Silty Clay with Sand (CL-ML)

Time Reading @ 8.0 ksf



Time Readings @ 8.0 ksf

Square root of time (min)	DIAL READING (10 ⁻⁴ IN)
0	712
0.40	856
0.50	863
0.71	874
1.00	885
1.41	893
2.00	903
2.83	909
3.87	919
5.48	923
7.75	930
10.95	937
15.49	945
21.91	954
53.67	970

UNCONSOLIDATED UNDRAINED TRIAXIAL TEST (ASTM D 2850)

Client: Diaz Yourman & Associates, Inc

HAI Project No.: DYAL 10-001

Project Name: ARTIC

Tested by: PM

Project No.: 2009-021

Checked by: JT

Boring No.: DYB10-12

Sample No.: 12

Depth: 48'

Date: 3/22/2010

Soil Description: Olive Brown Sandy Lean Clay (CL)

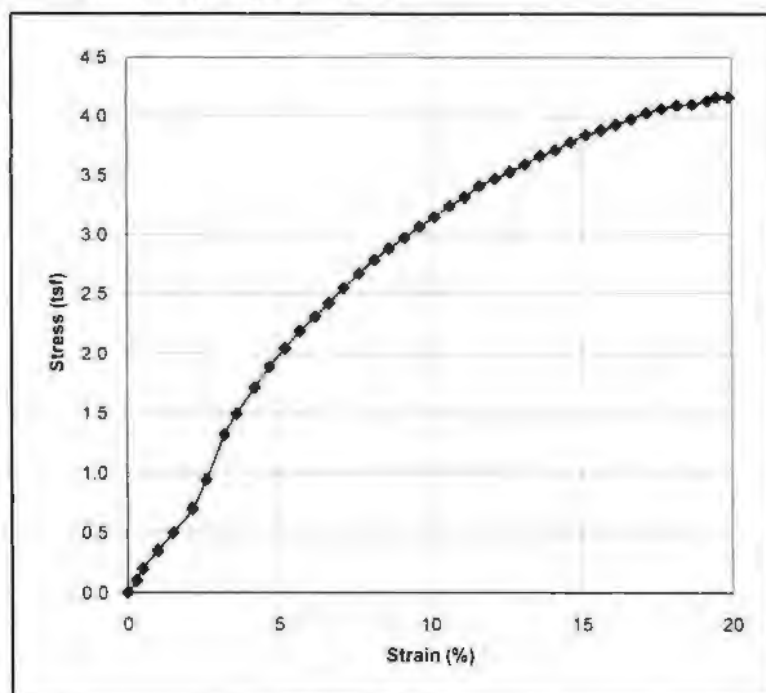
Initial wet weight: (g) 756.90

Height: (in) 4.98

Diameter: (in) 2.40

Moisture Content: (%) 22.6

Dry Density: (pcf) 104.3



Elapsed Time (min.)	Vertical Load (lbs)	Cell Pressure (psi)	Vertical Disp. (inch)	Strain (%)	Stress (tsf)
0	0	27.8	0	0	0
0.05	22.84	27.8	0.01	0.3	0.10
0.10	22.64	27.8	0.03	0.5	0.20
1.52	22.43	27.7	0.08	1.0	0.35
1.75	22.77	27.7	0.09	1.5	0.50
2.00	29.42	27.7	0.11	2.1	0.70
2.47	66.11	27.7	0.13	2.6	0.94
3.07	90.88	27.7	0.16	3.2	1.32
3.47	102.58	27.8	0.18	3.6	1.49
4.07	117.75	27.8	0.21	4.2	1.71
4.57	129.76	27.8	0.23	4.7	1.89
5.07	140.82	27.8	0.26	5.2	2.04
5.57	151.09	27.8	0.28	5.7	2.19
6.08	160.08	27.8	0.31	6.2	2.31
6.53	168.43	27.8	0.33	6.7	2.42
7.03	177.94	27.8	0.36	7.2	2.55
7.53	187.01	27.8	0.38	7.7	2.67
8.03	195.64	27.8	0.41	8.2	2.78
8.55	203.45	27.8	0.43	8.7	2.88
9.05	210.93	27.8	0.46	9.2	2.97
9.55	218.33	27.8	0.48	9.7	3.06
10.05	225.52	27.8	0.51	10.2	3.15
10.57	233.15	27.8	0.53	10.7	3.24
11.07	239.69	27.8	0.56	11.2	3.31
11.57	247.69	27.8	0.58	11.7	3.41
12.07	253.57	27.8	0.61	12.2	3.47
12.58	259.46	27.8	0.63	12.7	3.53
13.08	265.21	27.8	0.66	13.2	3.59
13.58	271.94	27.8	0.68	13.7	3.66
14.08	277.04	27.8	0.71	14.2	3.71
14.58	283.82	27.8	0.73	14.7	3.78
15.08	289.99	27.8	0.76	15.2	3.84
15.58	294.54	27.8	0.78	15.7	3.88
16.10	299.67	27.8	0.81	16.2	3.92
16.60	304.87	27.8	0.83	16.7	3.97
17.10	310.57	27.8	0.86	17.2	4.02
17.60	315.44	27.8	0.88	17.7	4.06
18.10	319.48	27.8	0.91	18.2	4.09
18.60	322.05	27.8	0.93	18.7	4.10
19.12	326.63	27.8	0.96	19.2	4.13
19.67	333.17	27.8	0.99	19.5	4.16
19.93	332.27	27.8	1.00	19.9	4.16

σ_3 : (ksf) 4.0

PLATE
C37

UNCONSOLIDATED UNDRAINED TRIAXIAL TEST
(ASTM D 2850)

Client: Diaz Yourman & Associates, Inc

HAI Project No.: DYAL 10-001

Project Name: ARTIC

Tested by: PM

Project No.: 2009-021

Checked by: JT

Boring No.: DYB10-15

Sample No.: 13

Depth: 52.5'

Date: 3/22/2010

Soil Description: Reddish Brown Lean Clay with Sand (CL)

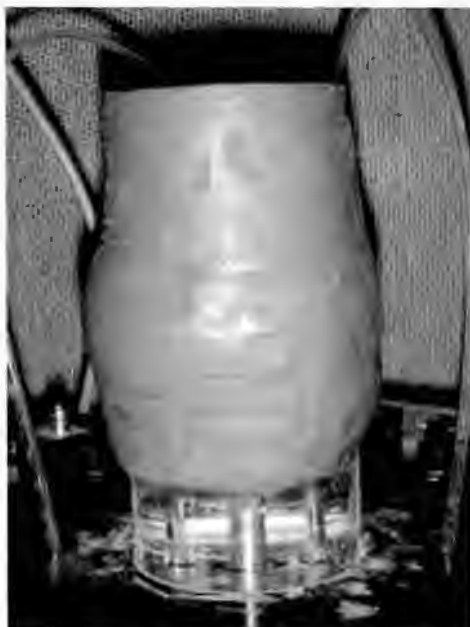
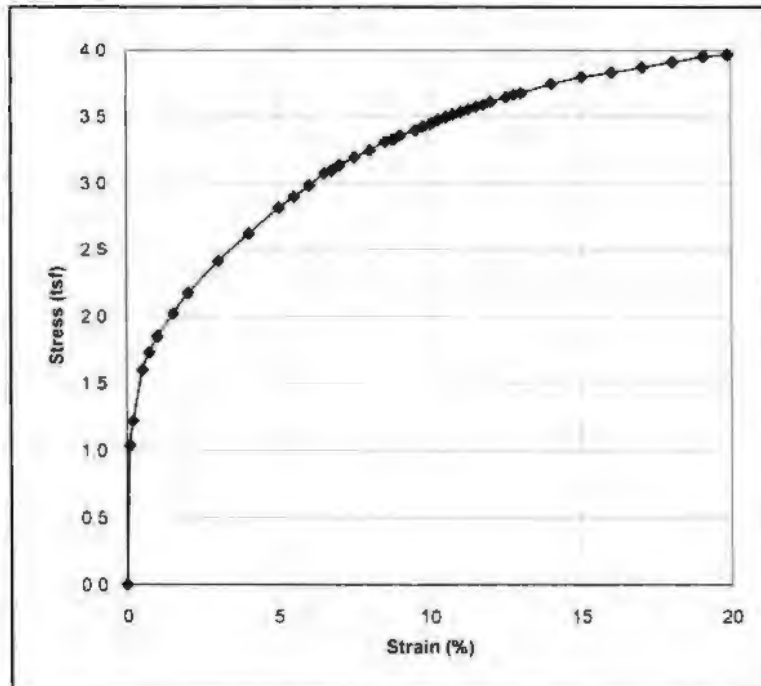
Initial wet weight: (g) 803.87

Height: (in) 5.29

Diameter: (in) 2.41

Moisture Content: (%) 24.1

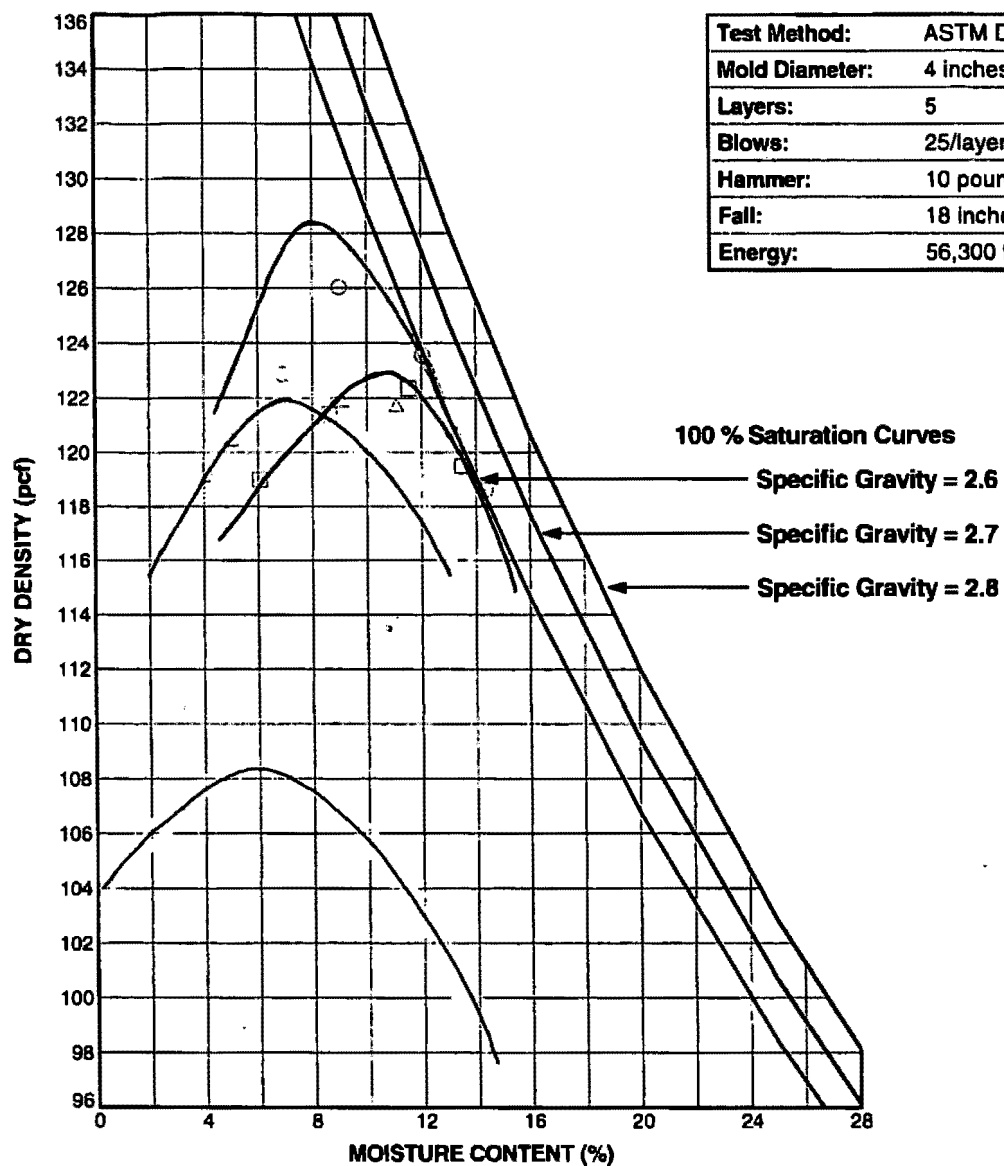
Dry Density: (pcf) 102.2



Elapsed Time (min.)	Vertical Load (lbs)	Cell Pressure (psi)	Vertical Disp. (inch)	Strain (%)	Stress (tsf)
0	52.69	34.7	0	0	0
0.10	72.63	34.7	0.01	0.1	1.04
0.22	84.20	34.7	0.01	0.2	1.22
0.52	108.70	34.7	0.03	0.5	1.60
0.75	117.36	34.7	0.04	0.7	1.73
1.02	125.32	34.7	0.05	1.0	1.85
1.55	136.96	34.7	0.08	1.5	2.02
2.05	147.20	34.7	0.11	2.0	2.17
3.05	164.49	34.7	0.16	3.0	2.41
4.05	179.75	34.7	0.21	4.0	2.62
5.05	194.36	34.7	0.27	5.0	2.81
5.55	201.09	34.7	0.29	5.5	2.90
6.05	207.74	34.7	0.32	6.1	2.98
6.57	215.01	34.7	0.35	6.6	3.07
6.82	216.95	34.7	0.36	6.8	3.09
7.07	220.50	34.7	0.37	7.1	3.13
7.57	225.58	34.7	0.40	7.6	3.19
8.07	230.53	34.7	0.43	8.1	3.25
8.57	236.15	34.7	0.45	8.6	3.31
8.82	237.68	34.7	0.47	8.8	3.32
9.07	240.63	34.7	0.48	9.1	3.36
9.57	244.70	34.7	0.51	9.6	3.40
9.82	247.24	34.7	0.52	9.8	3.42
10.07	249.16	34.7	0.53	10.1	3.44
10.32	252.12	34.7	0.55	10.3	3.47
10.57	254.31	34.7	0.56	10.6	3.49
10.82	256.39	34.7	0.57	10.8	3.51
11.07	258.42	34.7	0.59	11.1	3.53
11.32	260.64	34.7	0.60	11.3	3.55
11.57	262.70	34.7	0.61	11.6	3.57
11.82	264.67	34.7	0.63	11.8	3.59
12.07	267.07	34.7	0.64	12.1	3.61
12.57	270.92	34.7	0.67	12.6	3.64
12.83	273.25	34.7	0.68	12.8	3.67
13.08	274.76	34.7	0.69	13.1	3.68
14.08	283.12	34.6	0.74	14.1	3.75
15.08	290.05	34.6	0.80	15.1	3.80
16.08	296.16	34.6	0.85	16.1	3.83
17.08	302.68	34.6	0.90	17.1	3.87
18.08	309.43	34.6	0.96	18.1	3.91
19.10	316.32	34.6	1.01	19.1	3.95
20.02	320.96	34.6	1.06	19.9	3.97

σ_3 : (ksf) 5.0

PLATE
C38



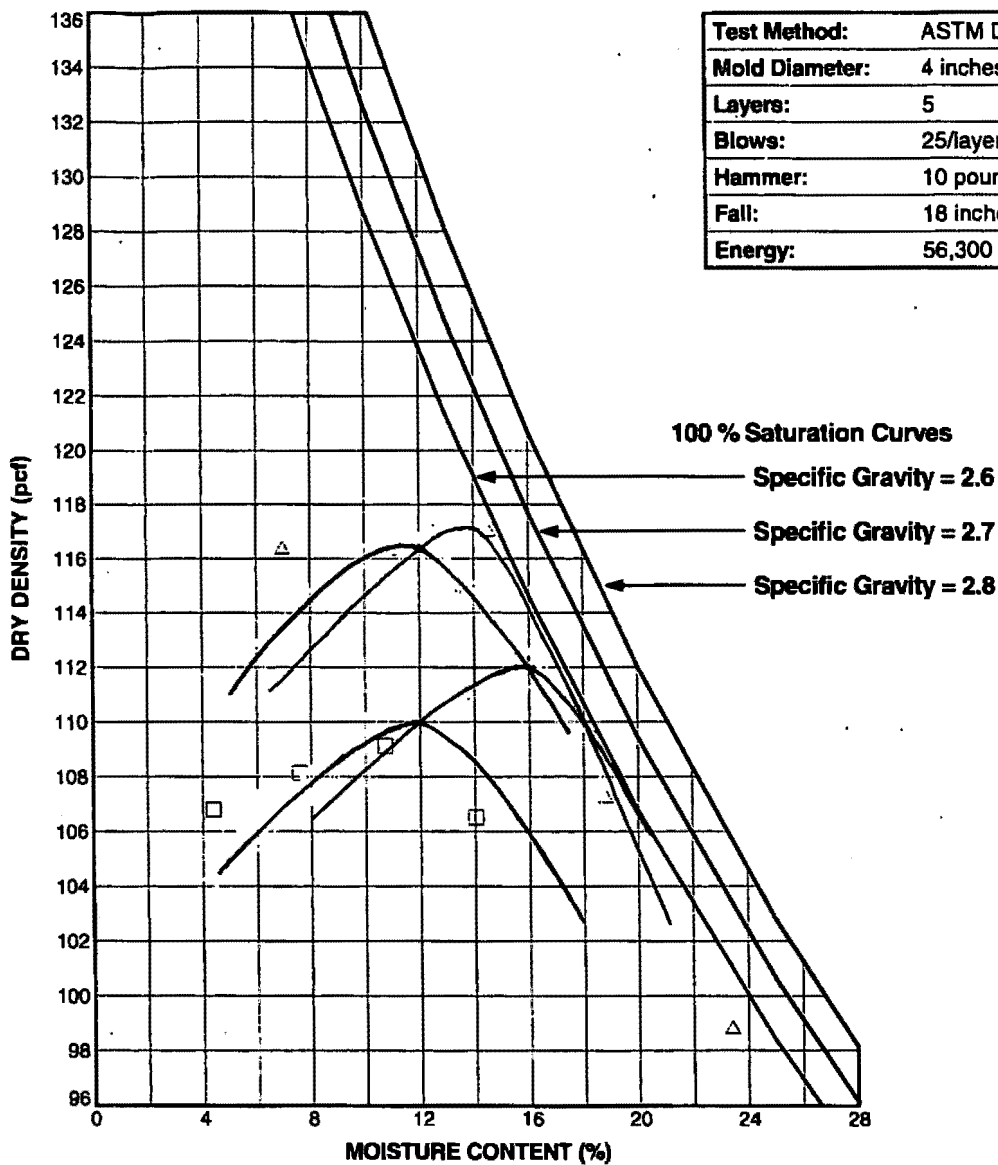
Laboratory Testing by: AP Engineering and Testing, Inc., Hushmand Associates, Inc., and Diaz Yourman & Associates

Symbol	Source	Depth (feet)	Classification	Optimum Moisture Content (%)	Maximum Dry Density (pcf)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	DYB10-01	2.5	SILTY SAND (SM)	8	128.5			
□	DYB10-04	2.5	SILTY SAND (SM)	11	123			17
△	DYB10-04	5.0	SILTY SAND (SM)	7	122			
.	DYB10-10	2.5	POORLY GRADED SAND (SP)	6	108.5			

COMPACTION TEST DATA

Anaheim Regional Transportation Intermodal Center
 Project No. 2009-021

PLATE
C40



Laboratory Testing by: AP Engineering and Testing, Inc., Hushmand Associates, Inc., and Diaz Yourman & Associates

Symbol	Source	Depth (feet)	Classification	Optimum Moisture Content (%)	Maximum Dry Density (pcf)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	DYB10-12	2.5	POORLY GRADED SAND (SP)	12	116.5			
□	DYB10-17	2.5	POORLY GRADED SAND (SP)	12	110			
△	DYB10-18	2.5	ELASTIC SILT (MH)	14	117			
.	DYB10-19	2.5	SILTY SAND (SM)	16	112			88

COMPACTION TEST DATA

Anaheim Regional Transportation Intermodal Center
Project No. 2009-021

PLATE
C41



AP Engineering & Testing, Inc.

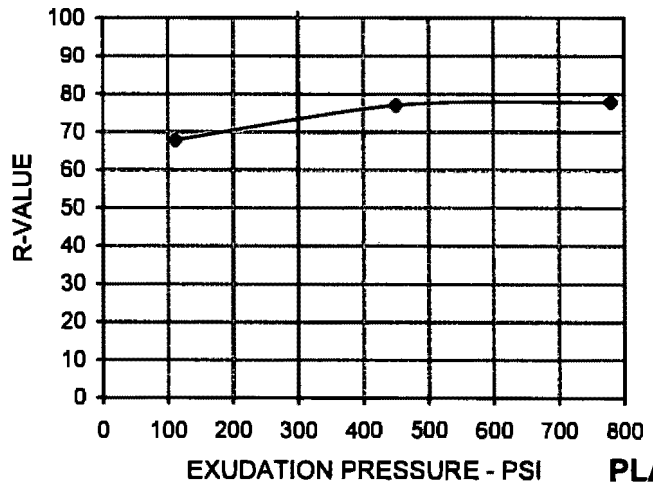
R-VALUE TEST DATA
ASTM D2844

Project Name: ARTIC Tested By: ST/KM Date: 03/06/10
Project Number: 2009-021 Checked By: AP Date: 03/15/10
Boring No.: DYB10-01
Sample No.: Bulk Depth (ft.): 0-5
Location: N/A
Soil Description: Gray Silty Sand (SM)

Mold Number	B	C	A		
Water Added, g	48	65	57		
Compact Moisture(%)	8.3	9.9	9.1		
Compaction Gage Pressure, psi	230	180	180		
Exudation Pressure, psi	780	111	450		
Sample Height, Inches	2.5	2.5	2.5		
Gross Weight Mold, g	3063	3081	3072		
Tare Weight Mold, g	1967	1969	1970		
Net Sample Weight, g	1095	1112	1102		
Expansion, inches $\times 10^4$	0	0	0		
Stability 2,000 (160 psi)	15/23	19/34	14/24		
Turns Displacement	4.23	4.40	4.22		
R-Value Uncorrected	78	68	77		
R-Value Corrected	78	68	77		
Dry Density, pcf	122.6	122.6	122.4		
Traffic Index	8.0	8.0	8.0		
G.E. by Stability	0.37	0.55	0.39		
G.E. by Expansion	0.00	0.00	0.00		

R-Value by Exudation = 73
R-Value by Expansion = N/A
Equilibrium R-Value = 73
(by Exudation)

Remarks: $G_r = 1.5$
1.3 % Retained on the $\frac{3}{4}$ "





AP Engineering & Testing, Inc.

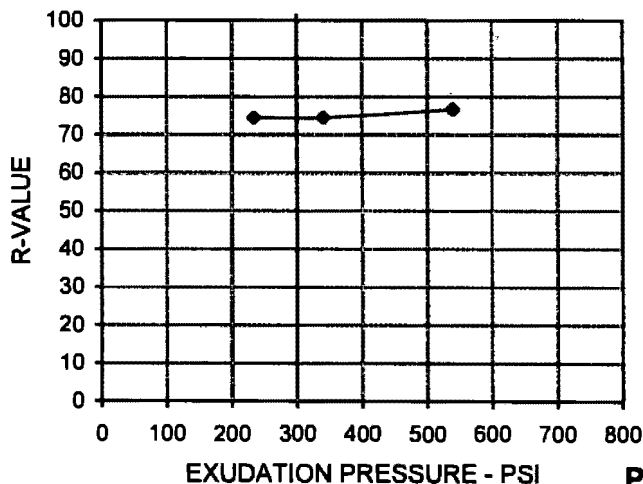
R-VALUE TEST DATA
ASTM D2844

Project Name: ARTIC Tested By: ST/KM Date: 03/06/10
Project Number: 2009-021 Checked By: AP Date: 03/15/10
Boring No.: DYB10-04
Sample No.: Bulk Depth (ft.): 0-5
Location: N/A
Soil Description: Light Brownish Gray Silty Sand (SM)

Mold Number	D	E	F		
Water Added, g	10	20	16		
Compact Moisture(%)	10.1	11.1	10.6		
Compaction Gage Pressure, psi	240	170	170		
Exudation Pressure, psi	540	234	340		
Sample Height, inches	2.4	2.4	2.4		
Gross Weight Mold, g	3026	3021	2933		
Tare Weight Mold, g	1971	1957	1871		
Net Sample Weight, g	1055	1064	1062		
Expansion, inchesx10 ⁻⁴	0	0	0		
Stability 2,000 (160 psi)	12/20	14/22	14/22		
Turns Displacement	4.89	4.90	4.89		
R-Value Uncorrected	78	76	76		
R-Value Corrected	77	75	75		
Dry Density, pcf	121.0	120.9	121.1		
Traffic Index	8.0	8.0	8.0		
G.E. by Stability	0.39	0.43	0.43		
G.E. by Expansion	0.00	0.00	0.00		

R-Value by Exudation = 74
R-Value by Expansion = N/A
Equilibrium R-Value = 74
(by Exudation)

Remarks: $G_r = 1.5$
0.0 % Retained on the $\frac{3}{4}$ "





AP Engineering & Testing, Inc.

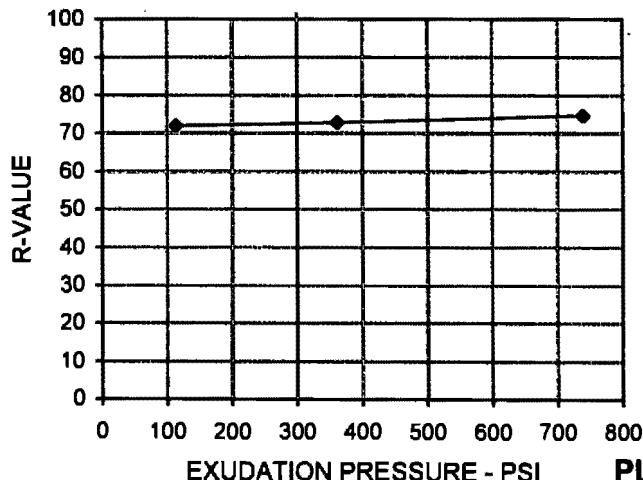
R-VALUE TEST DATA
ASTM D2844

Project Name: ARTIC Tested By: ST/KM Date: 03/09/10
Project Number: 2009-021 Checked By: AP Date: 03/15/10
Boring No.: DYB10-12
Sample No.: Bulk Depth (ft.): 0-5
Location: N/A
Soil Description: Light Brown Poorly Graded Sand (SP)

Mold Number	D	E	F		
Water Added, g	83	66	76		
Compact Moisture(%)	11.3	9.5	10.6		
Compaction Gage Pressure, psi	170	170	170		
Exudation Pressure, psi	113	740	361		
Sample Height, Inches	2.6	2.6	2.6		
Gross Weight Mold, g	3047	3016	2942		
Tare Weight Mold, g	1971	1957	1871		
Net Sample Weight, g	1076	1059	1071		
Expansion, inchesx10 ⁻⁴	0	0	0		
Stability 2,000 (160 psi)	17/30	14/24	16/26		
Turns Displacement	4.65	5.25	5.24		
R-Value Uncorrected	70	73	71		
R-Value Corrected	72	75	73		
Dry Density, pcf	112.7	112.7	112.9		
Traffic Index	8.0	8.0	8.0		
G.E. by Stability	0.47	0.43	0.46		
G.E. by Expansion	0.00	0.00	0.00		

R-Value by Exudation = 72
R-Value by Expansion = N/A
Equilibrium R-Value = 72
(by Exudation)

Remarks: $G_r = 1.5$
1.2 % Retained on the $\frac{3}{4}$ "





AP Engineering & Testing, Inc.

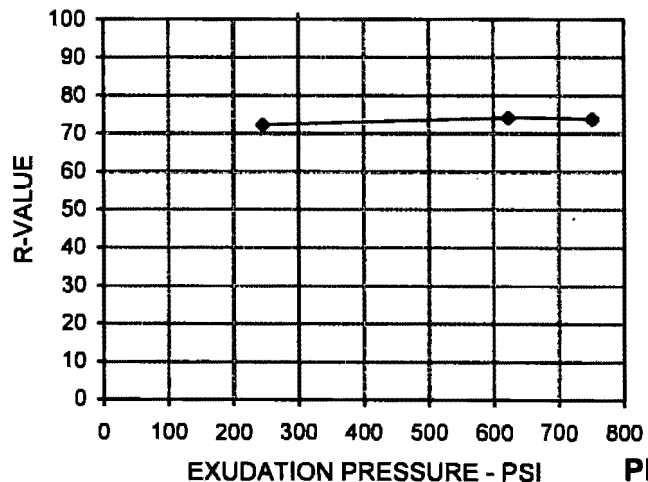
R-VALUE TEST DATA
ASTM D2844

Project Name: ARTIC Tested By: ST/KM Date: 03/07/10
Project Number: 2009-021 Checked By: AP Date: 03/15/10
Boring No.: DYB10-17
Sample No.: Bulk Depth (ft.): 0-5
Location: N/A
Soil Description: Light Yellowish Brown Poorly Graded Sand (SP)

Mold Number	D	E	F		
Water Added, g	65	80	92		
Compact Moisture(%)	11.3	12.9	14.2		
Compaction Gage Pressure, psi	160	160	160		
Exudation Pressure, psi	752	623	244		
Sample Height, Inches	2.5	2.5	2.5		
Gross Weight Mold, g	2952	2958	2883		
Tare Weight Mold, g	1971	1957	1871		
Net Sample Weight, g	981	1001	1012		
Expansion, inches $\times 10^{-4}$	0	0	0		
Stability 2,000 (160 psi)	15/24	15/24	17/26		
Turns Displacement	5.00	4.92	4.94		
R-Value Uncorrected	74	74	72		
R-Value Corrected	74	74	72		
Dry Density, pcf	106.8	107.5	107.4		
Traffic Index	8.0	8.0	8.0		
G.E. by Stability	0.44	0.44	0.47		
G.E. by Expansion	0.00	0.00	0.00		

R-Value by Exudation = 72
R-Value by Expansion = N/A
Equilibrium R-Value = 72
(by Exudation)

Remarks: $G_r = 1.5$
0.1 % Retained on the $\frac{3}{4}$ "





AP Engineering & Testing, Inc.

CORROSION TEST RESULTS

Client Name: Diaz Yourman

AP Job No.: 10-0313

Project Name: ARTIC

Date: 03/11/10

Project No.: 2009-021

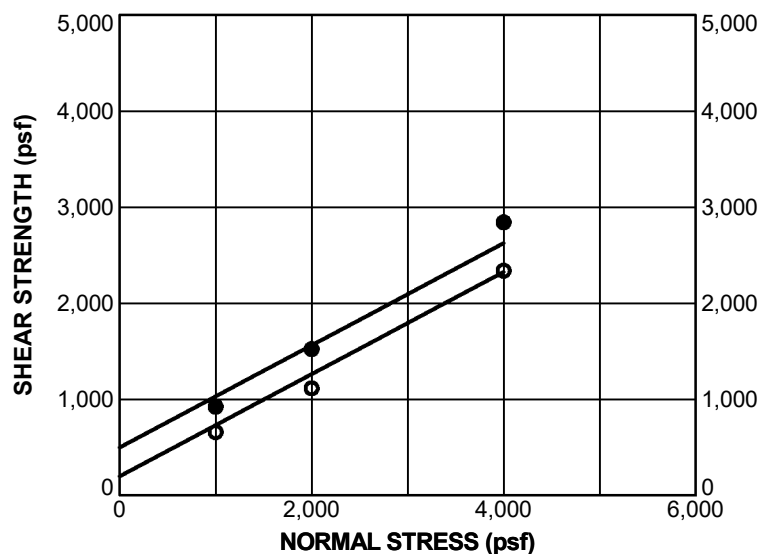
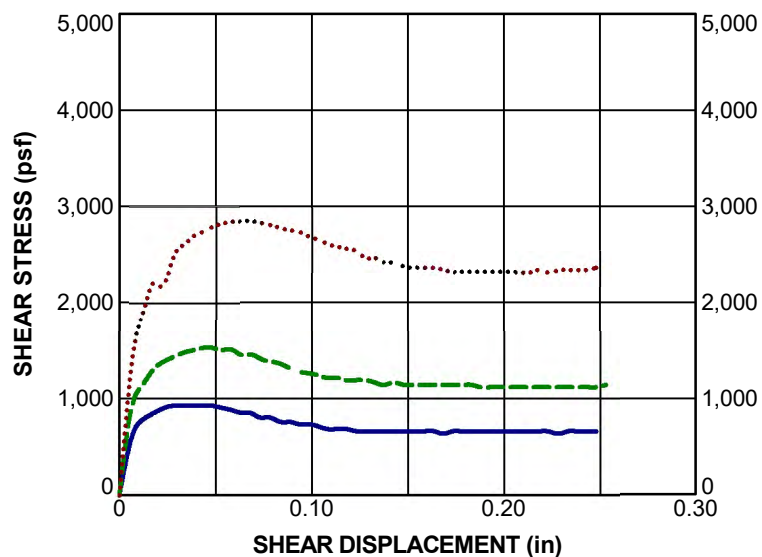
Boring No.	Sample No.	Depth (ft)	Soil Type	Minimum Resistivity (ohm-cm)	pH	Sulfate Content (ppm)	Chloride Content (ppm)
DYB10-09	1 to 9	1 to 36	SP	13000	8.1	47	128

NOTES: Resistivity Test and pH: California Test Methods 532 and 643
Sulfate Content : California Test Method 417
Chloride Content : California Test Method 422
ND = Not Detectable
NA = Not Sufficient Sample
NR = Not Requested

2607 Pomona Boulevard, Pomona, CA 91768
Tel. (909) 869-6316 Fax. (909) 869-6318

PLATE
C51

N = 1,000 psf ———
 N = 2,000 psf - - - -
 N = 4,000 psf ······



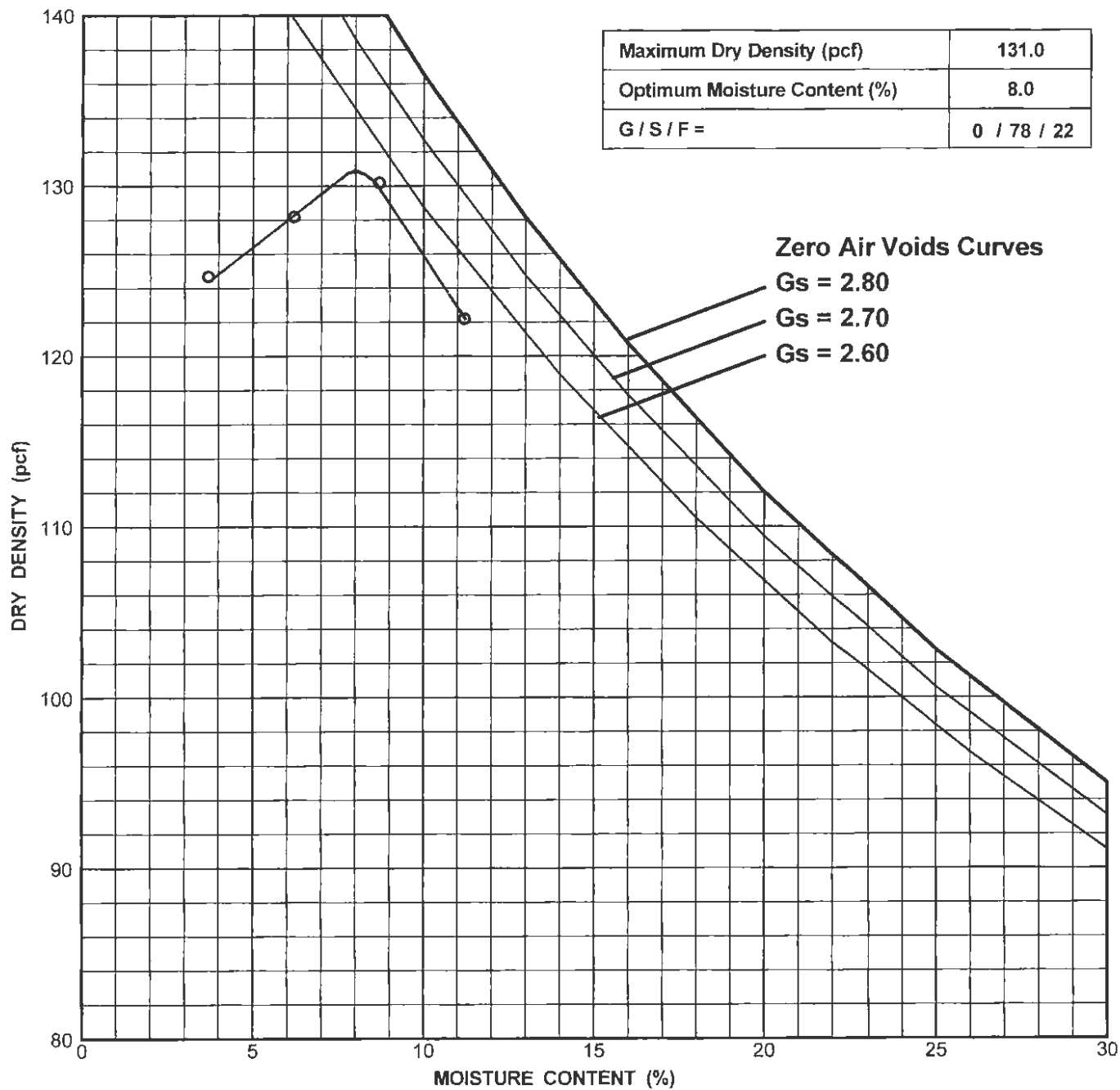
Boring No. H-15		Sample No. B-1		Depth: 15.0 ft	
Sample Description: (Qal) Yellowish brown silty SAND				USCS: SM	
Liquid Limit:		Plasticity Index:		Percent Passing No. 200 Sieve: 22	
Final Moisture Content (%): 18.5		Final Dry Density (pcf): 118.0		Degree of Saturation (%): 100	
Sample Type: Remolded to 90% R.C.		Rate of Shear (in./min.): 0.05			
SHEAR STRENGTH PARAMETERS					
Parameter		Peak ●		Ultimate ○	
Cohesion (psf)		500		200	
Friction Angle (degrees)		28.0		28.0	

DIRECT SHEAR TEST RESULTS

AREP/OC Vibe
 Anaheim, CA
 PROJECT NO. 20065-01



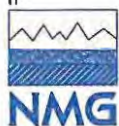
Geotechnical, Inc.



Boring No. H-15		Sample No. B-1	Depth: 15.0 - 20.0 ft
Sample Description: (Qal) Yellowish brown silty SAND			USCS: SM
Liquid Limit:	Plasticity Index:		Percent Passing No. 200 Sieve: 22
Comments: 1557A			

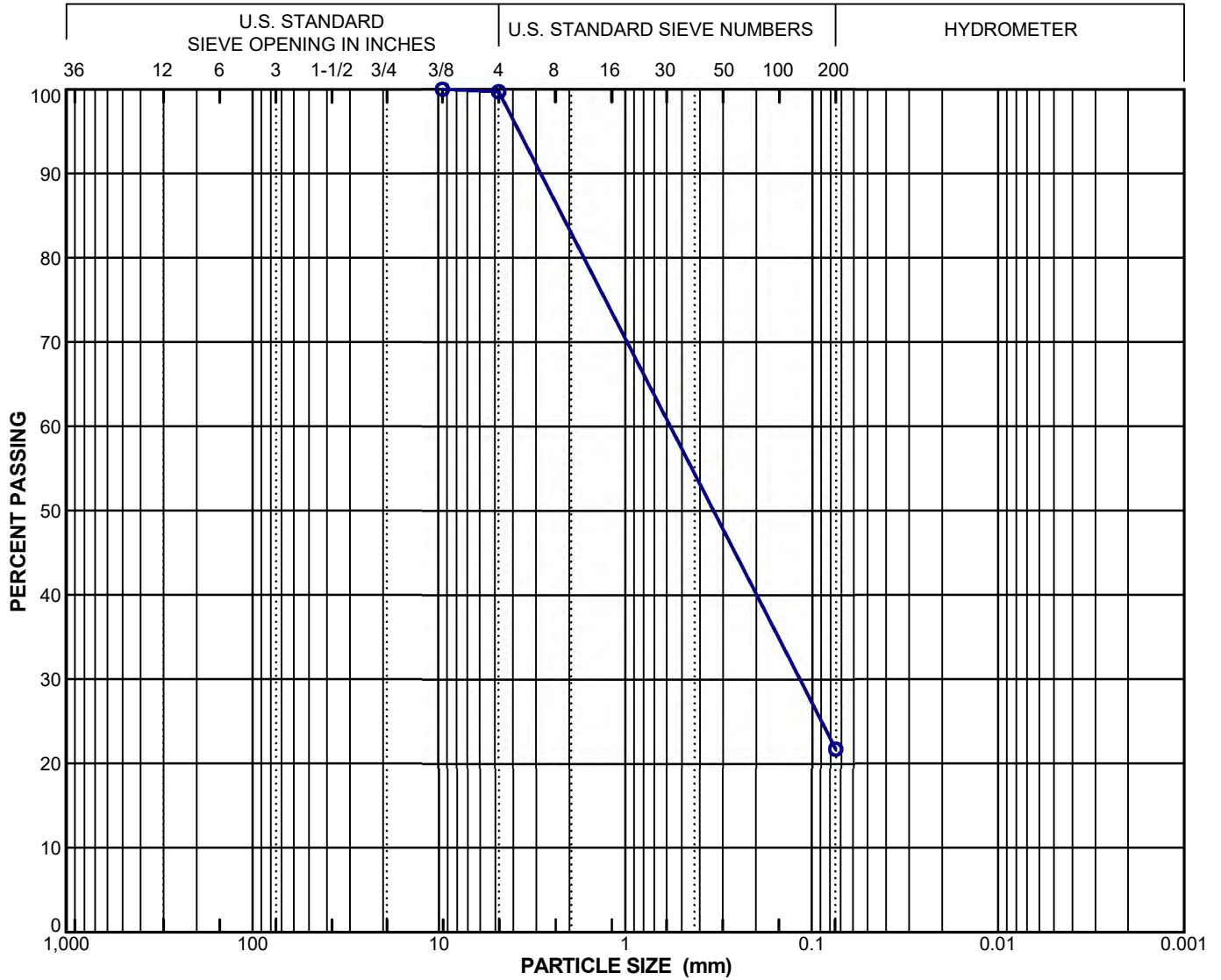
COMPACTION TEST RESULTS

AREP/OC Vibe
 Anaheim, CA
 PROJECT NO. 20065-01



Geotechnical, Inc.

BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	



Symbol	Boring Number	Sample Number	Depth (feet)	Field Moisture (%)	LL	PI	Activity PI/-2 μ	C _u	C _c	Passing No. 200 Sieve (%)	Passing 2 μ (%)	USCS
○	H-15	B-1	15.0	19						22		SM

PARTICLE SIZE DISTRIBUTION

AREP/OC Vibe
Anaheim, CA
PROJECT NO. 20065-01



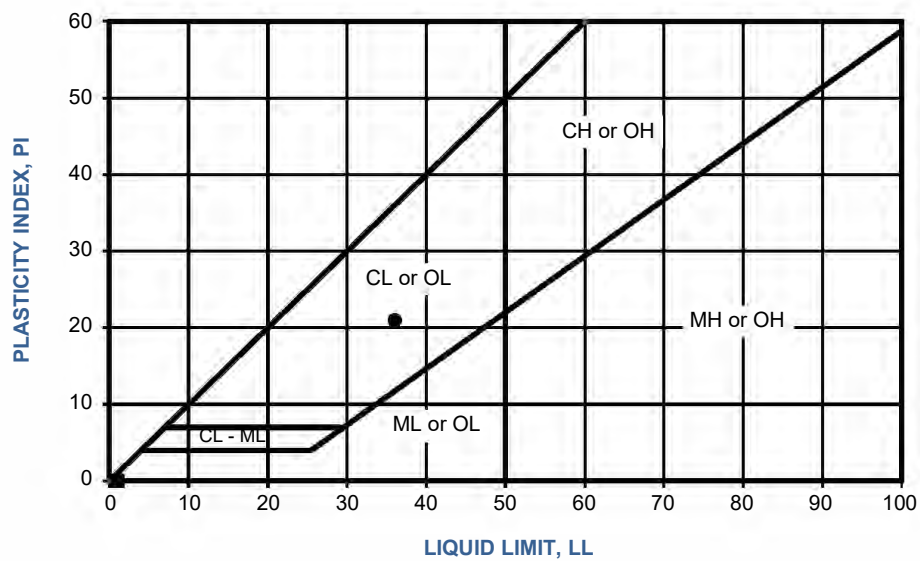
Geotechnical, Inc.

SAMPLE LOCATION	SAMPLE DEPTH (ft)	DESCRIPTION	PERCENT PASSING NO. 4	PERCENT PASSING NO. 200	USCS (TOTAL SAMPLE)
B-1	0.0-5.0	Poorly Graded SAND with Silt	89	12	SP-SM
B-1	10.0-11.5	Silty SAND	98	16	SM
B-1	15.0-16.5	Poorly Graded SAND with Silt	97	11	SP-SM
B-1	30.0-31.5	Poorly Graded SAND with Silt	100	5	SP-SM
B-1	40.0-41.5	Lean CLAY	100	72	CL
B-1	50.0-51.5	Clayey SAND with Gravel	63	22	SC
B-1	60.0-61.0	Clayey SAND with Gravel	73	19	SC
TP-4	1.0-2.0	Silty SAND with Gravel	78	29	SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 1140

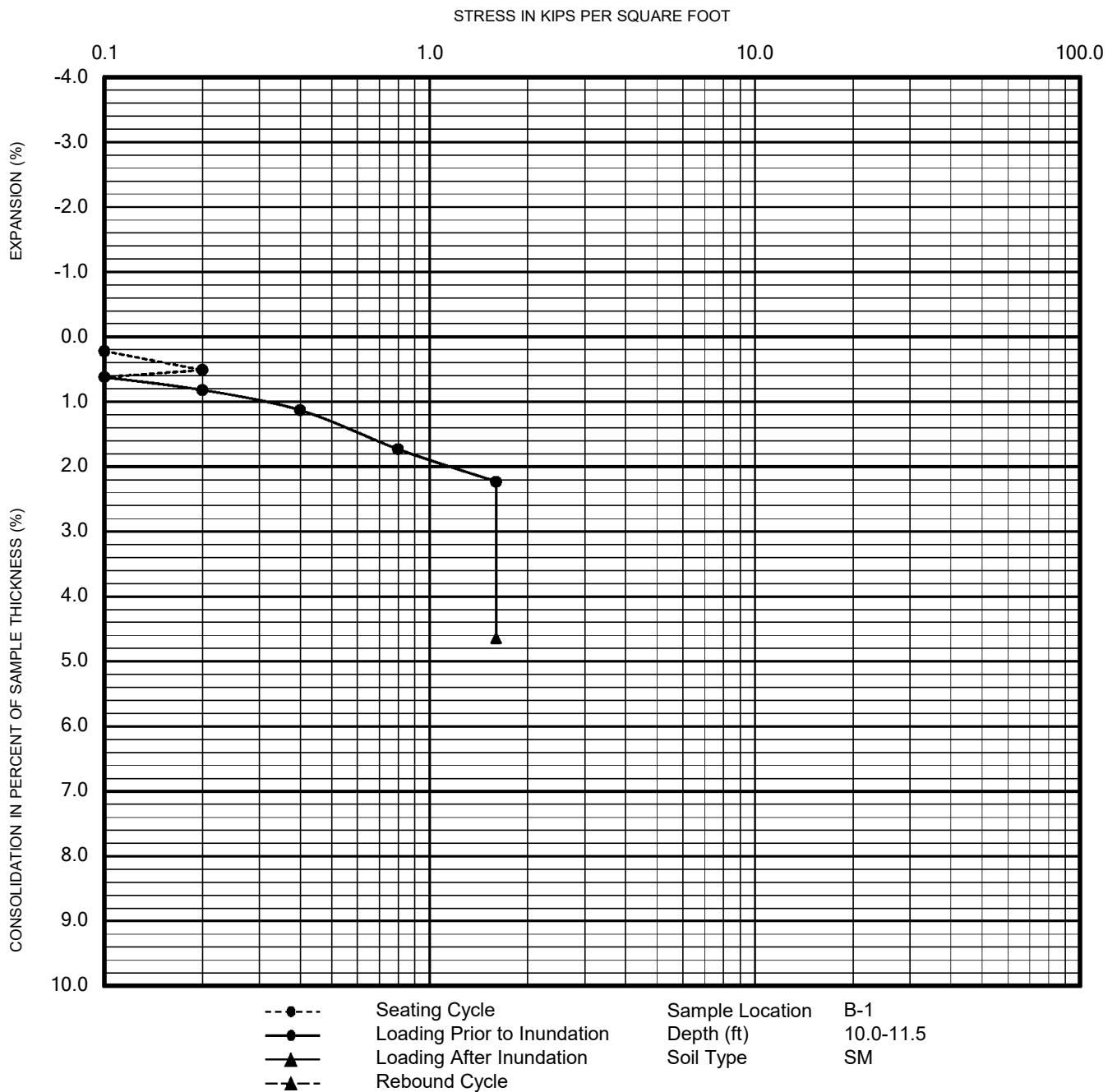
FIGURE C-1

SYMBOL	LOCATION	DEPTH (ft)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	USCS CLASSIFICATION (Fraction Finer Than No. 40 Sieve)	USCS
•	B-1	40.0-41.5	36	15	21	CL	CL



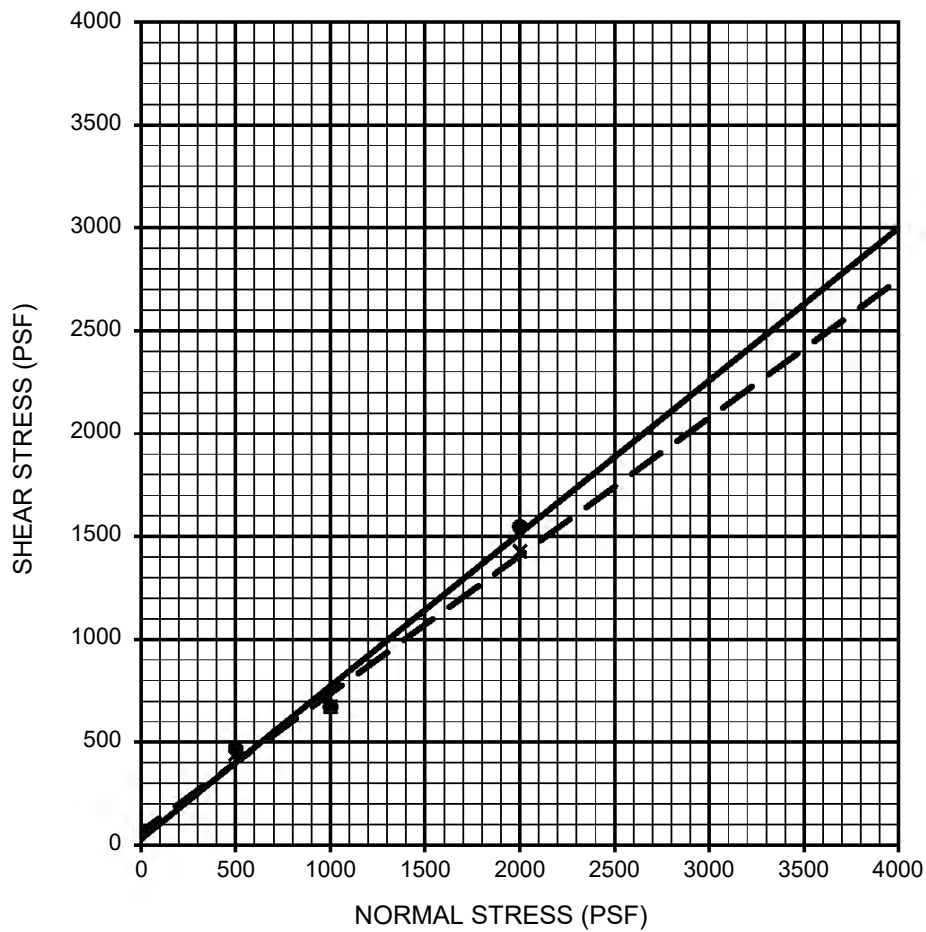
PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 4318

FIGURE C-2



PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2435

FIGURE C-4



Description	Symbol	Sample Location	Depth (ft)	Shear Strength	Cohesion (psf)	Friction Angle (degrees)	Soil Type
SILTY SAND	—●—	B-1	10.0-11.5	Peak	30	37	SM
SILTY SAND	- - X - -	B-1	10.0-11.5	Ultimate	66	34	SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 3080

FIGURE C-5

SAMPLE LOCATION	SAMPLE DEPTH (ft)	pH ¹	RESISTIVITY ¹ (ohm-cm)	SULFATE CONTENT ²		CHLORIDE CONTENT ³ (ppm)
				(ppm)	(%)	
B-1	0.0-5.0	7.5	5,963	10	0.001	10

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

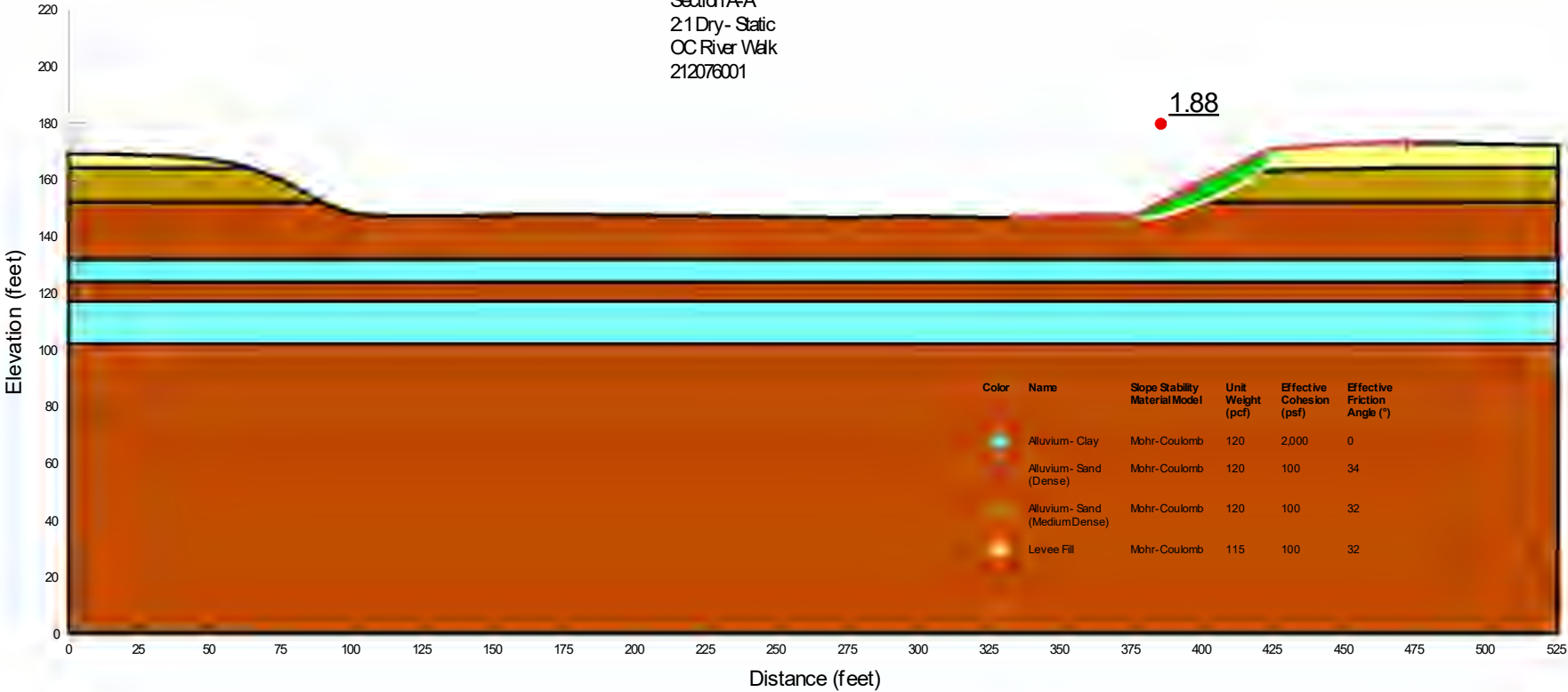
CORROSIVITY TEST RESULTS

BURRIS BASIN GWRS TURNOUT PROJECT
ANAHEIM, CALIFORNIA

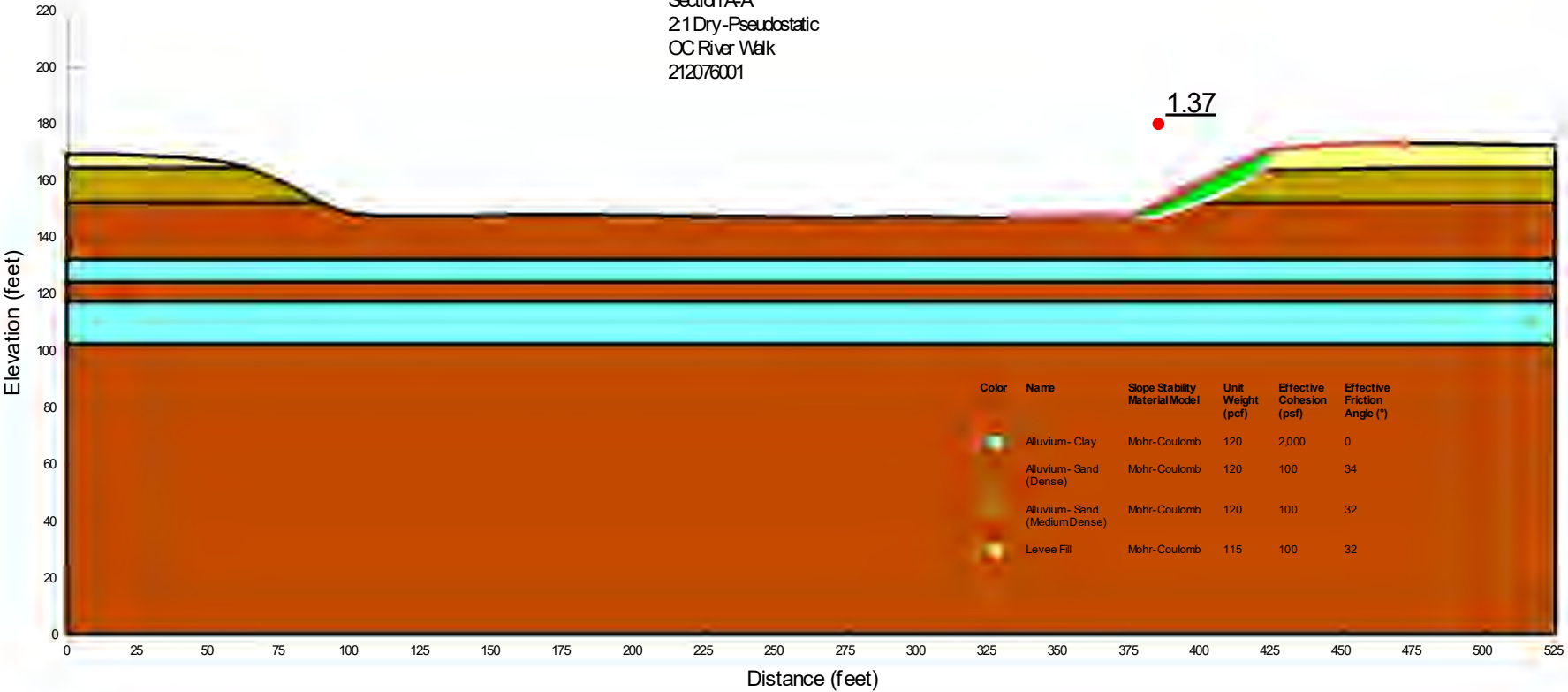
APPENDIX C

Slope Stability Analyses

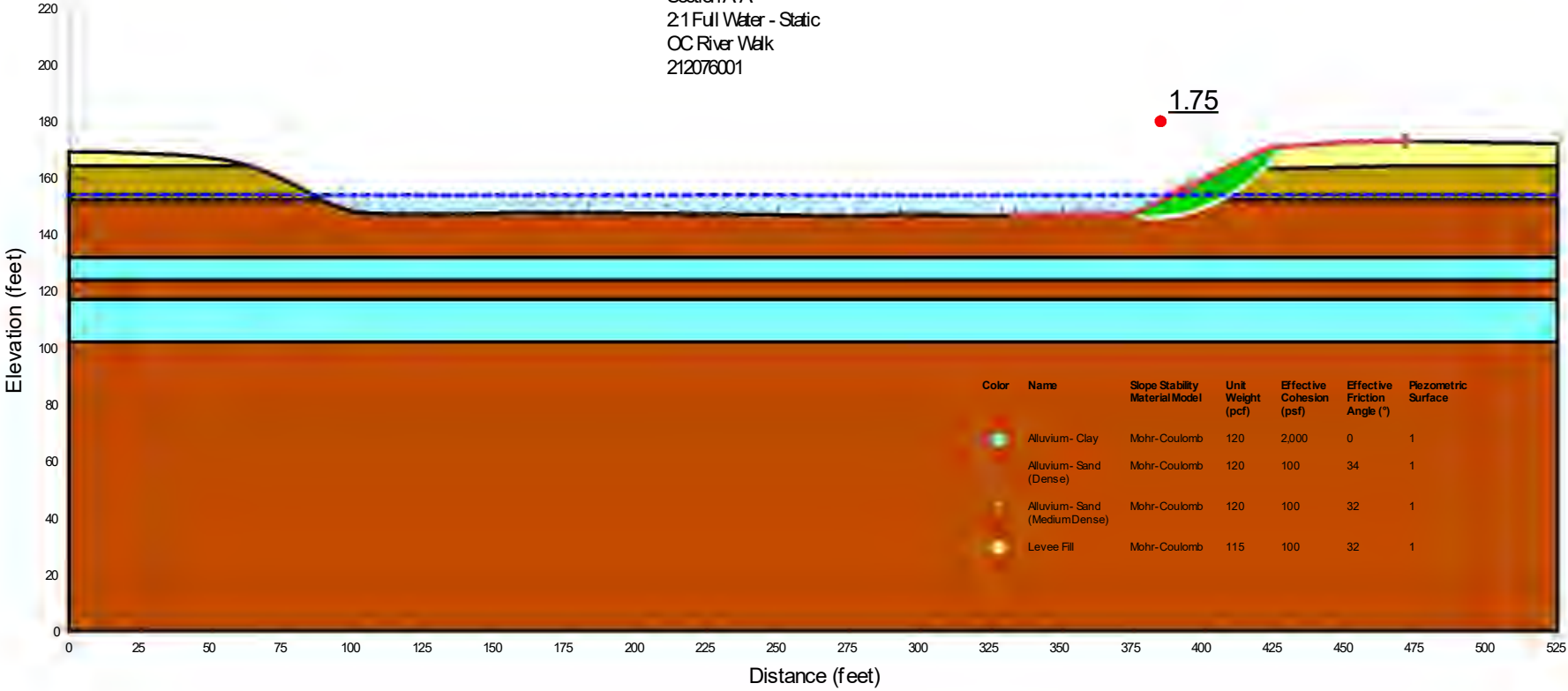
Section A-A'
2.1 Dry- Static
OC River Walk
212076001



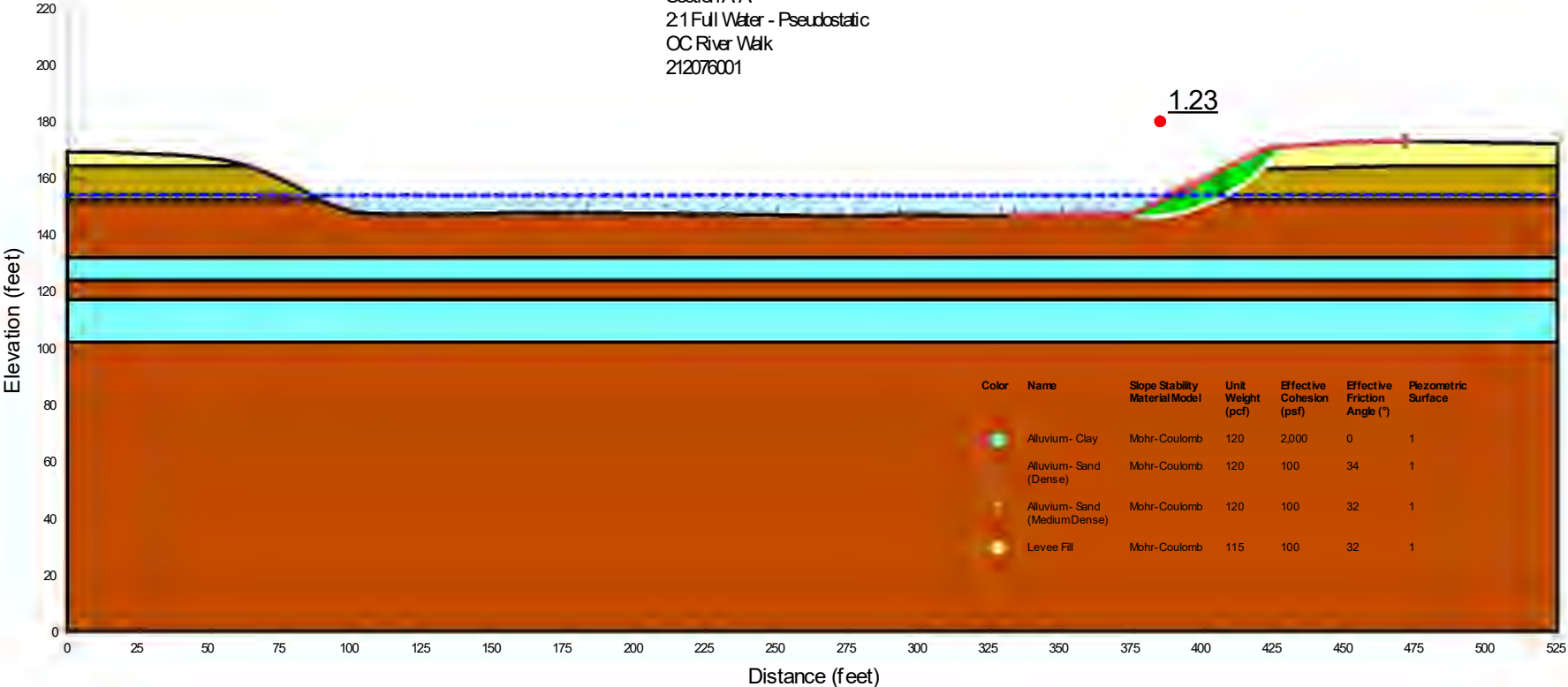
Section A-A'
2:1 Dry-Pseudostatic
OC River Walk
212076001



Section A-A'
2:1 Full Water - Static
OC River Walk
212076001

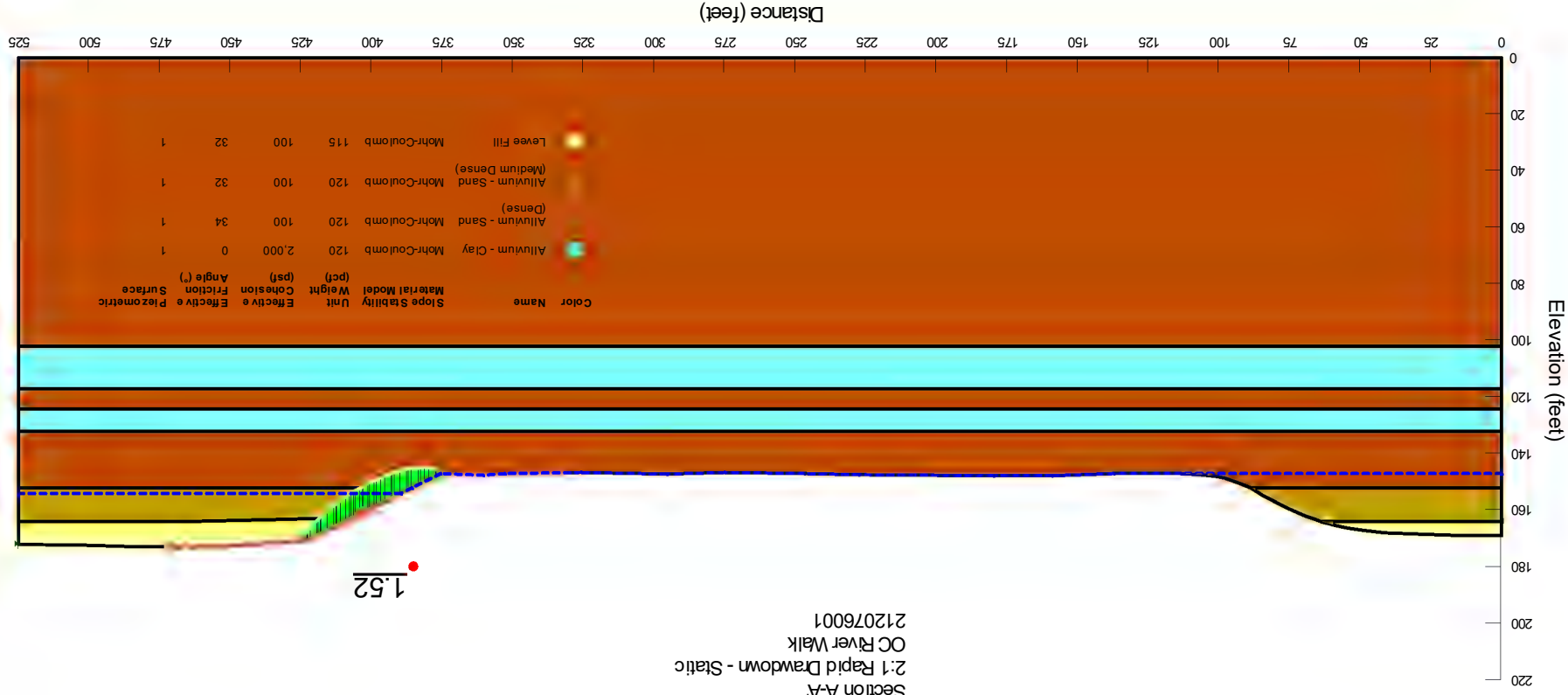


Section A-A'
2:1 Full Water - Pseudostatic
OC River Walk
212076001

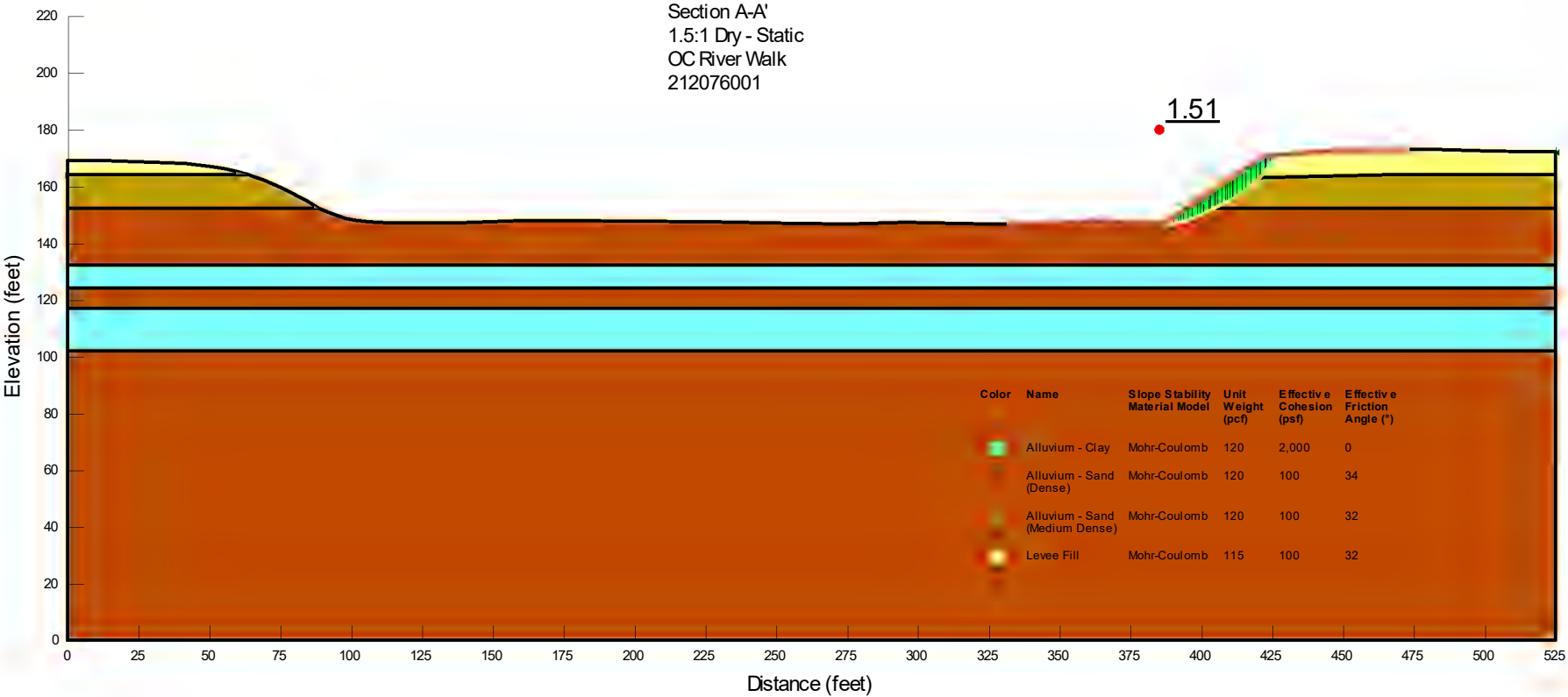


Section A-A'
2:1 Rapid Drawdown - Static
OC River Walk
212076001

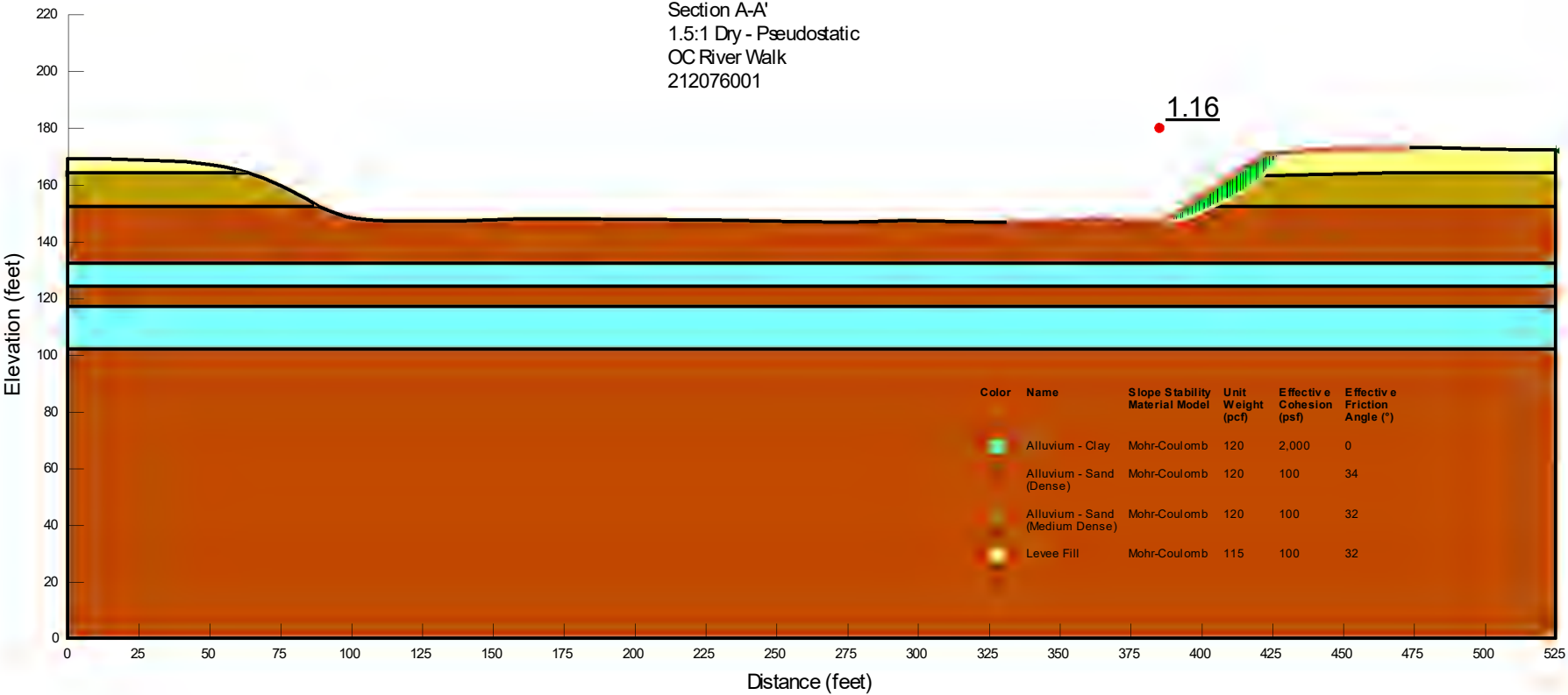
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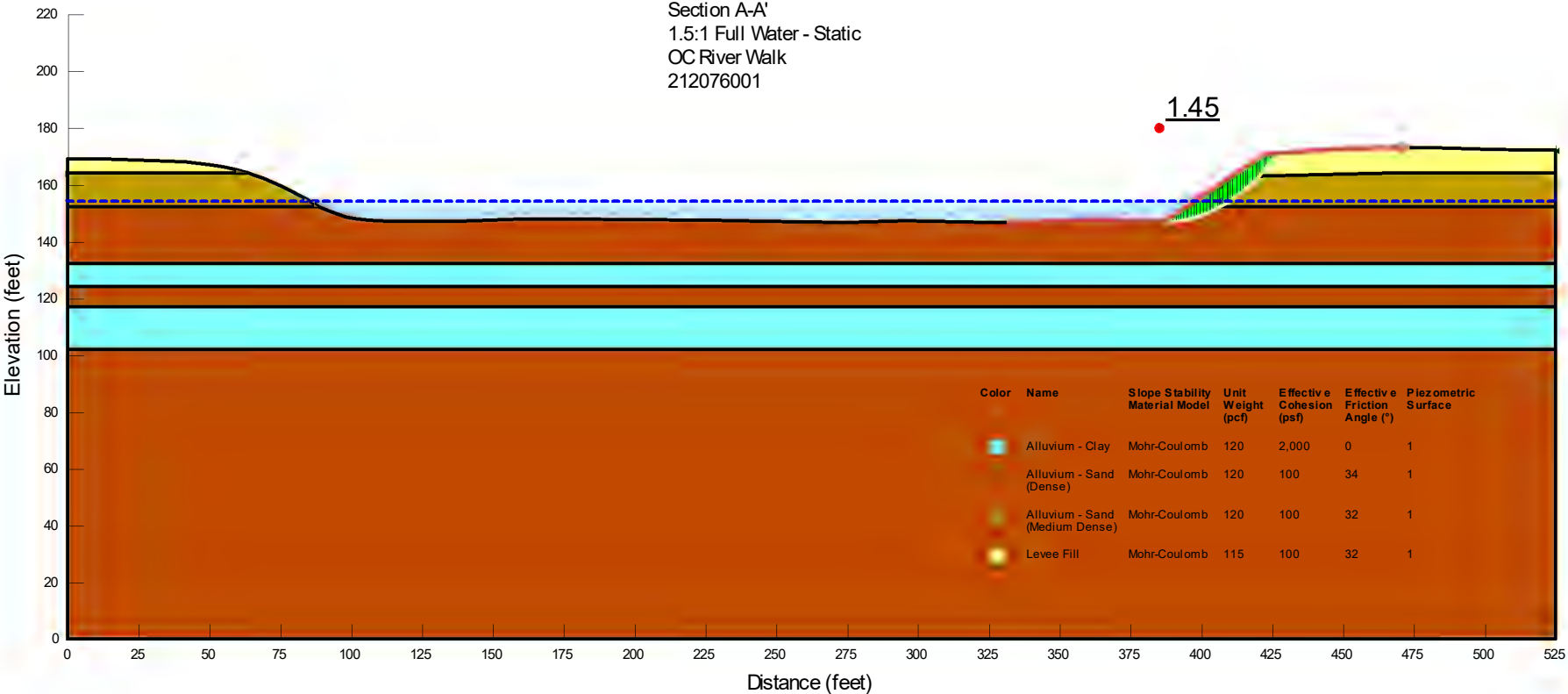
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1.5:1 Dry - Static
OC River Walk
212076001



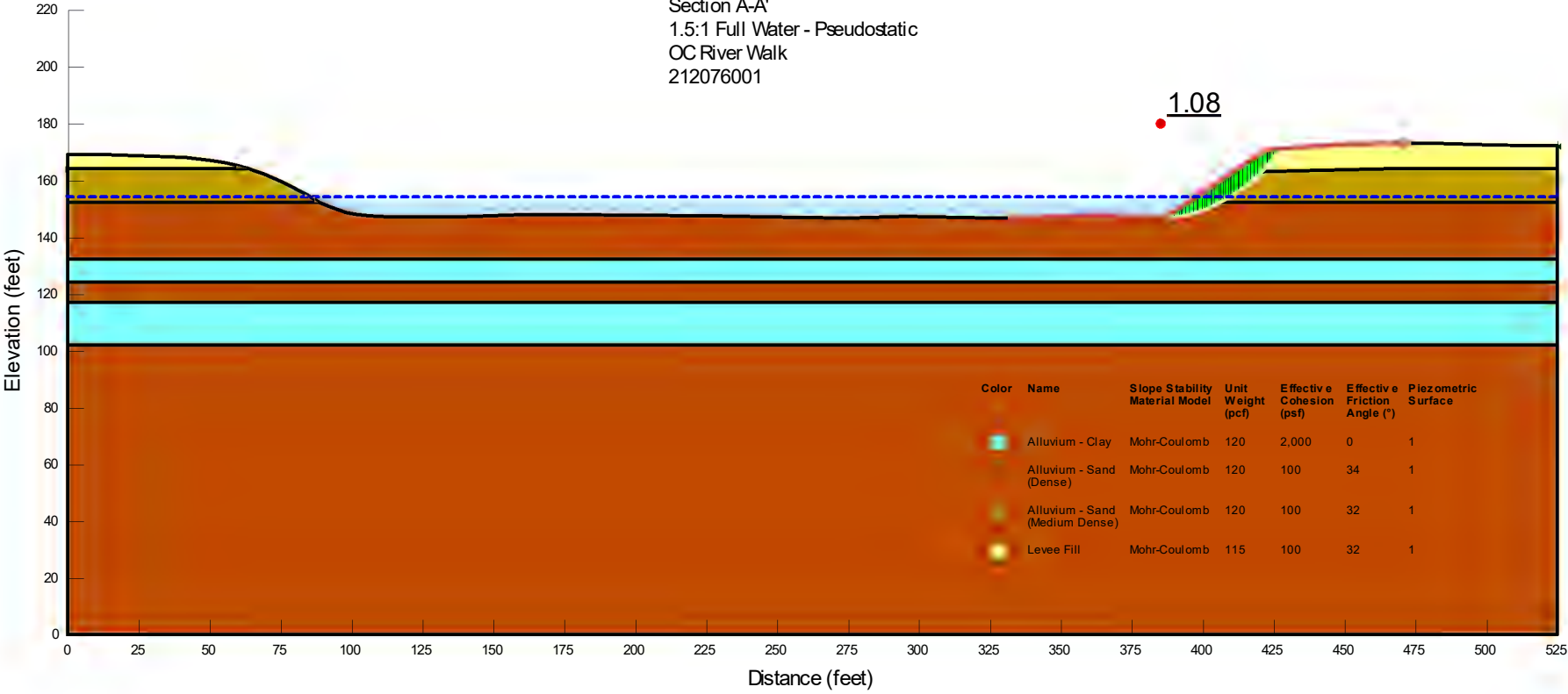
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1.5:1 Dry - Pseudostatic
OC River Walk
212076001



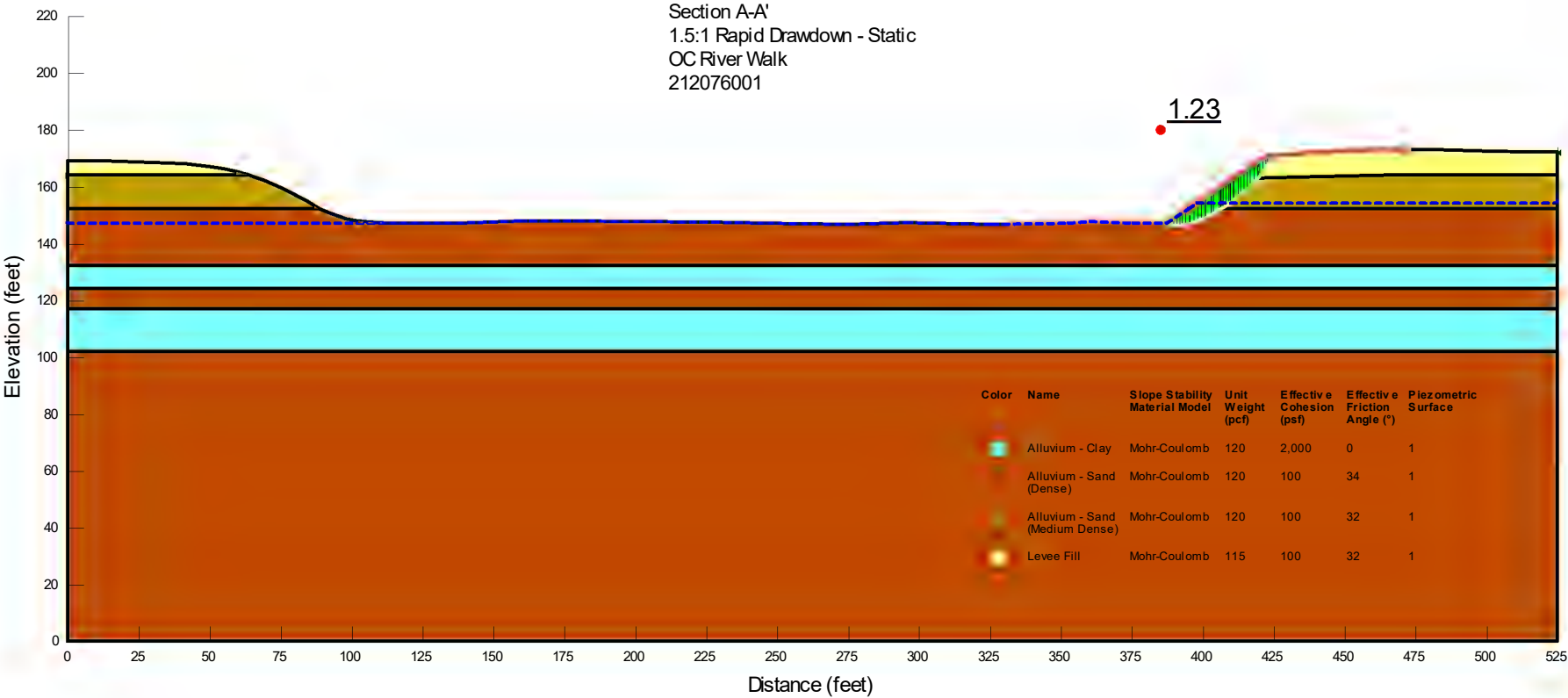
Section A-A'
1.5:1 Full Water - Static
OC River Walk
212076001



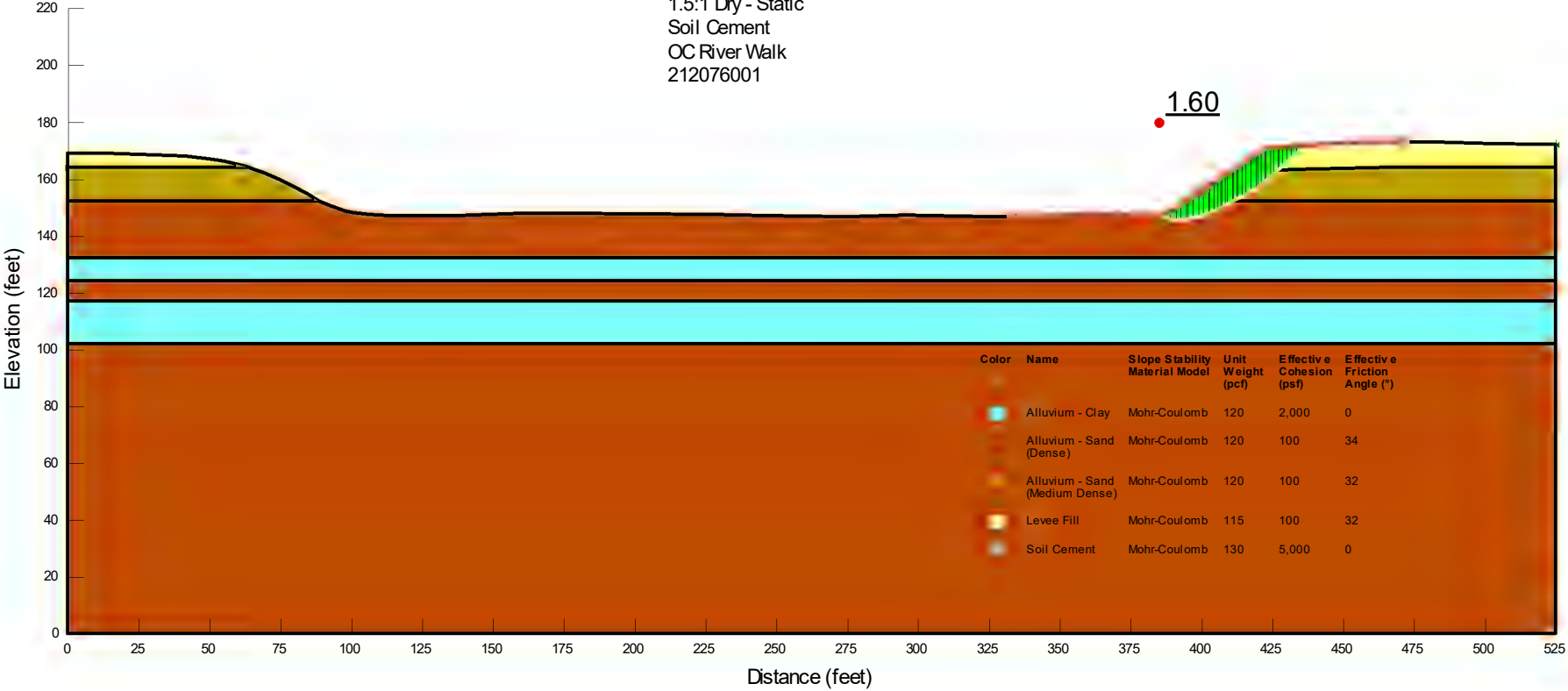
Section A-A'
1.5:1 Full Water - Pseudostatic
OC River Walk
212076001



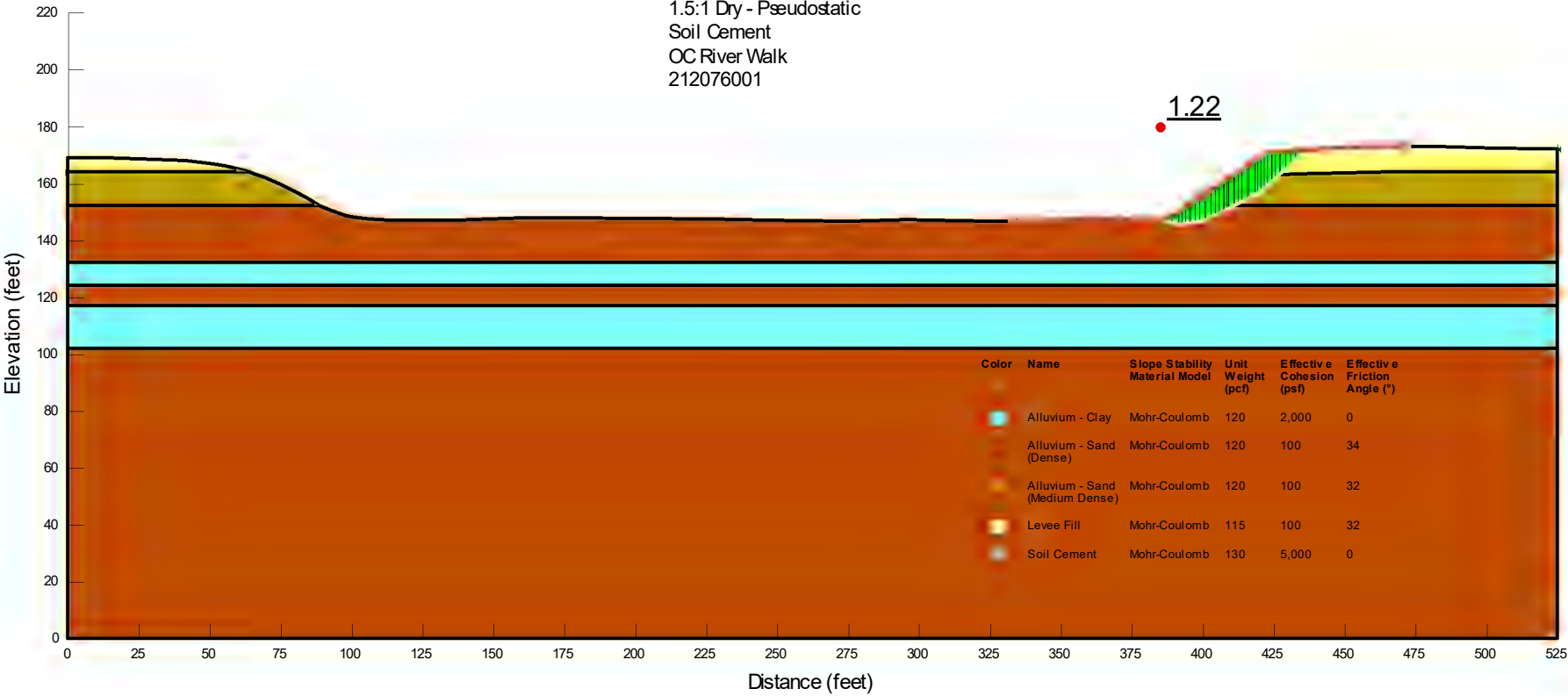
Section A-A'
1.5:1 Rapid Drawdown - Static
OC River Walk
212076001



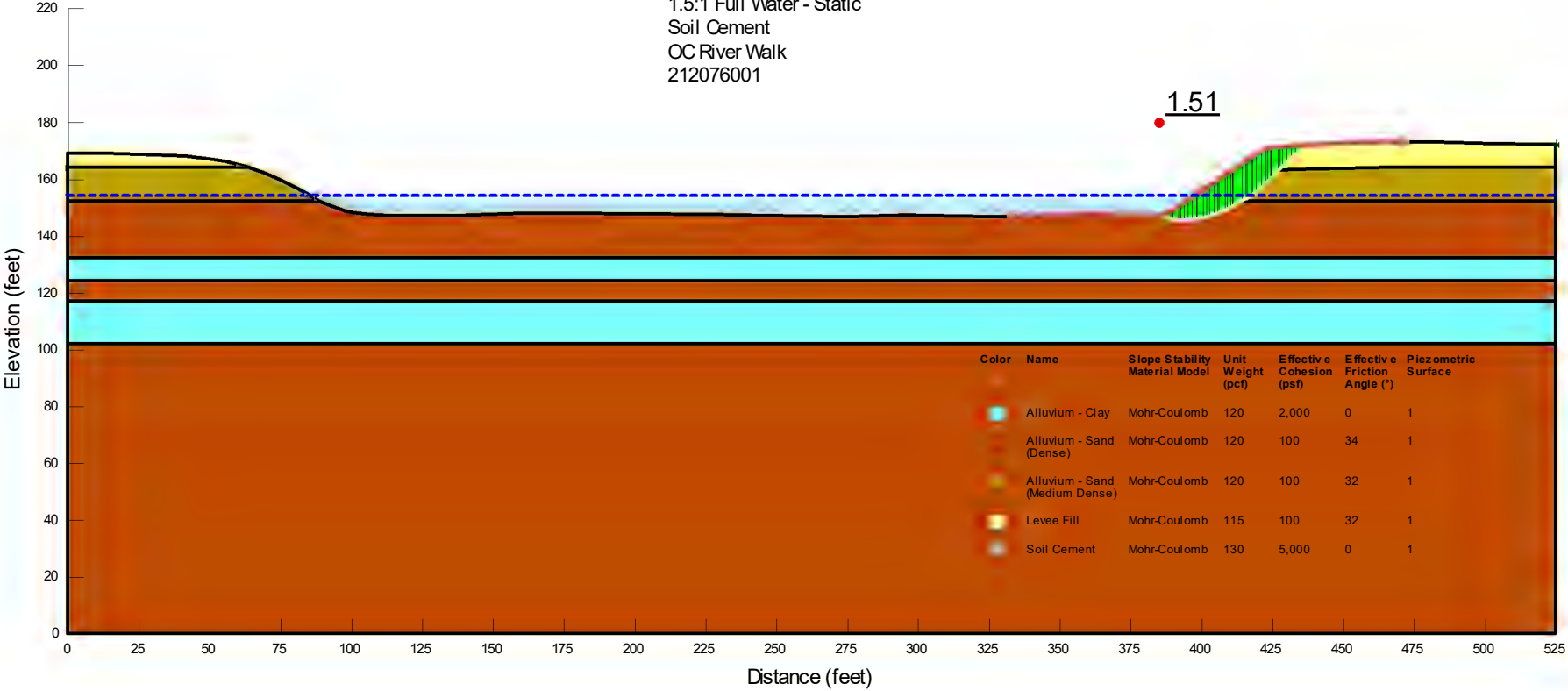
Section A-A'
1.5:1 Dry - Static
Soil Cement
OC River Walk
212076001



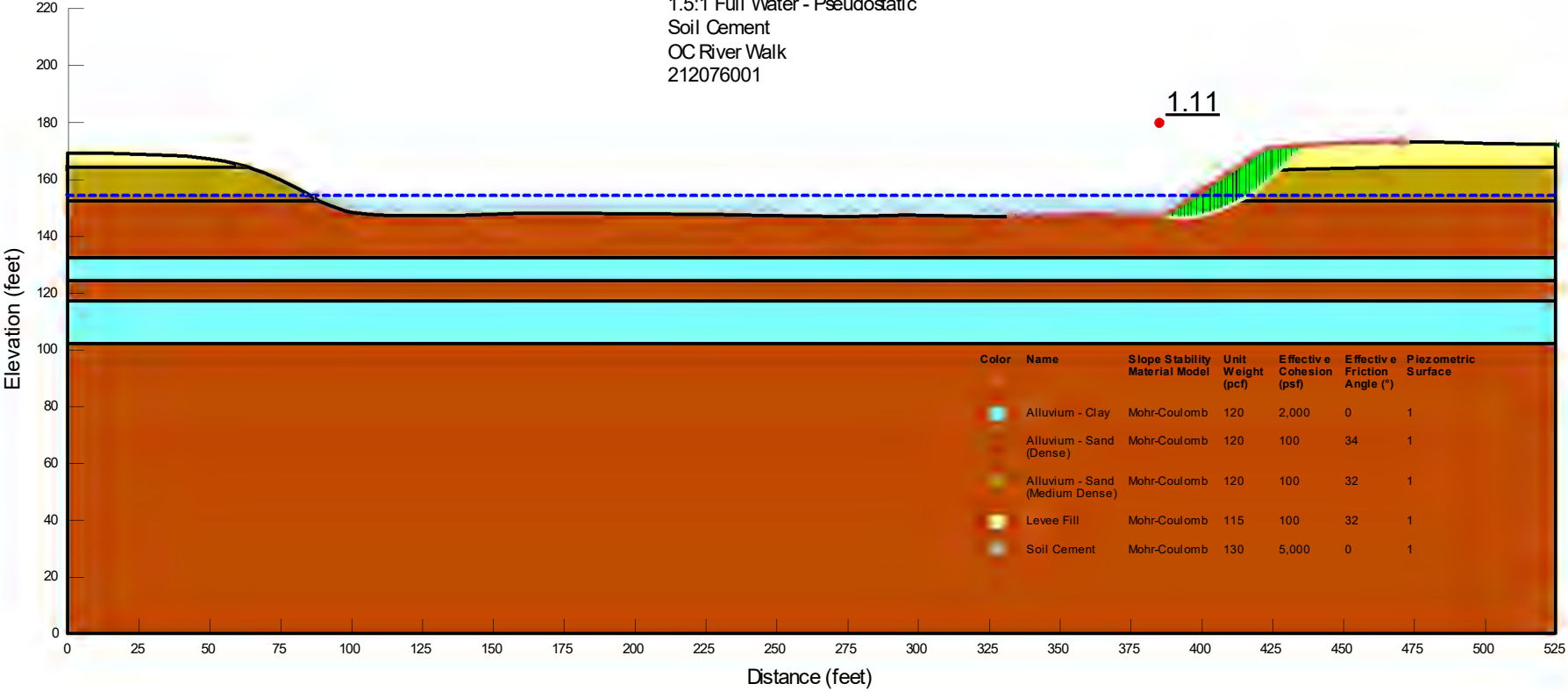
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1.5:1 Dry - Pseudostatic
Soil Cement
OC River Walk
212076001



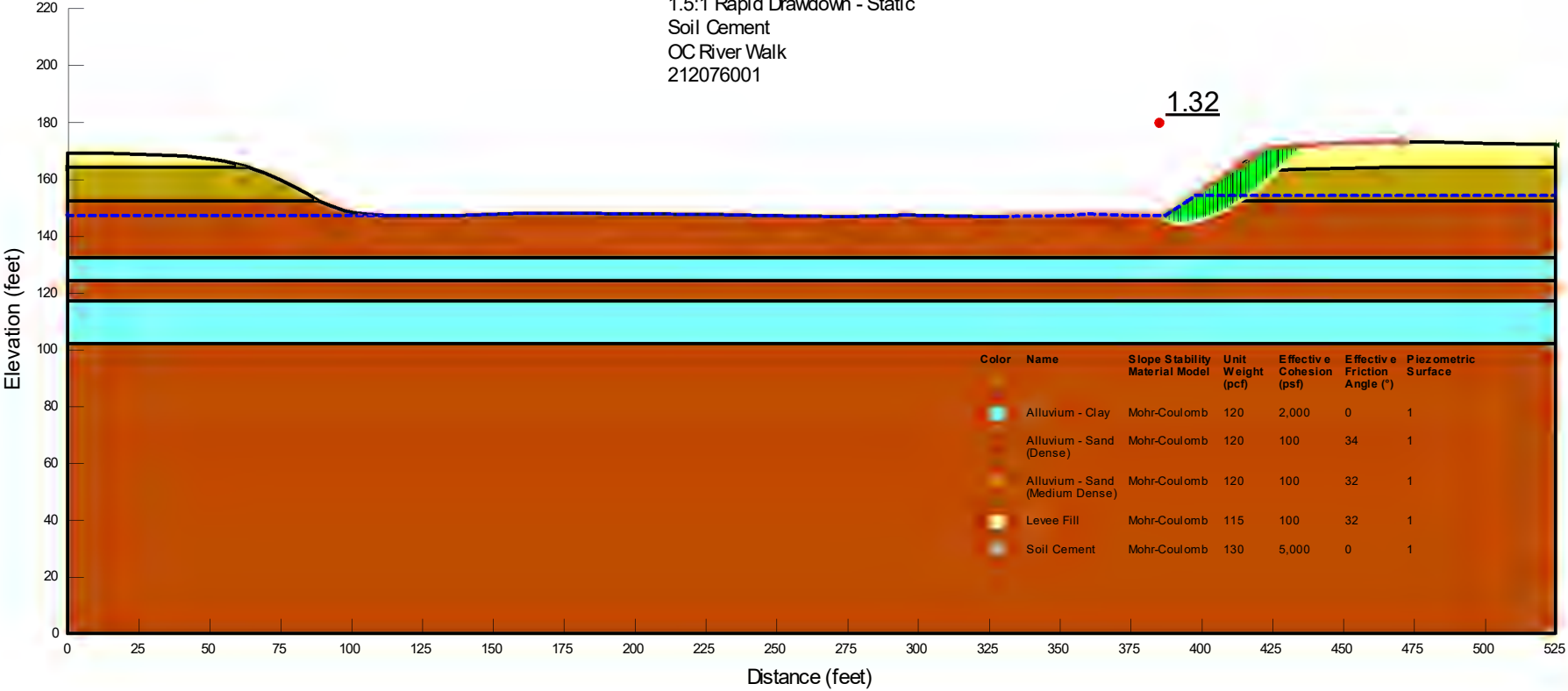
Section A-A'
1.5:1 Full Water - Static
Soil Cement
OC River Walk
212076001



Section A-A'
1.5:1 Full Water - Pseudostatic
Soil Cement
OC River Walk
212076001

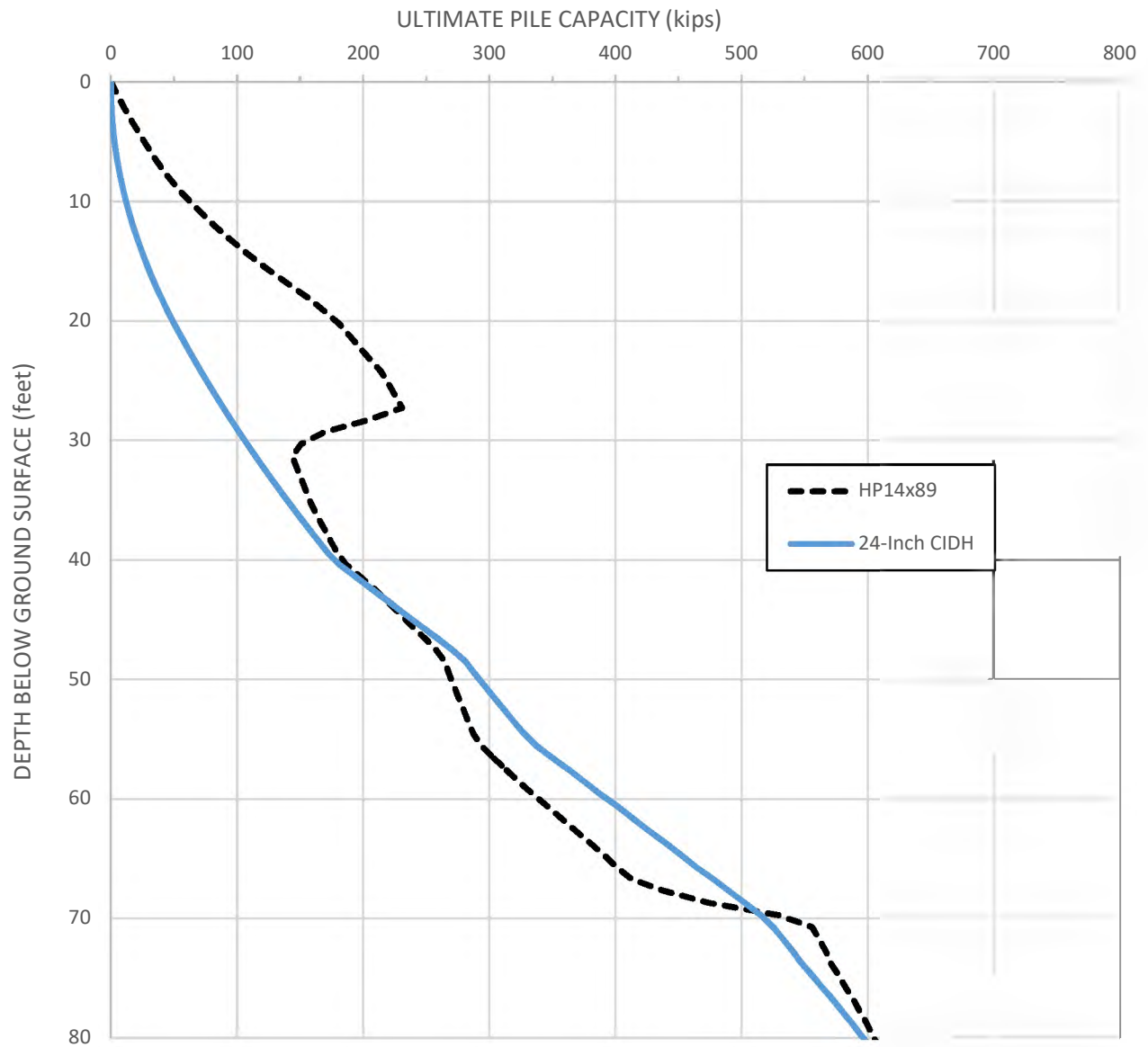


Section A-A'
1.5:1 Rapid Drawdown - Static
Soil Cement
OC River Walk
212076001



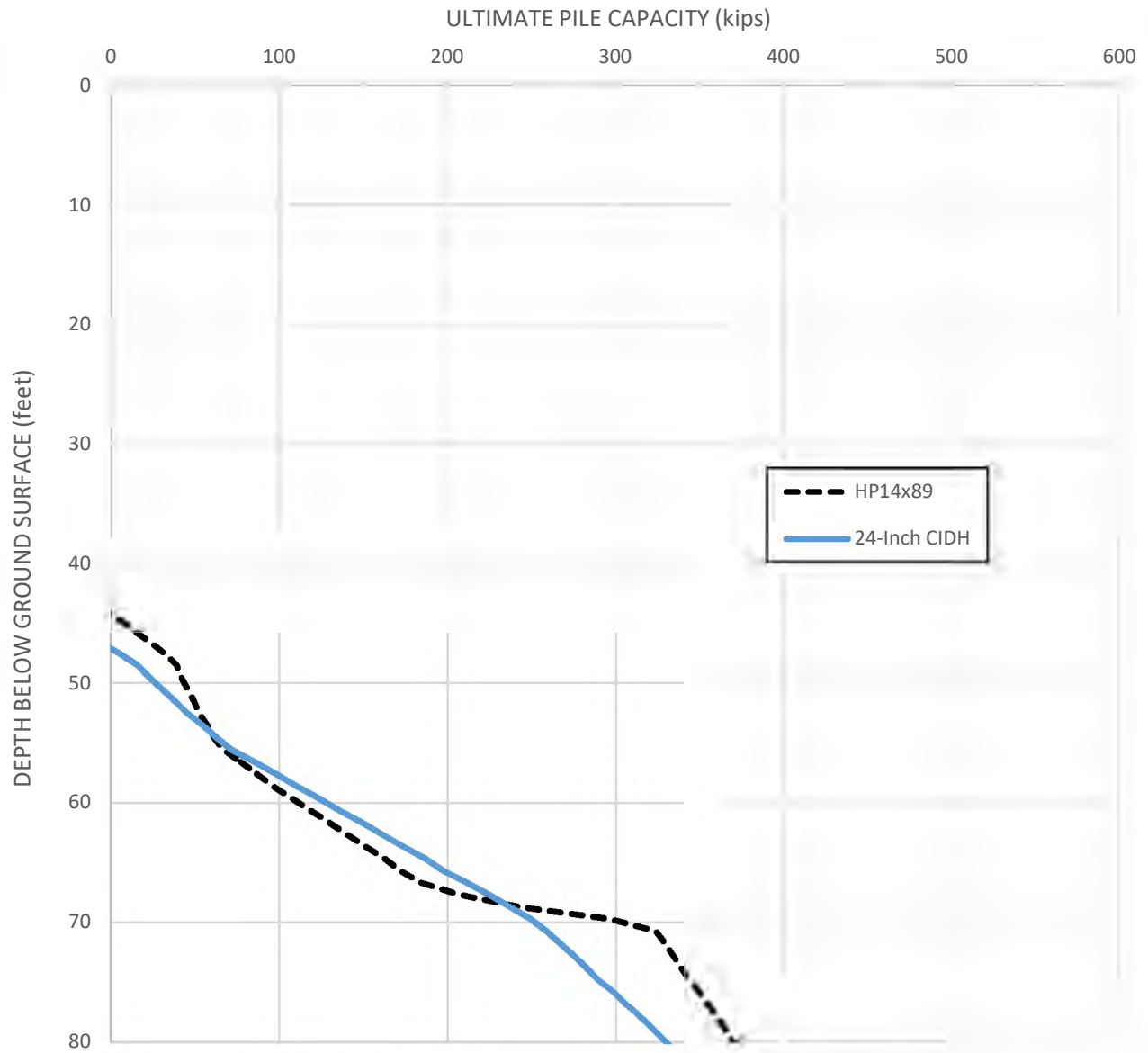
APPENDIX D

Pile Axial Capacity Plots



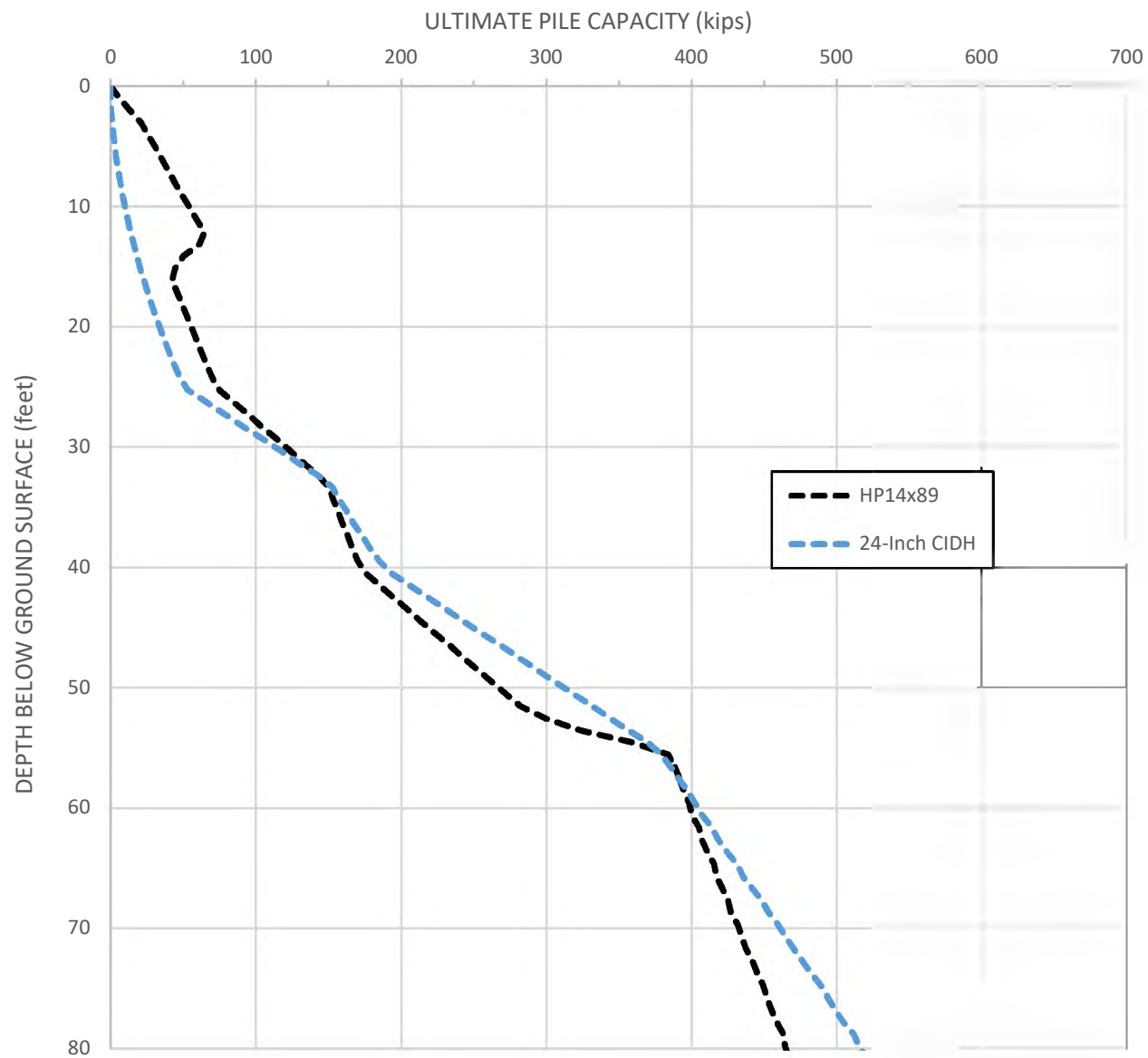
STATIC CONDITION

ABUTMENT PILES



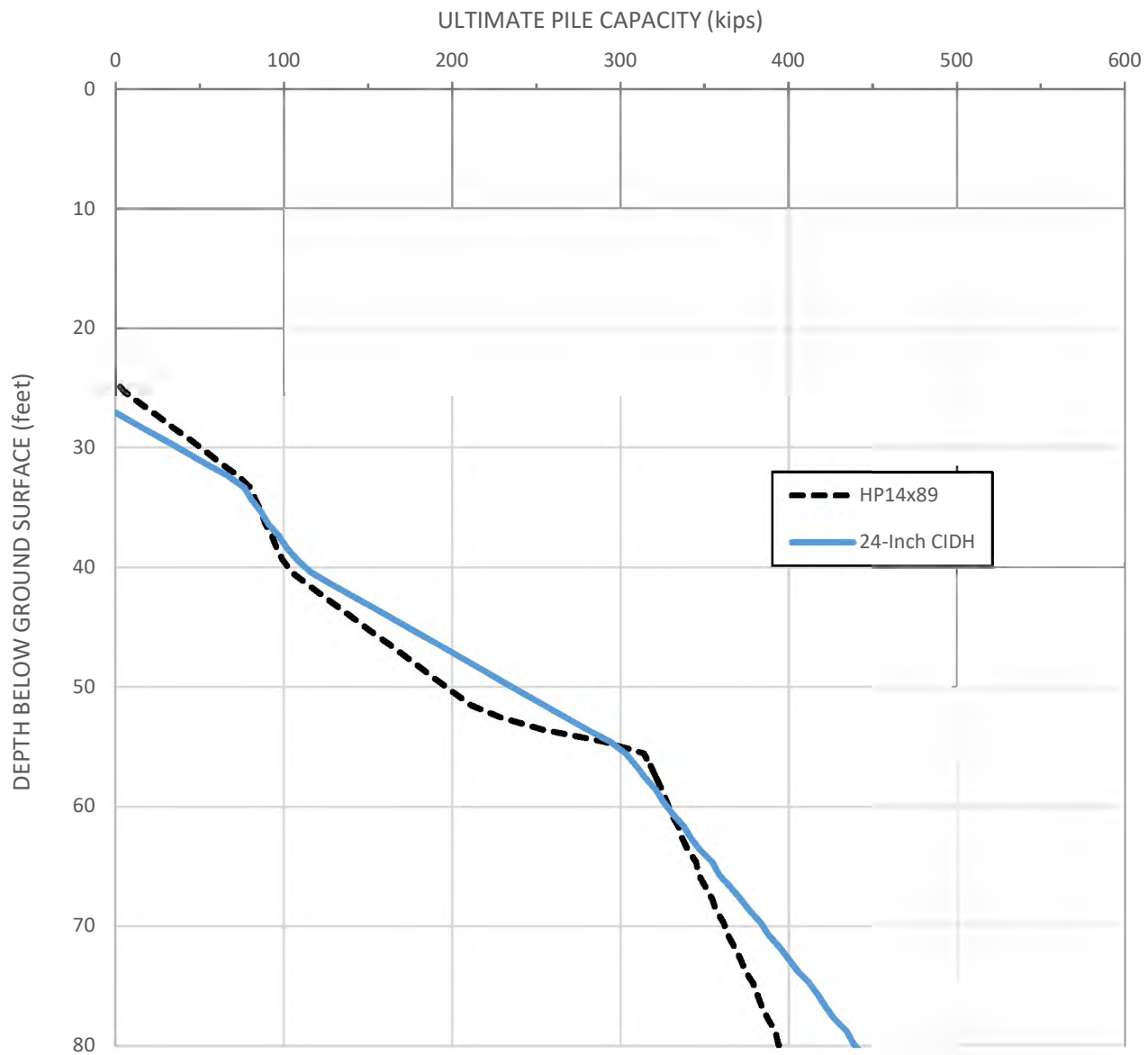
DYNAMIC CONDITION

ABUTMENT PILES



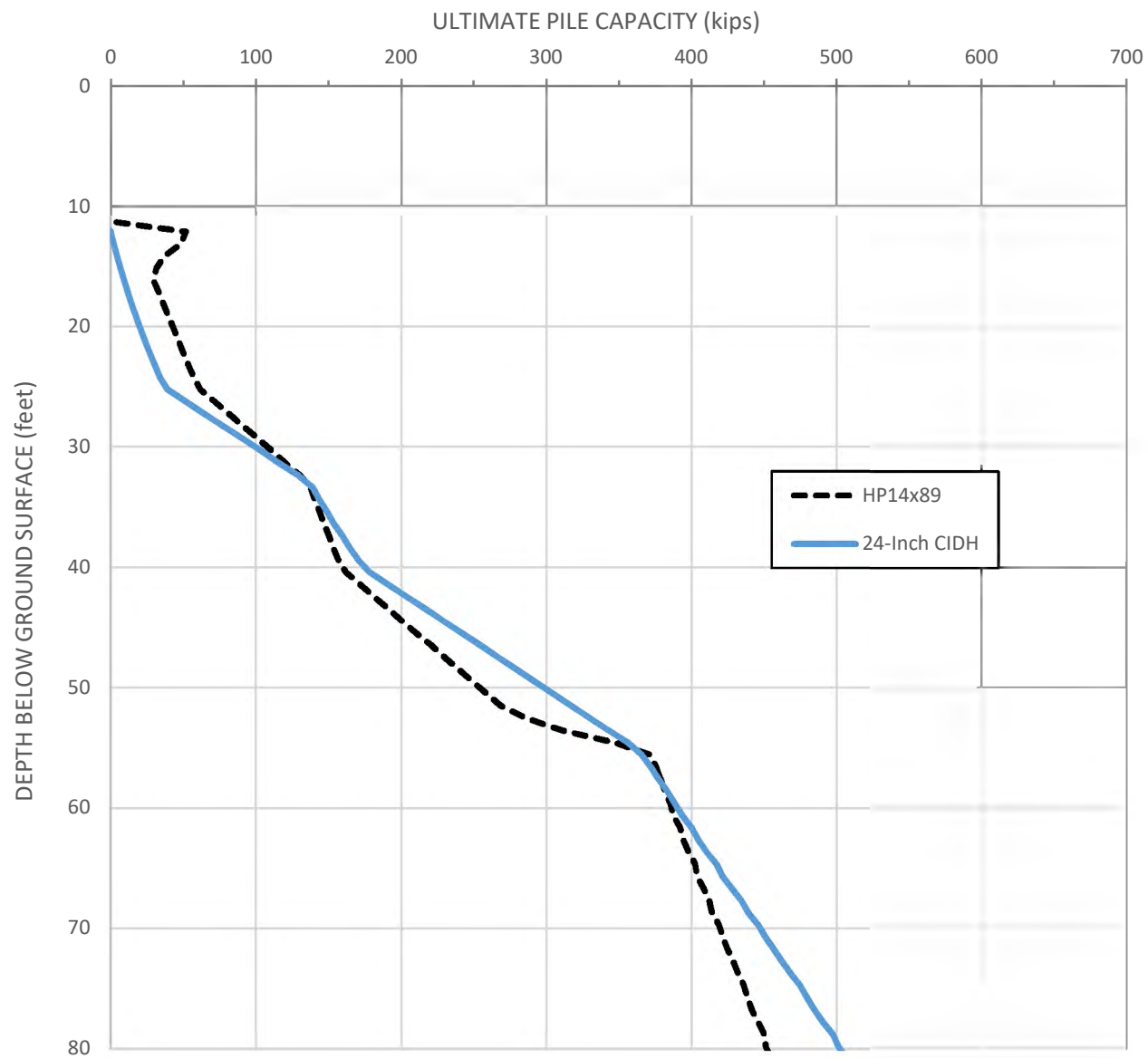
STATIC CONDITION

BENT PILES



DYNAMIC CONDITION

BENT PILES



SCOUR CONDITION

BENT PILES



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

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