Appendix F
Geotechnical Report

ESA

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Report of Geotechnical Foundation Investigation, EF International Language Campus – New Dormitory Buildings and Site Improvements, 3150 Bear Street City of Costa Mesa, California

Prepared for EFEKTA GROUP, INC.

March 1, 2019

GMU Project No. 18-252-00

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TRANSMITTAL

EFEKTA GROUP, INC.
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Cambridge, MA 02141

DATE: March 1, 2019

PROJECT: 18-252-00

ATTENTION: Ms. Bev Garth, Executive Vice President

SUBJECT: Report of Geotechnical Foundation Investigation,
EF International Language Campus
New Dormitory Buildings and Site Improvements
3150 Bear Street
City of Costa Mesa, California

DISTRIBUTION:

Addressee: electronic copy

Gensler
Attn: Mr. Tom Williams (four (4) wet signature copies and an electronic copy)

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INTRODUCTION

PURPOSE

This report presents the results of our geotechnical foundation investigation of soil and geologic conditions for the proposed three (3) dormitory buildings and site improvements located at 3150 Bear Street, City of Costa Mesa, California.

SCOPE

The scope of our geotechnical foundation investigation, as outlined in our December 20, 2018 proposal, was as follows:

1. Staked eleven (11) hollow-stem-auger, truck-mounted drill holes and four (4) cone penetration testing (CPT) soundings locations, coordinated with EFEKTA Group, Inc., and contacted Underground Service Alert (USA/Dig Alert) in order to provide advance notification of the subsurface drill holes and CPTs planned within the project site.

2. Performed a field subsurface exploration program consisting of:

    - Advanced eight (8) HSA drill holes to a maximum depth of approximately 31.5 feet, and four (4) CPTs to depths of approximately 50 feet within the footprints of the new dorm buildings. The CPTs were utilized to obtain shear wave velocities, to verify the current groundwater level and perform a liquefaction analysis.
    - Performed an additional three (3) HSA drill holes to a depth of approximately 5 feet below the existing ground surface to perform preliminary percolation testing.

    Logged all field exploration work and obtained bulk, SPT and drive soil samples for geotechnical laboratory testing.

3. Performed laboratory testing on soil samples obtained from the drill holes. Testing included moisture and density, gradation, Atterberg limits, maximum density, expansion index, shear strength characteristics, consolidation, R-value, and full chemical analysis.

4. Interpreted and evaluated the field and laboratory data collected from this investigation, and performed geotechnical engineering design analyses which included; bearing capacity and settlement analysis, liquefaction analysis, seismic analysis in accordance with the 2016 California Building Code (CBC) standards, and pavement analysis.

5. Supported the schematic design "SD" processes by providing geotechnical design memos/e-mails with geotechnical design conclusions and recommendations, which included the following:

   - Foundation design and anticipated settlement of the dorm buildings;
   - Site preparation, building foundation over-excavation, and precise grading requirements;
   - Acceptability of the site soils for use as fill and backfill;
   - Infiltration results;
   - Shrinkage and subsidence figures relative to earthwork;
   - Site seismicity and seismic design parameters;
   - Lateral earth pressures and temporary slopes;
   - Liquefaction potential and seismic settlement of the site soils;
   - Installation of underground utilities;
   - Flatwork design; and
   - Asphalt pavement and concrete pavement designs.

6. Prepared and distributed this formal geotechnical foundation report for the project, containing our final geotechnical conclusions and recommendations to support the main project submittal and permitting processes.

7. Geotechnical reviews and geotechnical response letters to the grading and building departments of our foundation investigation report, and final project precise grading and foundation plans for the project will be performed under separate covers at a later date.

LOCATION

The subject site is bound by the 405 Freeway on the north, Bear Street on the west, existing single family homes on the south, and existing single family homes on the east. The general location of the project site is shown on our Plate 1 – Location Map.

SITE DESCRIPTION

The site was previously occupied by the Trinity Broadcast Network, a 6.19 acre property containing and existing 2-story 65,650 square foot building with extensive site improvements such as existing landscape areas, Portland cement concrete and asphalt concrete pavement, concrete flatworks,

foundation areas, and miscellaneous auxiliary structures. The site is relatively flat with gentle sloping from south to north.

PROJECT DESCRIPTION

It is our understanding that The EFEKTA Group Inc., which is in escrow on the subject 6.19 acre property is planning on constructing one (1) 3-story dormitory building and two (2) 4-story dormitory buildings. The 3-story building is identified as Building No 3, and the 4-story buildings are identified as Buildings No. 1 and 2 in this report. The location of each building is identified on Plate 2 – Geotechnical Map. The improvements will also include associated drives, parking stalls, flatwork, pool, basketball, soccer and volleyball areas, landscape, and appurtenant structures.

Preliminary structural loads for the buildings were provided by Nabih Youssef Structural Engineers (NYSE). NYSE anticipates maximum building footprint loading of 600 psf (dead load) and 160 psf (live load), with columns loads on the order of 475 kips (dead + live load).

SUBSURFACE EXPLORATION

GMU conducted a subsurface exploration program to evaluate the soil conditions below the proposed dorm buildings, parking areas, and appurtenant structures. A total of fifteen (15) exploratory borings and CPTs were performed, which consisted of the following:

- Eleven (11) hollow stem auger exploratory borings to a maximum depth of 31.5 feet.
- Four (4) CPT soundings to a maximum depth of 50 feet.

The boring locations and CPTs are shown on Plate 2 – Geotechnical Map. Boring logs are contained in Appendix A-1. The hollow stem auger borings were logged by our Staff Engineer, with emphasis on obtaining deep samples up to 31.5 feet below the ground surface. Samples were collected in each of the borings for subsequent laboratory testing. The CPT logs are also contained in Appendix A-1.

LABORATORY TESTING

Laboratory testing was performed on bulk and relatively undisturbed samples collected from the exploratory borings during our recent subsurface exploration. Testing on soil samples included the following:

- Moisture and density
- Sieve analysis and hydrometer
- Atterberg limits
- Expansion index
- Maximum density
- Consolidation
- Direct shear tests
- R-value
- Corrosion (pH, resistivity, chlorides, soluble sulfates)

The results of our laboratory testing are summarized on Table B-1 and included within Appendix B-1 – Laboratory Testing.

GEOLOGIC FINDINGS

REGIONAL GEOLOGIC SETTING

The site is located within the northwestern portion of the Peninsular Ranges Province and the southern portion of the Los Angeles Basin Block, approximately 2.8 miles east of the Santa Ana River and approximately 2.5 miles northeast of the Newport Inglewood Fault. It is underlain by Holocene and Late Pliocene axial channel deposits (Morton et al., 2004).

SUBSURFACE MATERIALS

Topsoil

Top soils were encountered in all of our exploratory drill holes. The topsoil was approximately 1 foot in thickness.

Artificial Fill (Qaf)

Artificial fill was not observed during drilling; however, based on surface observations, site history, and existing site conditions, it is likely that the upper 1 to 2 feet of soil has been disturbed or reworked or deeper fills exist in vicinity of existing improvements. It is anticipated that these soils will be soft to firm, damp to moist, and consist of materials similar to the Young Alluvial Deposits. These soils will not be suitable for support of the planned improvements.

Young Alluvial Deposits (Qya)

Young alluvial deposits underlie the fill material and extended to the maximum depth of the exploratory drill holes. The young alluvial deposits consist of moist to wet, firm to stiff clay and silt material, and moist to very moist, medium dense to very dense sand materials.

GROUNDWATER

Groundwater was encountered at depths ranging from 18 to 20 feet below the existing grade. The historic high depth to groundwater is reportedly 10 to 30 feet below the existing grade at the project site. Groundwater conditions may vary across the site due to stratigraphic and hydrologic conditions, and may change over time as a consequence of seasonal and meteorological fluctuations, or activities by humans at this site and nearby sites. Groundwater is unlikely to impact the proposed development, however, very moist to wet/saturated clayey soils should be expected even in shallow excavations.

GEOLOGIC HAZARDS

FAULTING AND SEISMICITY

The subject site is not within an Alquist-Priolo Earthquake Fault Zone, and no known active faults are shown on current geologic maps as crossing the site. However, the site is located within close proximity of several surface faults that are presently zoned as active or potentially active by the California Geological Survey (CGS). The nearest known active faults are the San Joaquin Hills Blind Thrust and Newport-Inglewood Fault Zone, which are located about 0.4 mile and 5.0 miles from the site, respectively.

Most of southern California is subject to some level of ground shaking (ground motion) because of movement along active and potentially active fault zones in the region. Several sizeable, historic earthquakes have occurred in southern California. Given the proximity of the site to several active and potentially active faults, the site will likely be subject to earthquake ground motions in the future. The level of ground motion at a given site resulting from an earthquake is a function of several factors including earthquake magnitude, type of faulting, rupture propagation path, distance from the epicenter, earthquake depth, duration of shaking, site topography, and site geology.

Seismic Hazard Zones

The subject is located within an area mapped as having the potential for seismically induced liquefaction but not landsliding, as shown on the Seismic Hazard Zone Map for Newport Beach Quadrangle (CGS, 1997).

LIQUEFACTION & EARTHQUAKE-INDUCED SETTLEMENTS

Liquefaction

A liquefaction evaluation was performed on each CPT by means of CLiq, v.1.7.6.49 software and the Robertson (2009) methodology. The analysis was based on the 2016 CBC and ASCE 7-10 criteria. During our recent field exploration, groundwater was encountered at a depth of approximately 18 feet below the existing grade. However, according to the California Geological Survey (CDMG, 197), historic high groundwater is reportedly at a depth between 10 and 30 feet below the existing grade. A historic high groundwater depth of 10 feet was used in the analysis.

The results of our analysis indicate liquefaction does occur in discrete zones below a depth of 24 feet. Seismic settlement related to liquefaction along with dry sand seismic settlement was also calculated for the site. The analysis indicates seismic settlements on the order of 1.5 inches below Building No.1 and 0.5 inch beneath Buildings No. 2 and 3. The results of the liquefaction and earthquake-induced settlement analyses are included in the attached Appendix C.

LANDSLIDES

Based on our review of available geologic maps, literature, topographic maps, aerial photographs, and our subsurface evaluation, no landslides or related features underlie or are adjacent to the subject site. Due to the relatively level nature of the site and surrounding areas, the potential for landslides to occur at the project site is considered negligible.

TSUNAMI, SEICHE, AND FLOODING

The site is not located on any State of California – County of Orange Tsunami Inundation Map for Emergency Planning. The potential for the site to be adversely impacted by earthquake-induced tsunamis is considered to be negligible because the site is located several miles inland from the Pacific Ocean coast at an elevation exceeding the maximum height of potential tsunami inundation.

The potential for the site to be adversely impacted by earthquake-induced seiches is considered to be negligible due to the lack of any significant enclosed bodies of water located in the vicinity of the site.

According to the County of Orange FEMA Flood Insurance Rate Map, the site is located within "Zone", an area of 0.2% annual chance flood, 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile, and protected by levees from 1% annual chance flood. The potential for the site to be adversely impacted by significant flooding is considered low.

GEOTECHNICAL ENGINEERING FINDINGS

STATIC SETTLEMENT/COMPRESSIBILITY

Engineered Fills and Alluvial Deposits

Static settlement of the site will be induced by introducing new building loads to existing grades and subsurface soils. The underlying alluvial deposits encountered were found to be firm to stiff and medium dense to very dense, however, the upper approximately 30 feet of the site are considered susceptible to significant consolidation upon loading. The static settlement at the site was analyzed under our recommended bearing capacity utilizing the approximate preliminary building foundation loads provided by the structural engineer by means of our consolidation laboratory tests for the site. The magnitude of total static settlements beneath Building No. 1 and No. 2 is expected to be approximately 2 inches and beneath Building No. 3 to be approximately 1.75 inches.

FOUNDATION SYSTEMS

Based on the static/compressibility characteristics of the on-site alluvial soils, the results of the liquefaction hazard analysis, we recommend that Building No. 1 be supported on a mat foundation system, while Buildings No. 2 and 3 be supported on either a mat foundation or shallow spread footing foundation system supported on rammed aggregate piers.

SOIL EXPANSION

Based on our expansion index testing, the near-surface materials have a ***high to very high expansion potential***. Although portions of the alluvial soils encountered were relatively coarse-grained, the majority of alluvial soils encountered were fine-grained and expansive. Additional expansion index

testing is recommended below the proposed improvements upon completion of precise grading and prior to construction.

SOIL CORROSION

The results of the laboratory chemical tests performed on representative samples collected within the site indicate the following:

- A high sulfate exposure to concrete or an "S2" exposure in accordance with ACI Table19.3.2.1.
- A high chloride content (corrosive to ferrous metals).
- A low level of resistivity, which indicates that the soil is severely corrosive to ferrous metals.

The results of the laboratory chemical tests performed within the site are included in Appendix B.

PRELIMINARY PERCOLATION TESTING

Three (3) preliminary percolation tests were performed in general conformance with the Santa Ana Regional Water Quality Control Board Technical Guidance Document (TGD), Appendices dated March 2011. The "Shallow Percolation" test procedure contained in Section VII.3.8 was utilized. The percolation borings were drilled to a maximum depth of 5 feet below the existing grade using a hollow-stem-auger, truck-mounted drill rig. The calculated infiltration rates are presented in the table below.

Calculated Infiltration Rates

Drill Hole	Depth Below Finish Grade (feet)	Infiltration Rate (inches/hour)*
DH-3	4.92	0.02
DH-7	5.0	0.02
DH-9	5.0	0.01

**Rates incorporate a factor of safety of 2.*

The calculated infiltrate rates do not meet the minimum requirement of 0.3 inches/hour per the TGD manual. On this basis, infiltration of storm water into the site soils is deemed not feasible.

EXCAVATION CHARACTERISTICS

Rippability

The majority of the soil materials underlying the site can be excavated with scrapers and other conventional grading equipment.

IN-SITU SOIL MOISTURE CHARACTERISTICS

The fill and alluvial soils within the site are generally moist to very moist, and at certain locations wet. Fill and alluvial soils within the upper 7 feet have an average degree of saturation of more than 85%. It should be noted, however, that the moisture content within the upper several feet may vary depending on rainfall and the time of year in which grading occurs. Consequently, one or more of the following measures during remedial grading may be required: 1) locally drying back of the soils, and/or 2) mixing of the soils with cement to reduce the expansive nature and very moist to wet nature of the onsite soils.

SUMMARY OF CONCLUSIONS

Based on the geologic and geotechnical findings, the following is a summary of our conclusions:

1. It is our opinion that the proposed project is feasible assuming all applicable recommendations contained herein are implemented.
2. The proposed 4-story Building No. 1 may be supported on a mat foundation, while the proposed 4 and 3-story Buildings No. 2 and 3 may be supported on a mat foundation or shallow spread footings supported on rammed aggregate piers.
3. Groundwater is not anticipated to directly impact the planned precise grading or during the installation of shallow underground utilities.
4. There are no known active faults crossing the subject site. The site seismicity is typical for the Irvine area. Structure design should be in accordance with the current CBC.
5. The magnitude of total seismic settlement beneath Building No. 1 is expected to be on the order of 1.5 inches and beneath Buildings No. 2 and 3 on the order of 0.5 inch.
6. The magnitude of total static settlements beneath Building No. 1 and 2 is expected to be less than 2.0 inch, and the magnitude of total static settlement beneath Building No. 3 is expected to be less than 1.75 inches, provided that the corrective grading and/or ground improvement recommendations are performed during construction.
7. Due to the potential for highly expansive soils, special design considerations will be required for the flatwork associated with the proposed improvements, and for the slab-on-grade within Buildings No. 2 and 3, if a mat foundation is not selected.

8. The on-site soils are severely corrosive to ferrous metals and have a potential for severe sulfate and chloride corrosion exposure to concrete (i.e., as defined by the CBC) and reinforcement. Special design considerations will be required for proposed improvements in contact with on-site soil.
9. Based on preliminary percolation testing and calculated infiltration rates, infiltration of storm water into the site soils is deemed not feasible.
10. The fill and alluvial soils within the site are found to be in a moist to very moist condition, while some locations containing wet soil conditions. Ground mitigation is anticipated during the grading process.

RECOMMENDATIONS

SEISMIC DESIGN OF THE PROPOSED BUILDINGS

Site-specific seismic design parameters were determined using the USGS computer program title ASCE 7 Hazard Tool. The site coordinates used in the analysis were 33.6868° North Latitude and 117.8912° West Longitude. Based on our field exploration and the site soil profile, the site should be designated as Site Class D based on the measured shear wave velocities at CPT-1, CPT-2, and CPT-4, resulting in V_{S30} of 895 feet/sec, 845 feet/sec, and 910 feet/sec respectively. The seismic design coefficients based on ASCE 7-10 and 2016 CBC are listed in table below.

2016 CBC Site Categorization and Site Coefficients

Categorization/Coefficient	Design Value
Site Class based on Soil Profile (ASCE 7, Table 20.3-1)	D
Short Period Spectral Acceleration S_s**	1.562
1-sec. Period Spectral Acceleration S_1**	0.577
Site Coefficient F_a (Table 11.4-1)**	1.000
Site Coefficient F_v (Table 11.4-2)**	1.500
Short Period MCE* Spectral Acceleration S_{MS}**	1.562
1-sec. Period MCE Spectral Acceleration S_{M1}**	0.865
Short Period Design Spectral Acceleration S_{DS}**	1.041
1-sec. Period Design Spectral Acceleration S_{D1}**	0.577
MCE Peak Ground Acceleration (PGA) *	0.604
Site Coefficient F_{PGA} (Table 11.8-1)**	1.000
MCE Peak Ground Acceleration (PGA_M) *	0.604
Modal Contributing Magnitude to MCE Event	6.6

* *MCE: Maximum Considered Earthquake*
** *Values Obtained from USGS Earthquake Hazards Program website are based on the ASCE7-10 and 2016 CBC.*

The Maximum Considered Earthquake (MCE) Peak Horizontal Ground Acceleration (PHGA) is 0.60g as determined in accordance with the 2016 CBC. This PHGA is primarily dominated by earthquakes with a modal magnitude of 6.6 at a mean distance of 8.2 miles from the site using the USGS 2014 Interactive Deaggregation website.

It should be recognized that much of southern California is subject to some level of damaging ground shaking as a result of movement along the major active (and potentially active) fault zones that characterize this region. Design utilizing the 2016 CBC is not meant to completely protect against damage or loss of function. Therefore, the preceding parameters should be considered as minimum design criteria.

GENERAL SITE PREPARATION AND GRADING (EXCLUDING BUILDING AREAS)

General

All site preparation and grading outside the building areas should be performed in accordance with the City of Irvine grading code requirements and the recommendations presented in this report.

Clearing

All significant organic material such as weeds, brush, tree branches, roots, construction debris, old irrigation lines, or other decomposable material should be removed from areas to be graded.

Corrective Grading (Within Building Areas)

Removal and re-compaction of soils within building areas will be required to provide a stable platform for construction of proposed foundations and to limit static settlement.

The corrective grading should be conducted to the satisfaction of the soils technician to ensure that the subgrade soils are thoroughly mixed and that all significant organics (roots, wood debris, etc.) that could decompose with time and cause settlement are removed.

It should be noted that the recommendations provided herein are based on our subsurface exploration and knowledge of the on-site geology. Actual removals may vary in configuration and volume based on observations of geologic materials and conditions encountered during grading. The bottom of all remedial grading removals should be observed by a GMU representative to verify the suitability of in-place soils prior to performing the scarification and recompaction. General remedial grading recommendations are outlined below.

Buildings No. 1 and 2 – Supported on Mat Foundation

Given the saturated in-place soil conditions, the presence of highly expansive soil, the relatively soft subgrade and associated seismic settlement, a mat foundation system with subgrade mitigation may be used to support the proposed 4-story Buildings No. 1 and 2. We recommend that the mat foundation be supported on 5 feet of cement treated soil. Grading recommendations for the proposed Buildings No. 1 and 2 foundation should consist of the following:

- The mat foundation should be excavated to a depth of at least 5 feet below bottom of the mat foundation. The lateral extent of the overexcavation should be at least 5 feet beyond the edge of the mat.
- The bottom of the excavation should then be scarified to a depth of at least 8 inches, mixed with 6% cement, moisture conditioned to 1-3% above optimum moisture content, and recompacted to at least 92% relative compaction.
- The onsite material mixed with 6% cement may then be used as fill material to achieve the planned mat foundation bottom elevation. The fill material mixed thoroughly with cement should be placed in 6- to 8-inch-thick lifts, moisture conditioned to 1-3% above optimum moisture content, and compacted to achieve 92% relative compaction.

Building No. 3 – Supported on Mat Foundation

Given the saturated in-place soil conditions, the presence of highly expansive soil, the relatively soft subgrade and associated seismic settlement, a mat foundation system with subgrade mitigation may be used to support the proposed 3-story Building No. 3. We recommend that the mat foundation be supported on 3 feet of cement treated soil. Grading recommendations for the proposed Building No. 3 foundation should consist of the following:

- The mat foundation should be excavated to a depth of at least 3 feet below bottom of the mat foundation. The lateral extent of the overexcavation should be at least 3 feet beyond the edge of the mat.
- The bottom of the excavation should then be scarified to a depth of at least 8 inches, mixed with 6% cement, moisture conditioned to 1-3% above optimum moisture content, and recompacted to at least 92% relative compaction.
- The onsite material mixed with 6% cement may then be used as fill material to achieve the planned mat foundation bottom elevation. The fill material mixed thoroughly with cement should be placed in 6- to 8-inch-thick lifts, moisture conditioned to 1-3% above optimum moisture content, and compacted to achieve 92% relative compaction.

Buildings No. 2 and 3 – Supported on Geopiers or Equivalent Gravel Piers

If shallow spread footings supported on Geopiers or equivalent gravel piers are selected to support Buildings No. 2 and 3, then the slab-on-grade (SOG) subgrade will require corrective grading prior

to construction of the slab structural section. Grading for Buildings No. 2 and 3 SOG should consist of the following:

- The SOG subgrade should be excavated to a depth of at least 18 inches below bottom of the slab section (i.e., bottom of the aggregate base).
- The bottom of the excavation should then be scarified to a depth of at least 6 inches, mixed with approximately 6% cement, moisture conditioned to 1-3% above optimum moisture content, and recompacted to at least 92% relative compaction.
- The onsite material mixed with 6% cement may then be used as fill material to achieve the planned SOG subgrade elevation. The fill material mixed thoroughly with cement should be placed in 6- to 8-inch-thick lifts, moisture conditioned to 1-3% above optimum moisture content, and compacted to achieve 92% relative compaction.

We note, a soil cement mix design should be performed to evaluate the required amount of cement to achieve a minimum 7-day unconfined compressive strength of 300 psi. Based on the soil types encountered, we anticipate that 6% cement will be sufficient to achieve the design strength.

Corrective Grading (Outside Building Areas)

Removal and re-compaction of areas to receive new improvements that are outside the buildings areas will be required for adequate performance relative to expansive soil uplift.

The corrective grading should be conducted to the satisfaction of the soils technician to ensure that the subgrade soils are thoroughly mixed and that all significant organics (roots, wood debris, etc.) that could decompose with time and cause settlement are removed.

It should be noted that the recommendations provided herein are based on our subsurface exploration and knowledge of the on-site geology. Actual removals may vary in configuration and volume based on observations of geologic materials and conditions encountered during grading. The bottom of all remedial grading removals should be observed by a GMU representative to verify the suitability of in-place soils prior to performing the scarification and recompaction. General remedial grading recommendations are outlined below.

<u>Vehicular Pavement:</u> Grading recommendations for the new vehicular pavement areas should consist of the following:

- The vehicular pavement section should be over-excavated to a depth of at least 12 below the bottom of the pavement section (i.e., 12 inches below the bottom of the aggregate base).
- The bottom of the over-excavation should then be scarified to a depth of at least 6 inches, moisture conditioned to least 4% above optimum moisture content, and recompacted to at least 90% relative compaction.

- Following the approval of the over-excavation bottom by a representative of GMU, the onsite material may be used as fill material to achieve the planned subgrade elevation.
- The fill material should then be placed in 6- to- 8-inch-thick lifts, moisture conditioned to at least 4% above optimum moisture content, and compacted to achieve 90% relative compaction.

Retaining Walls: Grading recommendations for the retaining wall foundation should consist of the following:

- The retaining wall foundation should be over-excavated to a depth of at least 18 below the bottom of footing.
- The bottom of the over-excavation should then be scarified to a depth of at least 6 inches, moisture conditioned to least 4% above optimum moisture content, and recompacted to at least 90% relative compaction.
- Following the approval of the over-excavation bottom by a representative of GMU, the onsite material may be used as fill material to achieve the planned subgrade elevation.
- The fill material should then be placed in 6- to- 8-inch-thick lifts, moisture conditioned to at least 4% above optimum moisture content, and compacted to achieve 90% relative compaction.

Flatwork/Hardscape/Sports Court/Pool Shell and Deck: Grading recommendations for the new concrete flatwork/hardscape/sports court/pool area and deck should consist of the following:

- The flatwork/hardscape/sports court/pool shell and deck section should be over-excavated to a depth of at least 12 inches below the bottom of the hardscape/flatwork/sports court/pool shell and deck section (i.e., 12 inches below the bottom of the aggregate base).
- The bottom of the over-excavation should then be scarified to a depth of at least 6 inches, moisture conditioned to least 4% above optimum moisture content, and recompacted to at least 90% relative compaction.
- Following the approval of the over-excavation bottom by a representative of GMU, the onsite material may be used as fill material to achieve the planned subgrade elevation.
- The fill material should then be placed in 6- to- 8-inch-thick lifts, moisture conditioned to at least 4% above optimum moisture content, and compacted to achieve 90% relative compaction.

Additional Grading Recommendations

If the existing loose fill materials are found to be disturbed to depths greater than the proposed remedial grading, the depth of excavation, scarification, and re-compaction should be increased accordingly in local areas as recommended by representative of the Geotechnical Engineer of Record. In addition, if soft and unstable subgrade are encountered, they should be stabilized in accordance with the ***Subgrade Stabilization*** section of this report. The Geotechnical Engineer of

Record should observe these conditions in the field and provide site-specific recommendations based on their observation.

FILL MATERIAL AND PLACEMENT

Suitability and Selective Grading

All on-site soil materials within the limits of grading are suitable for use as compacted fill if care is taken to remove all significant organic and other decomposable debris, to separate and selectively place and/or stockpile rock materials larger than 6 inches in diameter, and to dry back the material to the 4% above optimum moisture content.

Compaction Standard and Moisture Requirements

All on-site soil material used as compacted fill, or material processed in place or used to backfill trenches, should be moistened, dried, or blended as necessary to achieve a minimum of 4% over optimum moisture content for compaction, and densified to at least 90% relative compaction as determined by ASTM Test Method D 1557. Final surface subgrade soils should be frequently watered in order to keep the soil moist until building slabs, flatwork, or any other final improvements are installed. If the soil is allowed to dry out and deep shrinkage cracks appear, at least the upper foot should be re-processed, moisture conditioned to 4% over optimum, and compacted.

Use of Rock or Broken Concrete

No rock or broken concrete greater than 6 inches in diameter should be utilized in the fills.

SUBGRADE STABILIZATION

Based on the observed moisture content, there is a potential to encounter moist to wet, soft subgrade soils in the proposed pavement/flatwork/hardscape areas. If soft subgrade soils are encountered, remedial measures would be required to stabilize the subgrade prior to placement of the vehicular pavement and/or the flatwork/hardscape section. The measures to stabilize the subgrade should consist of the following:

- Removal of the unstable soils to a depth of approximately 12 inches below the top of the unstable material, placement of geotextile material (Mirafi RS580i or equivalent) followed by placement of approximately 12 inches of Crushed Aggregate Base (CAB) or Crushed Miscellaneous Base (CMB) to replace the unstable soil that was removed.

- The thickness of the aggregate base will depend on the amount of Aggregate Base (AB) or Crushed Miscellaneous Base (CMB) required to create a stable platform. The recommended depth of remediation (i.e., approximately 12 inches for the geogrid/aggregate base replacement) could be greater or less, depending on the conditions encountered.

- The bottom of the excavation should be left relatively undisturbed prior to placement of the geotextile. Upon placement of the geotextile, the CAB or CMB should then be placed in a 1-foot-thick lift and compacted to 90% relative compaction.

- A representative of GMU should observe the excavation bottom prior to utilizing this mitigation method.

TEMPORARY EXCAVATIONS

Temporary excavations for demolitions, earthwork, footings, and utility trenches are expected. We anticipate that unsurcharged excavations with vertical side slopes less than 4 feet high will generally be stable. Our recommendations for temporary excavations are as follows:

- Temporary, unsurcharged excavation sides over 4 feet in height to maximum allowable slopes excavation of 20 feet should be sloped based on a Type B soil in accordance with OSHA requirements.
- Where sloped excavations are created, the tops of the slopes should be barricaded so that vehicles and storage loads do no encroach within 10 feet of the tops of the excavated slopes. A greater setback may be necessary when considering heavy vehicles, such as concrete trucks and cranes. GMU should be advised of such heavy vehicle loadings so that specific setback requirements can be established.
- If the temporary construction slopes are to be maintained during the rainy season, berms are recommended to be graded along the tops of the slopes in order to prevent runoff water from entering the excavation and eroding the slope faces.

Our temporary excavation recommendations are provided only as **minimum** guidelines. All work associated with temporary excavations should meet the minimal requirements as set forth by CALOSHA. Temporary slope construction, maintenance, and safety are the responsibility of the contractor.

BUILDING NO. 1 RECOMMENDATIONS

The following recommendations apply for design and construction of Building No. 1 proposed at the far north side of the property.

Preliminary Mat Foundation Design Parameters

- The preliminary design parameters presented below may be used for foundation structural design.
  - Bearing Material: Cement Treated Soil (See Corrective Grading Section)
    - Removal and Re-compaction Depth: 5 feet below bottom of footings
  - Minimum Mat Foundation:
    - Based on our correspondence with the project structural engineer and provided preliminary loading, and based on an estimated building foot print dimension of 45 feet by 280 feet, we estimate that the building load distributed uniformly over the mat foundation footprint may induce an approximate uniform pressure of 760 psf for dead plus live loads.
  - Assumed Minimum Thickness: 24 inches
    - Final mat foundation thickness shall be determined by the structural engineer.
  - Allowable Bearing Capacity:
    - Based on the assumptions made above, the mat foundation estimate approximate uniform pressure of 760 psf can be also taken as the allowable bearing capacity. However, for localized loading conditions, a maximum allowable bearing pressure of 3,000 psf may be used.
  - Above value may be increased by 1/3 for temporary loads such as wind and seismic

- Settlement:
  - For the purpose of preparing this preliminary settlement estimate, we have assumed a uniform bearing pressure of 760 psf under the mat slab.
  - Static Settlement:
    - Total: 2.0 inch
    - Differential: 1.0 inch over a span of 40 feet
  - Seismic Settlement:
    - Total : 1.5 inches
    - Differential: 1.0 inch over a span of 40 feet

- Modulus of Subgrade Reaction (k):
  - 200 pci (static)
  - This value assumes that the mat foundation subgrade is treated with cement

- Lateral Foundation Resistance:
    - Allowable passive resistance: 500 psf/ft (disregard upper 6 inches, max 5,000 psf)
    - Allowable friction coefficient: 0.35
    - These values assumes that the mat foundation subgrade is treated with cement.
    - Above values may be combined without reduction and may be increased by 1/3 for temporary loads such as wind or seismic

The mat slab should be designed by the project structural engineer. ***In addition, in order to finalize the mat foundation recommendations, we recommend that the structural engineer model the mat foundation with all anticipated point loads utilizing the provided Modulus of Subgrade Reaction (k) in this section, and provide this office with the analyses, including bearing pressure and settlement contour under the slab.***

BUILDING NO. 2 RECOMMENDATIONS

The following recommendations apply for design and construction of Building No. 2 proposed at the west side of the property. The proposed building may be supported on either on Option A) a mat foundation with cement treated soil, or Option B) shallow spread footings supported on rammed aggregate piers and a structural slab.

Building No. 2: Option A – Mat Foundation

Preliminary Mat Foundation Design Parameters

- The preliminary design parameters presented below may be used for foundation structural design.
  - Bearing Material: Cement Treated Soil ***(See Corrective Grading Section)***
    - Removal and Re-compaction Depth: 5 feet below bottom of footings
  - Minimum Mat Foundation:
    - Based on our correspondence with the project structural engineer and provided preliminary loading, and based on an estimated building foot print dimension of 47 feet by 219 feet, we estimate that the building load distributed uniformly over the mat foundation footprint may induce an approximate uniform pressure of 760 psf for dead plus live loads.
  - Assumed Minimum Thickness: 24 inches
    - Final mat foundation thickness shall be determined by the structural engineer.
  - Allowable Bearing Capacity:
    - Based on the assumptions made above, the mat foundation estimate approximate uniform pressure of 760 psf can be also taken as the allowable bearing capacity. However, for localized loading conditions, a maximum allowable bearing pressure of 3,000 psf may be used.
  - Above value may be increased by 1/3 for temporary loads such as wind and seismic
- Settlement:
  - For the purpose of preparing this preliminary settlement estimate, we have assumed a uniform bearing pressure of 760 psf under the mat slab.

- Static Settlement:
  - Total: 2.0 inch
  - Differential: 1.0 inch over a span of 40 feet
- Seismic Settlement:
  - Total : 0.5 inches
  - Differential: 0.25 inches over a span of 40 feet

- Modulus of Subgrade Reaction (k):
  - 200 pci (static)
  - This value assumes that the mat foundation subgrade is treated with cement

- Lateral Foundation Resistance:
  - Allowable passive resistance: 500 psf/ft (disregard upper 6 inches, max 5,000 psf)
  - Allowable friction coefficient: 0.35
  - These values assumes that the mat foundation subgrade is treated with cement.
  - Above values may be combined without reduction and may be increased by 1/3 for temporary loads such as wind or seismic

The mat slab should be designed by the project structural engineer. ***In addition, in order to finalize the mat foundation recommendations, we recommend that the structural engineer model the mat foundation with all anticipated point loads utilizing the provided Modulus of Subgrade Reaction (k) in this section, and provide this office with the analyses, including bearing pressure and settlement contour under the slab.***

<u>Building No. 2: Option B – Shallow Spread Footings with Rammed Aggregate Piers</u>

Recommended Shallow Spread Footings Design Scheme

We recommend that shallow spread footings be supported on rammed aggregate piers and the slab-on-grade (SOG) be designed for expansion potential and settlement. The SOG may be designed by either the WRI or PTI method.

Geopiers or Equivalent Gravel Piers

Based on the site conditions, it is our opinion that Geopiers or equivalent gravel piers supported shallow spread/continuous foundation systems may be used for support of the proposed Building No. 2. The allowable bearing capacity provided by the Geopier or equivalent system is typically up to 5,000 psf, which result in smaller size of shallow foundations based on our assumed structural loads. The gravel piers are anticipated to be 24 inches in diameter and embedded on the order of 13 to 15 below the bottom of the footing. We recommend that once a generalized foundation plan is developed, we review the applicability of Geopier-supported foundations at this site. If suitable

based on the structural loading conditions, Geopier-supported foundations could be a cost-effective solution for structure support, which should be designed by the specialty contractor.

Special Expansive Soil Mitigation Slab Design

If Geopiers or equivalent gravel piers are selected to support the proposed building foundations, the SOG should be designed for both expansion potential and settlement in accordance with either the WRI or PTI methods. Design parameters for the proposed slab-on-grade are discussed in the following sections:

Deepened Slab Edge. The perimeter slab footing should extend a minimum of 36 inches below the lowest adjacent grade to act as a moisture cut-off. The edge footing should be a minimum of 12 inches wide. Minimum reinforcement should consist of two #5 bars both top and bottom. In addition, all utilities going into the building should have their permeable backfill zones sealed with either sand-cement slurry or cementious grout.

Perimeter Structural Stiffening. The perimeter of the building slab should be designed to accommodate expansive soil movements that may occur due to the existence of the planters. The slabs may be designed by either the WRI or PTI method. Recommendations are presented below for slabs supported on cement treated soil:

WRI Methodology
- Cw = 15
- PI = 25

PTI Methodology

Edge Lift:	e_m = 4.5’/y_m = 1.05”
Center Lift (edge drop):	e_m = 8.9’ / y_m = 0.25”
Modulus of Subgrade Reaction:	100 pci

The slab deflection should be designed such that the deflection will be compatible with the structure and overlying improvements. This should be coordinated with the architect.

In addition, the following recommendations should be implemented and/or considered:

- Surface drainage in the planters adjacent to the building should be robust (i.e., with adequate fall and redundant drainage inlets).
- A perimeter French drain should be considered around the outside edge of the foundations. The drain should consist of a 4-inch-diameter perforated pipe wrapped in ¾-inch rock wrapped in filter fabric. The perforated pipe should outlet into area drains or other suitable outlet points.

Slab Subgrade and Slab Design

Perimeter Portion of Slabs. The perimeter of the slabs shall be rationally designed based on the criteria in the previous section.

Interior Portion of Slabs. The interior portion of the slab should be a minimum of 5 inches thick and be reinforced with No. 4 bars placed 18 inches on center. Final design and jointing layout and details should be provided to our office by the design structural engineer.

Slab Subsection. The entire building slab-on-grade should be founded on a moisture vapor retarder in accordance with the recommendations provided in the ***Moisture Vapor Transmission*** section of this report. Capillary break below the retarder is not required. Sand above the moisture retarder/barrier is not required from a geotechnical standpoint. This should be provided by the structural engineer.

BUILDING NO. 3 RECOMMENDATIONS

The following recommendations apply for design and construction of Building No. 3 proposed at the east side of the property. The proposed building may be supported on either on Option A) a mat foundation with cement treated soil, or Option B) shallow spread footings supported on rammed aggregate piers and a structural slab.

Building No. 3: Option A – Mat Foundation

Preliminary Mat Foundation Design Parameters

- The preliminary design parameters presented below may be used for foundation structural design.
  - Bearing Material: Cement Treated Soil ***(See Corrective Grading Section)***
    - Removal and Re-compaction Depth: 3 feet below bottom of footings
  - Minimum Mat Foundation:
    - Based on our correspondence with the project structural engineer and provided preliminary loading, and based on an estimated building foot print dimension of 47 feet by 219 feet, we estimate that the building load distributed uniformly over the mat foundation footprint may induce an approximate uniform pressure of 600 psf for dead plus live loads.
  - Assumed Minimum Thickness: 24 inches
    - Final mat foundation thickness shall be determined by the structural engineer.

- Allowable Bearing Capacity:
  - Based on the assumptions made above, the mat foundation estimate approximate uniform pressure of 600 psf can be also taken as the allowable bearing capacity. However, for localized loading conditions, a maximum allowable bearing pressure of 3,000 psf may be used.
- Above value may be increased by 1/3 for temporary loads such as wind and seismic

- Settlement:
  - For the purpose of preparing this preliminary settlement estimate, we have assumed a uniform bearing pressure of 600 psf under the mat slab.
  - Static Settlement:
    - Total: 1.75 inch
    - Differential: 1.0 inch over a span of 40 feet
  - Seismic Settlement:
    - Total : 0.5 inches
    - Differential: 0.25 inches over a span of 40 feet

- Modulus of Subgrade Reaction (k):
  - 200 pci (static)
  - This value assumes that the mat foundation subgrade is treated with cement

- Lateral Foundation Resistance:
  - Allowable passive resistance: 500 psf/ft (disregard upper 6 inches, max 5,000 psf)
  - Allowable friction coefficient: 0.35
  - These values assumes that the mat foundation subgrade is treated with cement.
  - Above values may be combined without reduction and may be increased by 1/3 for temporary loads such as wind or seismic

The mat slab should be designed by the project structural engineer. ***In addition, in order to finalize the mat foundation recommendations, we recommend that the structural engineer model the mat foundation with all anticipated point loads utilizing the provided Modulus of Subgrade Reaction (k) in this section, and provide this office with the analyses, including bearing pressure and settlement contour under the slab.***

<u>Building No. 3: Option B – Shallow Spread Footings with Rammed Aggregate Piers</u>

Recommended Shallow Spread Footings Design Scheme

We recommend that the spread footings be supported on rammed aggregate piers and the slab-on-grade (SOG) be designed for expansion potential and settlement. The SOG may be designed by either the WRI or PTI method.

Geopiers or Equivalent Gravel Piers

Based on the site conditions, it is our opinion that Geopiers or equivalent gravel piers supported shallow spread/continuous foundation systems may be used for support of the proposed Building No. 3. The allowable bearing capacity provided by the Geopier or equivalent system is typically up to 5,000 psf, which result in smaller size of shallow foundations based on our assumed structural loads. The gravel piers are anticipated to be 24 inches in diameter and embedded on the order of 11 to 13 below the bottom of the footing. We recommend that once a generalized foundation plan is developed, we review the applicability of Geopier-supported foundations at this site. If suitable based on the structural loading conditions, Geopier-supported foundations could be a cost-effective solution for structure support, which should be designed by the specialty contractor.

Special Expansive Soil Mitigation Slab Design

If Geopiers or equivalent gravel piers are selected to support the proposed building foundations, the SOG should be designed for both expansion potential and settlement in accordance with either the WRI or PTI methods. Design parameters for the proposed slab-on-grade are discussed in the following sections:

Deepened Slab Edge. The perimeter slab footing should extend a minimum of 36 inches below the lowest adjacent grade to act as a moisture cut-off. The edge footing should be a minimum of 12 inches wide. Minimum reinforcement should consist of two #5 bars both top and bottom. In addition, all utilities going into the building should have their permeable backfill zones sealed with either sand-cement slurry or cementious grout.

Perimeter Structural Stiffening. The perimeter of the building slab should be designed to accommodate expansive soil movements that may occur due to the existence of the planters. The slabs may be designed by either the WRI or PTI method. Recommendations are presented below for slabs supported on cement treated soil:

WRI Methodology
- Cw = 15
- PI = 25

PTI Methodology

Edge Lift:	e_m = 4.5’/y_m = 1.05”
Center Lift (edge drop):	e_m = 8.9’ / y_m = 0.25”
Modulus of Subgrade Reaction:	100 pci

The slab deflection should be designed such that the deflection will be compatible with the structure and overlying improvements. This should be coordinated with the architect.

In addition, the following recommendations should be implemented and/or considered:

- Surface drainage in the planters adjacent to the building should be robust (i.e., with adequate fall and redundant drainage inlets).
- A perimeter French drain should be considered around the outside edge of the foundations. The drain should consist of a 4-inch-diameter perforated pipe wrapped in ¾-inch rock wrapped in filter fabric. The perforated pipe should outlet into area drains or other suitable outlet points.

Slab Subgrade and Slab Design

Perimeter Portion of Slabs. The perimeter of the slabs shall be rationally designed based on the criteria in the previous section.

Interior Portion of Slabs. The interior portion of the slab should be a minimum of 5 inches thick and be reinforced with No. 4 bars placed 18 inches on center. Final design and jointing layout and details should be provided to our office by the design structural engineer.

Slab Subsection. The entire building slab-on-grade should be founded on a moisture vapor retarder in accordance with the recommendations provided in the ***Moisture Vapor Transmission*** section of this report. Capillary break below the retarder is not required. Sand above the moisture retarder/barrier is not required from a geotechnical standpoint. This should be provided by the structural engineer.

POLE FOUNDATIONS

It is expected that the shade structures and light poles will be supported on pole foundations. As a minimum, the pole foundations should be at least 18 inches in diameter and at least 4 feet deep; however, the actual dimensions should be determined by the project structural engineer based on the following design parameters.

Bearing Materials. The pole foundations may bear into engineered fill soils or competent native soils approved by a representative from GMU.

Bearing Values. End-bearing capacity and skin friction may be combined to determine the allowable bearing capacities of the pole foundations. An allowable bearing pressure of 3,250 pounds per square foot (psf) may be used for pole foundations at least 18 inches in diameter and embedded a minimum of 4 feet below the lowest adjacent grade. A value of 180 pounds per square foot may be used to determine the skin friction between the concrete and surrounding fill.

Lateral Load Design. Lateral loads may be resisted by passive resistance within the adjacent earth materials. For passive resistance, an allowable passive earth pressure of 200 pounds per foot of pile diameter per foot of depth into competent bearing material may be used; however, passive resistance should be disregarded within the upper foot due to possible disturbance during drilling. The passive resistance value may be applied over an area equivalent to two pile diameters.

RETAINING WALL DESIGN AND CONSTRUCTION CRITERIA

The following criterion is considered applicable to the design and construction of retaining walls at the subject site. The design assumes a maximum 6-foot-high retaining wall (i.e., from top of footing to top of retaining portion of wall) with level backfill conditions. In addition, the design assumes the use of on-site select backfill in accordance with Plate 3 – Retaining Wall Construction Detail.

Foundation Design Parameters:

Minimum Foundation Width:	12 inches
Minimum Foundation Depth:	Depth below lowest adjacent grade to bottom of footing: o 24 inches
Bearing Materials:	Engineered fill
Allowable Bearing Capacity:	2,000 psf for footing on level ground o 1/3 increase for wind or seismic conditions
Allowable Coefficient of Friction:	0.30
Unit Weight of Backfill:	125 pcf
Allowable Passive Earth Pressure:	225 psf/ft of depth (static) o Disregard upper 6 inches o Reduce passive by one-third when combined with friction in sliding resistance o 1/3 increase for seismic conditions

Wall Design Parameters:

Active Earth Pressure:	45 pcf – level backfill (Assumes the use of select soils in backfill zone)
Weight of Backfill:	125 pcf

Control/Construction Joints:	As a minimum, maximum spacing of 15 feet and at angle points
Waterproofing:	The back side of all retaining walls should be waterproofed down to the top of the foundation prior to placing subdrains or backfill. The design and selection of the waterproofing system is outside the scope of our report and is outside our purview.
Concrete:	Type V cement with 0.45 w/c ratio (geotechnical perspective only).
Wall Backfill and Drainage:	See Retaining Wall Construction Detail Diagram and Notes (shown on Plate 3) for backfill and drainage requirements.

The unrestrained (active) values are applicable when the walls are designed and constructed as cantilevered walls allowing sufficient wall movement to mobilize active pressure conditions. This wall movement should not be less than 0.01 H (H = height of wall) for the unrestrained values to be applicable.

Provided that the retaining walls have a maximum height of less than 6 feet, the current 2016 CBC indicates that the incorporation of seismic earth pressures is not required.

STRUCTURAL CONCRETE

Laboratory tests indicate that the onsite soils are classified as having a “severe” sulfate exposure and “S2” sulfate exposure category per ACI 318-14, Table 19.3.1.1. For structural features that will be in direct contact with the site soils at depth, the type of Portland cement, water to cement ratio, and the concrete compressive strength should be in accordance with ACI 318-14, Table 19.3.2.1.
Wet curing of the concrete per ACI Publication 308 is also recommended.

The aforementioned recommendations in regards to concrete are made from a soils perspective only. Final concrete mix design is beyond our purview. All applicable codes, ordinances, regulations, and guidelines should be followed in regard to the designing a durable concrete with respect to the potential for sulfate exposure from the on-site soils and/or changes in the environment.

FERROUS METAL CORROSION

The results of the laboratory chemical tests performed on a sample of soil collected within the site indicate that the on-site soils are severely corrosive to ferrous metals. Consequently, metal

structures which will be in direct contact with the soil (i.e., underground metal conduits, pipelines, metal sign posts, etc.) and/or in close proximity to the soil (wrought iron fencing, etc.) may be subject to corrosion. The use of special coatings or cathodic protection around buried metal structures has been shown to be beneficial in reducing corrosion potential. Additional provisions will be required to address high chloride contents of the soil per the 2016 CBC to protect the concrete reinforcement. The laboratory testing program performed for this project does not address the potential for corrosion to copper piping. In this regard, a corrosion engineer should be consulted to perform more detailed testing and develop appropriate mitigation measures (if necessary).

The laboratory testing program performed for this project does not address the potential for corrosion to copper piping. In this regard, a corrosion engineer should be consulted to perform more detailed testing and develop appropriate mitigation measures (if necessary). The above discussion is provided for general guidance in regards to the corrosiveness of the on-site soils to typical metal structures used for construction. Detailed corrosion testing and recommendations for protecting buried ferrous metal and/or copper elements are beyond our purview. If detailed testing is required, a corrosion engineer should be consulted to perform the testing and develop appropriate mitigation measures.

MOISTURE VAPOR TRANSMISSION

Moisture Vapor Retarder

A vapor retarder or barrier such as Stego 15 Mil Class A or equivalent should be utilized beneath the slab. The retarder/barrier should be installed as follows:

- Below moisture-sensitive floor areas.
- Installed per manufacture's specifications as well as with all applicable recognized installation procedures such as ASTM E1643-98.
- Joints between the sheets and the openings for utility piping should be lapped and taped. If the barrier is not continuously placed across footings/ribs, the barrier should, as a minimum, be lapped into the sides of the footings/rib trenches down to the bottom of the trench.
- Punctures in the vapor barrier should be repaired prior to concrete placement.

A capillary break is not required. Also, sand and/or the amount of sand above the moisture vapor retarder should be specified by the owner. The selection of sand above the retarder is not a geotechnical engineering issue and is hence outside our purview.

Water Vapor Transmission Discussion

The placement of a moisture vapor retarder below all slab areas is recommended where moisture sensitive flooring will be placed. It should be noted that the moisture retarder is intended only to reduce moisture vapor transmissions from the soil beneath the concrete and is consistent with the current standard of the industry in building construction in Southern California. It is not intended to provide a "waterproof" or "vapor proof" barrier or reduce vapor transmission from sources above the retarder (i.e., concrete). Sources above the retarder include any sand placed on top of the retarder (i.e., to be determined by the project structural designer) and from the concrete itself (i.e., vapor emitted during the curing process). The evaluation of water vapor from any source and its effect on any aspect of the proposed building space above the slab (i.e., floor covering applicability, mold growth, etc.) is outside our purview and the scope of this report.

Floor Coverings

Prior to the placement of flooring, the floor slabs should be properly cured and tested to verify that the water vapor transmission rate (WVTR) is compatible with the flooring requirements.

SURFACE DRAINAGE

Surface drainage should be carefully controlled during and after grading to prevent ponding and uncontrolled runoff adjacent to building structures and/or other properties. Particular care will be required during grading to maintain slopes, swales, and other erosion control measures needed to direct runoff toward permanent surface drainage facilities. Positive drainage of at least 2% away from the perimeters of the structures and site pavements should be incorporated into the design. In addition, it is recommended that nuisance water be directed away from the perimeter of the structures by the use of area drains in adjacent landscape and flatwork areas and roof drains tied into the site storm drain system.

BIORETENTION AREAS

We recommend that an impermeable liner be installed at the bottom and sides of all bioretention areas at the subject site to prevent vertical and lateral water migration into the adjacent structures and pavements.

UTILITY TRENCH BACKFILL CONSIDERATIONS

General

New utility line pipelines should be backfilled with both select bedding materials beneath and around the pipes and compacted soil above the pipe bedding. Recommendations for the types of the materials to be used and the proper placement of these materials are provided in the following sections:

Pipe Bedding

The pipe bedding materials should extend from at least 6 inches below the pipes to at least 12 inches above the crown of the pipes. Pipe bedding should consist of either clean sand with a sand equivalent (SE) of at least 30 or crushed rock. If crushed rock is used, it should consist of ¾-inch crushed rock that conforms to Table 200-1.2.1 (A) of the 2018 "Greenbook." Pipe bedding should also meet the minimum requirements of the County of Orange. If the requirements of the County are more stringent, they should take precedence over the geotechnical recommendations. Sufficient laboratory testing should be performed to verify the bedding meets the minimum requirements of the Greenbook and City of Irvine grading code.

Based on our subsurface exploration and knowledge of the onsite materials, the soils that will be excavated from the pipeline trenches will not meet the recommendations for pipe bedding materials; therefore, imported materials will be required for pipe bedding.

Granular pipe bedding material having a sand equivalent of 30 or greater should be properly placed in thicknesses not exceeding 3 feet, and then sufficiently flooded or jetted in place.

Crushed rock, if used, should be capped with filter fabric (Mirafi 140N, or equivalent) to prevent the migration of fines into the rock.

Trench Backfill

All existing soil material within the limits of the pipeline alignment are considered suitable for use as trench backfill above the pipe bedding zone if care is taken to remove all significant organic and other decomposable debris, moisture condition the soil materials as necessary, and separate and selectively place and/or stockpile any inert materials larger than 6 inches in maximum diameter.

Imported soils are not anticipated for backfill since the on-site soils are suitable. However, if imported soils are used, the soils should consist of clean, granular materials with physical and chemical characteristics similar to those described herein for on-site soils. Any imported soils to be used as backfill should be evaluated and approved by GMU prior to placement.

Soils to be used as trench backfill should be moistened, dried, or blended as necessary to achieve a minimum of 4% over optimum moisture content for compaction, placed in loose lifts no greater than 8 inches thick, and mechanically compacted/densified to at least 90% relative compaction as determined by ASTM Test Method D 1557. Jetting is not permitted in this trench zone.

No rock or broken concrete greater than 6 inches in maximum diameter should be utilized in the trench backfills.

SPORTS COURT DESIGN RECOMMENDATIONS

General

Due to the site being underlain by highly expansive soils, it is recommended that the basketball court be designed using a post-tensioned mat slab in accordance with the following parameters.

Soil Bearing Pressure and Modulus of Subgrade Reaction

Allowable Bearing Value:	1,500 psf
Coefficient of Friction:	0.30
Modulus of Subgrade Reaction:	75 pci

Sub-Slab Section

Pre-saturation Depth:	18 inches below design subgrade at a minimum of 4% over optimum moisture content to the satisfaction of the geotechnical engineer.

Minimum Requirements

Foundation Type:	Post-tensioned mat slab.
Slab Thickness:	Per Structural Engineer (5-inch-thick minimum)
Edge Beam Thickness:	12 inches from top of slab.

Slab Pre-stressing

The project structural engineer should utilize a high pre-stress amount such that stresses are maintained throughout the slab system. This is especially critical for the large spans of basketball courts where stress losses due to subgrade friction can result in the total loss of stress within the center regions of the slab.

Calculations should be performed by the structural engineer for the PT slab that show that all pre-stress losses have been accounted for and that there will be sufficient residual stress remaining in the slab. In this regard, the slab design by the structural engineer should provide for a minimum residual compressive stress throughout the slab of between 125 and 150 psi.

Slab Subgrade Friction

To decrease the amount of subgrade friction, it is recommended that the mat slab be placed on a double moisture vapor retarder/barrier system as described in the subsequent section. The PT design engineer should determine an appropriate friction coefficient value expected to be effective during tendon stressing.

Vapor Retarder/Barrier

- The moisture vapor retarder system should consist of a Stegowrap 15 mil or equivalent should be placed.
- A capillary break is not required. Consequently, sand is not required to be placed below the moisture vapor retarder/barrier system from a geotechnical perspective.
- The need for sand/crushed rock and/or the amount of sand/crushed rock above the moisture vapor retarder should be specified by the structural engineer or post-tension designer.

SWIMMING POOL DESIGN CRITERIA

The proposed shell and deck for the swimming pool should be designed for high to very expansive soil conditions and be in minimum accordance with Plate 4 – Pool Deck Detail For Expansive Soil Sites and Plate 5 – Swimming Pool Design Criteria. Highly expansive, severely corrosive, and severe levels of sulfate conditions should be considered in the design. The swimming pool excavation will expose expansive subgrade soils that will require pre-saturation and grading in accordance with the ***Corrective Grading*** section of this report.

Pool Bottom

It is expected that the pool bottom will rest entirely on engineered fill material in accordance with the grading recommendations in this report.

Plumbing

Leakage from the spa or from any of the appurtenant plumbing could create adverse saturated conditions of the surrounding subgrade soils. Localized areas of over-saturation can lead to differential settlement or expansion (heave) of the subgrade soils and subsequent raising and shifting of concrete flatwork. Therefore, it is essential that all plumbing fixtures be absolutely leak-free. For similar reasons, drainage from deck areas should be directed to local area drains and/or graded earth swales designed to carry runoff water to the adjacent street.

Although the pool excavation may be free of water at the time of construction, future irrigation could result in the development of perched water zones which could affect subsurface improvements. Heavy-duty pipes and flexible couplings should be used for the pool plumbing system to minimize leaking which may produce additional pressures on the pool shell. In addition, installation of a pressure valve in the pool bottom should be used to mitigate any potential buildup of pressure.

PAVEMENT DESIGN CONSIDERATIONS

General

It is expected that the driveways within the site will be constructed with both asphalt pavement and Portland cement concrete. Therefore, recommendations for both types of pavement areas are provided in the following sections. In order to accommodate fire truck and trash truck loading, a traffic index (T.I.) of 5.5 has been assumed for the drive areas.

Asphalt Pavement Design

Based on the R-value test results, an R-value of 8 was used for the design. The following pavement thicknesses should be anticipated:

Location	R-Value	Traffic Index	Asphalt Concrete (in.)	Aggregate Base* (in.)
Driveways	8	5.5	4.0	9.0
Parking Stalls	8	4.0	3.0	6.0

** assumed R-Value = 78*

The above design sections will be verified based on additional testing performed at the completion of future precise grading of the specific locations.

The planned pavement structural sections should consist of aggregate base materials (AB) and asphalt concrete materials (AC) of a type meeting the minimum City of Costa Mesa standards. The subgrade soils should be moisture conditioned to a minimum 4% above the optimum moisture content to a depth of at least 18 inches, and compacted to 90% relative compaction. The AB and AC should be compacted to at least 95% relative compaction.

Portland Cement Concrete Pavement Design

Driveways, vehicular drives, and appurtenant concrete paving, such as trash receptacle bays, will require Portland cement concrete (PCC) pavement. Assuming a T.I. of 6 to 7, a design section of 8 inches of PCC over 6 inches AB should be adequate. PCC vehicular pavement should be designed in accordance with the City of Costa Mesa standards and the requirements presented on the concrete flatwork table within the ***Concrete Flatwork Design Considerations*** section of this report.

CONCRETE FLATWORK DESIGN CONSIDERATIONS

Due to the highly expansive nature of the on-site soils, we recommend that the subgrade for the subject concrete flatwork be moisture conditioned to 4% over optimum to a depth of 18 inches below finish grade and compacted to 90% relative compaction. A 6-inch-thick section of Class 2 aggregate base (AB) or crushed miscellaneous base (CMB) should then be placed on the compacted subgrade soils, brought to 2% above optimum moisture condition, and compacted to 95% relative compaction prior to placement of walkway and patio flatwork reinforcing steel and concrete. For flatwork concrete underlain by aggregate base, Type V cement may be used.

The Concrete Flatwork Table below summarizes our flatwork recommendations:

Concrete Flatwork Table

Description	Subgrade Preparation (1)	Aggregate Base (Class 2 or CMB) (2)	Minimum Concrete Thickness	Cut-Off Barrier or Edge Thickness	Reinforcement(3)	Joint Spacing (Maximum)	Concrete(5)
Concrete Sidewalks and Walkways(4)	4% over optimum to 18 inches at 90% relative compaction	6-inch-thick section at 95% relative compaction	4 inches	Not Required	No. 3 bars @ 18”o.c.b.w. and dowel into building and curb using 9-inch Speed Dowels @ 18"o.c	5-foot x 5-foot using 9-inch speed dowels with No. 3 bars @ 18" o.c. (6)	Type V
Concrete Patios(4)	4% over optimum to 18 inches at 90% relative compaction	6-inch-thick section at 95% relative compaction	5 inches	Where adjacent to landscape areas – 12” from adjacent finish grade. Minimum of 8” width.	No. 3 bars @ 18”o.c.b.w. and dowel into building and curb using 9-inch Speed Dowels @ 18"o.c	5-foot x 5-foot using 9-inch speed dowels with No. 3 bars @ 18" o.c. (6)	Type V
Concrete Driveways(4)	4% over optimum to 18 inches at 90% relative compaction	6-inch-thick section at 95% relative compaction	8 inches	Where adjacent to landscape areas – 16” from adjacent finish grade. Minimum of 8” width.	No. 4 bars @ 18”o.c.b.w. and dowel into building and curb using 9-inch Speed Dowels @ 18"o.c	10-foot x 10-foot using 9-inch speed dowels with No. 3 bars @ 18" o.c. (6)	Type V

(1) The moisture content and compaction of the subgrade must be verified by the geotechnical consultant prior to base placement.
(2) For pedestrian usages only, S.E. 30 sand may be used instead of Aggregate Base.
(3) Reinforcement to be placed in the middle of the recommended concrete section.
(4) Where flatwork is adjacent to a stucco surface, a ¼” to ½” foam separation/expansion joint should be used.
(5) The site has severe levels of sulfates as defined by CBC. Concrete mix designs shall be selected by the concrete designer such that sulfate attack mitigation is balanced with shrinkage crack control. Concrete mix design is outside the geotechnical engineer’s purview.
(6) If dowels are placed in cored holes, the core holes shall be placed at alternating in-plane angles (i.e., not cored straight into the slab.

RECYLED PCC MATERIAL

The use of stockpiled in-place recycled PCC and crushed miscellaneous base (CMB) for new engineered fill subgrade and for the crushed miscellaneous base (CMB) under new asphalt concrete pavement and hardscape will require GMU to conduct conformance laboratory testing of representative samples of the pulverized recycled concrete pavement to confirm that the samples meet the 2018 Greenbook Section 200-2.4 standards for Crushed Miscellaneous Base (CMB). GMU recommends that this recycled CMB may be used as engineered fill for exterior subgrade structural support of new asphalt concrete and hardscape improvements outside of the building envelopes. The recycled concrete pavement is not to be used as compacted fill for support under any of the building areas or in the planters on the subject site.

PLANTERS AND TREES

Where new trees or large shrubs are to be located in close proximity of new concrete flatwork, rigid moisture/root barriers should be placed around the perimeter of the flatwork to at least 12 inches in depth in order to offer protection to the adjacent flatwork against potential root and moisture damage. Existing mature trees near flatwork areas should also incorporate a rigid moisture/root barrier placed at least 2 feet in depth below the top of the flatwork.

PLAN REVIEW / GEOTECHNICAL TESTING DURING GRADING / FUTURE REPORTS

Plan Review

Our office should review the final approved precise grading plans and landscape plans for the site and comment on the anticipated effects of any major changes from the plan reviewed for this report. In addition, the final office building foundation plans and final foundation loads will need to be reviewed to confirm that settlements are within tolerable limits.

FUTURE SERVICES

GMU should review the final construction plans to confirm they are consistent with our recommendations provided in this report.

Geotechnical Testing

It is recommended that geotechnical observation and testing be performed by GMU during the following stages of precise grading and construction:

- During site clearing and grubbing.
- During removal of any buried irrigation lines or other subsurface structures.
- During all phases of precise grading including over-excavation, temporary excavations, removals, scarification, ground preparation, moisture conditioning, proof-rolling, over-excavation, and placement and compaction of all fill materials.
- During installation of all conventional foundations and floor slab elements.
- During backfill of structure walls and underground utilities.
- During pavement section placement and compaction.
- When any unusual conditions are encountered.

LIMITATIONS

All parties reviewing or utilizing this report should recognize that the findings, conclusions, and recommendations presented represent the results of our professional geological and geotechnical engineering efforts and judgements. Due to the inexact nature of the state of the art of these professions and the possible occurrence of undetected variables in subsurface conditions, we cannot guarantee that the conditions actually encountered during grading and foundation installation will be identical to those observed and sampled during our study or that there are no unknown subsurface conditions which could have an adverse effect on the use of the property. We have exercised a degree of care comparable to the standard of practice presently maintained by other professionals in the fields of geotechnical engineering and engineering geology, and believe that our findings present a reasonably representative description of geotechnical conditions and their probable influence on the grading and use of the property.

Because our conclusions and recommendations are based on a limited amount of current and previous geotechnical exploration and analysis, all parties should recognize the need for possible revisions to our conclusions and recommendations during grading of the project. Additionally, our conclusions and recommendations are based on the assumption that our firm will act as the geotechnical engineer of record during grading of the project to observe the actual conditions exposed, to verify our design concepts and the grading contractor's general compliance with the project geotechnical specifications, and to provide our revised conclusions and recommendations should subsurface conditions differ significantly from those used as the basis for our conclusions and recommendations presented in this report.

Detailed corrosion testing and recommendations for protecting buried ferrous metal and/or copper elements are beyond our purview.

This report has not been prepared for use by other parties or projects other than those named or described herein. This report may not contain sufficient information for other parties or other purposes.

CLOSURE

We are pleased to present the results of our geotechnical foundation investigation for this project. The Plates and Appendices that complete this report are listed in the Table of Contents.

If you have any questions concerning our findings or recommendations, please do not hesitate to contact us and we will be happy to discuss them with you.

Respectfully submitted,

GMU GEOTECHNICAL, INC.

REGISTERED PROFESSIONAL ENGINEER
NADIM T. SUNNA
C 84197
CIVIL
STATE OF CALIFORNIA

Nadim Sunna, M.S., P.E. 84197
Project Geotechnical Engineer

David R. Atkinson
Senior Engineer/Project Manager

Reviewed By:

Gregory P. Silver, M.S., P.E., G.E.
President/Principal Engineer

ns/18-252-00 (03-01-2019)

REFERENCES

SITE-SPECIFIC REFERENCES

Conceptual Grading Plan, EF International Language Campus, Costa Mesa, prepared by Fuscoe Engineering for Gensler, dated March 1, 2019.

TECHNICAL REFERENCES

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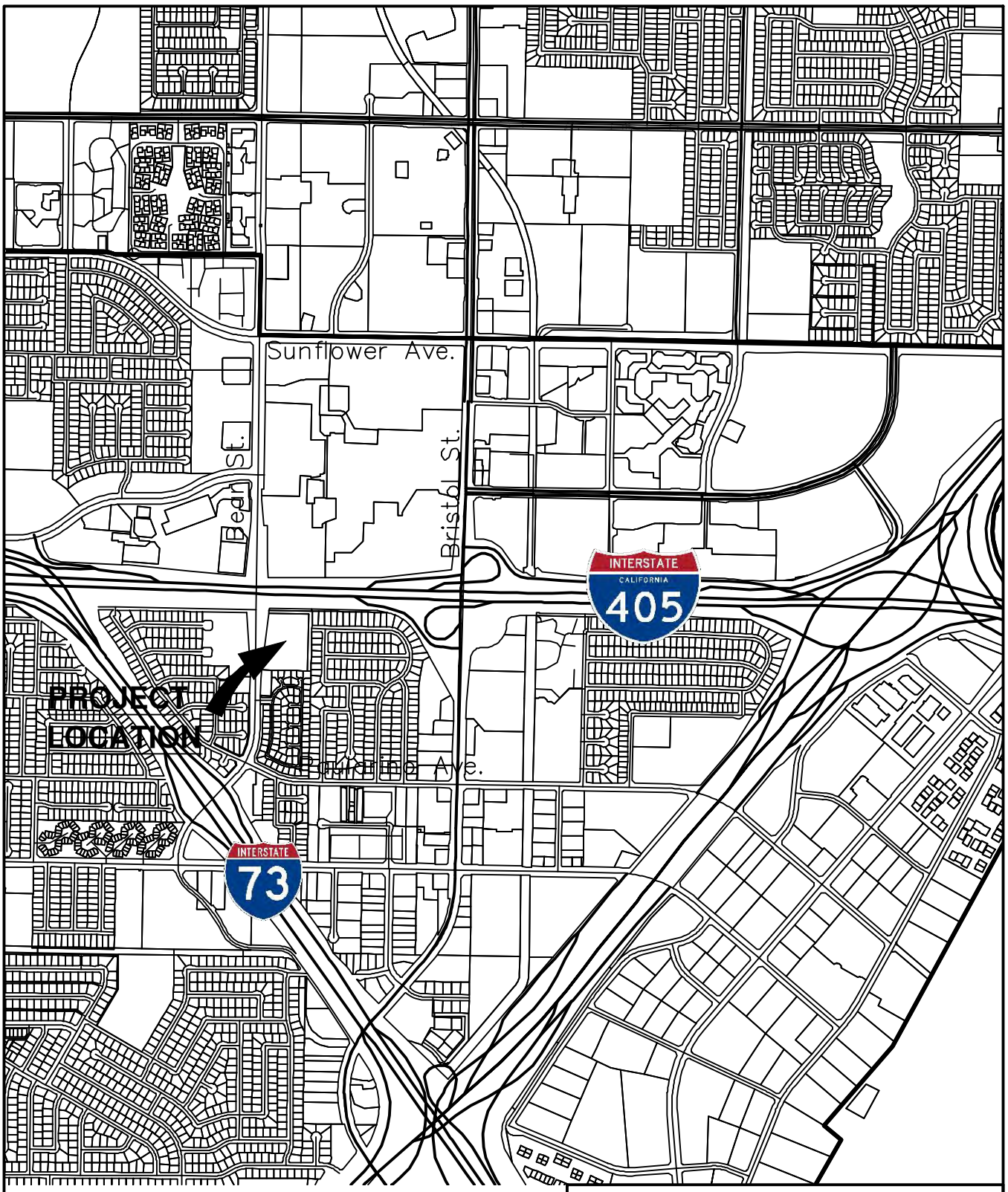


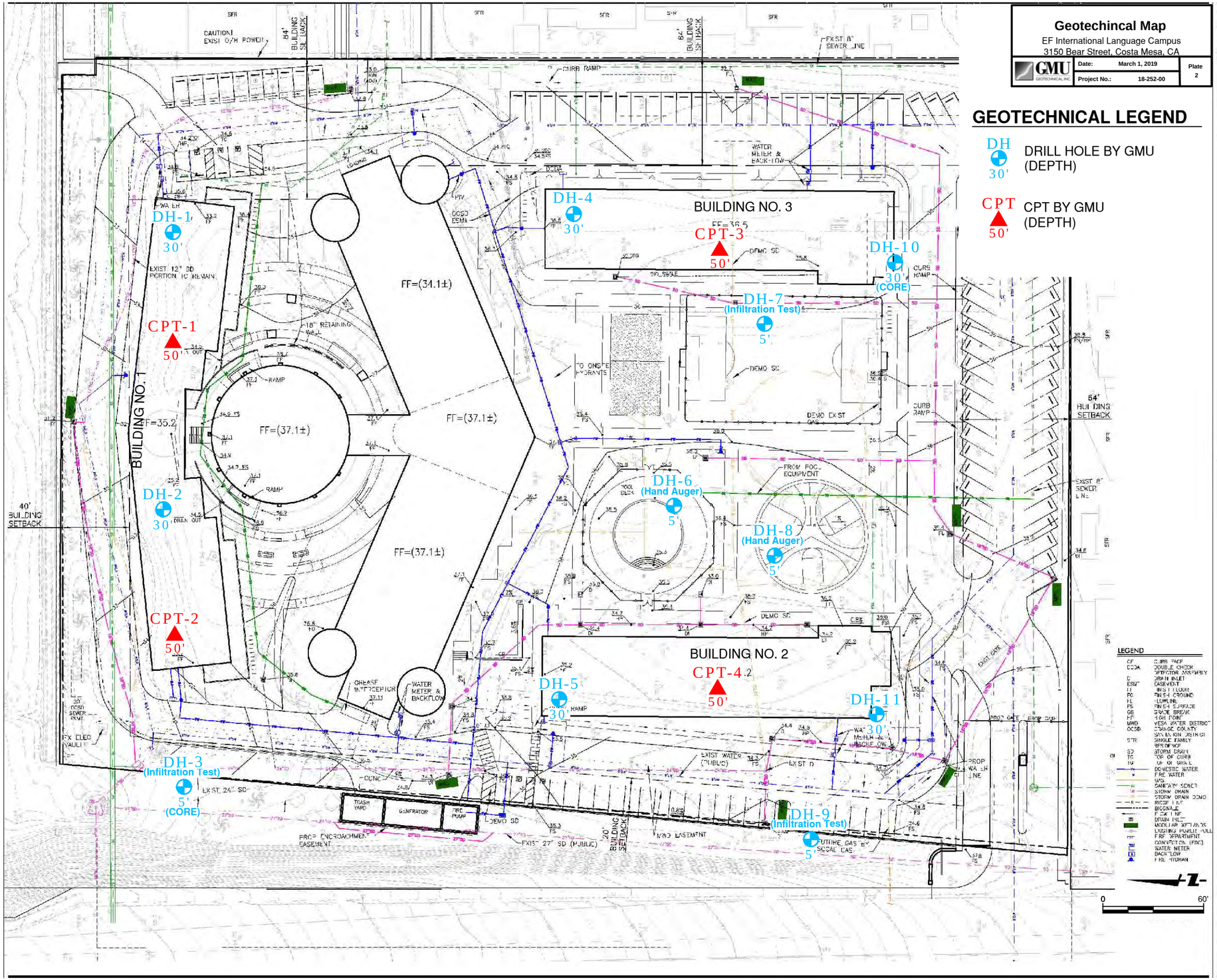
Location
3150 Bear Street
Costa Mesa, CA.

LOCATION MAP

GMU GEOTECHNICAL, INC.

Date:	March 1, 2019	Plate 1
Project No.:	18-252-00	

DRAWING: q:\2018\18-252-00\dwg\1825200_plate 1_site location map.dwg PLOTTED: 2/27/2019 11:37 AM BY: Nadim Sunna



Geotechincal Map

EF International Language Campus
3150 Bear Street, Costa Mesa, CA

GMU GEOTECHNICAL INC	Date: March 1, 2019	Plate 2
	Project No.: 18-252-00	

GEOTECHNICAL LEGEND

DH 30' — DRILL HOLE BY GMU (DEPTH)

CPT 50' — CPT BY GMU (DEPTH)

EFEKTA GROUP, INC.
3150 Bear St.
Costa Mesa, CA 92626

Gensler
700 South Figueroa Street
Los Angeles, California 90017
United States
Tel 213.327.3630
Fax 213.327.3631

Date	Description

Seal / Signature

NOT FOR CONSTRUCTION

Project Name
EF INTERNATIONAL LANGUAGE CAMPUS COSTA MESA

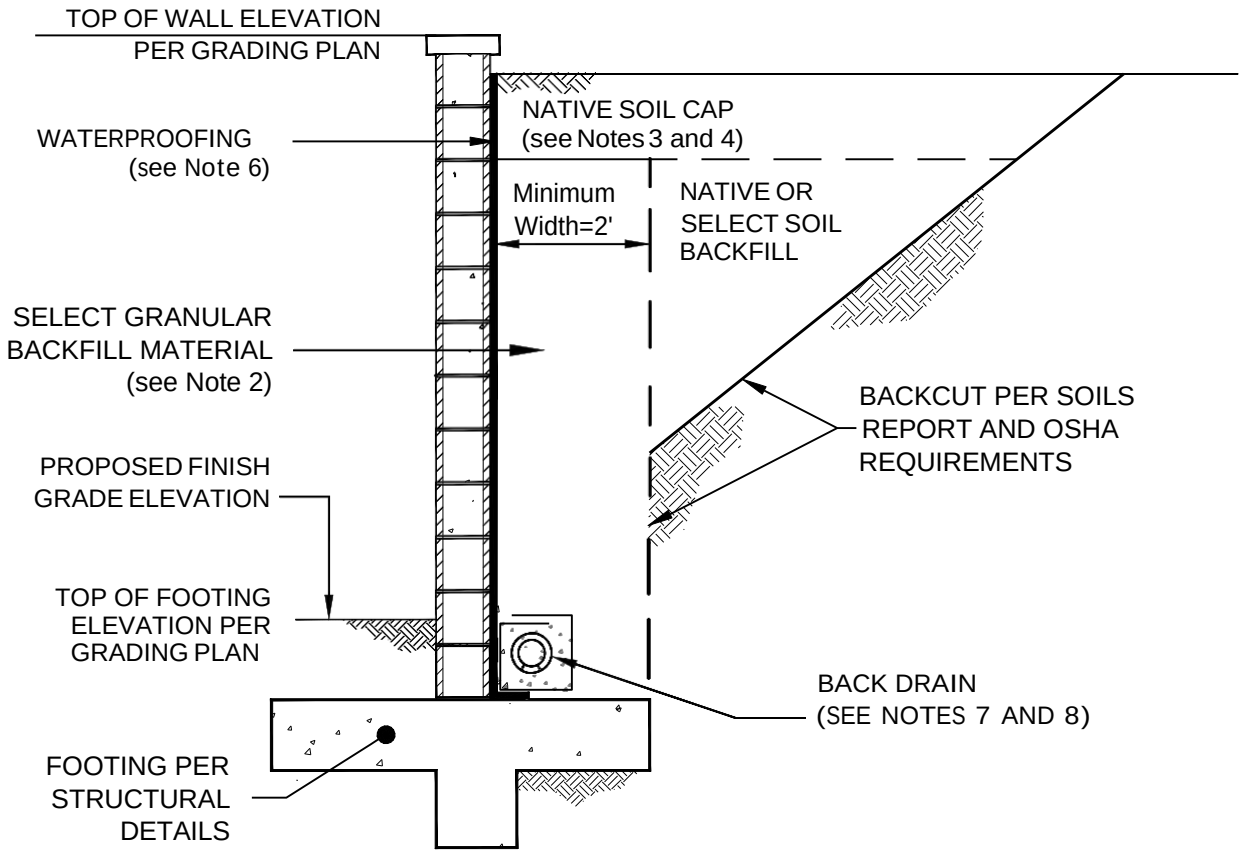
Project Number
05.9948.500

RIBCOE ENGINEERING
1793.001

Description
CONCEPTUAL GRADING PLAN

Scale

1



RETAINING WALL DETAIL

NOT TO SCALE

1. FINAL DETERMINATION OF THE MATERIAL TO BE USED FOR BACKFILL SHALL BE MADE BY GMU.

2. ALL SELECT BACKFILL TO WITHIN 1 TO 2 FEET OF FINAL GRADE SHOULD CONSIST OF FREE-DRAINING GRANULAR MATERIAL (I.E. SE 30 SAND, PEA GRAVEL, OR CRUSHED ROCK). CRUSHED ROCK, IF USED, SHOULD BE WRAPPED IN FILTER FABRIC (MIRAFI 140N OR EQUIVALENT) TO MINIMIZE THE POTENTIAL FOR MIGRATION OF FINES INTO THE ROCK. THE SELECT BACKFILL SHOULD BE MOISTURE CONDITIONED TO ACHIEVE OVER OPTIMUM MOISTURE CONTENT PER THE SOILS REPORT AND COMPACTED TO AT LEAST 90% RELATIVE COMPACTION AS DETERMINED BY ASTM TEST METHOD D 1557.

3. FINE-GRAINED NATIVE SOILS SHOULD BE USED TO CAP THE SELECT BACKFILL ZONE.

4. ALL NATIVE OR SELECT SOIL WALL BACKFILL SHOULD BE MOISTURE CONDITIONED AS NECESSARY TO OVER OPTIMUM MOISTURE CONTENT PER THE SOILS REPORT AND COMPACTED TO AT LEAST 90% RELATIVE COMPACTION AS DETERMINED BY ASTM TEST METHOD D 1557.

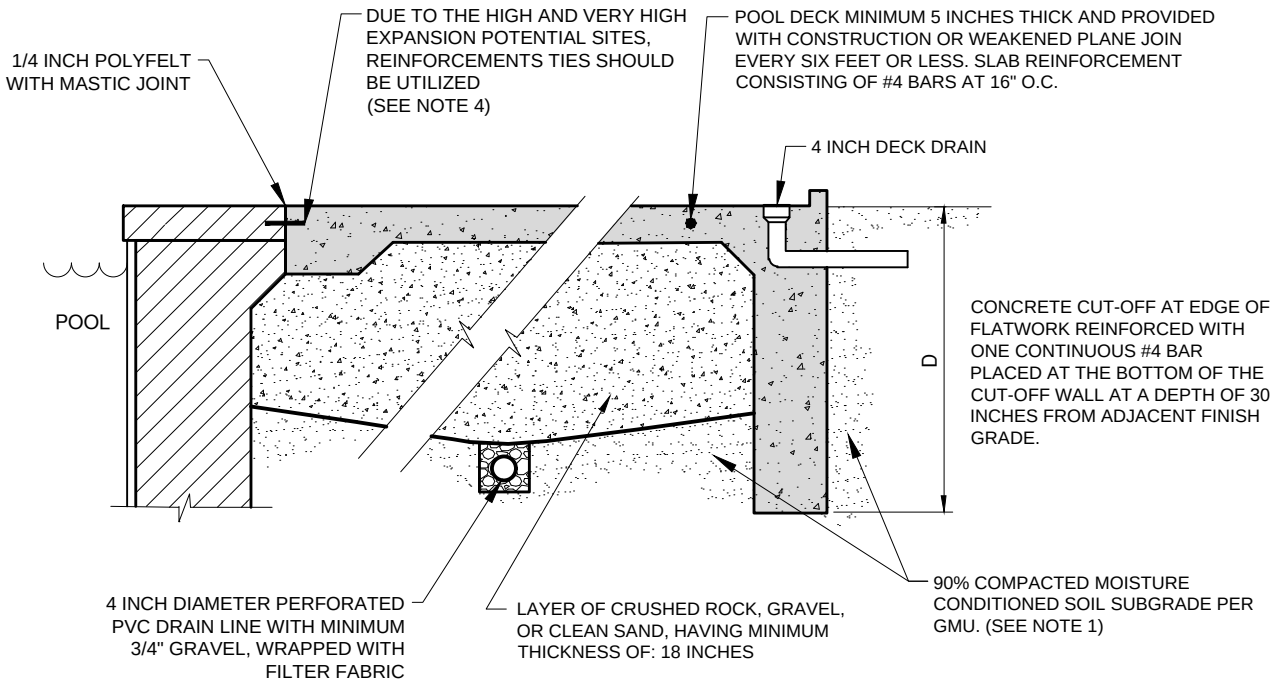
5. THE BACKSIDE OF THE WALLS SHOULD BE WATERPROOFED DOWN TO AND ACROSS THE TOP OF THE FOOTING. THE DESIGN AND SELECTION OF THE WATERPROOFING SYSTEM IS OUTSIDE OF THE PURVIEW OF GMU.

6. THE WATERPROOFING SYSTEM AND ANY DRAIN BOARDS SHOULD BE PROTECTED FROM DAMAGE BY CONSTRUCTION ACTIVITIES. THE TOP EDGE OF THE WATERPROOFING AND ANY DRAIN BOARDS SHOULD BE PROPERLY ADHERED TO THE WALL AND SEALED TO PREVENT THE POSSIBLE ACCUMULATION OF DEBRIS BETWEEN THE DRAINAGE/WATERPROOFING SYSTEM AND THE WALL.

7. THE BACKDRAIN SYSTEM SHOULD CONSIST OF 4" PERFORATED PIPE SURROUNDED BY AT LEAST ONE CUBIC FOOT OF 3/4"-1.5" OPEN GRADED GRAVEL WRAPPED IN MIRAFI 140N FILTER FABRIC (OR EQUIVALENT). THE PERFORATED PIPE SHOULD CONSIST OF SDR-35 OR SCHEDULE 40 PVC PIPE (OR APPROVED EQUIVALENT) LAID ON AT LEAST 2" OF CRUSHED ROCK WITH THE PERFORATIONS LAID DOWN. THE BACKDRAIN GRADIENT SHOULD NOT BE LESS THAN 1% WHEN POSSIBLE. THE PERFORATED PIPE SHOULD OUTLET INTO AREA DRAINS OR OTHER SUITABLE OUTLET POINTS AT RUNS OF 200 FEET OR LESS, IF PRACTICAL. IF THE BACKDRAINS CANNOT BE OUTLETED BY GRAVITY FLOW, A SUMP PUMP SYSTEM WILL NEED TO BE DESIGNED AND CONSTRUCTED. REDUNDANT BACK-UP PUMPS OR COMPONENTS ARE RECOMMENDED. DESIGN OF THIS SYSTEM IS OUTSIDE OF THE PURVIEW OF GMU.

8. THE TIE-IN LOCATIONS FOR BACKDRAIN OUTLETS SHOULD BE SHOWN ON THE PRECISE GRADING, SITE WALL, AND/OR LANDSCAPE PLANS.

GMU GEOTECHNICAL, INC.	**RETAINING WALL CONSTRUCTION DETAIL**	PLATE **3**



1. TO REDUCE THE POTENTIAL FOR EXCESSIVE CRACKING DUE TO EXPANSIVE SOIL FORCES, POOL DECK CONCRETE SLABS SHOULD BE A MINIMUM OF 5 INCHES THICK AND PROVIDED WITH CONSTRUCTION OR WEAKENED PLANE JOINTS AT FREQUENT INTERVALS (e.g., EVERY 6 FEET OR LESS). SLABS SHOULD BE UNDERLAIN BY A LAYER OF CRUSHED ROCK, GRAVEL, OR CLEAN SAND HAVING A MINIMUM THICKNESS OF 18 INCHES. PRESOAKING THE SUB GRADE TO A MINIMUM OF 4% OVER OPTIMUM AND TO A DEPTH OF 12 INCHES IS RECOMMENDED. PRESOAKING SHOULD BE OBSERVED, TESTED, AND ACCEPTED BY GMU PRIOR TO POURING THE CONCRETE.

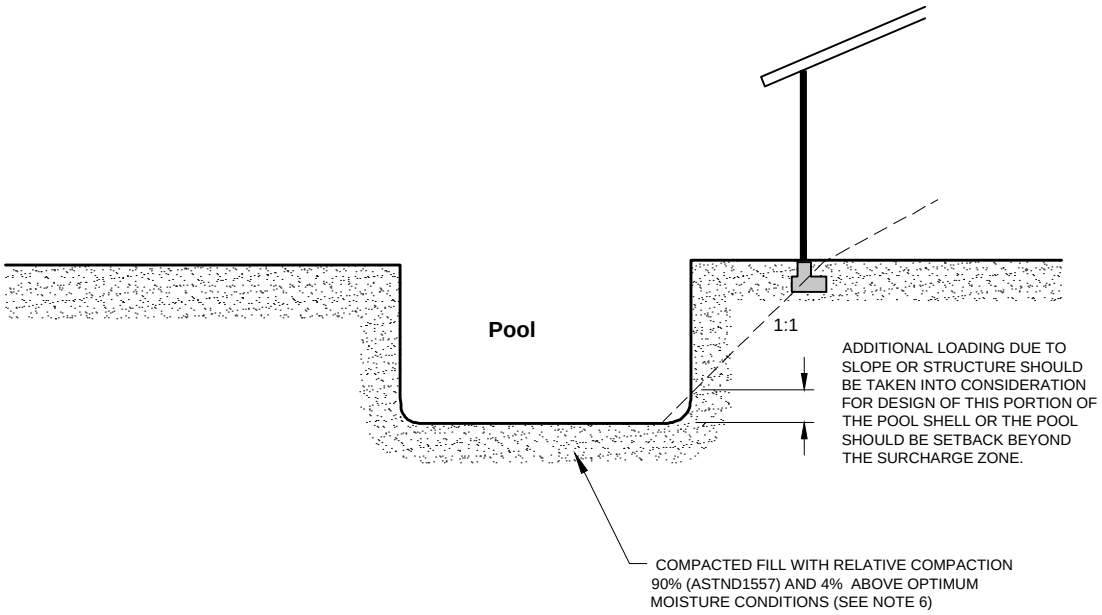
2. FOR POOL DECK ON SUBGRADES HAVING HIGH OR VERY HIGH EXPANSION POTENTIAL, A SUBDRAIN SYSTEM CONSISTING OF 4-INCH DIAMETER PERFORATED PIPE (PVC SCHEDULE 40, SDR 35, ARRMCO A2000 PVC, OR APPROVED EQUIVALENT), WRAPPED WITH FILTER FABRIC (MIRAFI 140N, 140NS, SUPAC 4NP, AMOCO 4545, TREVIRA 1114, OR APPROVED EQUIVALENT) SHOULD BE PROVIDED WITHIN THE SAND LAYER. ONE LINE OF SUBDRAIN AROUND THE SWIMMING POOL AREA IS CONSIDERED SUFFICIENT. THE PURPOSE OF THIS SUBDRAIN IS TO DRAIN POTENTIAL ACCUMULATED WATER WITHIN THE SAND LAYER AND OUTLET THE WATER INTO THE AREA DRAIN SYSTEM MINIMIZING THIS ACCUMULATION FROM SUBSTANTIALLY PERCOLATING DOWN INTO THE UNDERLYING SUBGRADE SOILS.

3. ALL CONCRETE HAS A TENDENCY TO CRACK AND CRACKS IN CONCRETE CAN BE CAUSED BY MANY DIFFERENT FACTORS. WHEN CONSTRUCTING CONCRETE DECKS, PATIOS, SIDEWALKS ETC., IT IS IMPORTANT THAT THE GROUND ON WHICH THESE IMPROVEMENTS ARE TO REST PROPERLY PREPARED, INCLUDING MOISTURE CONDITIONING. SLAB THICKNESS, LOCATION OF JOINTS, REINFORCEMENT, AND CONCRETE MIXTURE MUST ALSO BE APPROPRIATE FOR THE INTENDED USE. PROPER PLACEMENT, FINISHING, AND CURING OF CONCRETE ARE ALSO VERY IMPORTANT FACTORS IN MINIMIZING CRACKING.

4. DUE TO THE HIGH TO VERY HIGH EXPANSION POTENTIAL, IT IS RECOMMENDED THAT THE DECK BE STRUCTURALLY TIED TO THE POOL WALL. THE POOL DESIGNER SHOULD EVALUATE THE EFFECTS OF THIS CONNECTION ON THE POOL SHELL (IF ANY) AND PROVIDE FINAL DESIGN FOR THE REINFORCEMENT. IF THE POOL DESIGNER ELECT NOT TO STRUCTURALLY TIE THE DECK TO THE POOL, UPLIFT OF THE DECK RELATIVE TO THE POOL SHOULD BE EXPECTED.

5. THE SITE HAS SEVERE LEVELS OF SULFATES. CONSEQUENTLY, THE CEMENT TYPE SHOULD BE Type V. CONCRETE MIX DESIGN SHALL BE SELECTED BY THE CONCRETE DESIGNER SUCH THAT SULFATE ATTACK MITIGATION IS BALANCED WITH SHRINKAGE CRACK CONTROL. CONCRETE MIX DESIGN IS OUTSIDE THE GEOTECHNICAL ENGINEER'S PURVIEW.

GMU GEOTECHNICAL, INC.	**POOL DECK DETAIL FOR EXPANSIVE SOIL SITES**	Plate **4**



1. THE POOL WALLS SHOULD BE DESIGNED TO ACCOUNT FOR A HIGH TO VERY HIGH EXPANSION - EFP = 125psf/ft THE ACTUAL EXPANSIVENESS OF SOILS EXPOSED IN POOL EXCAVATION SHOULD BE EVALUATED UPON COMPLETION OF THE EXCAVATION AS POOL SUBGRADE SOILS ARE EXPOSED.

2. WHERE POOLS ARE PLANNED NEAR STRUCTURES, APPROPRIATE SURCHARGE LOADS SHOULD BE INCORPORATED INTO THE DESIGN AND CONSTRUCTION.

3. IN ORDER TO PROVIDE UNIFORM CONDITIONS, THE BOTTOM OF THE POOL EXCAVATION MAY NEED TO BE OVER-EXCAVATED AND REPLACED TO POOL SUBGRADE WITH COMPACTED FILL.

4. WHEREAS POOL EXCAVATION MAY BE FREE OF WATER AT A TIME OF CONSTRUCTION, FUTURE IRRIGATION COULD RESULT IN THE DEVELOPMENT OF PERCHED WATER ZONES WHICH COULD AFFECT SUBSURFACE IMPROVEMENTS. HEAVY-DUTY PIPES AND FLEXIBLE COUPLINGS SHOULD BE USED FOR THE POOL PLUMBING SYSTEM TO MINIMIZE LEAKING WHICH MAY PRODUCE ADDITIONAL PRESSURES ON THE POOL SHELL. IN ADDITION, INSTALLATION OF A PRESSURE VALVE IN THE POOL BOTTOM SHOULD BE USED TO MITIGATE POTENTIAL BUILD-UP OF PRESSURE.

5. IN GENERAL, ALL BELOW GRADE IMPROVEMENTS MUST BE CONSTRUCTED BY QUALIFIED PROFESSIONALS UTILIZING APPROPRIATE DESIGNS WHICH ACCOUNT FOR THE ON-SITE GEOTECHNICAL AND GEOLOGIC CONDITIONS. OBSERVATION/TESTING SHOULD BE PERFORMED BY GMU DURING POOL EXCAVATION TO VERIFY EXPOSED SOIL CONDITIONS ARE CONSISTENT WITH THE ASSUMED DESIGN CONDITIONS.

6. THE DESIGN SHOULD CONSIDER THAT THE ONSITE SOILS ARE SEVERELY CORROSIVE TO FERROUS METALS. IN ADDITION, DUE TO THE SEVERE SULFATE EXPOSURE (SULFATE EXPOSURE CATEGORY "S2"), THE TYPE OF PORTLAND CEMENT, WATER TO CEMENT RATIO, AND THE CONCRETE COMPRESSIVE STRENGTH SHOULD BE IN ACCORDANCE WITH ACI 318-14, TABLE 19.3.2.1. FINAL CONCRETE MIX DESIGN IS OUTSIDE OUR PURVIEW.

7. IT SHOULD BE NOTED THAT IMPLEMENTATION OF THE ABOVE RECOMMENDATIONS ONLY SERVE TO REDUCE THE POTENTIAL FOR EXPANSIVE SOIL RELATED MOVEMENTS INCLUDING SLOPE CREEP AND LATERAL FILL EXTENSION. THE RECOMMENDATIONS ARE NOT INTENDED TO ELIMINATE THESE TYPES OF MOVEMENTS. CONSEQUENTLY, SOME DISTORTION SHOULD BE ANTICIPATED.

APPENDIX A

Geotechnical Exploration Procedures, Drill Hole Logs, and Cone Penetration Testing Data by GMU Geotechnical, Inc.

GMU
GEOTECHNICAL, INC.

APPENDIX A

GMU GEOTECHNICAL EXPLORATION PROCEDURES, DRILL HOLE LOGS, AND CONE PENETRATION TESTING DATA

Our exploration at the subject site consisted of eleven (11) drilled holes to a maximum depth of 31.5 feet below the existing grade and four (4) Cone Penetration Testing (CPT) soundings to a maximum depth of 50 feet below the existing grade. Our drilled holes were logged by a Staff Engineer, and drive, bulk, and Standard Penetration Test (SPT) samples of the excavated soils were collected. Blow counts recorded during sampling from the California Modified Sampler (Cal Mod) and SPT are shown on the drill hole logs. The logs of each drill hole are contained in this Appendix A, and the Legend to Logs is presented as Plates A-1 and A-2. The CPT data are presented in Appendix A-1. The approximate locations of the drill holes and CPT's are shown on Plate 2 – Geotechnical Map.

"Undisturbed" Cal Mod samples were taken using a 3.0-inch, thin walled, outside-diameter drive sampler which contains a 2.416-inch-diameter brass sample sleeve that is 6 inches in length. SPT samples were obtained using a 2.0-inch outside diameter split spoon sampler without liners. Bulk samples of the soil materials were also collected from the upper 5 feet of the site soils.

The geologic and engineering field descriptions and classifications that appear on these logs are prepared according to Corps of Engineers and Bureau of Reclamation standards. Major soil classifications are prepared according to the Unified Soil Classification System as modified by ASTM Standard No. 2487. Since the descriptions and classifications that appear on the Log of Drill Hole are intended to be that which most accurately describe a given interval of a drill hole (frequently an interval of several feet), discrepancies do occur in the Unified Soil Classification System nomenclature between that interval and a particular sample in that interval. For example, an 8-foot-thick interval in a log may be identified as silty sand (SM) while one sample taken within the interval may have individually been identified as sandy silt (ML). This discrepancy is frequently allowed to remain to emphasize the occurrence of local textural variations in the interval.

MAJOR DIVISIONS			Group Letter	Symbol	TYPICAL NAMES
COARSE-GRAINED SOILS More Than 50% Retained On No.200 Sieve Based on The Material Passing The 3-Inch (75mm) Sieve. Reference: ASTM Standard D2487	**GRAVELS** 50% or More of Coarse Fraction Retained on No.4 Sieve	Clean Gravels	**GW**		Well Graded Gravels and Gravel-Sand Mixtures, Little or No Fines.
			GP		Poorly Graded Gravels and Gravel-Sand Mixtures Little or No Fines.
		Gravels With Fines	**GM**		Silty Gravels, Gravel-Sand-Silt Mixtures.
			GC		Clayey Gravels, Gravel-Sand-Clay Mixtures.
	SANDS More Than 50% of Coarse Fraction Passes No.4 Sieve	Clean Sands	**SW**		Well Graded Sands and Gravelly Sands, Little or No Fines.
			SP		Poorly Graded Sands and Gravelly Sands, Little or No Fines.
		Sands With Fines	**SM**		Silty Sands, Sand-Silt Mixtures.
			SC		Clayey Sands, Sand-Clay Mixtures.
FINE-GRAINED SOILS 50% or More Passe The No.200 Sieve Based on The Material Passing The 3-Inch (75mm) Sieve. Reference: ASTM Standard D2487	**SILTS AND CLAYS** Liquid Limit Less Than 50%		**ML**		Inorganic Silts, 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 50% or Greater		**MH**		Inorganic Silts, Micaceous or Diatomaceous Fine Sandy or Silty Soils, 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 and Other Highly Organic Soils.

The descriptive terminology of the logs is modified from current ASTM Standards to suit the purposes of this study

ADDITIONAL TESTS

DS = Direct Shear
HY = Hydrometer Test
TC = Triaxial Compression Test
UC = Unconfined Compression
CN = Consolidation Test
(T) = Time Rate
EX = Expansion Test
CP = Compaction Test
PS = Particle Size Distribution
EI = Expansion Index
SE = Sand Equivalent Test
AL = Atterberg Limits
FC = Chemical Tests
RV = Resistance Value
SG = Specific Gravity
SU = Sulfates
CH = Chlorides
MR = Minimum Resistivity
pH
(N) = Natural Undisturbed Sample
(R) = Remolded Sample
CS = Collapse Test/Swell-Settlement

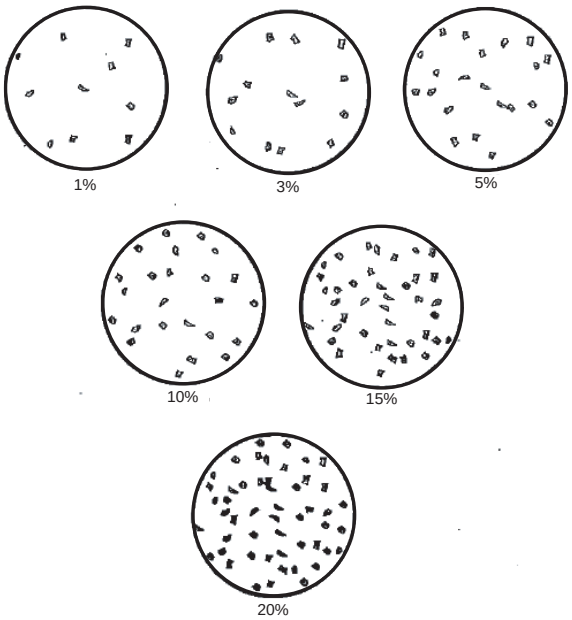
GEOLOGIC NOMENCLATURE

B = Bedding C = Contact J = Joint
F = Fracture Flt = Fault S = Shear
RS = Rupture Surface = Seepage
= Groundwater

SAMPLE SYMBOLS

Undisturbed Sample (California Sample)
Undisturbed Sample (Shelby Tube)
Bulk Sample
Unsuccessful Sampling Attempt
SPT Sample

10: 10 Blows for 12-Inches Penetration
6/4: 6 Blows Per 4-Inches Penetration
P: Push
(13): Uncorrected Blow Counts ("N" Values) for 12-Inches Penetration- Standard Penetration Test (SPT)



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LEGEND TO LOGS
ASTM Designation: D 2487
(Based on Unified Soil Classification System)

Plate
A-1

P8-11/16/2012

SOIL DENSITY/CONSISTENCY

FINE GRAINED

Consistency	Field Test	SPT (#blows/foot)	Mod (#blows/foot)
Very Soft	Easily penetrated by thumb, exudes between fingers	<2	<3
Soft	Easily penetrated one inch by thumb, molded by fingers	2-4	3-6
Firm	Penetrated over 1/2 inch by thumb with moderate effort	4-8	6-12
Stiff	Penetrated about 1/2 inch by thumb with great effort	8-15	12-25
Very Stiff	Readily indented by thumbnail	15-30	25-50
Hard	Indented with difficulty by thumbnail	>30	>50

COARSE GRAINED

Density	Field Test	SPT (#blows/foot)	Mod (#blows/foot)
Very Loose	Easily penetrated with 0.5" rod pushed by hand	<4	<5
Loose	Easily penetrated with 0.5" rod pushed by hand	4-10	5-12
Medium Dense	Easily penetrated 1' with 0.5" rod driven by 5lb hammer	10-30	12-35
Dense	Dificult to penetrat 1' with 0.5" rod driven by 5lb hammer	31-50	35-60
Very Dense	Penetrated few inches with 0.5" rod driven by 5lb hammer	>50	>60

BEDROCK HARDNESS

Density	Field Test	SPT (#blows/foot)
Soft	Can be crushed by hand, soil like and structureless	1-30
Moderately Hard	Can be grooved with fingernails, crumbles with hammer	30-50
Hard	Can't break by hand, can be grooved with knife	50-100
Very Hard	Scratches with knife, chips with hammer blows	>100

MODIFIERS

Trace	1%
Few	1-5%
Some	5-12%
Numerous	12-20%
Abundant	>20%

GRAIN SIZE

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

MOISTURE CONTENT

Dry- Very little or no moisture
Damp- Some moisture but less than optimum
Moist- Near optimum
Very Moist- Above optimum
Wet/Saturated- Contains free moisture

Project: EF International Language Campus **Project Location: 3150 Bear Street, Costa Mesa** **Project Number: 18-252-00**	**Log of Drill Hole DH- 1** Sheet 1 of 2

Date(s) Drilled	**1/2/19**	Logged By	**AAV**	Checked By	**NS**
Drilling Method	**Hollow Stem Auger**	Drilling Contractor	**2R Drilling, Inc.**	Total Depth of Drill Hole	**30.9 feet**
Drill Rig Type	**CME 75**	Diameter(s) of Hole, inches	**8**	Approx. Surface Elevation, ft MSL	**34.7**
Groundwater Depth [Elevation], feet	**20.5 [14.2]**	Sampling Method(s)	**Open drive sampler with 6-inch sleeve, SPT, and bulk samples**	Drill Hole Backfill	**Bentonite Chips and Native**
Remarks				Driving Method and Drop	**140lb hammer, 30" drop**

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE DATA: NUMBER OF BLOWS / 6"	SAMPLE DATA: DRIVING WEIGHT, lbs	TEST DATA: MOISTURE CONTENT, %	TEST DATA: DRY UNIT WEIGHT, pcf	TEST DATA: ADDITIONAL TESTS
			TOPSOIL some rootlets		SILTY CLAY (CL); olive brown with white and olive mottling, moist, firm to stiff, some fine to medium grained sand, some fine gravel						
			YOUNG AXIAL CHANNEL DEPOSITS (Qya)		FAT CLAY (CH); olive brown with white and olive mottling, moist, firm to stiff, some fine to medium grained sand, some fine gravel		4 8 8	140	21	101	
30	5		some caliche		stiff		4 5 8	140	38	82	
			increase in caliche				7 11 13	140	30	89	
25	10				becomes olive with orange root stains, trace fine to medium grained sand		8 8 10	140	28	94	
					SILTY CLAY (CL); yellowish brown, moist, stiff		5 5 10	140	16	113	
					POORLY GRADED SAND WITH SILT (SP-SM); yellowish brown with orange staining, moist, medium dense, sand is very fine to fine grained						
20	15				sand becomes fien to medium grained with some coarse grained sand, some fine gravel with trace coarse gravel		8 10 13	140	4		
			some caliche		SILTY CLAY (CL); olive brown, very moist to wet, stiff, trace gravel						
15											

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GMU GEOTECHNICAL, INC.

Drill Hole DH- 1

Project: EF International Language Campus
Project Location: 3150 Bear Street, Costa Mesa
Project Number: 18-252-00

Log of Drill Hole DH- 1

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE DATA: NUMBER OF BLOWS / 6"	SAMPLE DATA: DRIVING WEIGHT, lbs	TEST DATA: MOISTURE CONTENT, %	TEST DATA: DRY UNIT WEIGHT, pcf	TEST DATA: ADDITIONAL TESTS
			some caliche				11 16 22	140	20	107	
10	25						6 19 25	140			
					SILTY SAND (SM); yellowish brown, wet, medium dense to dense, sand is fine to medium grained with coarse grained, some fine gravel						
					POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM); yellowish brown, wet, very dense, sand is medium to coarse grained, gravel is fine to coarse						
5	30						26 50/5"	140	8	136	
					Total Depth = 30.92 ft Groundwater encountered at 20.5 ft below ground surface						

GMU GEOTECHNICAL, INC.

Project: EF International Language Campus **Project Location: 3150 Bear Street, Costa Mesa** **Project Number: 18-252-00**	**Log of Drill Hole DH- 2** Sheet 1 of 2

Date(s) Drilled	**1/2/19**	Logged By	**AAV**	Checked By	**NS**
Drilling Method	**Hollow Stem Auger**	Drilling Contractor	**2R Drilling, Inc.**	Total Depth of Drill Hole	**31.5 feet**
Drill Rig Type	**CME 75**	Diameter(s) of Hole, inches	**8**	Approx. Surface Elevation, ft MSL	**35.3**
Groundwater Depth [Elevation], feet	**18.3 [16.9]**	Sampling Method(s)	**Open drive sampler with 6-inch sleeve, SPT, and bulk samples**	Drill Hole Backfill	**Bentonite Chips and Native**
Remarks				Driving Method and Drop	**140lb hammer, 30" drop**

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE DATA: NUMBER OF BLOWS / 6"	SAMPLE DATA: DRIVING WEIGHT, lbs	TEST DATA: MOISTURE CONTENT, %	TEST DATA: DRY UNIT WEIGHT, pcf	TEST DATA: ADDITIONAL TESTS
35			**TOPSOIL** some rootlets		LEAN CLAY (CL); brown to dark brown with some orange mottling, moist to very moist, stiff						
			YOUNG AXIAL CHANNEL DEPOSITS (Qya) some rootlets, some caliche		FAT CLAY (CH); brown to dark brown with some orange mottling, moist to very moist, stiff		5 7 12	140	23	99	
30	5				brown, moist, stiff, some fine grained sand		5 6 9	140	28	92	
					becomes brown with orange and black mottling		8 11 14	140	15	117	
25	10				becomes light brown with some very fine grained sand pockets		6 7 12	140	21	106	
			some caliche		SANDY SILT (ML); light brown with orange staining, damp to moist, stiff, sand is very fine grained, few fine gravel		8 11 13	140	17	115	
					CLAYEY SILT (ML); light brown, moist, stiff, some very fine grained sand pockets						
20	15				SANDY CLAY (CL); light brown with orange mottling and white veins, moist, stiff		9 10 12	140	26	100	

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GMU GEOTECHNICAL, INC.

Drill Hole DH- 2

Project: EF International Language Campus
Project Location: 3150 Bear Street, Costa Mesa
Project Number: 18-252-00

Log of Drill Hole DH- 2

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE DATA: NUMBER OF BLOWS / 6"	SAMPLE DATA: DRIVING WEIGHT, lbs	TEST DATA: MOISTURE CONTENT, %	TEST DATA: DRY UNIT WEIGHT, pcf	TEST DATA: ADDITIONAL TESTS
15					no white veins, becomes very moist, some fine grained sand		3 4 7	140			
10	25				SILTY SAND (SM); light yellowish brown, wet, dense, sand is very fine to fine grained with trace coarse sand		13 16 29	140	17	114	
5	30				POORLY GRADED SAND (SP) with GRAVEL; light brown, wet, medium dense to dense, sand is fine to medium grained with some coarse grained sand, some fine to coarse gravel		12 14 19	140			
					Total Depth = 31.5 ft Groundwater encountered at 18.33 ft below ground surface						

GMU GEOTECHNICAL, INC.

Project: EF International Language Campus **Project Location: 3150 Bear Street, Costa Mesa** **Project Number: 18-252-00**	**Log of Drill Hole DH- 3** Sheet 1 of 1

Date(s) Drilled	**1/2/19**	Logged By	**AAV**	Checked By	**NS**
Drilling Method	**Hollow Stem Auger**	Drilling Contractor	**2R Drilling, Inc.**	Total Depth of Drill Hole	**5.0 feet**
Drill Rig Type	**CME 75**	Diameter(s) of Hole, inches	**8**	Approx. Surface Elevation, ft MSL	**34.7**
Groundwater Depth [Elevation], feet	**N/A ▯**	Sampling Method(s)	**Open drive sampler with 6-inch sleeve, SPT, and bulk samples**	Drill Hole Backfill	**Native**
Remarks	**Infiltration test location**			Driving Method and Drop	**140lb hammer, 30" drop**

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE DATA: NUMBER OF BLOWS / 6"	SAMPLE DATA: DRIVING WEIGHT, lbs	TEST DATA: MOISTURE CONTENT, %	TEST DATA: DRY UNIT WEIGHT, pcf	TEST DATA: ADDITIONAL TESTS
			TOPSOIL some rootlets, some caliche		SILTY CLAY (CL); dark brown with some orange mottling, moist, stiff, trace fine to medium grained sand						
			YOUNG AXIAL CHANNEL DEPOSITS (Qya)		SILTY CLAY (CL); dark brown with some orange mottling, moist, stiff, trace fine to medium grained sand		6 6 13	140	19	108	
30	5				Total Depth = 5 ft No groundwater encountered Performed infiltration testing at this location						

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GMU GEOTECHNICAL, INC.

Drill Hole DH- 3

Project: EF International Language Campus **Project Location: 3150 Bear Street, Costa Mesa** **Project Number: 18-252-00**	**Log of Drill Hole DH- 4** Sheet 1 of 2

Date(s) Drilled	**1/4/19**	Logged By	**MTF**	Checked By	**NS**
Drilling Method	**Hollow Stem Auger**	Drilling Contractor	**2R Drilling, Inc.**	Total Depth of Drill Hole	**31.5 feet**
Drill Rig Type	**CME 75**	Diameter(s) of Hole, inches	**8**	Approx. Surface Elevation, ft MSL	**34.7**
Groundwater Depth [Elevation], feet	**20.0 [14.7]**	Sampling Method(s)	**Open drive sampler with 6-inch sleeve, SPT, and bulk samples**	Drill Hole Backfill	**Bentonite Chips and Native**
Remarks				Driving Method and Drop	**140lb hammer, 30" drop**

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE DATA: NUMBER OF BLOWS / 6"	SAMPLE DATA: DRIVING WEIGHT, lbs	TEST DATA: MOISTURE CONTENT, %	TEST DATA: DRY UNIT WEIGHT, pcf	TEST DATA: ADDITIONAL TESTS
			TOPSOIL some rootlets		SILTY CLAY (CL); brown, very moist, firm to stiff, with trace fine to medium grained sand						
			YOUNG AXIAL CHANNEL DEPOSITS		FAT CLAY (CH); brown, very moist, firm to stiff, with trace fine to medium grained sand						
					brown, gray, and dark gray, very moist, stiff		4 6 9	140	24	99	
30	5						7 8 13	140	28	86	
			some caliche		becomes light gray		7 9 11	140	32	84	
25	10		numerous caliche		SILTY CLAY (CL); light brown, very moist, stiff		8 10 11	140	17	113	
					LEAN CLAY (CL); light gray and white, very moist, very stiff		8 10 18	140	17	108	
20	15		numerous concretions		SITLY CLAY (CL); light brown, very moist, stiff		4 6 8	140			
15											

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GMU GEOTECHNICAL, INC.

Drill Hole DH- 4

Project: EF International Language Campus
Project Location: 3150 Bear Street, Costa Mesa
Project Number: 18-252-00

Log of Drill Hole DH- 4

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE DATA: NUMBER OF BLOWS / 6"	SAMPLE DATA: DRIVING WEIGHT, lbs	TEST DATA: MOISTURE CONTENT, %	TEST DATA: DRY UNIT WEIGHT, pcf	TEST DATA: ADDITIONAL TESTS
							11 14 17	140	16	112	
10	25				CLAYEY SAND (SC); brown and light brown, very moist to saturated, dense, sand is fine to medium grained		6 12 22	140			
					POORLY GRADED SAND (SP); light brown, saturated, dense to very dense, sand is medium grained						
5	30						8 22 38	140	16	118	
					Total Depth = 31.0 ft Groundwater Encountered at 20.0 ft below ground surface						

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GMU GEOTECHNICAL, INC.

Project: EF International Language Campus **Project Location: 3150 Bear Street, Costa Mesa** **Project Number: 18-252-00**	**Log of Drill Hole DH- 5** Sheet 1 of 2

Date(s) Drilled	**1/4/19**	Logged By	**MTF**	Checked By	**NS**
Drilling Method	**Hollow Stem Auger**	Drilling Contractor	**2R Drilling, Inc.**	Total Depth of Drill Hole	**31.5 feet**
Drill Rig Type	**CME 75**	Diameter(s) of Hole, inches	**8**	Approx. Surface Elevation, ft MSL	**34.7**
Groundwater Depth [Elevation], feet	**20.7 [14.0]**	Sampling Method(s)	**Open drive sampler with 6-inch sleeve, SPT, and bulk samples**	Drill Hole Backfill	**Bentonite Chips and Native**
Remarks				Driving Method and Drop	**140lb hammer, 30" drop**

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE DATA: NUMBER OF BLOWS / 6"	SAMPLE DATA: DRIVING WEIGHT, lbs	TEST DATA: MOISTURE CONTENT, %	TEST DATA: DRY UNIT WEIGHT, pcf	TEST DATA: ADDITIONAL TESTS
			TOPSOIL some rootlets		SILTY CLAY (CL); brown, very moist, firm to stiff, with some fine to medium grained sand						
			YOUNG AXIAL CHANNEL DEPOSITS		SILTY CLAY (CL); brown, very moist, firm to stiff, with some fine to medium grained sand						
					CLAYEY SAND (SC); orangeish brown, moist to very moist, medium dense, fine to medium grained sand with trace coarse grained sand		9 10 13	140	10	105	
30	5				SILTY CLAY (CL); light brown, damp to moist, very stiff, with some fine grained sand		15 15 29	140	6	120	
							10 14 24	140	11	124	
25	10				CLAYEY SAND (SC); light brown, moist to very moist, medium dense, medium grained sand		12 11 13	140	8	114	
					SILTY SAND (SM); light gray, very moist, very stiff, with some fine grained sand		9 12 16	140	5	107	
20	15		numerous caliche		SILTY CLAY (CL); light gray, very moist to saturated, stiff		5 7 12	140	20	104	
15											

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GMU GEOTECHNICAL, INC.

Drill Hole DH- 5

Project: EF International Language Campus
Project Location: 3150 Bear Street, Costa Mesa
Project Number: 18-252-00

Log of Drill Hole DH- 5

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE DATA: NUMBER OF BLOWS / 6"	SAMPLE DATA: DRIVING WEIGHT, lbs	TEST DATA: MOISTURE CONTENT, %	TEST DATA: DRY UNIT WEIGHT, pcf	TEST DATA: ADDITIONAL TESTS
							7 10 13	140	26	95	
10	25				becomes saturated		8 10 10	140			
					POORLY GRADED SAND WITH SILT (SP-SM); white, gray, and black, saturated, medium dense, medium grained sand						
5	30						4 7 13	140			
					Total Depth = 31.5 ft Groundwater encountered at 20.7 ft below ground surface						

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GMU GEOTECHNICAL, INC.

Project: EF International Language Campus **Project Location: 3150 Bear Street, Costa Mesa** **Project Number: 18-252-00**	**Log of Drill Hole DH- 6** Sheet 1 of 1

Date(s) Drilled	**1/2/19**	Logged By	**MTF**	Checked By	**NS**
Drilling Method	**Hand Auger**	Drilling Contractor	**Earthworks Techniques, Inc.**	Total Depth of Drill Hole	**5.8 feet**
Drill Rig Type	**N/A**	Diameter(s) of Hole, inches	**3**	Approx. Surface Elevation, ft MSL	**36.0**
Groundwater Depth [Elevation], feet	**N/A []**	Sampling Method(s)	**Open drive sampler with 6-inch sleeve, SPT, and bulk samples**	Drill Hole Backfill	**Native**
Remarks				Driving Method and Drop	**140lb hammer, 30" drop**

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE DATA: NUMBER OF BLOWS / 6"	SAMPLE DATA: DRIVING WEIGHT, lbs	TEST DATA: MOISTURE CONTENT, %	TEST DATA: DRY UNIT WEIGHT, pcf	TEST DATA: ADDITIONAL TESTS
			TOPSOIL		CLAYEY SAND (SC); brown, moist, medium dense, sand is fine to medium grained						
35			**YOUNG AXIAL CHANNEL DEPOSITS (Qya)**		SANDY CLAY (CL); brown, moist, stiff, sand is fine to medium grained						
					becomes orangish brown, moist to wet				15	107	
					becomes very moist, sand is fine to coarse grained						
	5				FAT CLAY (CH); dark grayish brown, very moist, stiff to very stiff				30	77	
					Total Depth = 5.83 ft No groundwater encountered						

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GMU GEOTECHNICAL, INC.

Drill Hole DH- 6

Project: EF International Language Campus **Project Location: 3150 Bear Street, Costa Mesa** **Project Number: 18-252-00**	**Log of Drill Hole DH- 7** Sheet 1 of 1

Date(s) Drilled	**1/2/19**	Logged By	**AAV**	Checked By	**NS**
Drilling Method	**Hollow Stem Auger**	Drilling Contractor	**2R Drilling, Inc.**	Total Depth of Drill Hole	**5.0 feet**
Drill Rig Type	**CME 75**	Diameter(s) of Hole, inches	**8**	Approx. Surface Elevation, ft MSL	**33.5**
Groundwater Depth [Elevation], feet	**N/A []**	Sampling Method(s)	**Open drive sampler with 6-inch sleeve, SPT, and bulk samples**	Drill Hole Backfill	**Native**
Remarks	**Infiltration test location**			Driving Method and Drop	**140lb hammer, 30" drop**

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE DATA: NUMBER OF BLOWS / 6"	SAMPLE DATA: DRIVING WEIGHT, lbs	TEST DATA: MOISTURE CONTENT, %	TEST DATA: DRY UNIT WEIGHT, pcf	TEST DATA: ADDITIONAL TESTS
			TOPSOIL some rootlets		SILTY CLAY (CL); brown to dark gray with white and orange mottling, moist, stiff						
			YOUNG AXIAL CHANNEL DEPOSITS (Qya)		FAT CLAY (CH); brown to dark gray with white and orange mottling, moist, stiff						
30							4 7 11	140	39	82	
	5				Total Depth = 5 ft No groundwater encountered Performed infiltration testing at this location						

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GMU GEOTECHNICAL, INC.

Drill Hole DH- 7

Project: EF International Language Campus **Project Location: 3150 Bear Street, Costa Mesa** **Project Number: 18-252-00**	**Log of Drill Hole DH- 8** Sheet 1 of 1

Date(s) Drilled	**1/2/19**	Logged By	**MTF**	Checked By	**NS**
Drilling Method	**Hand Auger**	Drilling Contractor	**Earthworks Techniques, Inc.**	Total Depth of Drill Hole	**5.7 feet**
Drill Rig Type	**N/A**	Diameter(s) of Hole, inches	**3**	Approx. Surface Elevation, ft MSL	**35.4**
Groundwater Depth [Elevation], feet	**N/A []**	Sampling Method(s)	**Open drive sampler with 6-inch sleeve, SPT, and bulk samples**	Drill Hole Backfill	**Native**
Remarks				Driving Method and Drop	**140lb hammer, 30" drop**

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE DATA: NUMBER OF BLOWS / 6"	SAMPLE DATA: DRIVING WEIGHT, lbs	TEST DATA: MOISTURE CONTENT, %	TEST DATA: DRY UNIT WEIGHT, pcf	TEST DATA: ADDITIONAL TESTS
35			**TOPSOIL**		CLAYEY SAND (SC); brown, damp to moist, medium dense, sand is fine to medium grained						
			YOUNG AXIAL CHANNEL DEPOSITS (Qya) some rootlets		SANDY CLAY (CL); brown to light brown, very moist, sand is fine grained, highly plastic						
					becomes light yellowish brown, with siltstone fragments				23	94	
					FAT CLAY (CH); dark grayish black, moist, stiff to very stiff						
	5										
30									15	90	
					Total Depth = 5.67 ft No groundwater encountered						

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GMU GEOTECHNICAL, INC.

Drill Hole DH- 8

Project: EF International Language Campus **Project Location: 3150 Bear Street, Costa Mesa** **Project Number: 18-252-00**	**Log of Drill Hole DH- 9** Sheet 1 of 1

Date(s) Drilled	**1/2/19**	Logged By	**AAV**	Checked By	**NS**
Drilling Method	**Hollow Stem Auger**	Drilling Contractor	**2R Drilling, Inc.**	Total Depth of Drill Hole	**5.0 feet**
Drill Rig Type	**CME 75**	Diameter(s) of Hole, inches	**8**	Approx. Surface Elevation, ft MSL	**34.0**
Groundwater Depth [Elevation], feet	**N/A []**	Sampling Method(s)	**Open drive sampler with 6-inch sleeve, SPT, and bulk samples**	Drill Hole Backfill	**Native**
Remarks	**Infiltration test location**			Driving Method and Drop	**140lb hammer, 30" drop**

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE DATA: NUMBER OF BLOWS / 6"	SAMPLE DATA: DRIVING WEIGHT, lbs	TEST DATA: MOISTURE CONTENT, %	TEST DATA: DRY UNIT WEIGHT, pcf	TEST DATA: ADDITIONAL TESTS
			TOPSOIL some rootlets, some caliche		SILTY CLAY (CL); dark brown with some orange mottling, moist, stiff, trace fine to medium grained sand						
			YOUNG AXIAL CHANNEL DEPOSITS (Qya)		SILTY CLAY (CL); dark brown with some orange mottling, moist, stiff, trace fine to medium grained sand						
30	5				Total Depth = 5 ft No groundwater encountered Performed infiltration testing at this location						

DH_REV3 18-252-00.GPJ GMULAB.GPJ 1/30/19

GMU GEOTECHNICAL, INC.

Drill Hole DH- 9

Project: EF International Language Campus **Project Location: 3150 Bear Street, Costa Mesa** **Project Number: 18-252-00**	**Log of Drill Hole DH-10** Sheet 1 of 2

Date(s) Drilled	**1/2/19**	Logged By	**AAV**	Checked By	**NS**
Drilling Method	**Hollow Stem Auger**	Drilling Contractor	**2R Drilling, Inc.**	Total Depth of Drill Hole	**31.5 feet**
Drill Rig Type	**CME 75**	Diameter(s) of Hole, inches	**8**	Approx. Surface Elevation, ft MSL	**34.6**
Groundwater Depth [Elevation], feet	**18.5 [16.1]**	Sampling Method(s)	**Open drive sampler with 6-inch sleeve, SPT, and bulk samples**	Drill Hole Backfill	**Bentonite Chips and Native**
Remarks				Driving Method and Drop	**140lb hammer, 30" drop**

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE DATA: NUMBER OF BLOWS / 6"	SAMPLE DATA: DRIVING WEIGHT, lbs	TEST DATA: MOISTURE CONTENT, %	TEST DATA: DRY UNIT WEIGHT, pcf	TEST DATA: ADDITIONAL TESTS
			PORTLAND CEMENT CONCRETE (PCC)		PORTLAND CEMENT CONCRETE (PCC) = 6-inches						
			AGGREGATE BASE (AB)		AGGREGATE BASE (AB); 3/4-inch crushed aggregate, dry to damp, very dense, subangular to angular, significant fines						
			YOUNG AXIAL CHANNEL DEPOSITS (Qya)		SILTY CLAY (CL); brown to dark brown, damp to moist, stiff, some fine to coarse grained sand, some fine to coarse gravel becomes dark gray		14 8 10	140	11	98	
					becomes brown						
30	5						7 7 17	140	21	104	
					becomes light gray, dry to damp, no sand or gravel						
					becomes gray with orange staining, some fine to medium grained sand		10 10 13	140	10	122	
25	10				becomes brown with orange staining, few fine gravel		10 13 20	140	10	124	
					CLAYEY SAND (SC); orangish brown, damp, dense, sand is fine to medium grained with coarse grained sand, some fine to coarse gravel		12 15 21	140	4	119	
20	15				SANDY CLAY (CL) with GRAVEL; yellowish brown, moist, dense to very dense, sand is fine to coarse grained, gravel is fine to coarse		13 22 29	140	11	122	
15											

Project: EF International Language Campus
Project Location: 3150 Bear Street, Costa Mesa
Project Number: 18-252-00

Log of Drill Hole DH-10

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE DATA: NUMBER OF BLOWS / 6"	SAMPLE DATA: DRIVING WEIGHT, lbs	TEST DATA: MOISTURE CONTENT, %	TEST DATA: DRY UNIT WEIGHT, pcf	TEST DATA: ADDITIONAL TESTS
					CLAYEY SAND (SC); yellowish brown, wet, dense, sand is fine to coarse grained, some fine gravel		14 23 23	140			
10	25				GRAVELLY SAND (SG) with CLAY; yellowish brown, wet, very dense, sand is medium to coarse grained, gravel is fine to coarse		32 50/5"	140	11	130	
5	30				POORLY GRADED SAND (SP) with SILT; grayish brown, wet, medium dense, sand is very fine to fine grained		7 12 10	140			
					Total Depth = 31.5 ft Groundwater encountered at 18.5 ft below ground surface						

DH_REV3 18-252-00.GPJ GMULAB.GPJ 1/30/19

GMU GEOTECHNICAL, INC.

Project: EF International Language Campus **Project Location: 3150 Bear Street, Costa Mesa** **Project Number: 18-252-00**	**Log of Drill Hole DH-11** Sheet 1 of 2

Date(s) Drilled	**1/2/19**	Logged By	**AAV**	Checked By	**NS**
Drilling Method	**Hollow Stem Auger**	Drilling Contractor	**2R Drilling, Inc.**	Total Depth of Drill Hole	**31.5 feet**
Drill Rig Type	**CME 75**	Diameter(s) of Hole, inches	**8**	Approx. Surface Elevation, ft MSL	**33.7**
Groundwater Depth [Elevation], feet	**18.9 [14.8]**	Sampling Method(s)	**Open drive sampler with 6-inch sleeve, SPT, and bulk samples**	Drill Hole Backfill	**Bentonite Chips and Native**
Remarks				Driving Method and Drop	**140lb hammer, 30" drop**

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE DATA: NUMBER OF BLOWS / 6"	SAMPLE DATA: DRIVING WEIGHT, lbs	TEST DATA: MOISTURE CONTENT, %	TEST DATA: DRY UNIT WEIGHT, pcf	TEST DATA: ADDITIONAL TESTS
			TOPSOIL some rootlets		SILTY CLAY (CL); dark brown, damp, firm to stiff, some fine to medium grained sand						
			YOUNG AXIAL CHANNEL DEPOSITS (Qya)		SILTY CLAY (CL); dark brown, damp, firm to stiff, some fine to medium grained sand		4 5 7	140	14	118	
30					SANDY CLAY (CL); reddish brown, damp, firm, sand is very fine to fine grained						
	5				SILTY CLAY (CL); reddish brown, moist, firm, some very fine to fine grained sand		3 5 6	140			
25					SANDY CLAY (CL); yellowish brown, moist to very moist, stiff, sand is very fine to fine grained		6 12 12	140	14	114	
	10						6 9 11	140			
20					CLAYEY SAND (SM); light yellowish brown, damp, medium dense, sand is very fine to fine grained		9 12 15	140	8	110	
	15				CLAYEY SILT (ML); light olive brown, moist to very moist, firm		4 5 7	140			
15					SILTY SAND (SM); light yellowish brown, wet, medium dense, sand is very fine to fine grained ∇						

DH_REV3 18-252-00.GPJ GMULAB.GPJ 1/30/19

GMU GEOTECHNICAL, INC.

Drill Hole DH-11

Project: EF International Language Campus
Project Location: 3150 Bear Street, Costa Mesa
Project Number: 18-252-00

Log of Drill Hole DH-11

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE DATA: NUMBER OF BLOWS / 6"	SAMPLE DATA: DRIVING WEIGHT, lbs	TEST DATA: MOISTURE CONTENT, %	TEST DATA: DRY UNIT WEIGHT, pcf	TEST DATA: ADDITIONAL TESTS
							7 9 14	140	21	110	
					SILTY CLAY (CL); ligth yellowish brown with orange staining, wet, stiff, trace fine gravel						
10											
	25				becomes very moist		5 12 15	140			
5											
					POORLY GRADED SAND (SP); light yellowish brown, wet, dense, sand is fine grained with medium grained sand						
	30						7 14 26	140	22	102	
					Total Depth = 31.5 ft Groundwater encountered at 18.92 ft below ground surface						

GMU GEOTECHNICAL, INC.

Drill Hole DH-11

APPENDIX A-1

Cone Penetration Testing Data by GMU Geotechnical, Inc.

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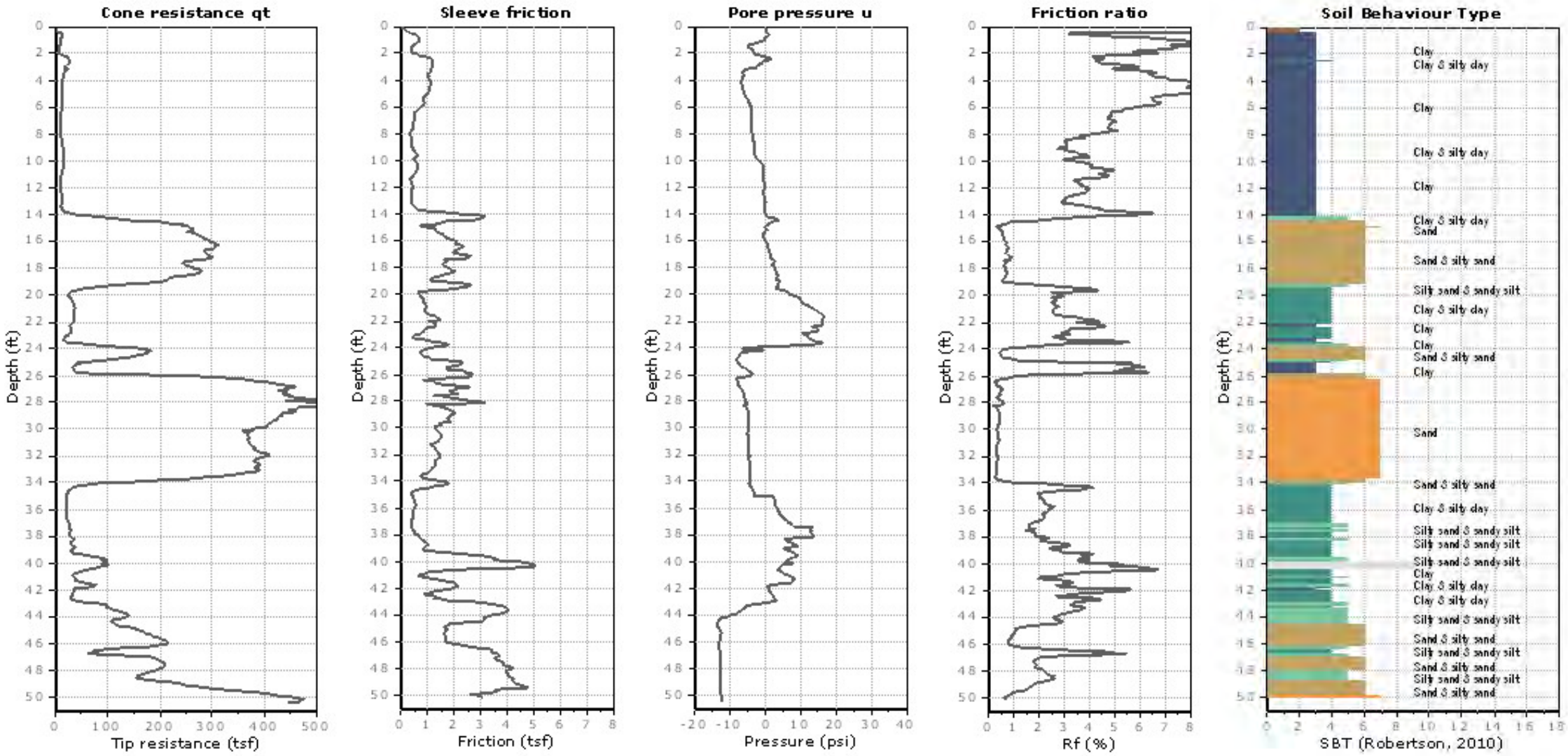
Kehoe Testing and Engineering
714-901-7270
steve@kehoetesting.com
www.kehoetesting.com

CPT-1

Project: **GMU Geotechnical / EF International**
Location: **3150 Bear St, Costa Mesa, CA**

Total depth: 50.46 ft, Date: 1/2/2019
Cone Type: Vertek

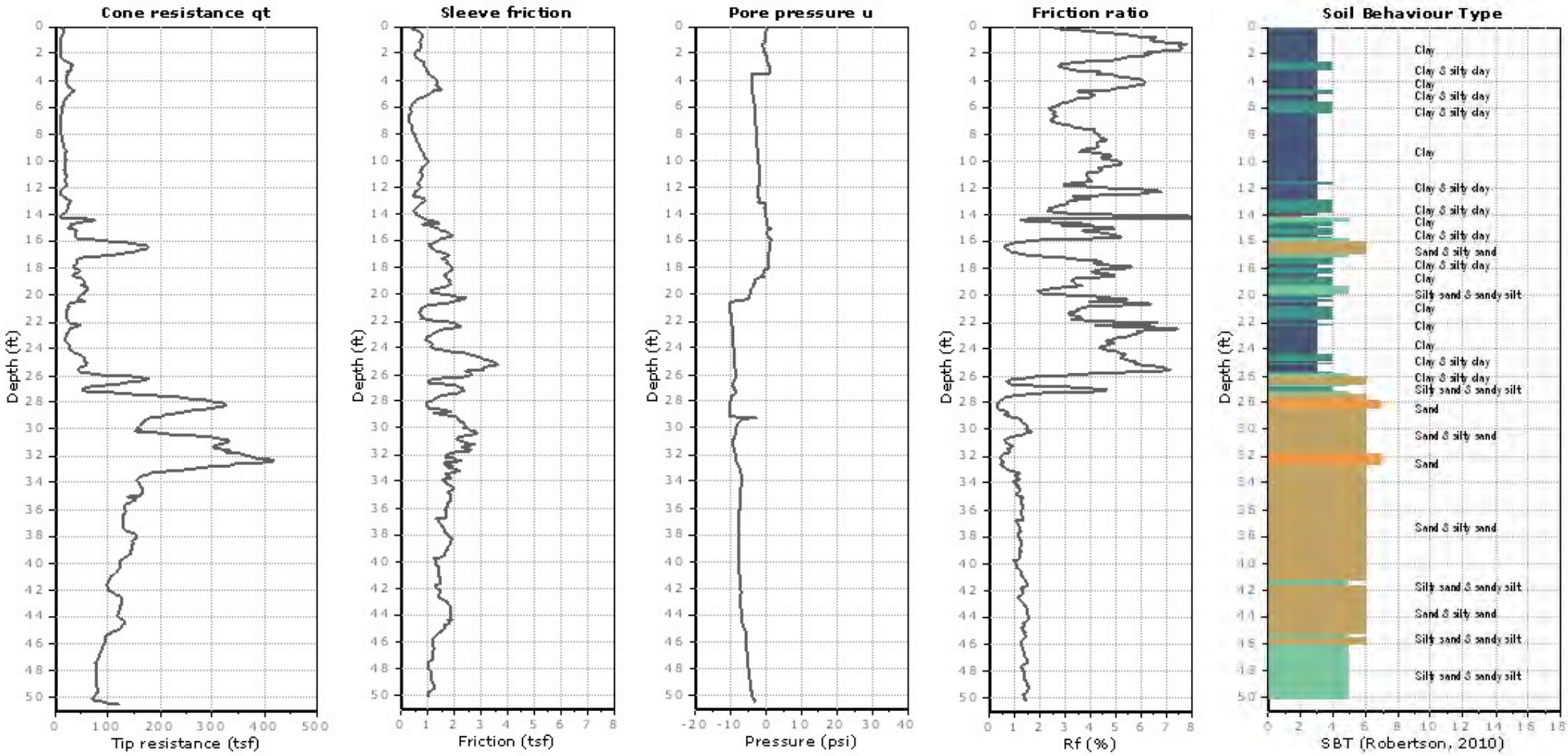


Kehoe Testing and Engineering
714-901-7270
steve@kehoetesting.com
www.kehoetesting.com

CPT-2A

Project: **GMU Geotechnical / EF International**
Location: **3150 Bear St, Costa Mesa, CA**

Total depth: 50.54 ft, Date: 1/2/2019
Cone Type: Vertek



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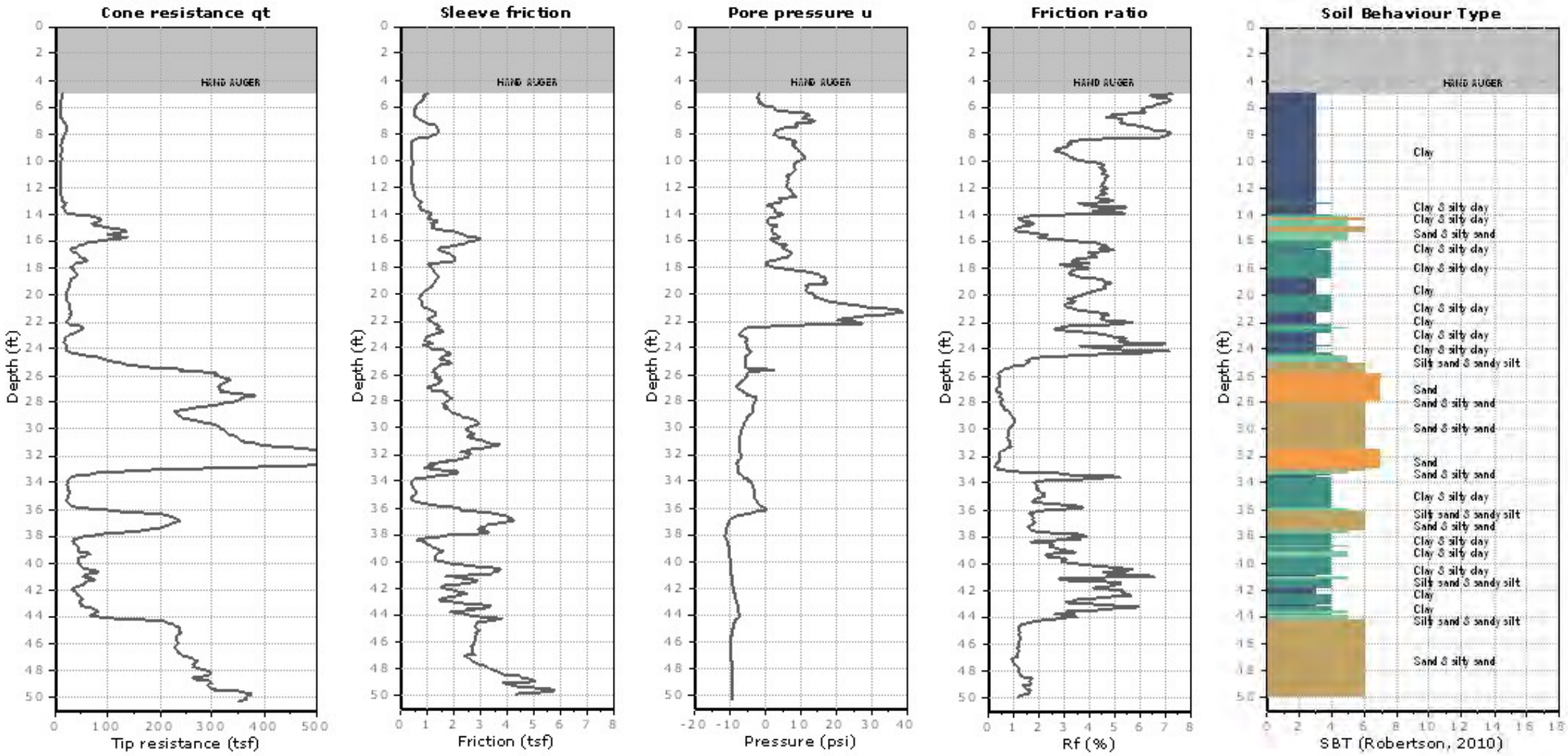
www.kehoetesting.com

CPT-3A

Project: **GMU Geotechnical / EF International**
Location: **3150 Bear St, Costa Mesa, CA**

Total depth: 50.34 ft, Date: 1/2/2019
Cone Type: Vertek

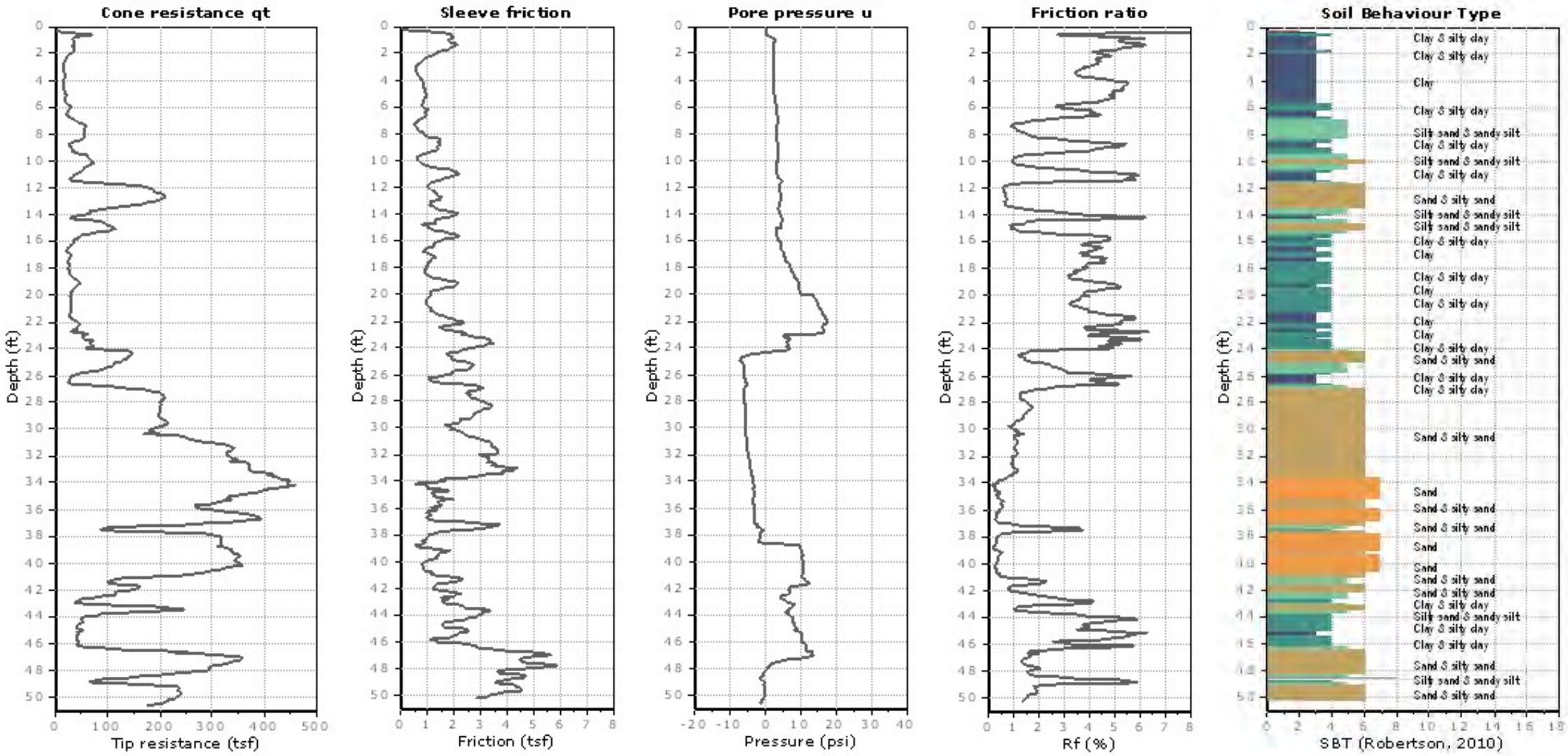


Kehoe Testing and Engineering
714-901-7270
steve@kehoetesting.com
www.kehoetesting.com

CPT-4

Project: **GMU Geotechnical / EF International**
Location: **3150 Bear St, Costa Mesa, CA**

Total depth: 50.61 ft, Date: 1/2/2019
Cone Type: Vertek



APPENDIX B

Geotechnical Laboratory Procedures and Test Results by GMU Geotechnical, Inc.

GMU
GEOTECHNICAL, INC.

APPENDIX B

GMU GEOTECHNICAL LABORATORY PROCEDURES AND TEST RESULTS

MOISTURE AND DENSITY

Field moisture content and in-place density were determined for selected 6-inch sample sleeve of undisturbed soil material obtained from the drill holes. The field moisture content was determined in general accordance with ASTM Test Method D 2216 by obtaining one-half the moisture sample from each end of the 6-inch sleeve. The in-place dry density of the sample was determined by using the wet weight of the entire sample.

At the same time the field moisture content and in-place density were determined, the soil material at each end of the sleeve was classified according to the Unified Soil Classification System. The results of the field moisture content and in-place density determinations are presented on the right-hand column of the Log of Drill Hole and are summarized on Table B-1. The results of the visual classifications were used for general reference.

PARTICLE SIZE DISTRIBUTION

As part of the engineering classification of the materials underlying the site, some samples were tested to determine the distribution of particle sizes. The distribution was determined in general accordance with ASTM Test Method D 422 using U.S. Standard Sieve Openings 3", 1.5", 3/4, 3/8, and U.S. Standard Sieve Nos. 4, 10, 20, 40, 60, 100, and 200. In addition, on some samples a standard hydrometer test was performed to determine the distribution of particle sizes passing the No. 200 sieve (i.e., silt and clay-size particles). The results of the tests are contained in this Appendix B. Key distribution categories (% gravel; % sand, etc.) are contained on Table B-1.

ATTERBERG LIMITS

As part of the engineering classification of the soil material, some samples of the on-site soil material were tested to determine relative plasticity. This relative plasticity is based on the Atterberg limits determined in general accordance with ASTM Test Method D 4318. The results of these tests are contained in this Appendix B and also Table B-1.

CHEMICAL TESTS

The corrosion potential of typical on-site materials under long-term contact with both metal and concrete was determined by chemical and electrical resistance tests. The soluble sulfate test for potential concrete corrosion was performed in general accordance with California Test Method 417, the minimum resistivity test for potential metal corrosion was performed in general accordance with California Test Method 643, and the concentration of soluble chlorides was determined in general accordance with California Test Method 422. The results of these tests are contained in Table B-1.

COMPACTION TESTS

A bulk sample representative of the on-site materials was tested to determine the maximum dry density and optimum moisture content of the soil. These compactive characteristics were determined in general accordance with ASTM Test Method D 1557. The results of this test are contained in this Appendix B and also Table B-1.

CONSOLIDATION TESTS

The one-dimensional consolidation properties of "undisturbed" samples were evaluated in general accordance with the provisions of ASTM Test Method D 2435. Sample diameter was 2.416 inches and sample height was 1.00 inch. Water was added during the test at various normal loads to evaluate the potential for hydro-collapse and to produce saturation during the remainder of the testing. Consolidation readings were taken regularly during each load increment until the change in sample height was less than approximately 0.0001 inch over a two-hour period. The graphic presentation of consolidation data is a representation of volume change in change in axial load. The results of these tests are contained in this Appendix B.

DIRECT SHEAR STRENGTH TESTS

Direct shear tests were performed on typical on-site materials. The general philosophy and procedure of the tests were in accord with ASTM Test Method D 3080 - "Direct Shear Tests for Soils Under Consolidated Drained Conditions".

The tests are single shear tests and are performed using a sample diameter of 2.416 inches and a height of 1.00 inch. The normal load is applied by a vertical dead load system. A constant rate of strain is applied to the upper one-half of the sample until failure occurs. Shear stress is monitored by a strain gauge-type precision load cell and deflection is measured with a digital dial indicator. This data is transferred electronically to data acquisition software which plots shear strength vs. deflection. The shear strength plots are then interpreted to determine either

peak or ultimate shear strengths. Residual strengths were obtained through multiple shear box reversals. A strain rate compatible with the grain size distribution of the soils was utilized. The interpreted results of these tests are shown in this Appendix B.

R-VALUE TESTS

A bulk sample representative of the underlying on-site materials was tested to measure the response of a compacted sample to a vertically applied pressure under specific conditions. The R-value of a material is determined when the material is in a state of saturation such that water will be exuded from the compacted test specimen when a 16.8 kN load (2.07 MPa) is applied. The results from these test procedures are reported in Table B-1.

TABLE B-1
SUMMARY OF SOIL LABORATORY DATA

Sample Information								Sieve/Hydrometer				Atterberg Limits			Compaction				Chemical Test Results			
Boring Number	Depth, feet	Elevation, feet	Geologic Unit	USCS Group Symbol	In Situ Water Content, %	In Situ Dry Unit Weight, pcf	In Situ Saturation, %	Gravel, %	Sand, %	<#200, %	<2μ, %	LL	PL	PI	Maximum Dry Unit Weight, pcf	Optimum Water Content, %	Expansion Index	R-Value	pH	Sulfate (ppm)	Chloride (ppm)	Min. Resistivity (ohm/cm)
DH-1	0	34.7	Qya	CL													121		7.8	68	696	692
DH-1	2.5	32.2	Qya	CH	21.3	101	89															
DH-1	5	29.7	Qya	CH	38.1	82	99															
DH-1	7.5	27.2	Qya	CH	30.3	89	93															
DH-1	10	24.7	Qya	CH	28.3	94	100															
DH-1	12.5	22.2	Qya	CL	15.6	113	89															
DH-1	15	19.7	Qya	SP-SM	4.0			11	78	11	5	NP	NP	NP								
DH-1	20	14.7	Qya	CL	20.5	107	99															
DH-1	30	4.7	Qya	SP-SM	8.1	136	97															
DH-2	0	35.3	Qal/Qt	CL											113.5	15.5						
DH-2	2.5	32.8	Qya	CH	23.2	99	93															
DH-2	5	30.3	Qya	CH	28.0	92	93					61	21	40								
DH-2	7.5	27.8	Qya	CH	15.2	117	96															
DH-2	10	25.3	Qya	CH	20.6	106	99															
DH-2	12.5	22.8	Qya	ML	16.5	115	100															
DH-2	15	20.3	Qya	CL	26.3	100	106															
DH-2	25	10.3	Qya	SM	17.4	114	101															
DH-3	2.5	32.2	Qya	CL	19.4	108	97															
DH-4	0	34.7	Qya	CL													129		7.4	2943	936	515
DH-4	2.5	32.2	Qya	CH	24.3	99	96															
DH-4	5	29.7	Qya	CH	28.4	86	81	0	3	97	69	97	31	66								
DH-4	7.5	27.2	Qya	CH	32.1	84	88															
DH-4	10	24.7	Qya	CL	17.0	113	97															
DH-4	12.5	22.2	Qya	CL	17.0	108	86															
DH-4	20	14.7	Qya	CL	16.2	112	91															

Project: EF International Language Campus
Project No. 18-252-00

GMU GEOTECHNICAL, INC.

GMU_TABLE_SOIL_LAB_DATA 18-252-00.GPJ FNC AB GWGN01.GDT 1/30/19

TABLE B-1
SUMMARY OF SOIL LABORATORY DATA

Sample Information								Sieve/Hydrometer				Atterberg Limits			Compaction				Chemical Test Results			
Boring Number	Depth, feet	Elevation, feet	Geologic Unit	USCS Group Symbol	In Situ Water Content, %	In Situ Dry Unit Weight, pcf	In Situ Saturation, %	Gravel, %	Sand, %	<#200, %	<2μ, %	LL	PL	PI	Maximum Dry Unit Weight, pcf	Optimum Water Content, %	Expansion Index	R-Value	pH	Sulfate (ppm)	Chloride (ppm)	Min. Resistivity (ohm/cm)
DH- 4	30	4.7	Qya	SP	15.6	118	102															
DH- 5	0	34.7	Qya	CL											114.0	14.0	120		8.5	443	696	692
DH- 5	2.5	32.2	Qya	CL	9.9	105	45															
DH- 5	5	29.7	Qya	CL	5.9	120	41															
DH- 5	7.5	27.2	Qya	CL	11.1	124	87															
DH- 5	10	24.7	Qya	SC	7.6	114	45															
DH- 5	12.5	22.2	Qya	SM	5.4	107	26															
DH- 5	15	19.7	Qya	CL	20.4	104	93															
DH- 5	20	14.7	Qya	CL	26.2	95	94															
DH- 5	30	4.7	Qya	SP-SM				0	90	10	5											
DH- 6	2.5	33.5	Qya	CL	15.0	107	72															
DH- 6	5	31.0	Qya	CH	29.5	77	68															
DH- 7	2.5	31.0	Qya	CH	38.8	82	101															
DH- 8	2.5	32.9	Qya	CL	22.5	94	78															
DH- 8	5	30.4	Qya	CH	15.5	90	49															
DH- 9	0	34.0	Qya	CL														8				
DH-10	0	34.6	Qya	CL											124.0	11.5						
DH-10	2.5	32.1	Qya	CL	10.7	98	41															
DH-10	5	29.6	Qya	CL	21.2	104	94															
DH-10	7.5	27.1	Qya	CL	10.4	122	77															
DH-10	10	24.6	Qya	CL	10.2	124	80															
DH-10	12.5	22.1	Qya	SC	4.1	119	28															
DH-10	15	19.6	Qya	CL	10.9	122	81															
DH-10	25	9.6	Qya	SG	10.5	130	103															
DH-11	2.5	31.2	Qya	CL	14.2	118	93															

Project: EF International Language Campus
Project No. 18-252-00

GMU GEOTECHNICAL, INC.

GMU_TABLE_SOIL_LAB_DATA 18-252-00.GPJ FNC AB GWGN01.GDT 1/30/19

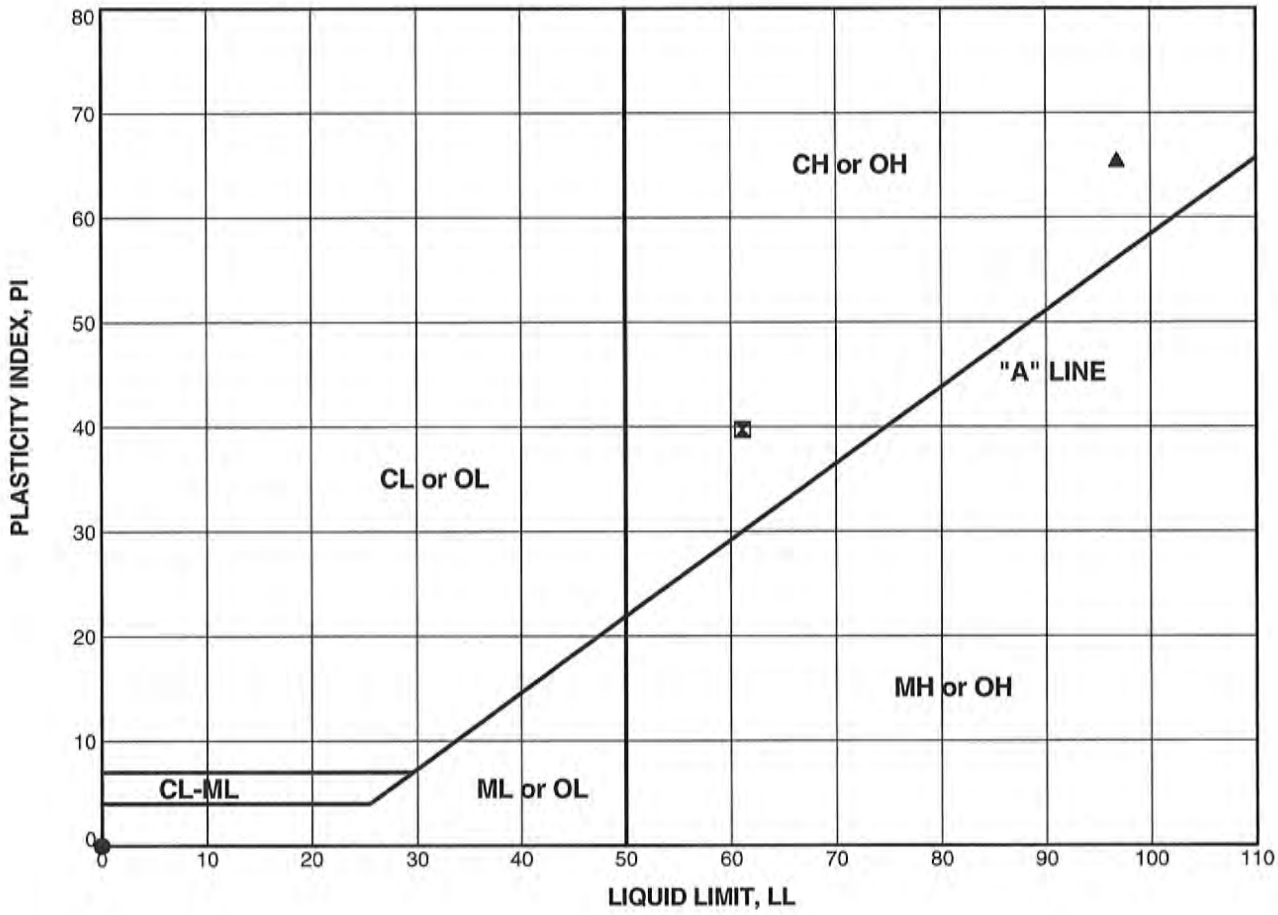
TABLE B-1
SUMMARY OF SOIL LABORATORY DATA

Sample Information								Sieve/Hydrometer				Atterberg Limits			Compaction				Chemical Test Results			
Boring Number	Depth, feet	Elevation, feet	Geologic Unit	USCS Group Symbol	In Situ Water Content, %	In Situ Dry Unit Weight, pcf	In Situ Saturation, %	Gravel, %	Sand, %	<#200, %	<2μ, %	LL	PL	PI	Maximum Dry Unit Weight, pcf	Optimum Water Content, %	Expansion Index	R-Value	pH	Sulfate (ppm)	Chloride (ppm)	Min. Resistivity (ohm/cm)
DH-11	7.5	26.2	Qya	CL	14.0	114	83															
DH-11	12.5	21.2	Qya	SC	8.5	110	44															
DH-11	20	13.7	Qya	SM	20.9	110	109															
DH-11	30	3.7	Qya	SP	22.2	102	95															

Project: EF International Language Campus
Project No. 18-252-00

GMU GEOTECHNICAL, INC.

GMU_TABLE_SOIL_LAB_DATA 18-252-00.GPJ FNC AB GWGN01.GDT 1/30/19



Boring Number	Depth (feet)	Geologic Unit	Test Symbol	Water Content (%)	LL	PL	PI	Classification
DH- 1	15.0	Qya	●	4	NP	NP	NP	POORLY GRADED SAND WITH SILT (SP-SM)
DH- 2	5.0	Qya	⊠	28	61	21	40	FAT CLAY (CH)
DH- 4	5.0	Qya	▲	28	97	31	66	FAT CLAY (CH)

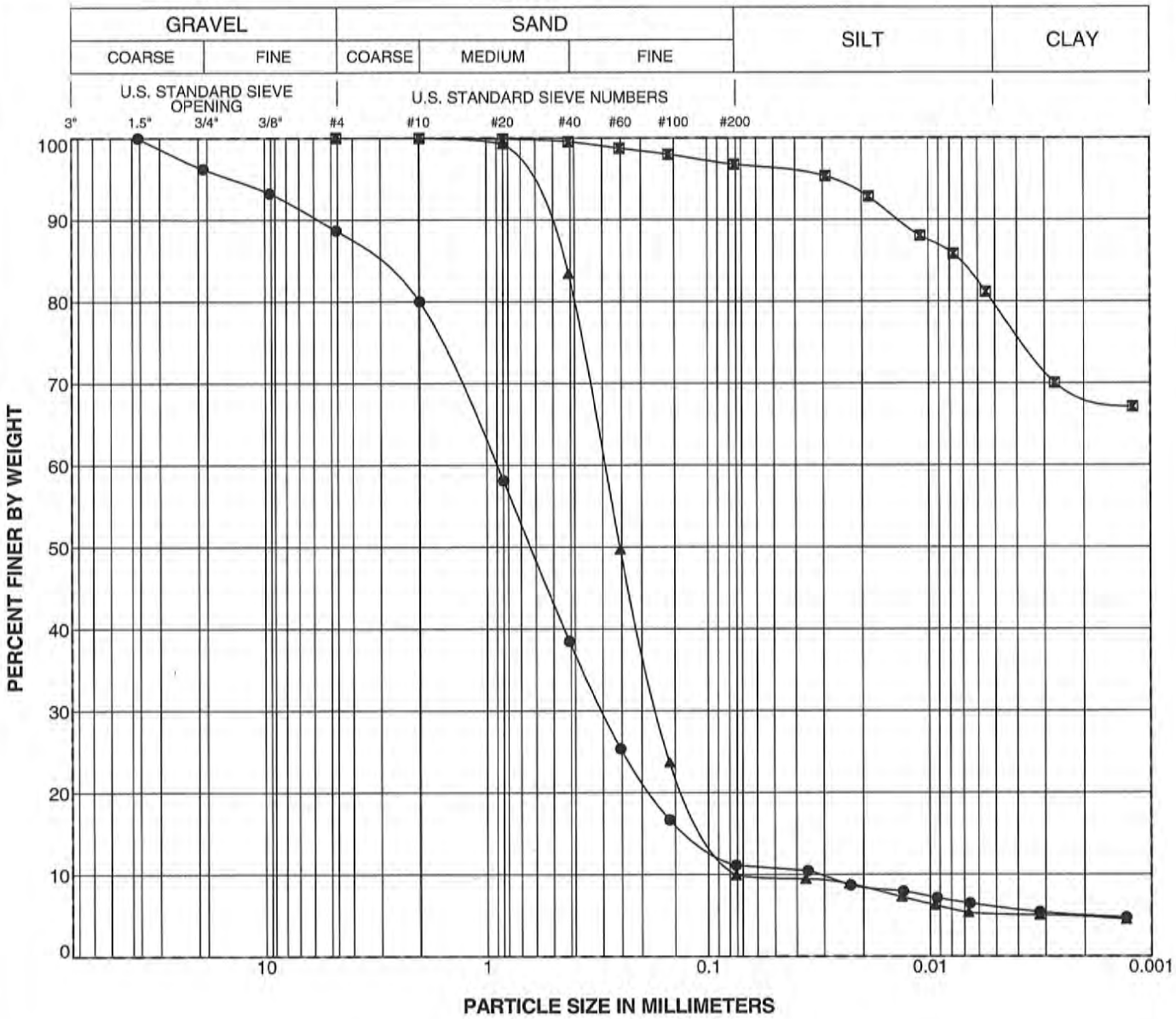
GMU_ATTERBERG_LIMITS_12 PTS 18-252-00.GPJ GM&U.GDT 1/30/19

ATTERBERG LIMITS

Project: EF International Language Campus

Project No. 18-252-00

GMU GEOTECHNICAL, INC.



Boring Number	Depth (feet)	Geologic Unit	Symbol	LL	PI	Classification
DH- 1	15.0	Qya	●	NP	NP	POORLY GRADED SAND WITH SILT (SP-SM)
DH- 4	5.0	Qya	⊠	97	66	FAT CLAY (CH)
DH- 5	30.0	Qya	▲			POORLY GRADED SAND WITH SILT (SP-SM)

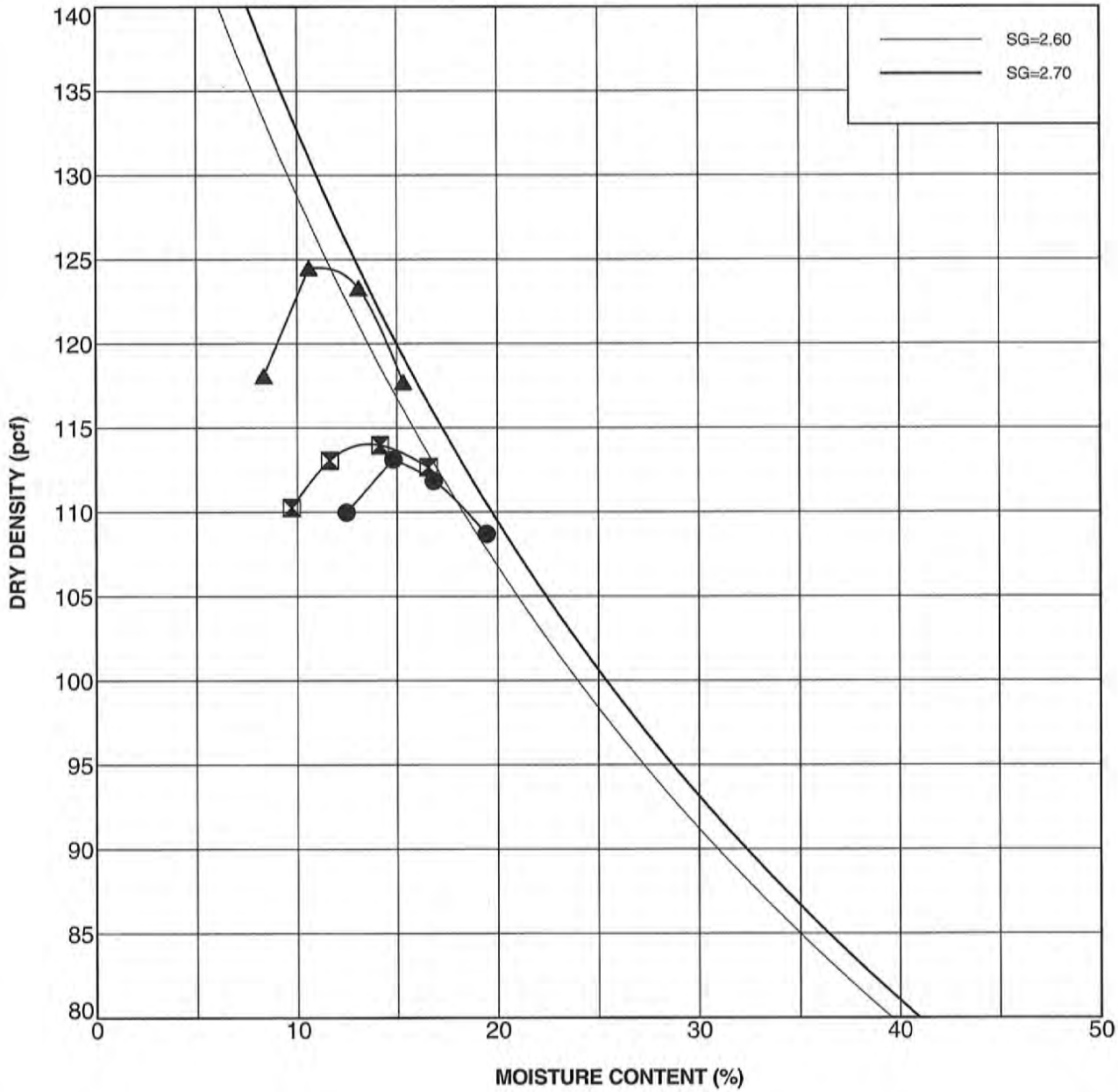
GMU_GRAIN_SIZE 18-252-00.GPJ 1/30/19

PARTICLE SIZE DISTRIBUTION

Project: EF International Language Campus

Project No. 18-252-00

GMU GEOTECHNICAL, INC.



Boring Number	Depth (feet)	Geologic Unit	Symbol	Maximum Dry Density, pcf	Optimum Moisture Content, %	Classification
DH- 2	0.0	Qal/Qt	●	113.5	15.5	LEAN CLAY (CL)
DH- 5	0.0	Qya	⊠	114	14	SILTY CLAY (CL)
DH-10	0.0	Qya	▲	124	11.5	SITLY CLAY (CL)

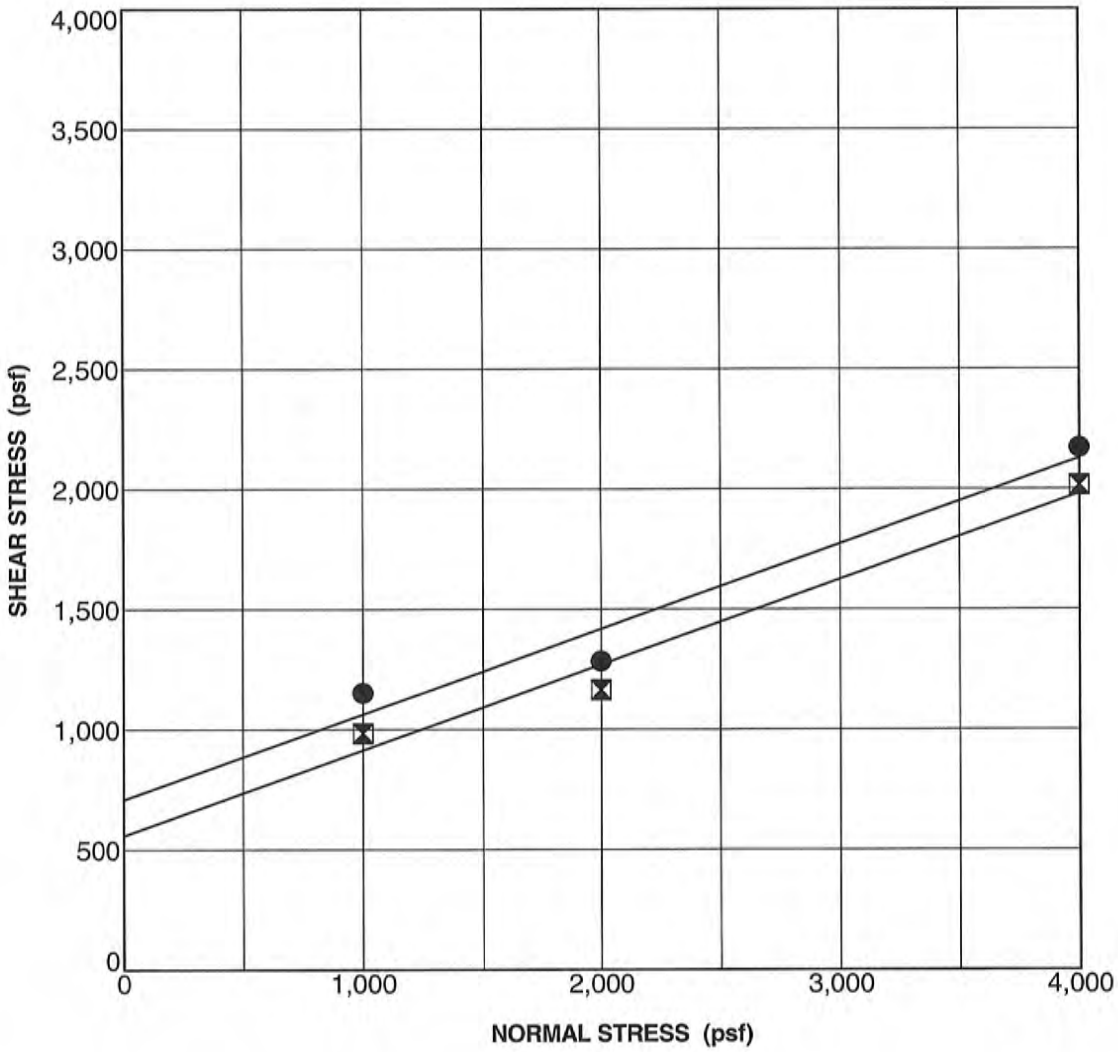
COMPACTION TEST DATA

Project: EF International Language Campus

Project No. 18-252-00

GMU GEOTECHNICAL, INC.

GMU_COMPACTION_4_SETS 18-252-00.GPJ 1/30/19



SAMPLE AND TEST DESCRIPTION
Sample Location: DH- 1 @ 2.5 ft **Geologic Unit:** Qya **Classification:** FAT CLAY (CH)
Strain Rate (in/min): 0.005 **Sample Preparation:** Undisturbed
Notes: Sample saturated prior and during shearing

STRENGTH PARAMETERS		
STRENGTH TYPE	**COHESION (psf)**	**FRICTION ANGLE (degrees)**
● Peak Strength	708	19.5
⊠ Ultimate Strength	558	19.5

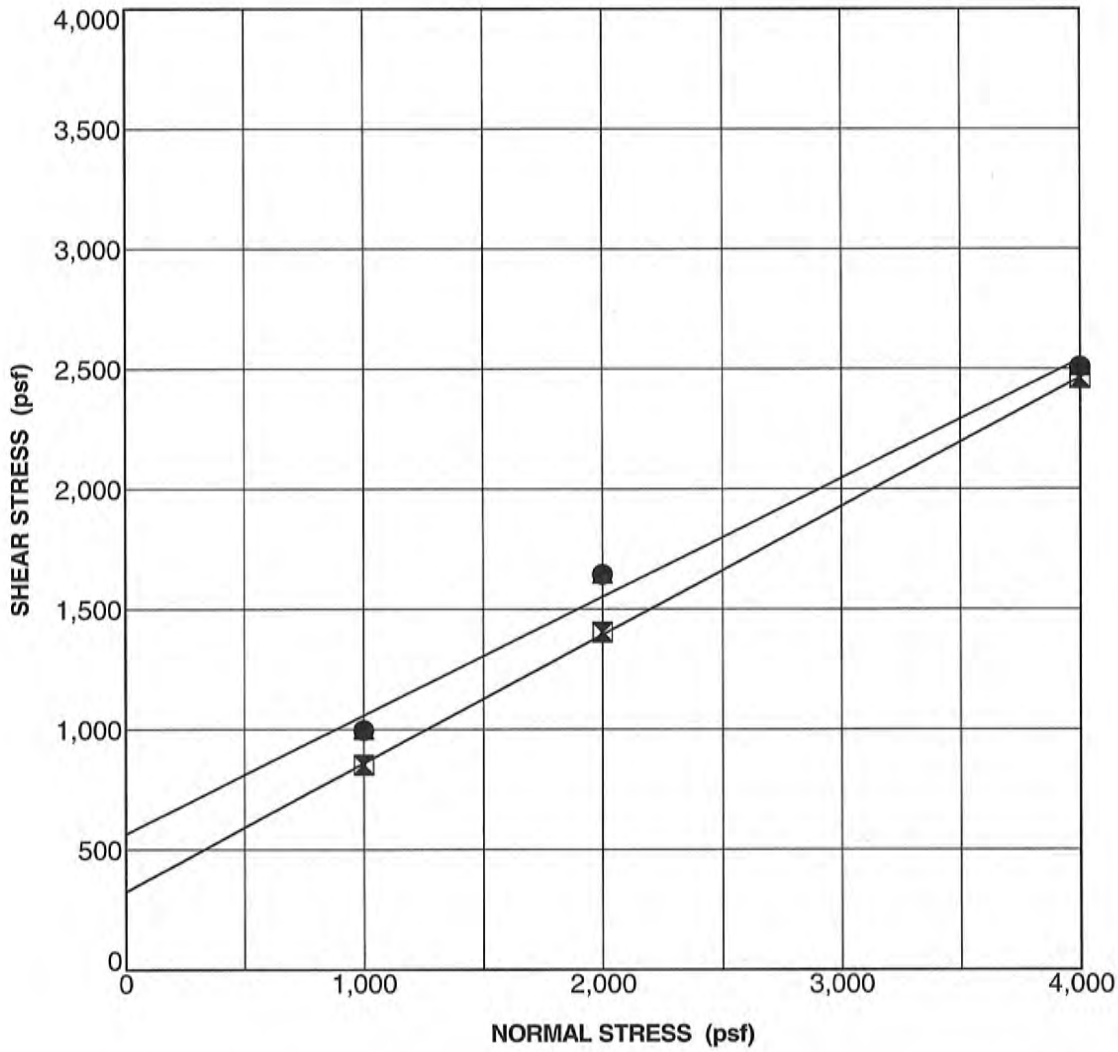
SHEAR TEST DATA

Project: EF International Language Campus

Project No. 18-252-00

GMU GEOTECHNICAL, INC.

GMU_DIRECT_SHEAR 18-252-00.GPJ GM&U.GDT 1/30/19



SAMPLE AND TEST DESCRIPTION
Sample Location: DH- 4 @ 0.0 ft **Geologic Unit:** Qya **Classification:** SILTY CLAY (CL)
Strain Rate (in/min): 0.005 **Sample Preparation:** Remolded
Notes:

STRENGTH PARAMETERS		
STRENGTH TYPE	**COHESION (psf)**	**FRICTION ANGLE (degrees)**
● Peak Strength	564	26.0
⊠ Ultimate Strength	324	28.1

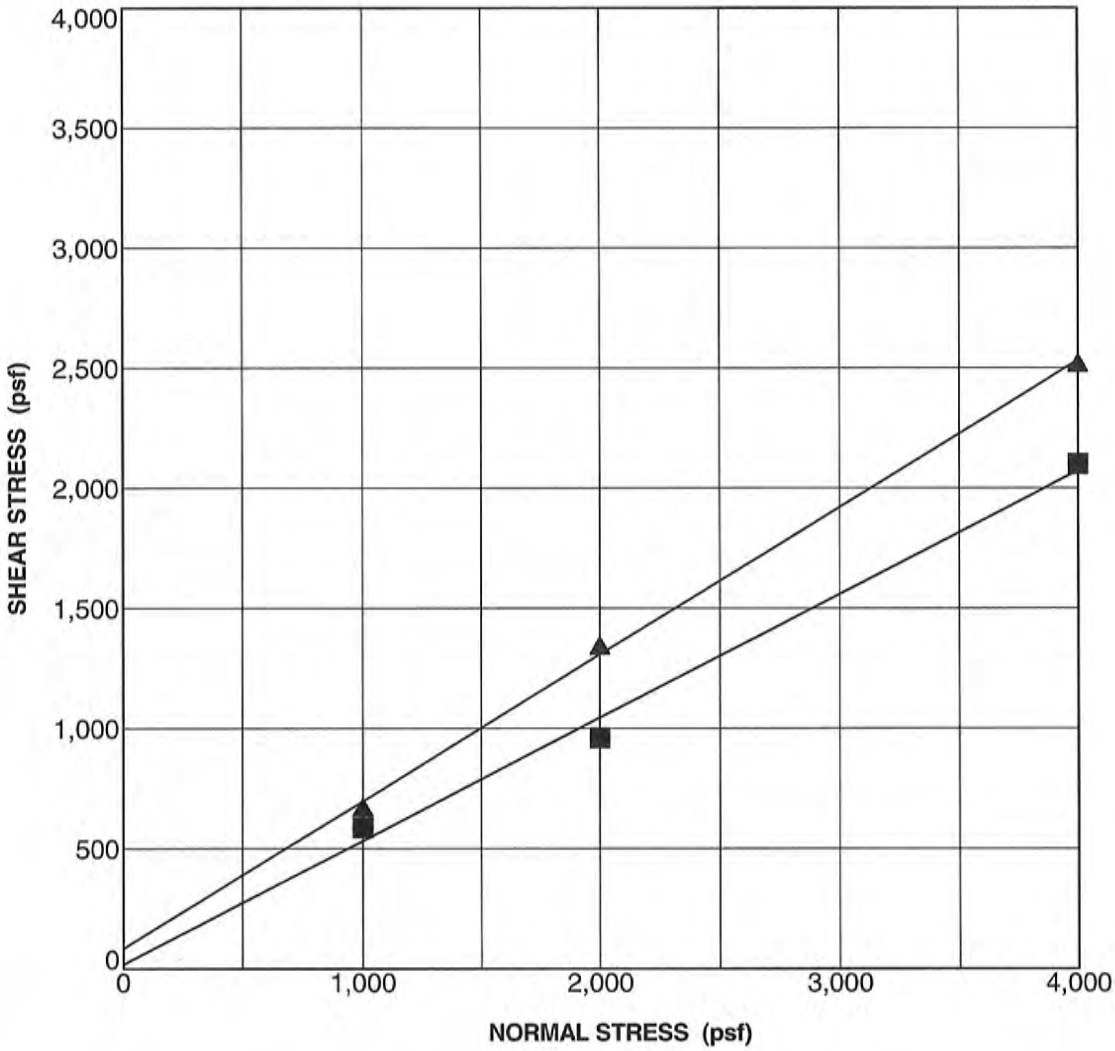
SHEAR TEST DATA

Project: EF International Language Campus

Project No. 18-252-00

GMU GEOTECHNICAL, INC.

GMU_DIRECT_SHEAR 18-252-00.GPJ GM&U.GDT 1/30/19



SAMPLE AND TEST DESCRIPTION
Sample Location: DH- 5 @ 5.0 ft **Geologic Unit:** Qya **Classification:** SILTY CLAY (CL)
Strain Rate (in/min): 0.005 **Sample Preparation:** Undisturbed
Notes: Sample saturated prior and during shearing

STRENGTH PARAMETERS		
STRENGTH TYPE	**COHESION (psf)**	**FRICTION ANGLE (degrees)**
● Peak Strength	84	31.0
⊠ Ultimate Strength	18	27.0

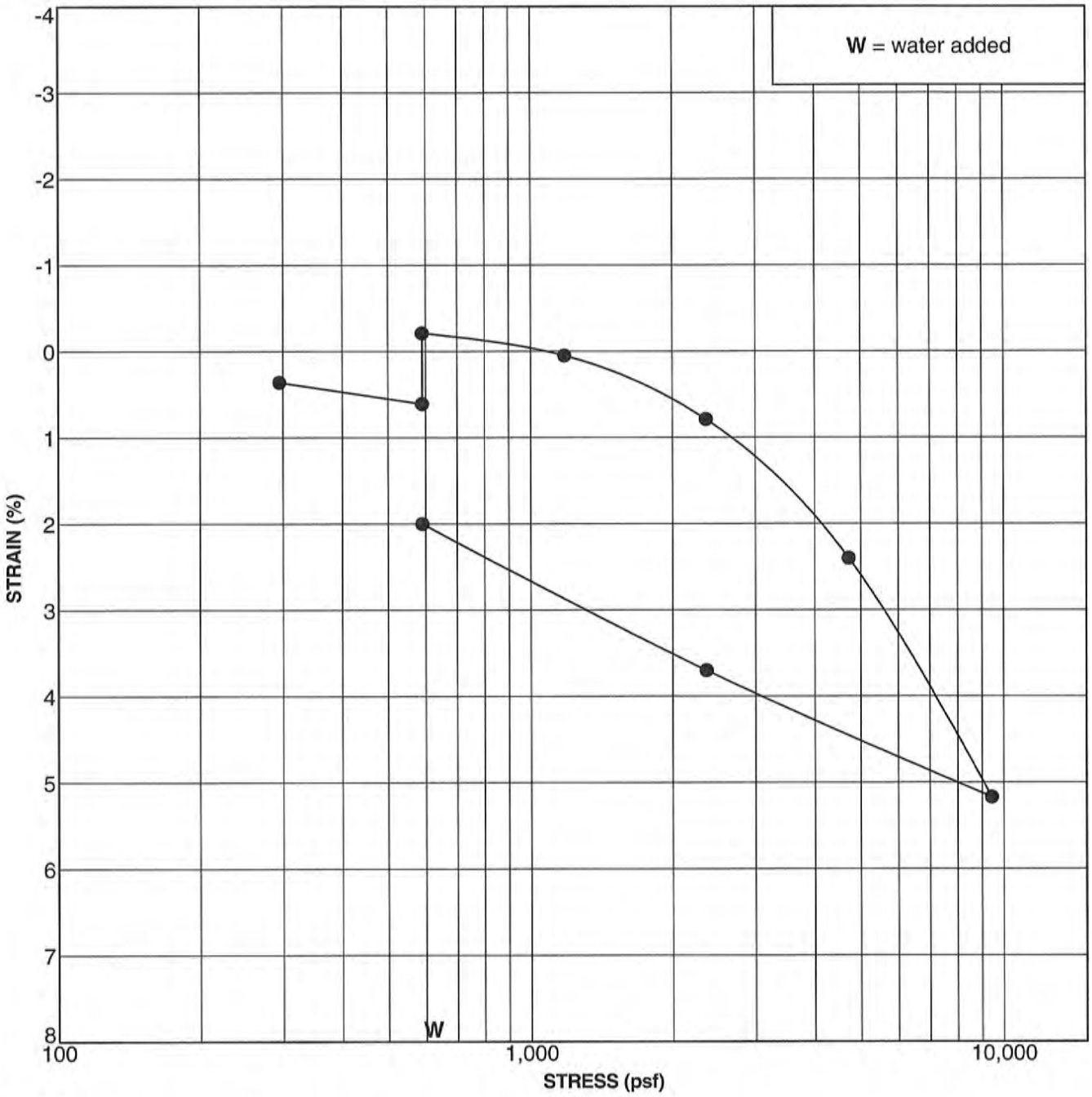
SHEAR TEST DATA

Project: EF International Language Campus

Project No. 18-252-00

GMU GEOTECHNICAL, INC.

GMU_DIRECT_SHEAR 18-252-00.GPJ GM&U.GDT 1/30/19



Boring Number	Depth (feet)	Geologic Unit	Symbol	In Situ or Remolded Sample	% Hydro-Collapse	Classification
DH- 1	5.0	Qya	●	In Situ	-0.82	FAT CLAY (CH)

CONSOLIDATION TEST DATA

Project: EF International Language Campus

Project No. 18-252-00

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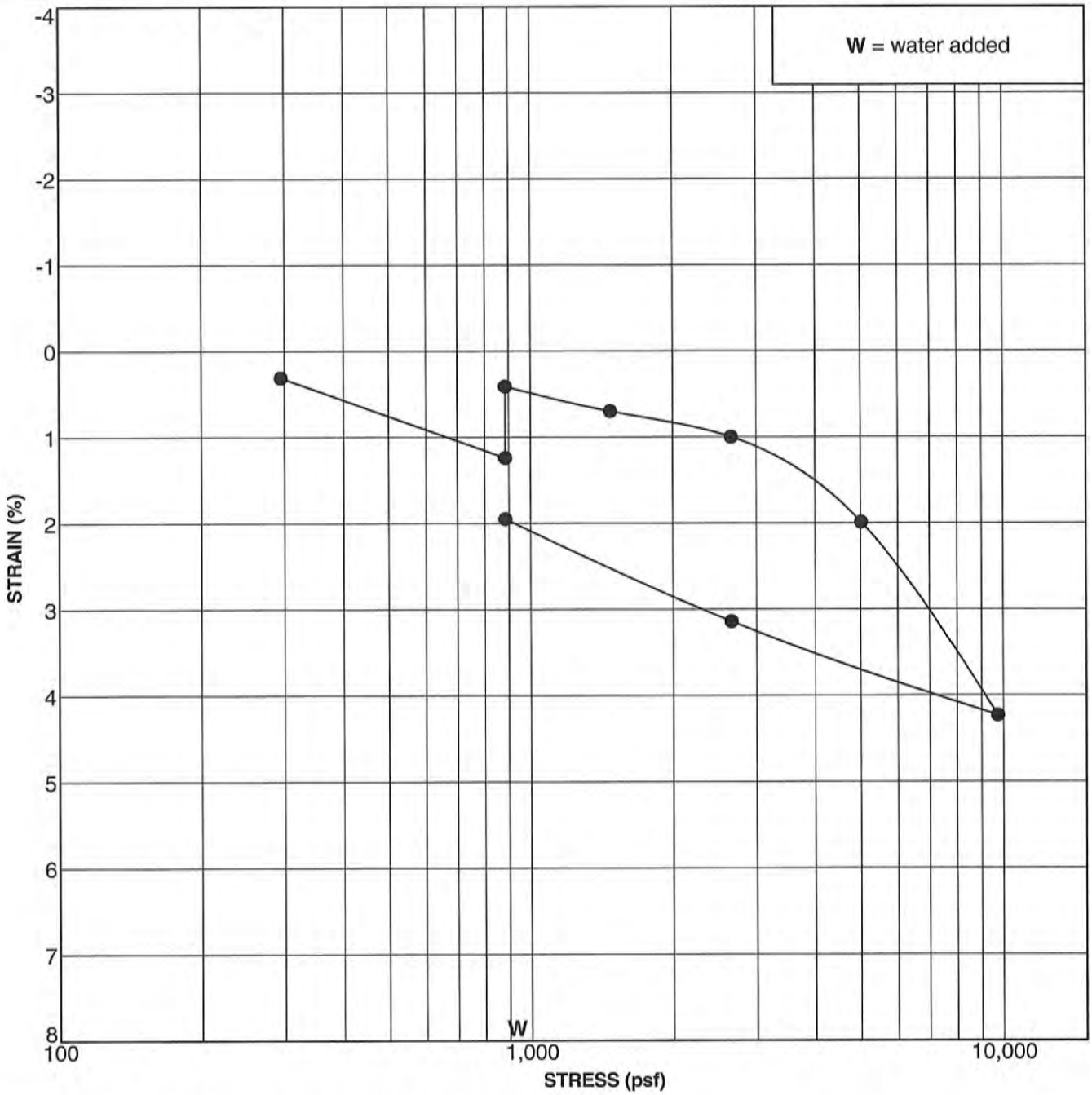

Boring Number	Depth (feet)	Geologic Unit	Symbol	In Situ or Remolded Sample	% Hydro-Collapse	Classification
DH- 1	7.5	Qya	●	In Situ	-0.83	FAT CLAY (CH)

CONSOLIDATION TEST DATA

Project: EF International Language Campus

Project No. 18-252-00

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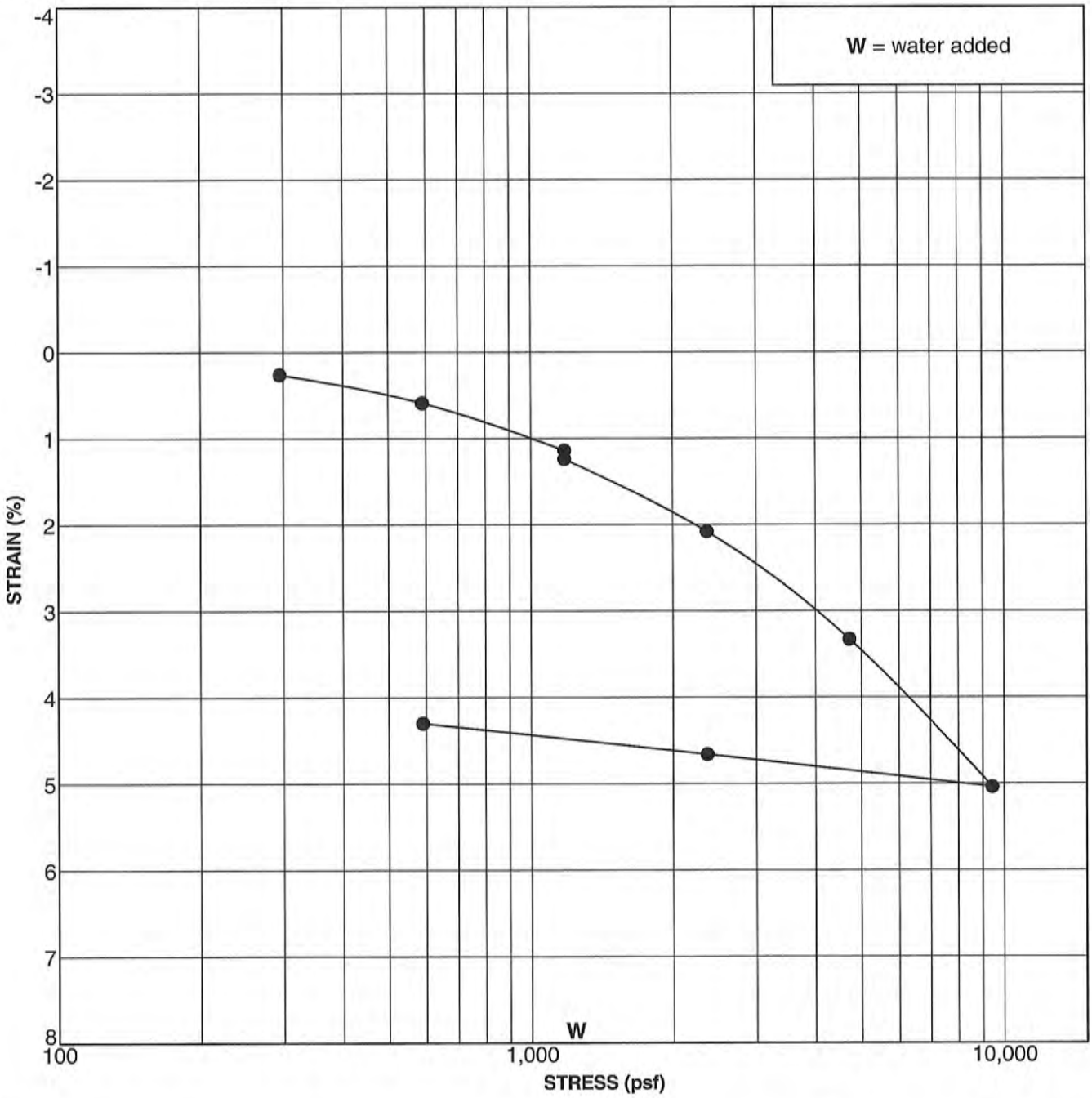

Boring Number	Depth (feet)	Geologic Unit	Symbol	In Situ or Remolded Sample	% Hydro-Collapse	Classification
DH- 2	10.0	Qya	●	In Situ	0.1	FAT CLAY (CH)

CONSOLIDATION TEST DATA

Project: EF International Language Campus

Project No. 18-252-00

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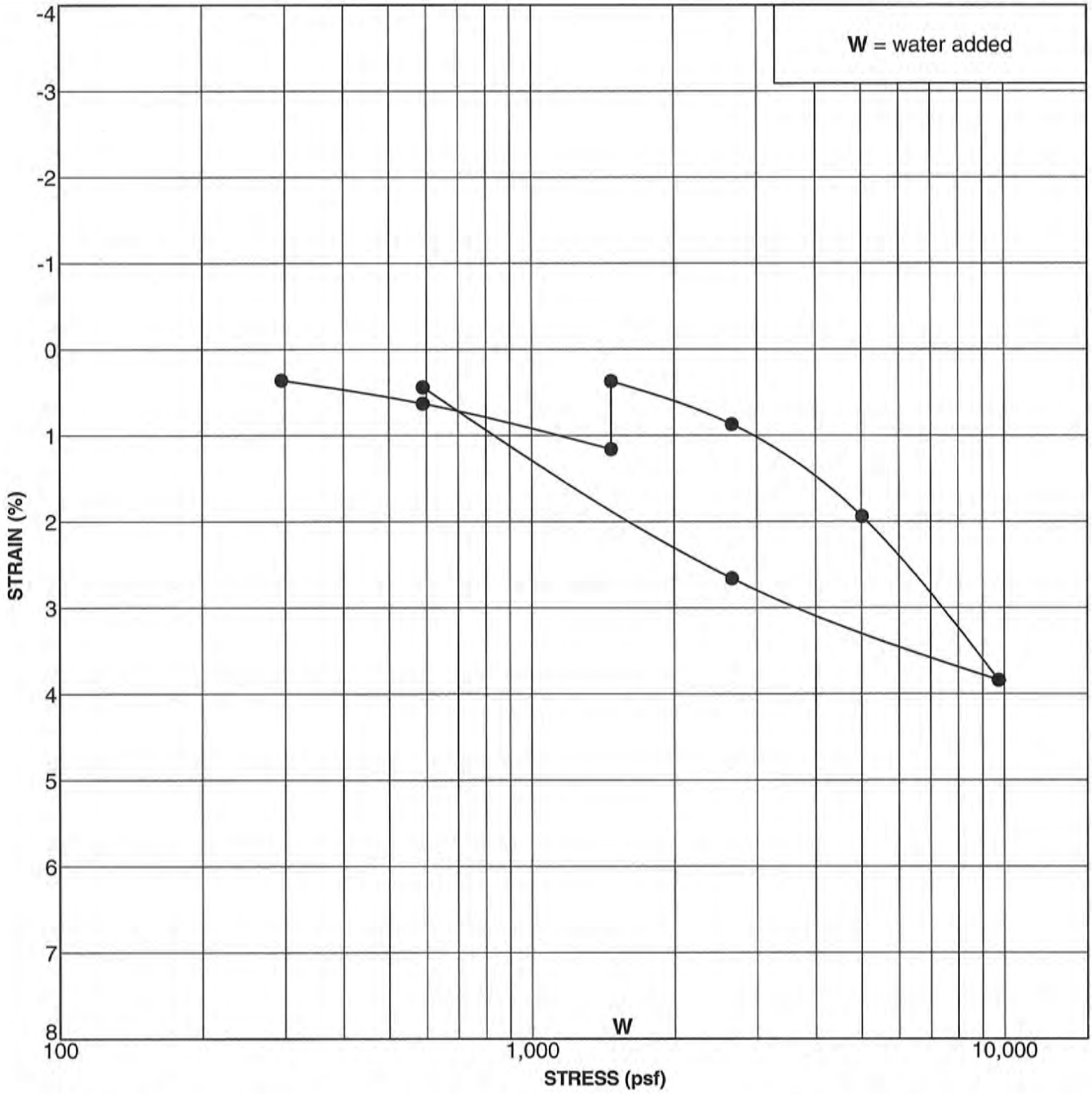

Boring Number	Depth (feet)	Geologic Unit	Symbol	In Situ or Remolded Sample	% Hydro-Collapse	Classification
DH- 4	12.5	Qya	●	In Situ	-0.79	LEAN CLAY (CL)

CONSOLIDATION TEST DATA

Project: EF International Language Campus

Project No. 18-252-00

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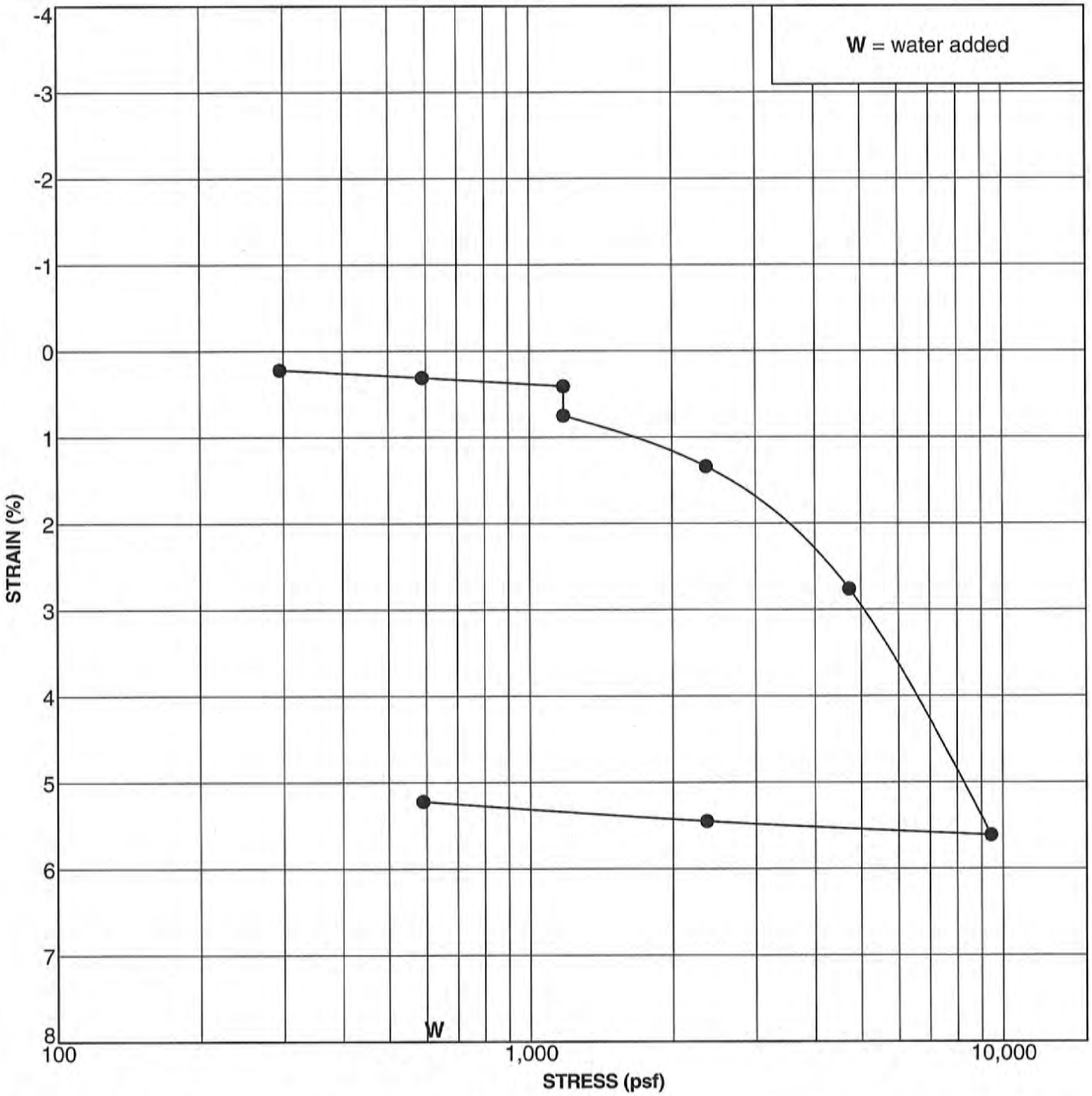

Boring Number	Depth (feet)	Geologic Unit	Symbol	In Situ or Remolded Sample	% Hydro-Collapse	Classification
DH- 5	5.0	Qya	●	In Situ	0.34	SILTY CLAY (CL)

CONSOLIDATION TEST DATA

Project: EF International Language Campus

Project No. 18-252-00

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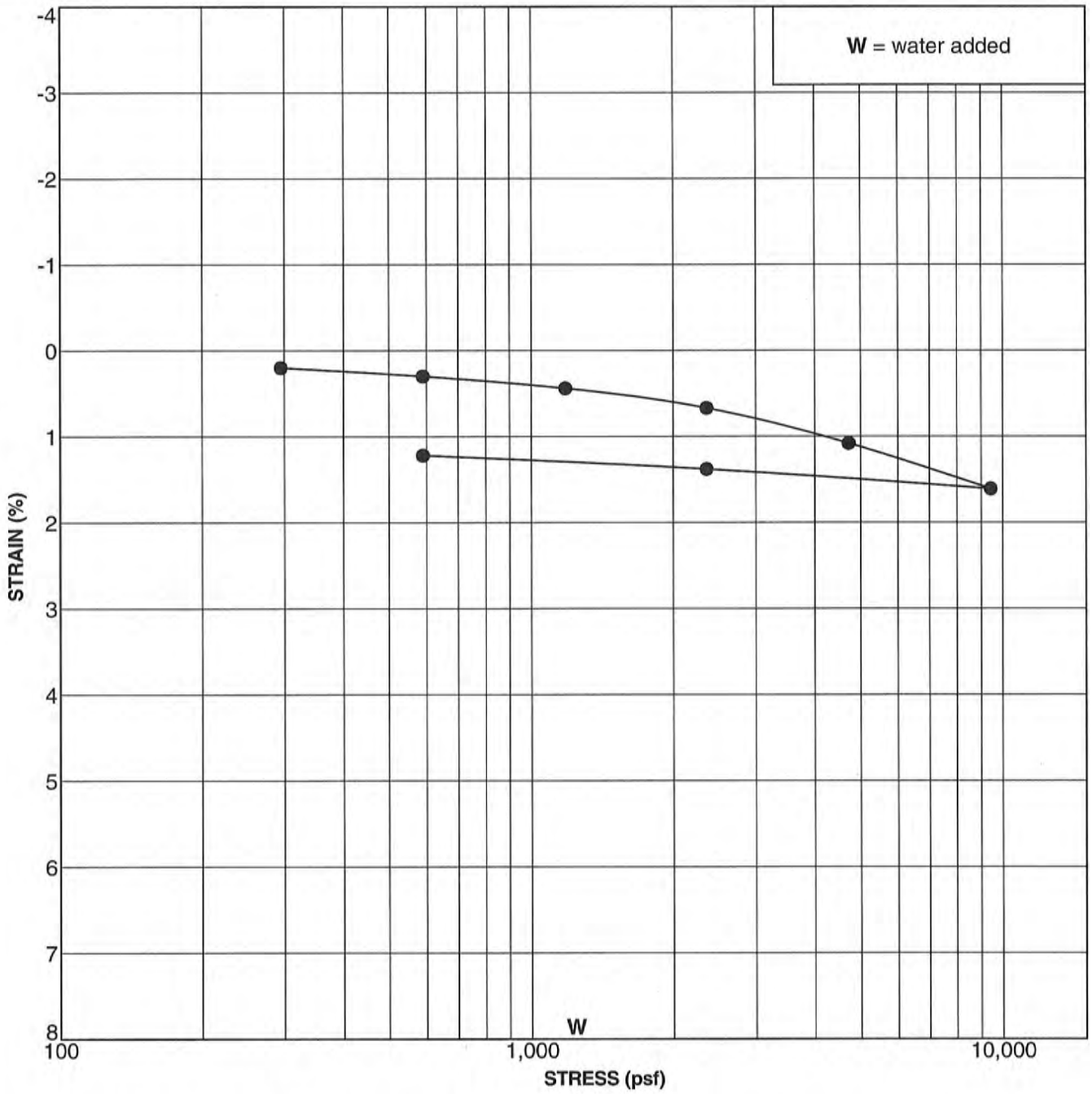


Boring Number	Depth (feet)	Geologic Unit	Symbol	In Situ or Remolded Sample	% Hydro-Collapse	Classification
DH-10	10.0	Qya	●	In Situ	0	SITLY CLAY (CL)

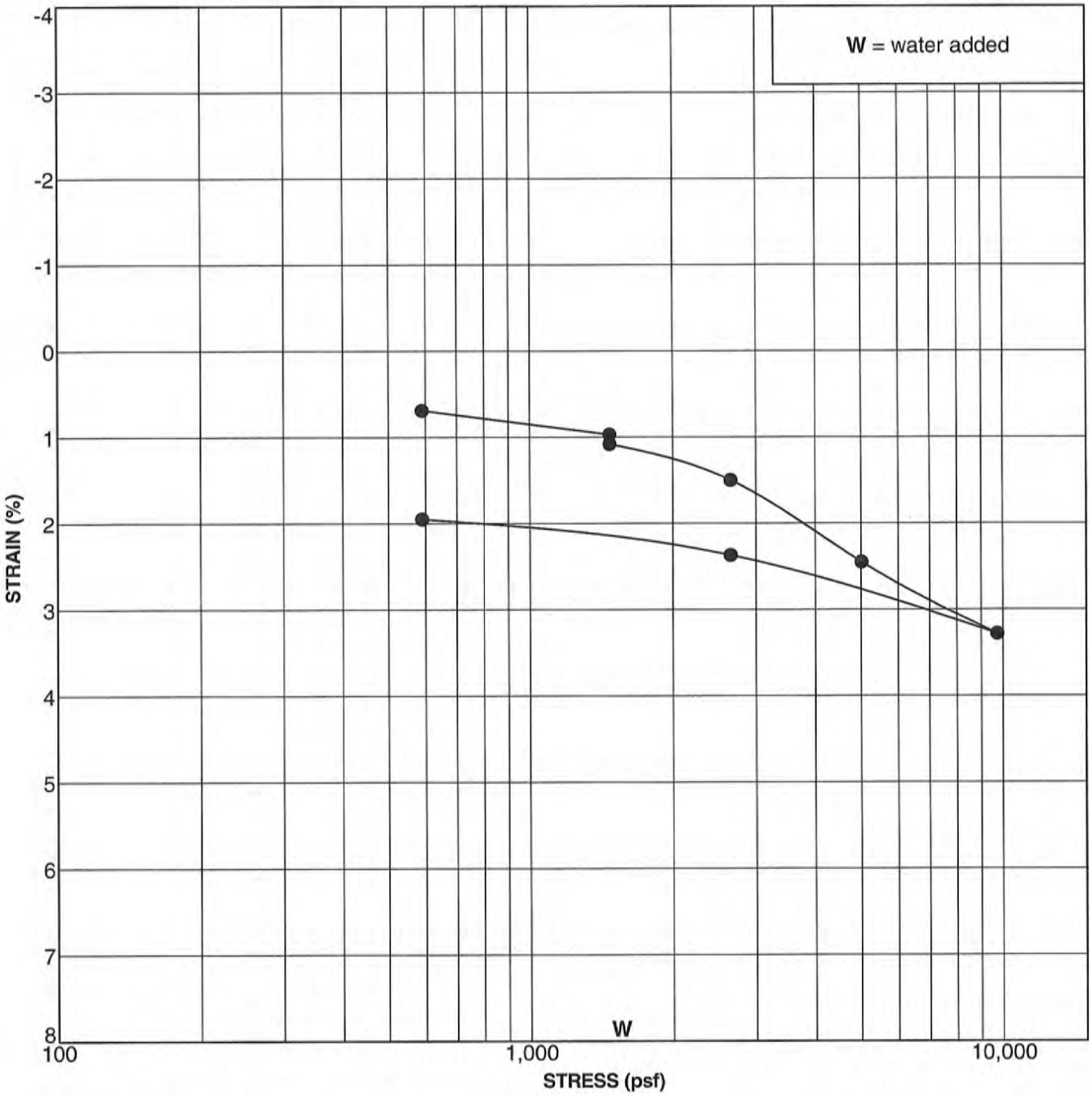
CONSOLIDATION TEST DATA

Project: EF International Language Campus

Project No. 18-252-00

GMU GEOTECHNICAL, INC.

GMU_CONSOL 18-252-00.GPJ GM&U.GDT 1/30/19



Boring Number	Depth (feet)	Geologic Unit	Symbol	In Situ or Remolded Sample	% Hydro-Collapse	Classification
DH-10	12.5	Qya	●	In Situ	11	CLAYEY SAND (SC)

CONSOLIDATION TEST DATA

Project: EF International Language Campus

Project No. 18-252-00

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APPENDIX C

Liquefaction Analysis

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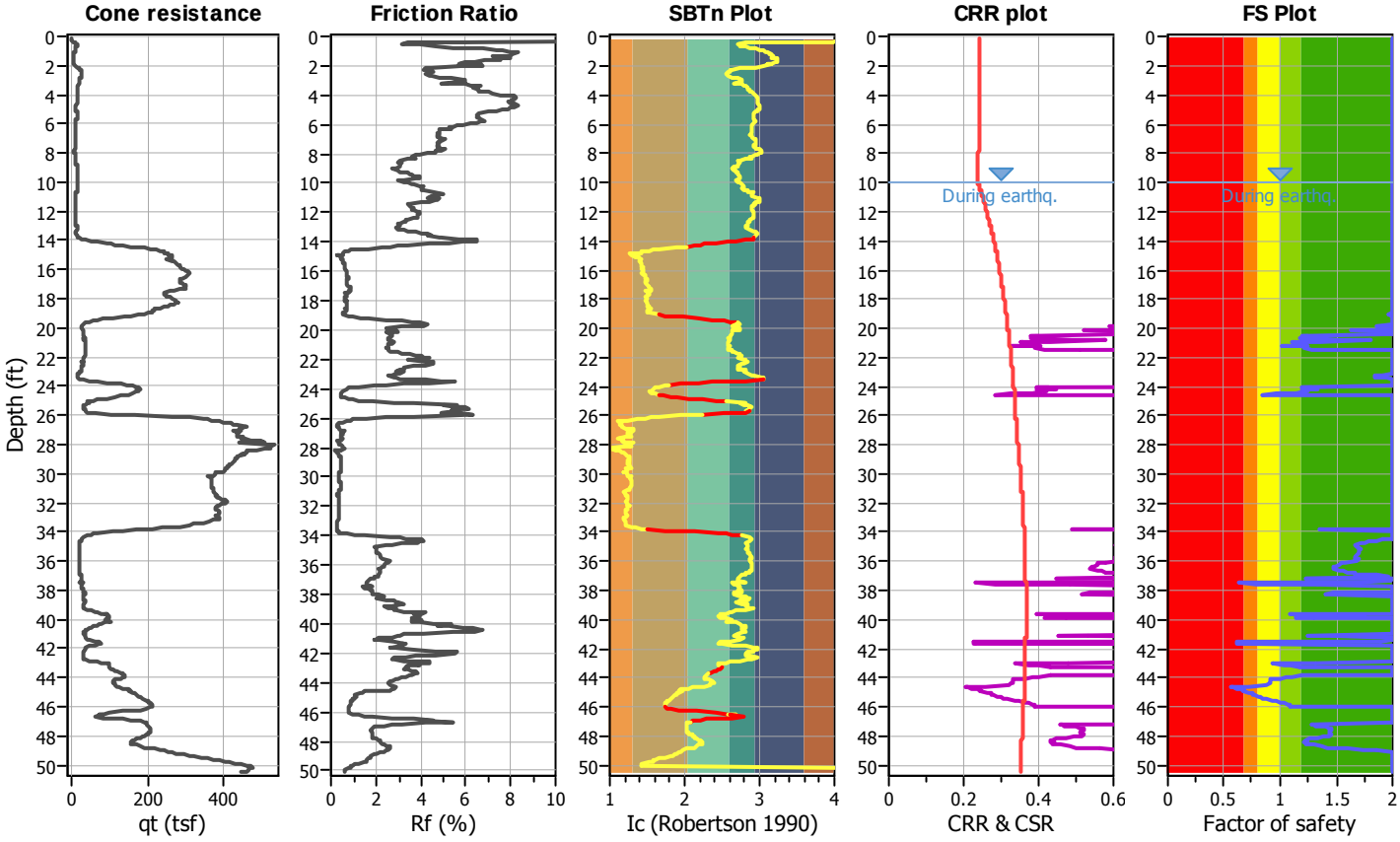
LIQUEFACTION ANALYSIS REPORT

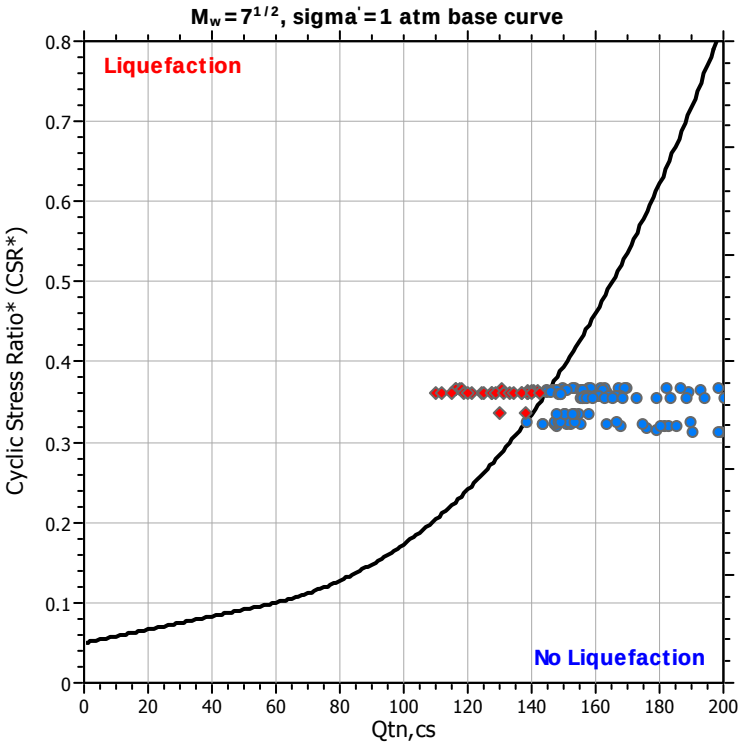
Project title : EF International Language Campus **Location : 3150 Bear St., Costa Mesa, CA**

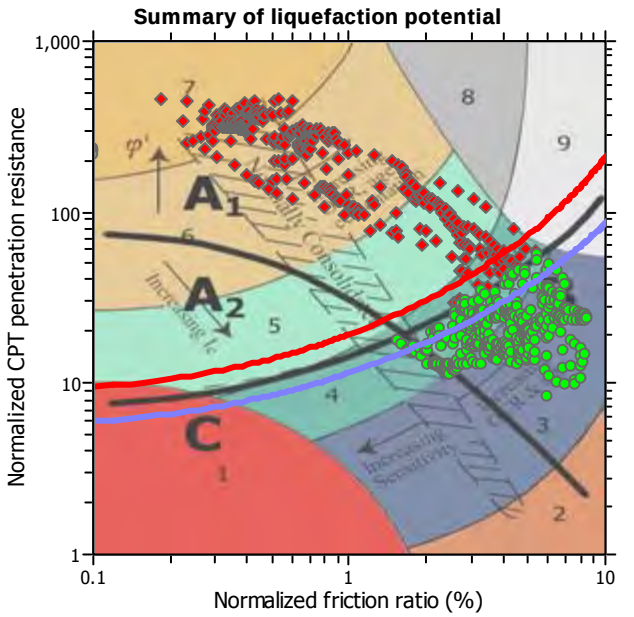
CPT file : CPT-1

Input parameters and analysis data

Analysis method:	Robertson (2009)	G.W.T. (in-situ):	18.00 ft	Use fill:	No	Clay like behavior applied:	All soils
Fines correction method:	Robertson (2009)	G.W.T. (earthq.):	10.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	1	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.54	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

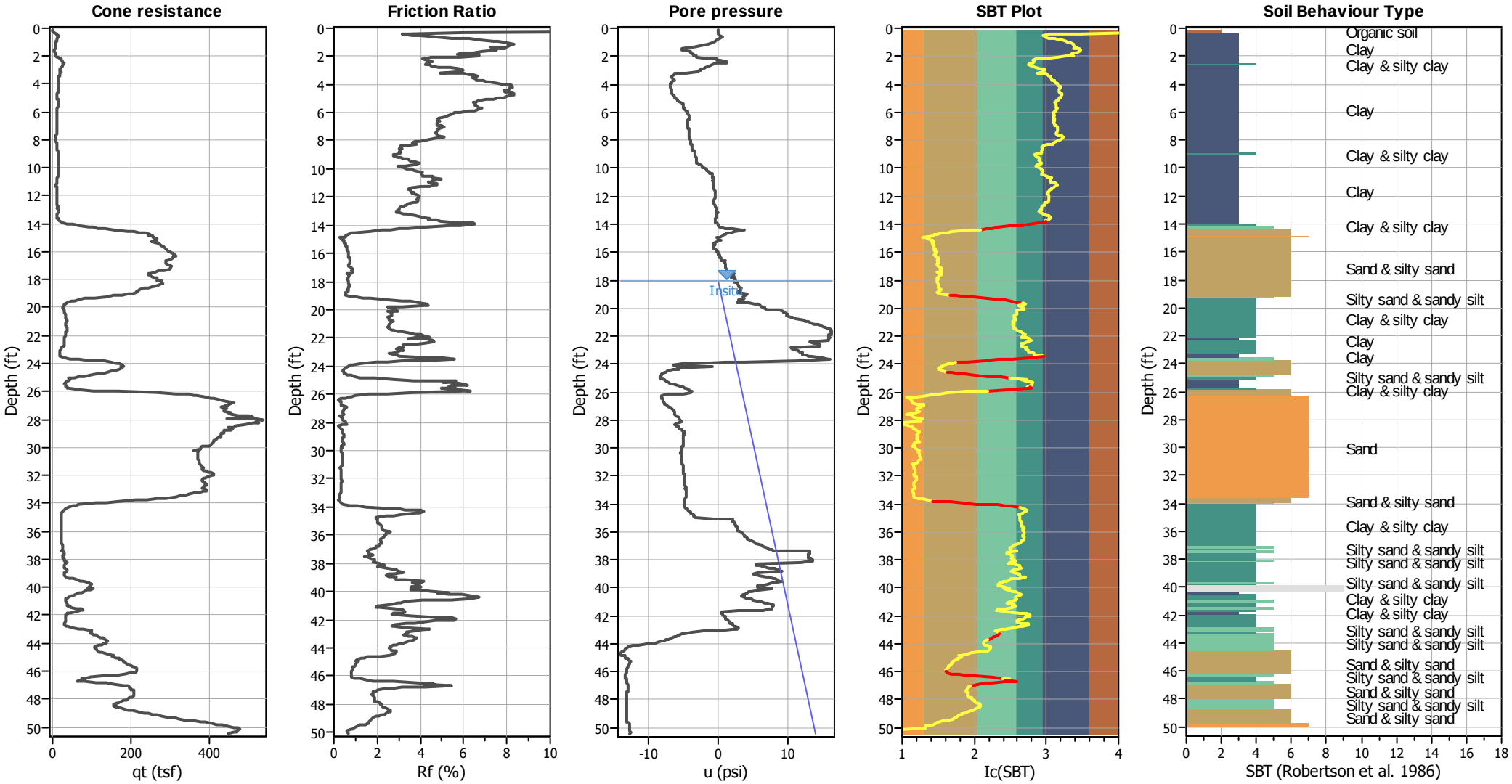






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



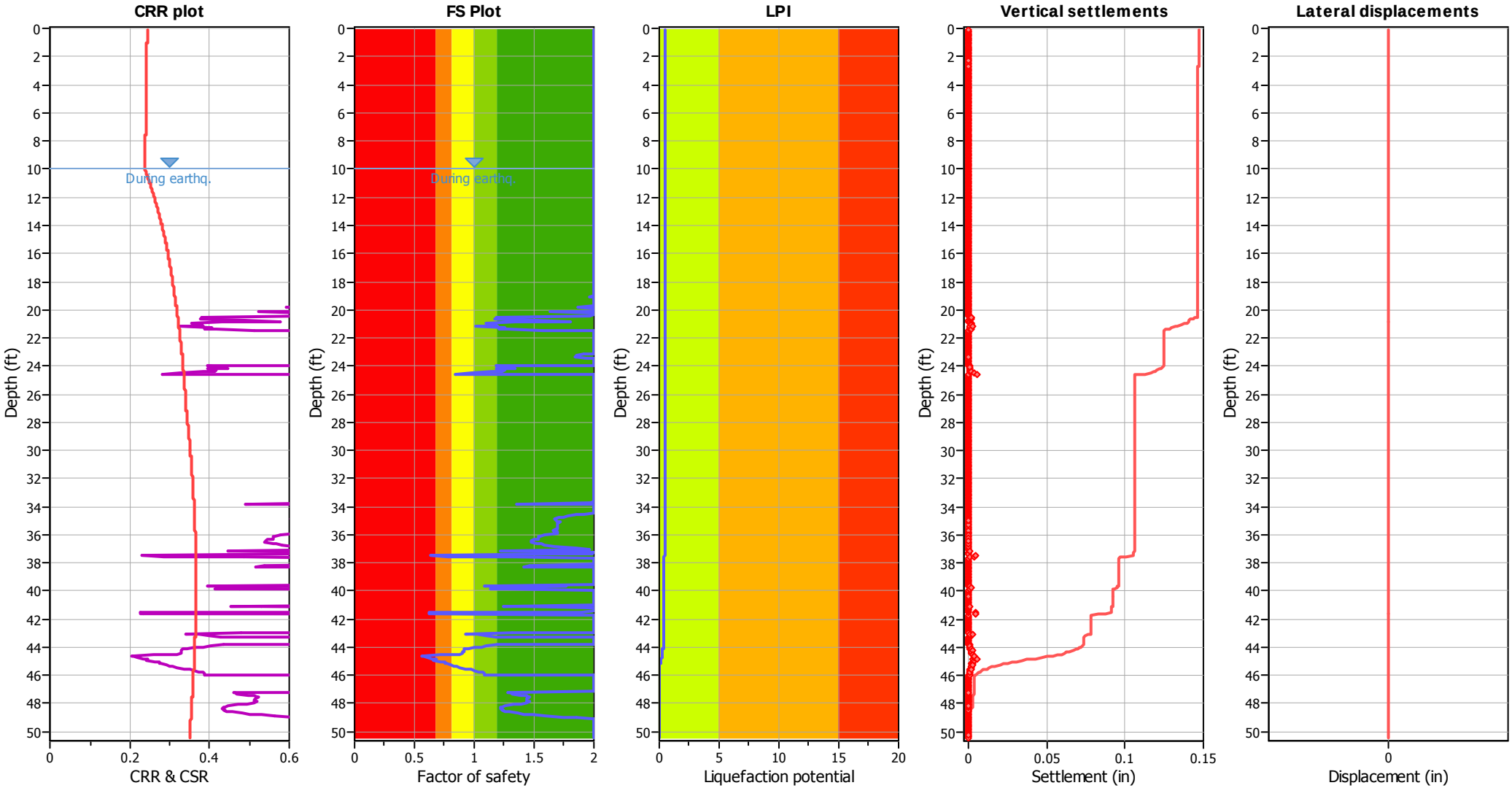
Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	10.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.54	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	18.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	10.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.54	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	18.00 ft	Fill height:	N/A	Limit depth:	N/A

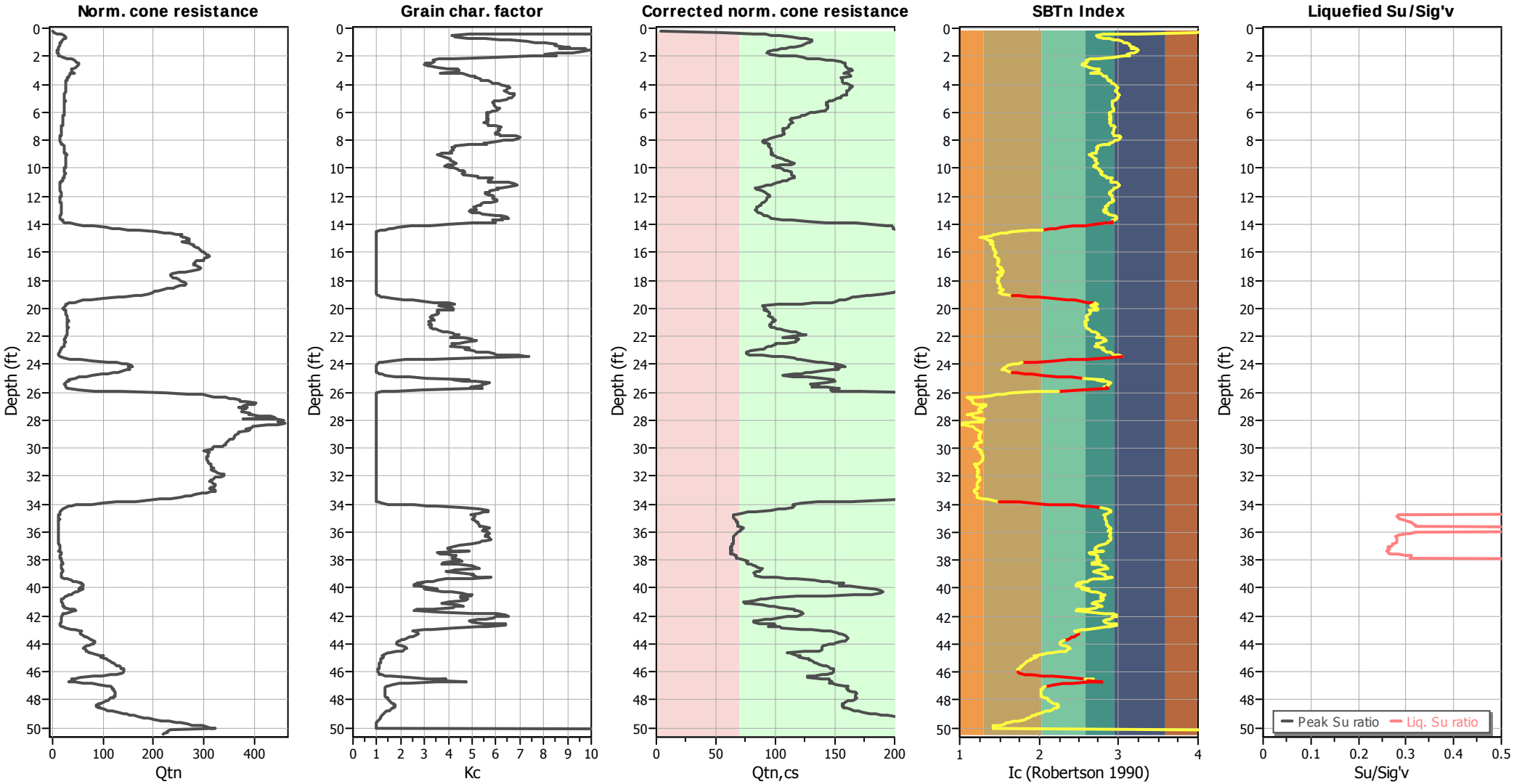
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	10.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.54	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	18.00 ft	Fill height:	N/A	Limit depth:	N/A

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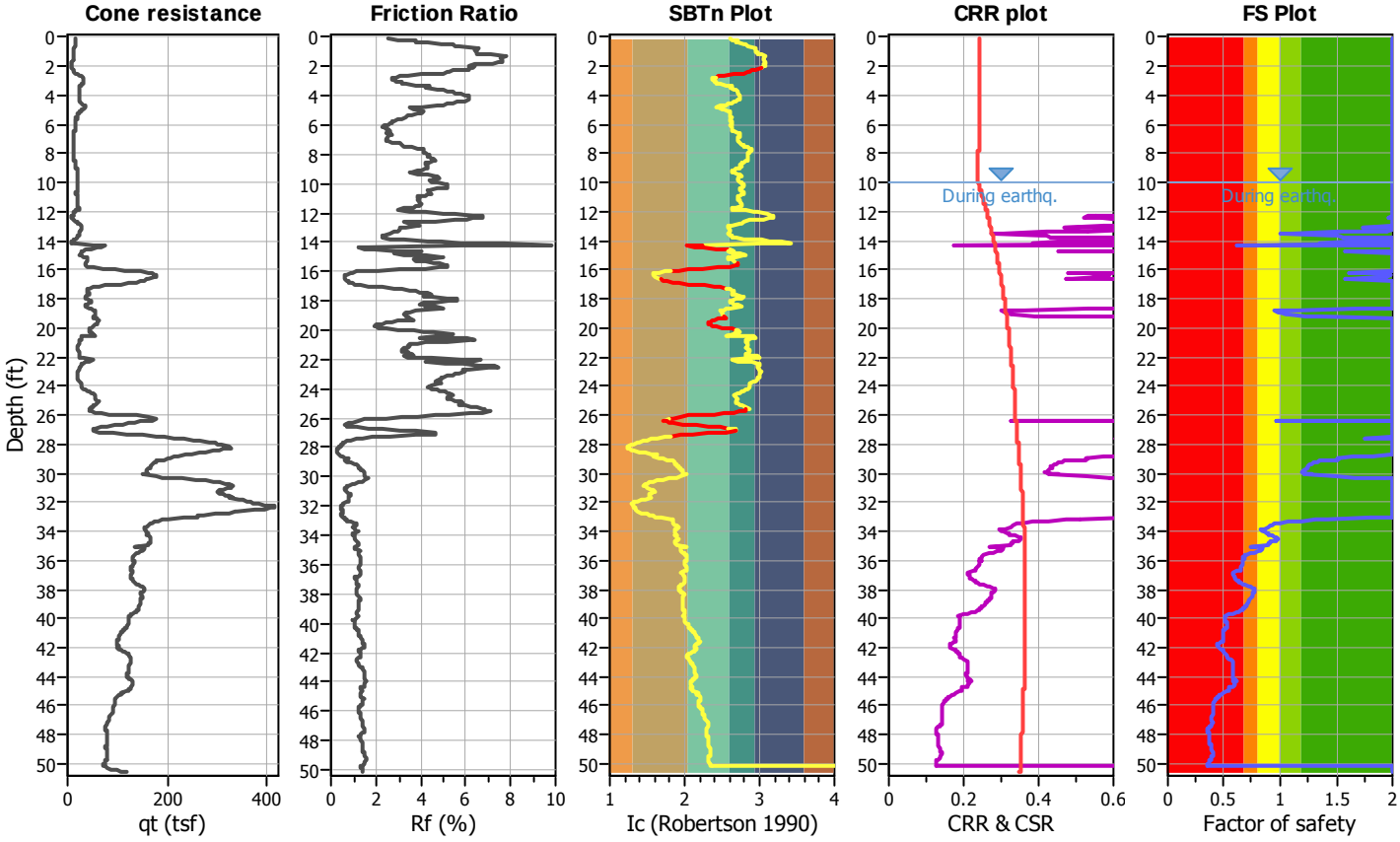
LIQUEFACTION ANALYSIS REPORT

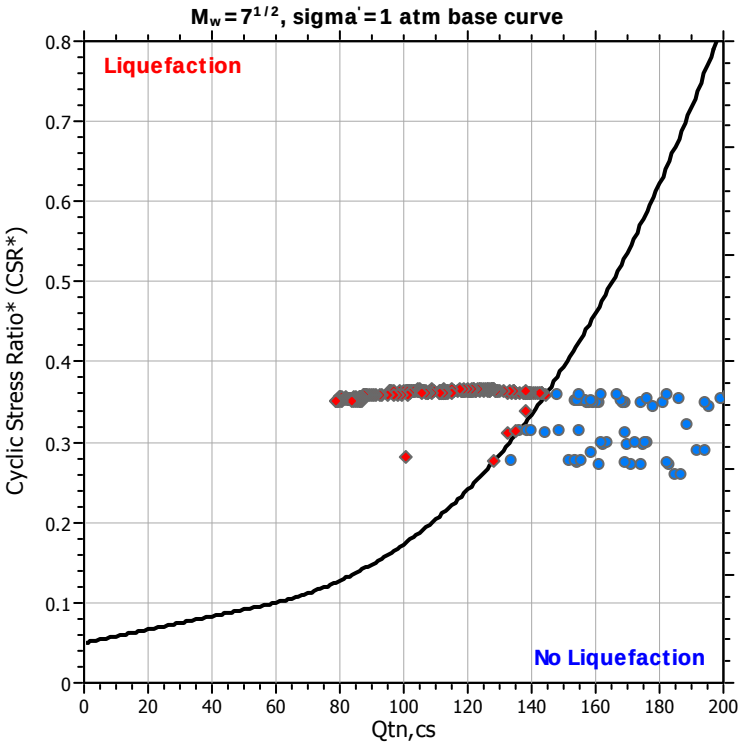
Project title : EF International Language Campus **Location : 3150 Bear St., Costa Mesa, CA**

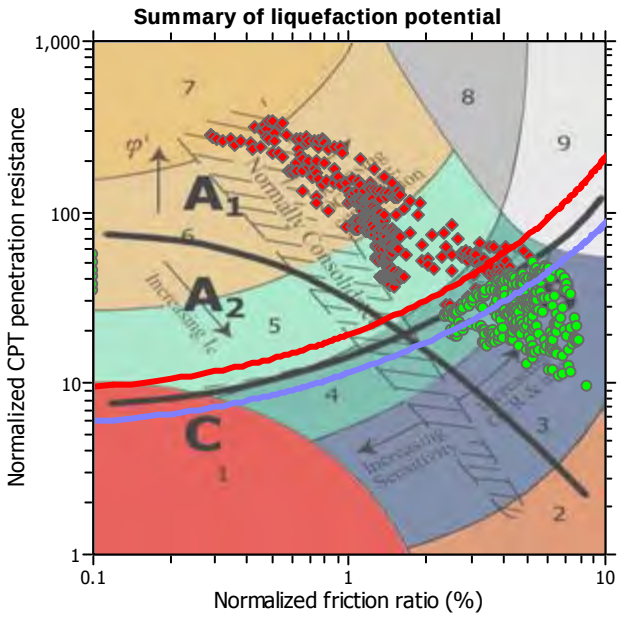
CPT file : CPT-2A

Input parameters and analysis data

Analysis method:	Robertson (2009)	G.W.T. (in-situ):	18.00 ft	Use fill:	No	Clay like behavior applied:	All soils
Fines correction method:	Robertson (2009)	G.W.T. (earthq.):	10.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	1	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.54	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

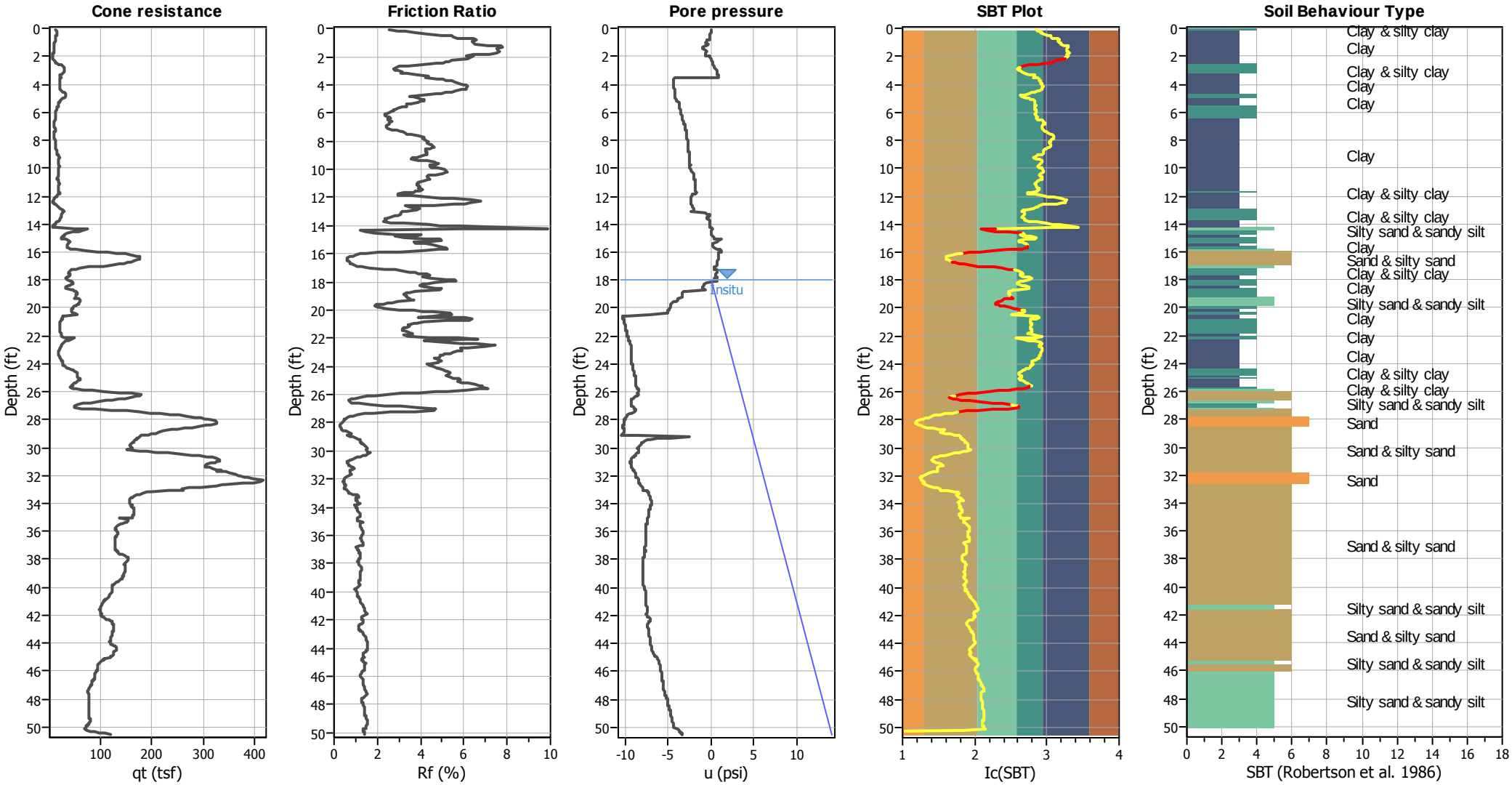






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



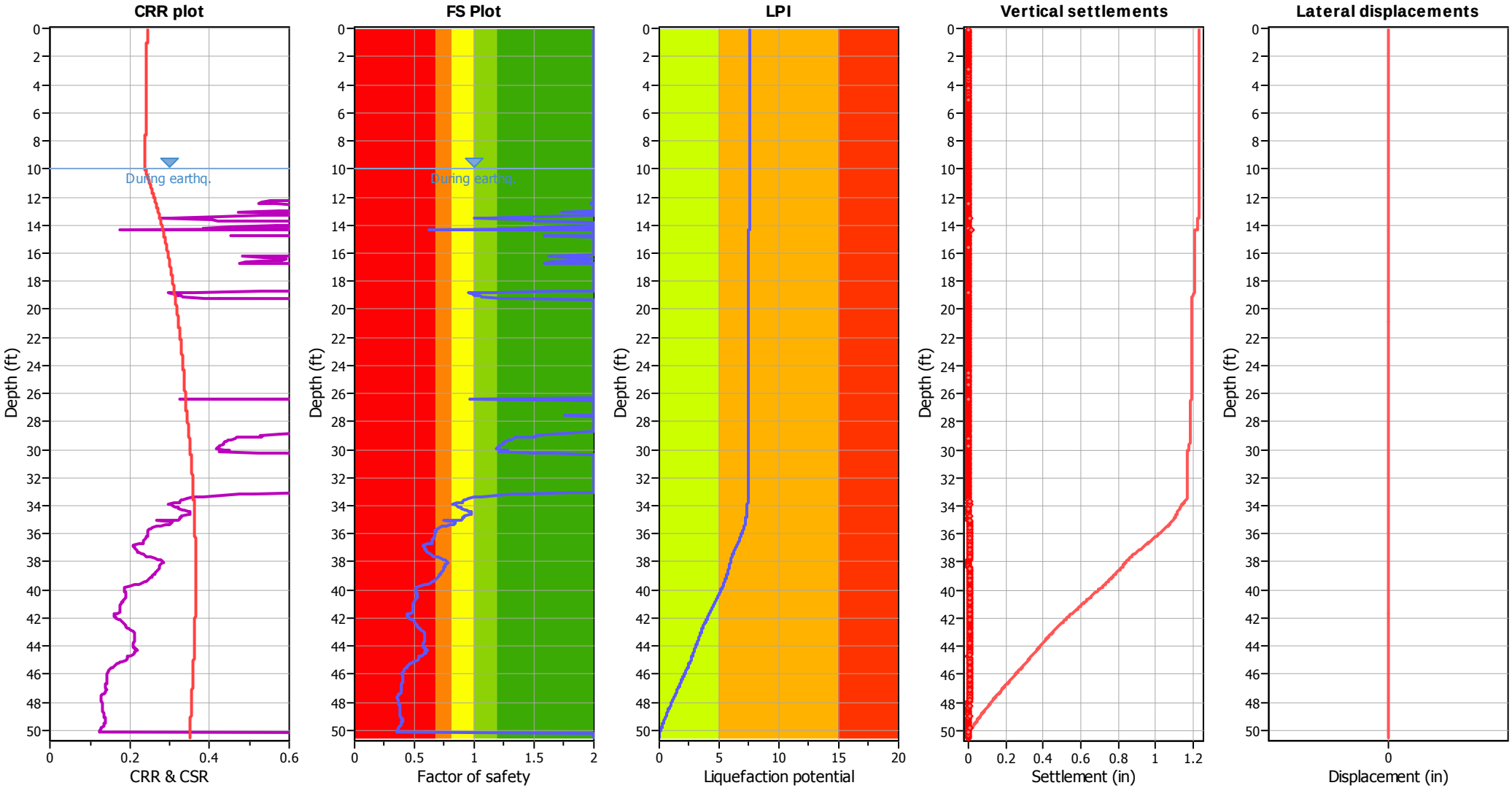
Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	10.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.54	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	18.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	10.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.54	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	18.00 ft	Fill height:	N/A	Limit depth:	N/A

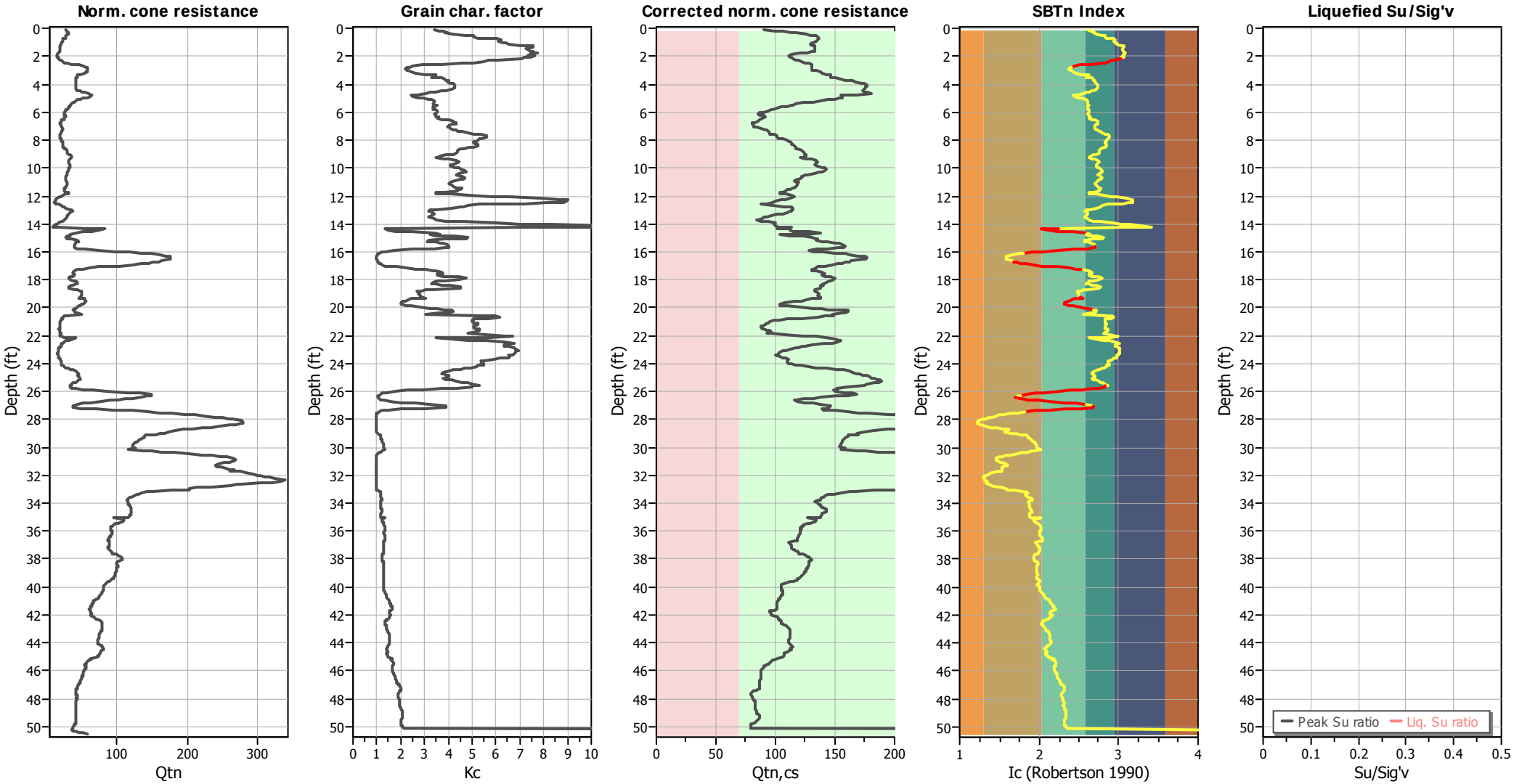
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	10.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.54	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	18.00 ft	Fill height:	N/A	Limit depth:	N/A

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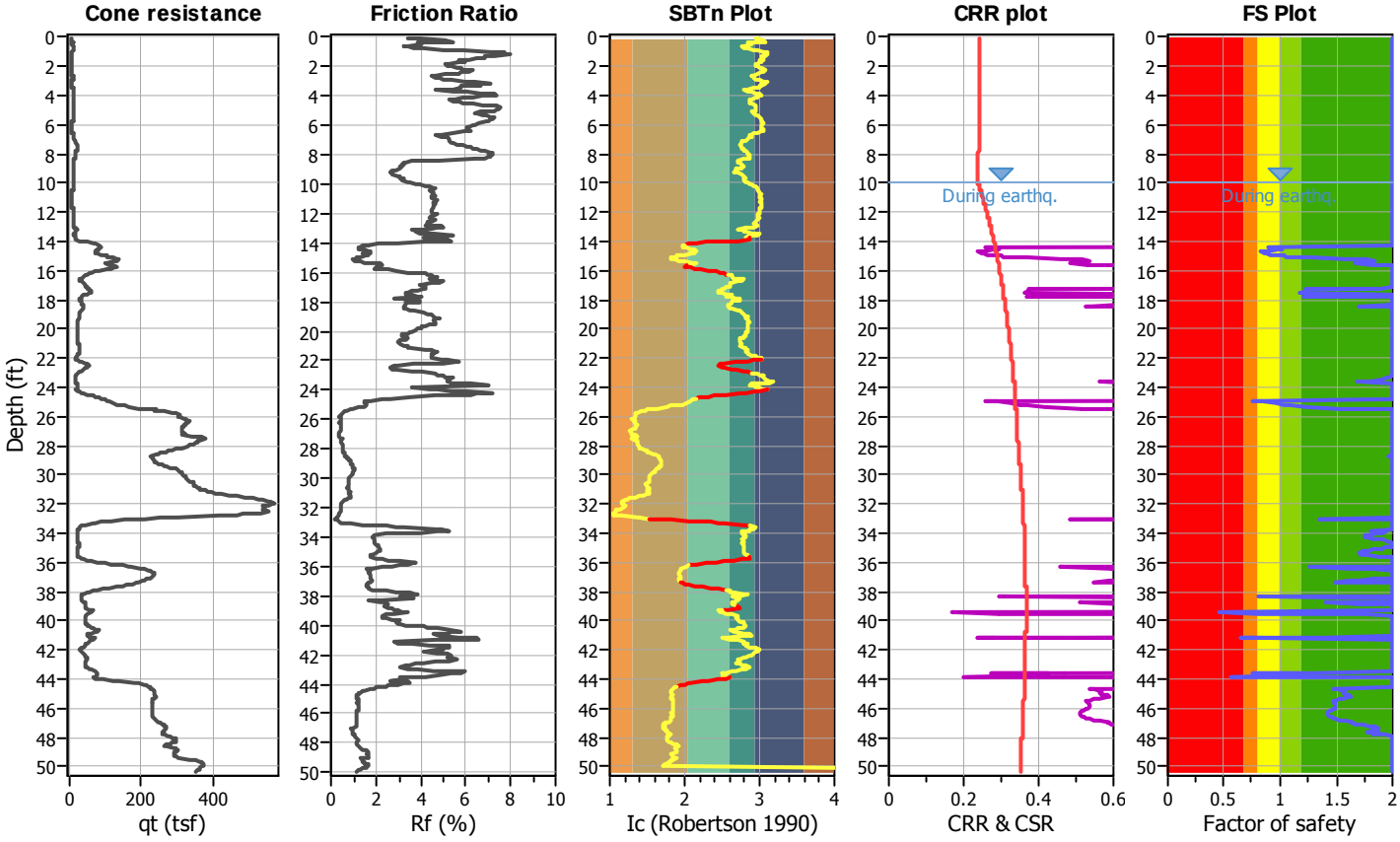
LIQUEFACTION ANALYSIS REPORT

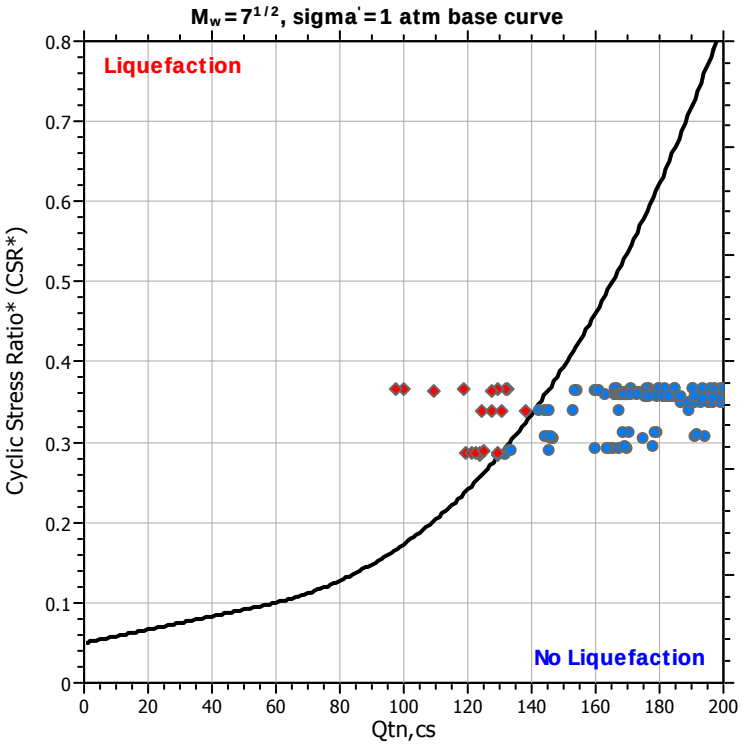
Project title : EF International Language Campus **Location : 3150 Bear St., Costa Mesa, CA**

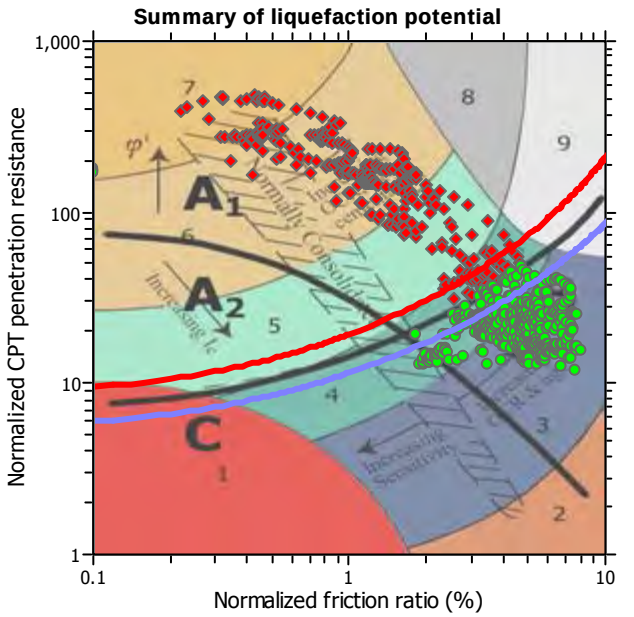
CPT file : CPT-3A

Input parameters and analysis data

Analysis method:	Robertson (2009)	G.W.T. (in-situ):	18.00 ft	Use fill:	No	Clay like behavior applied:	All soils
Fines correction method:	Robertson (2009)	G.W.T. (earthq.):	10.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	1	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.54	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

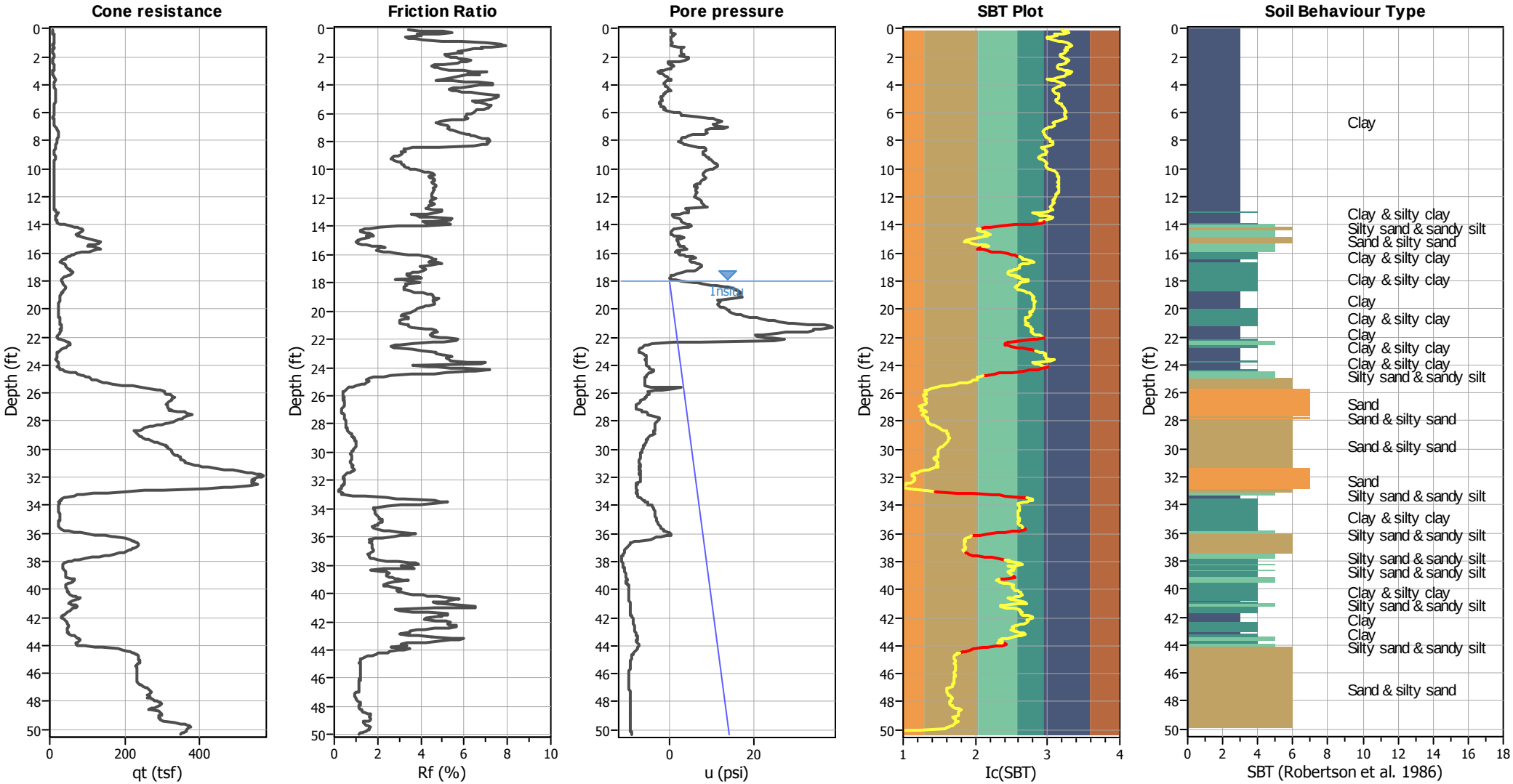






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



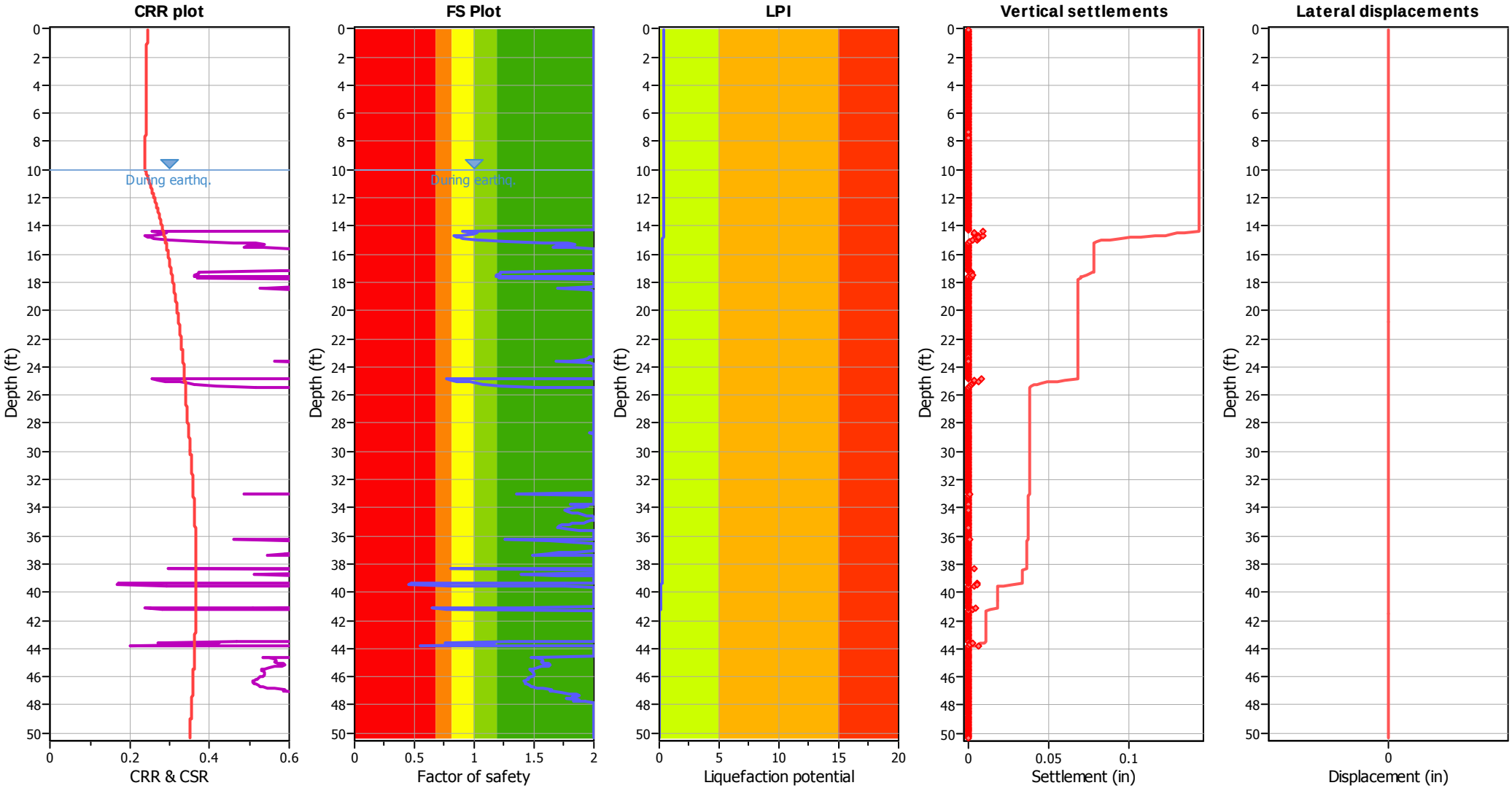
Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	10.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.54	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	18.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	10.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.54	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	18.00 ft	Fill height:	N/A	Limit depth:	N/A

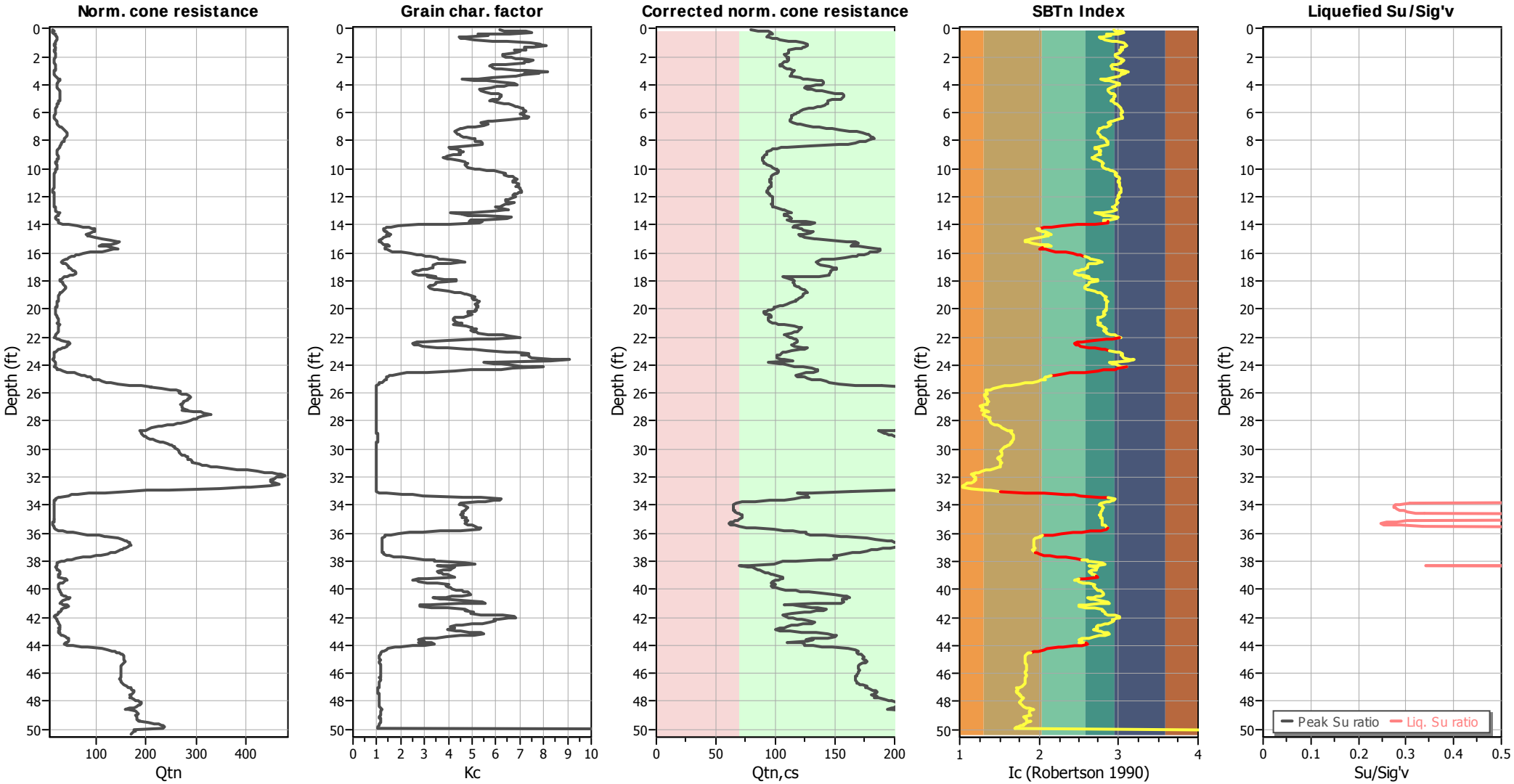
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	10.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.54	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	18.00 ft	Fill height:	N/A	Limit depth:	N/A

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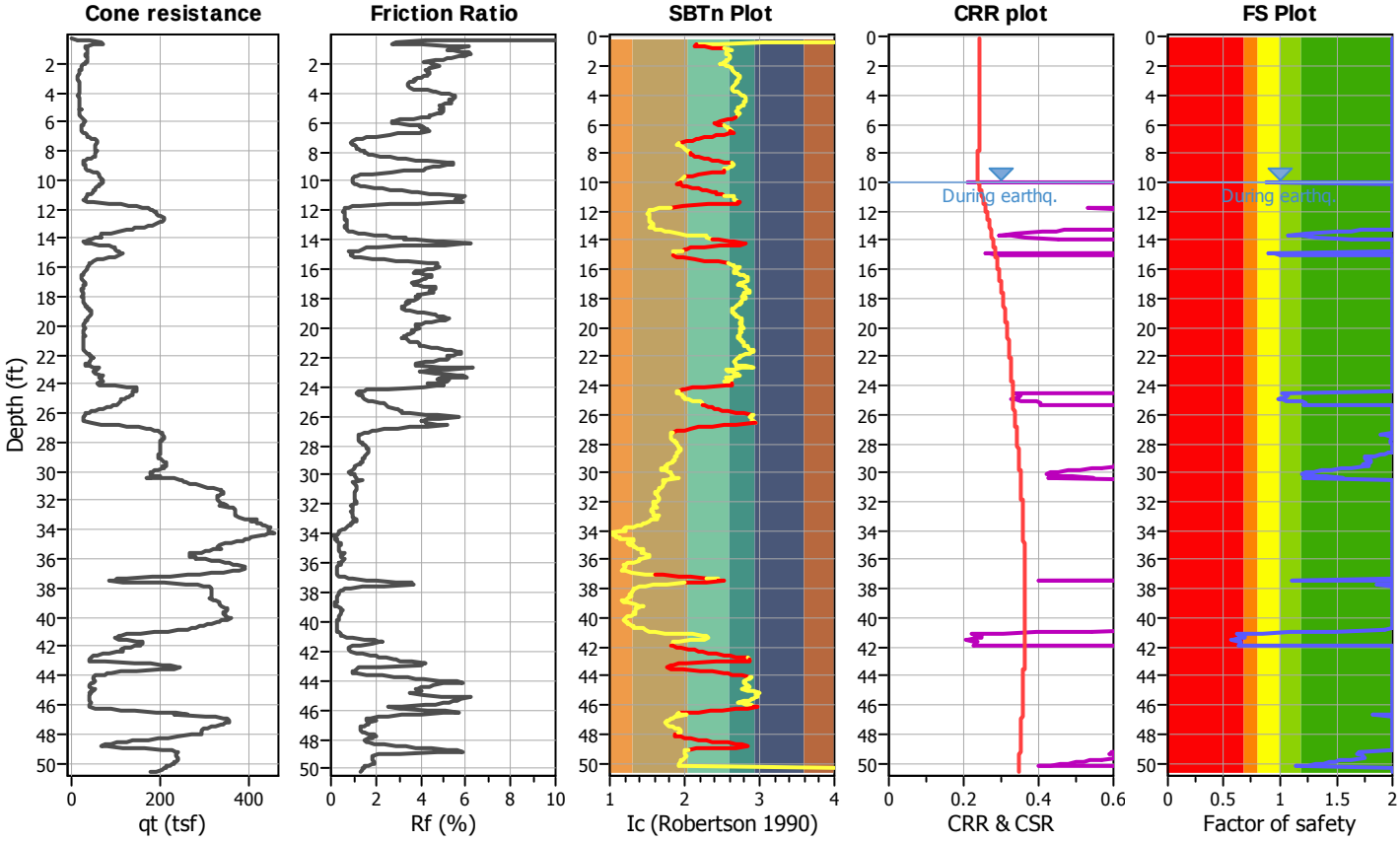
LIQUEFACTION ANALYSIS REPORT

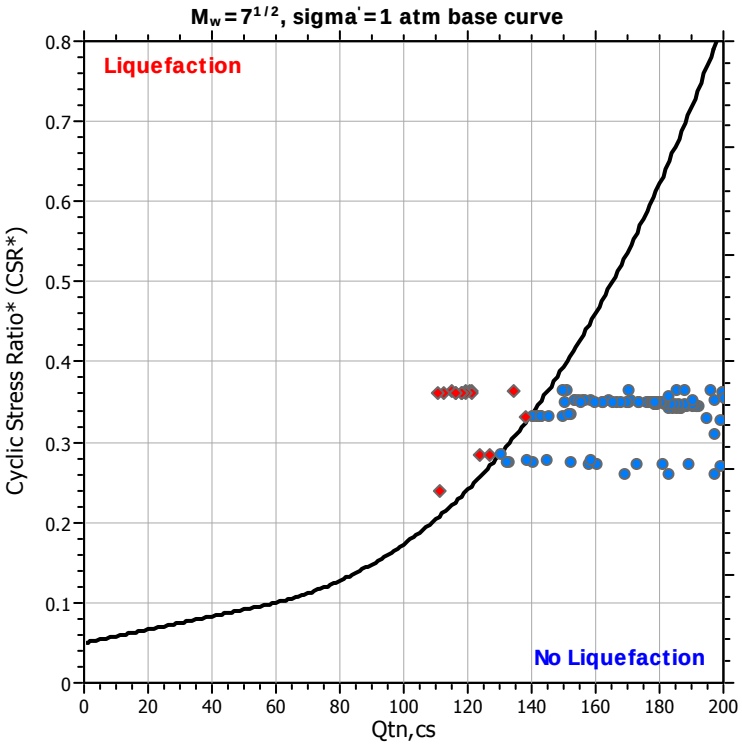
Project title : EF International Language Campus **Location : 3150 Bear St., Costa Mesa, CA**

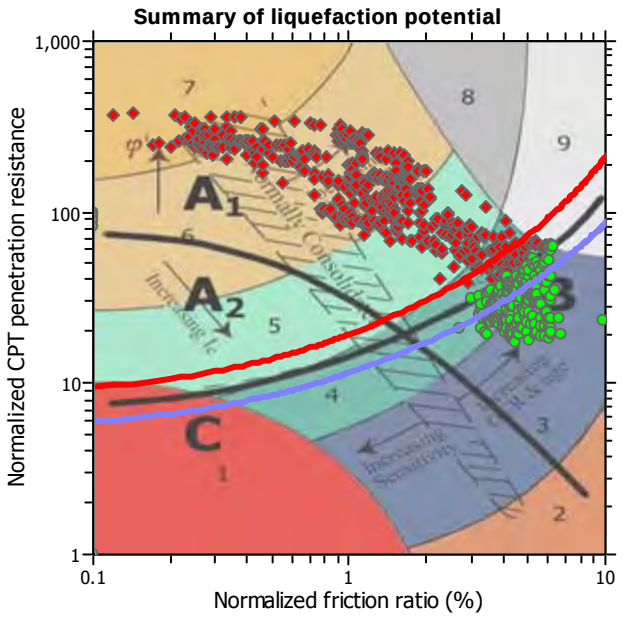
CPT file : CPT-4

Input parameters and analysis data

Analysis method:	Robertson (2009)	G.W.T. (in-situ):	18.00 ft	Use fill:	No	Clay like behavior applied:	All soils
Fines correction method:	Robertson (2009)	G.W.T. (earthq.):	10.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	1	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.54	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

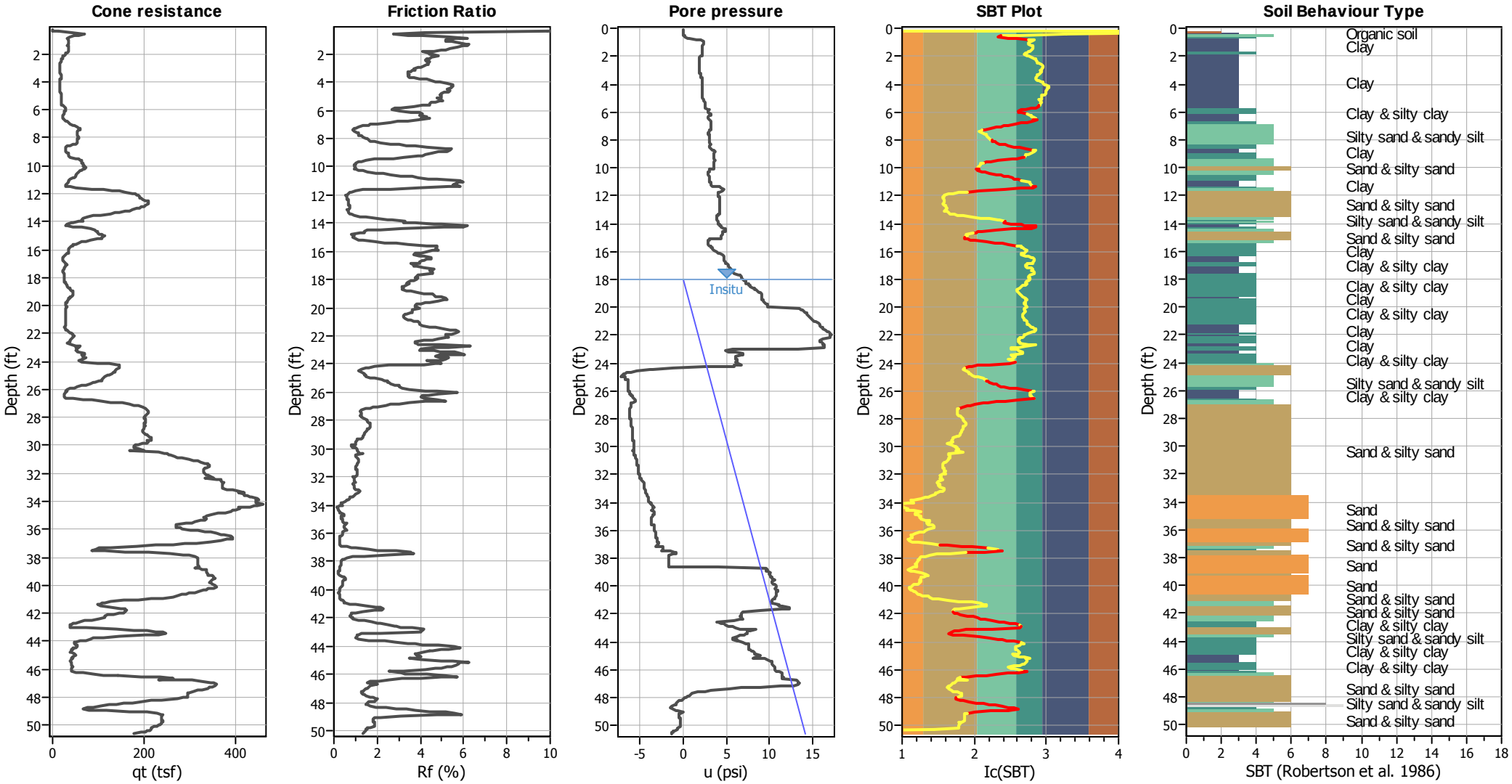






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



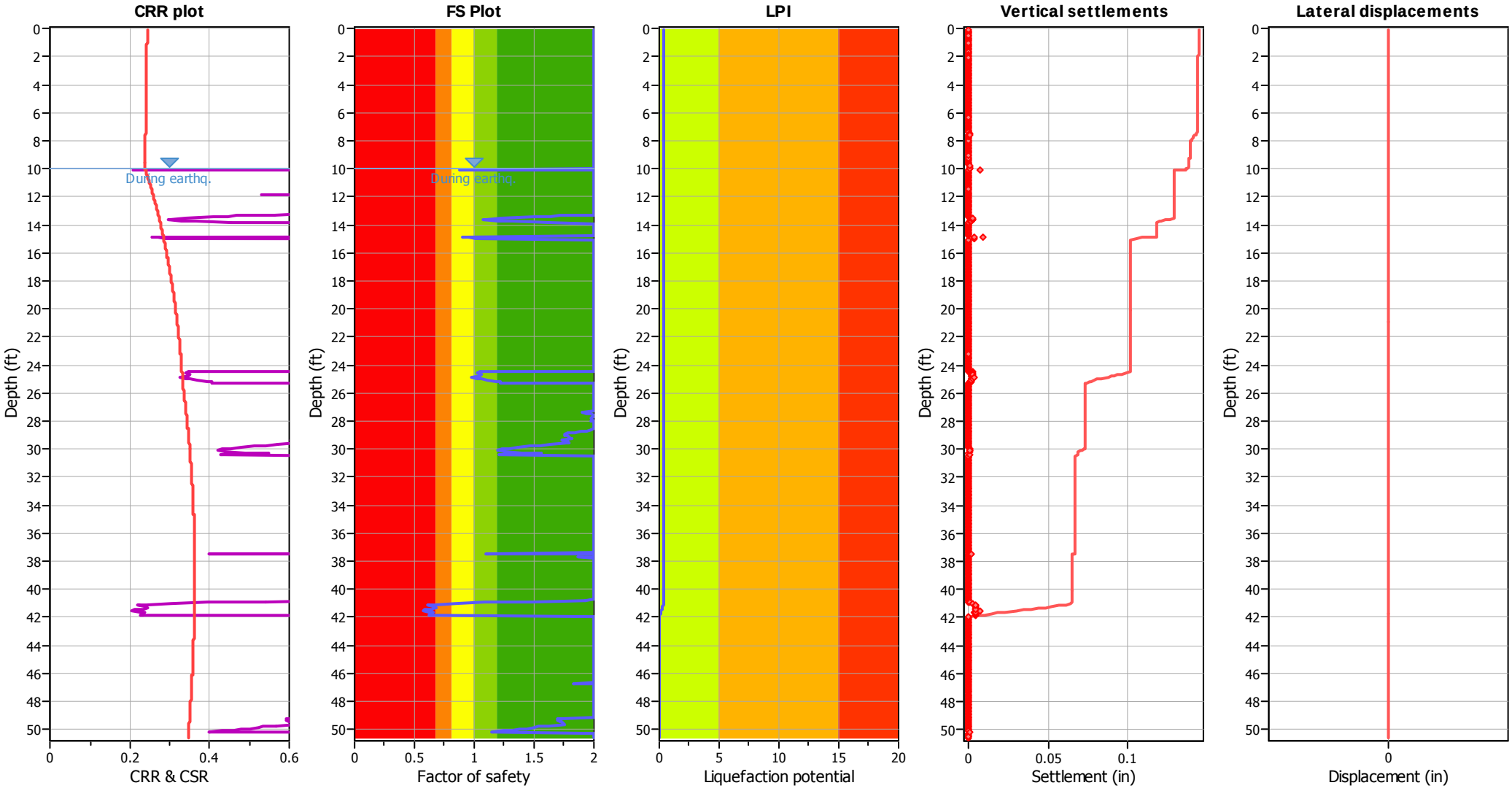
Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	10.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.54	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	18.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	10.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.54	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	18.00 ft	Fill height:	N/A	Limit depth:	N/A

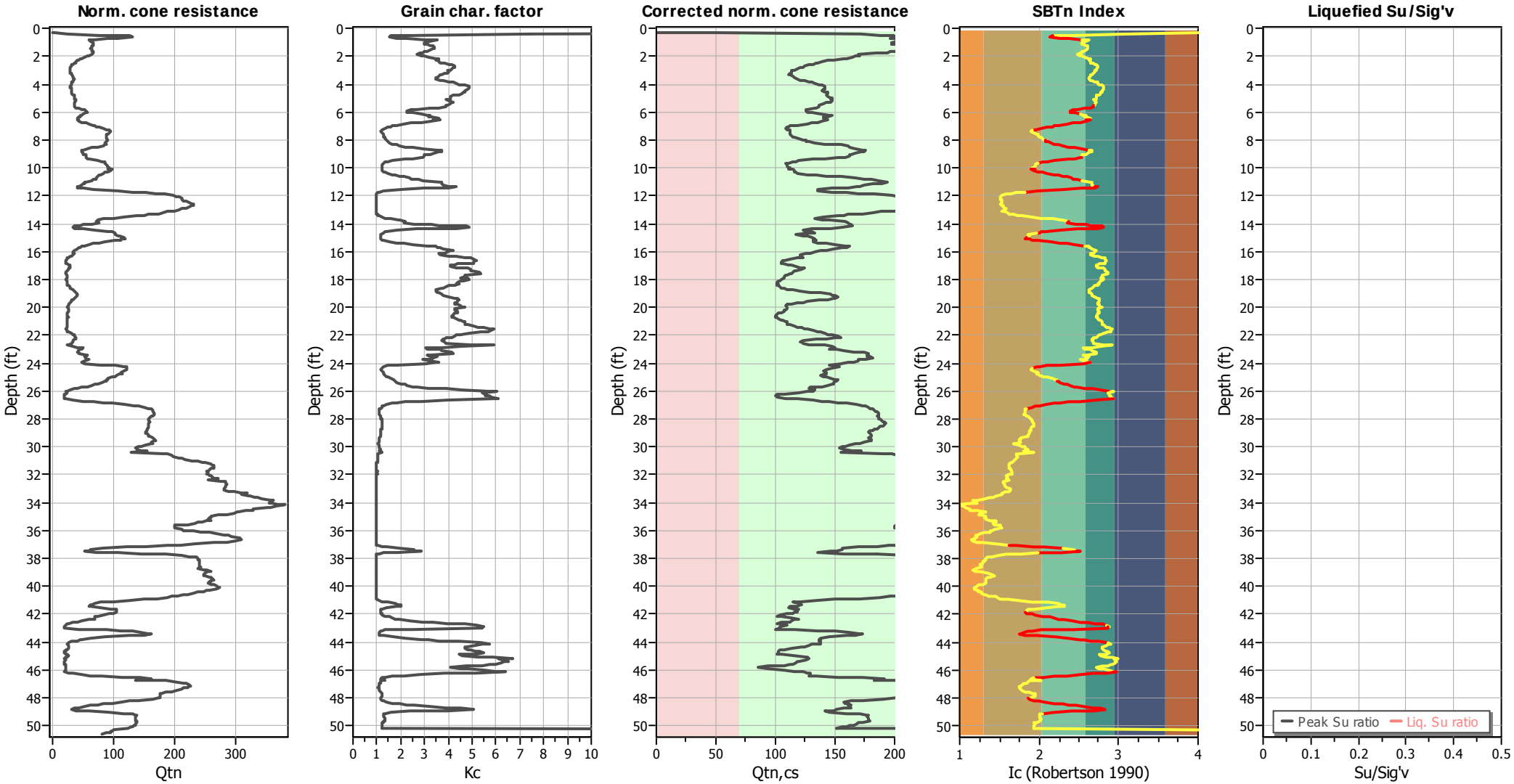
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	10.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.54	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	18.00 ft	Fill height:	N/A	Limit depth:	N/A

APPENDIX D

Percolation Test Result

GMU
GEOTECHNICAL, INC.

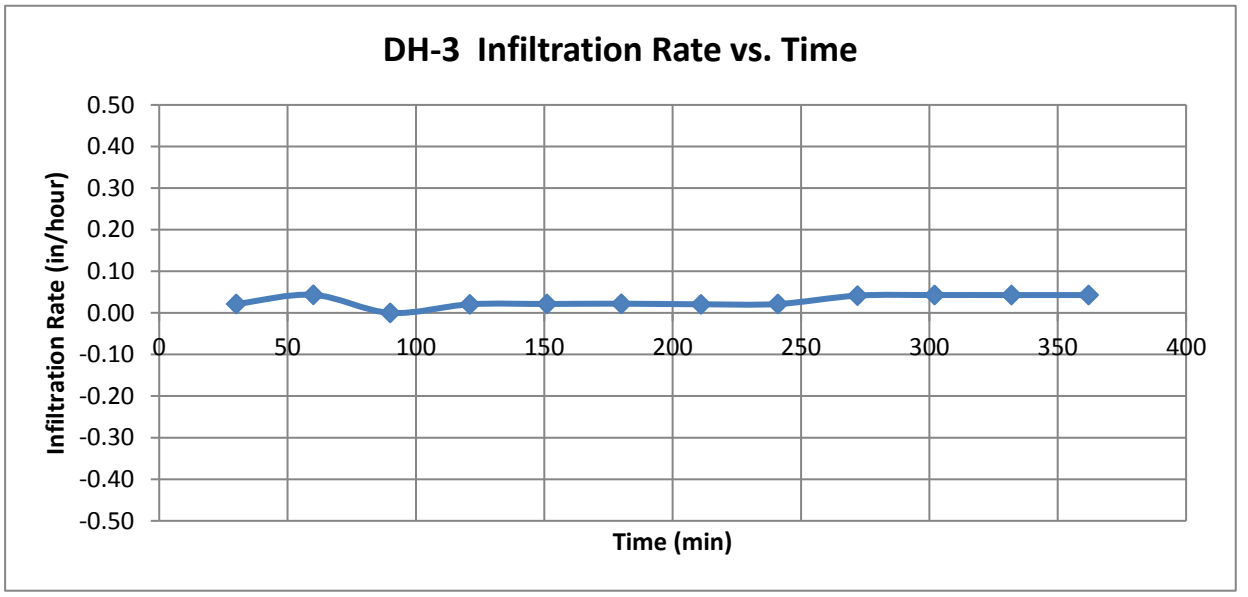
Riverside/Orange County - Infiltration Test in a Boring

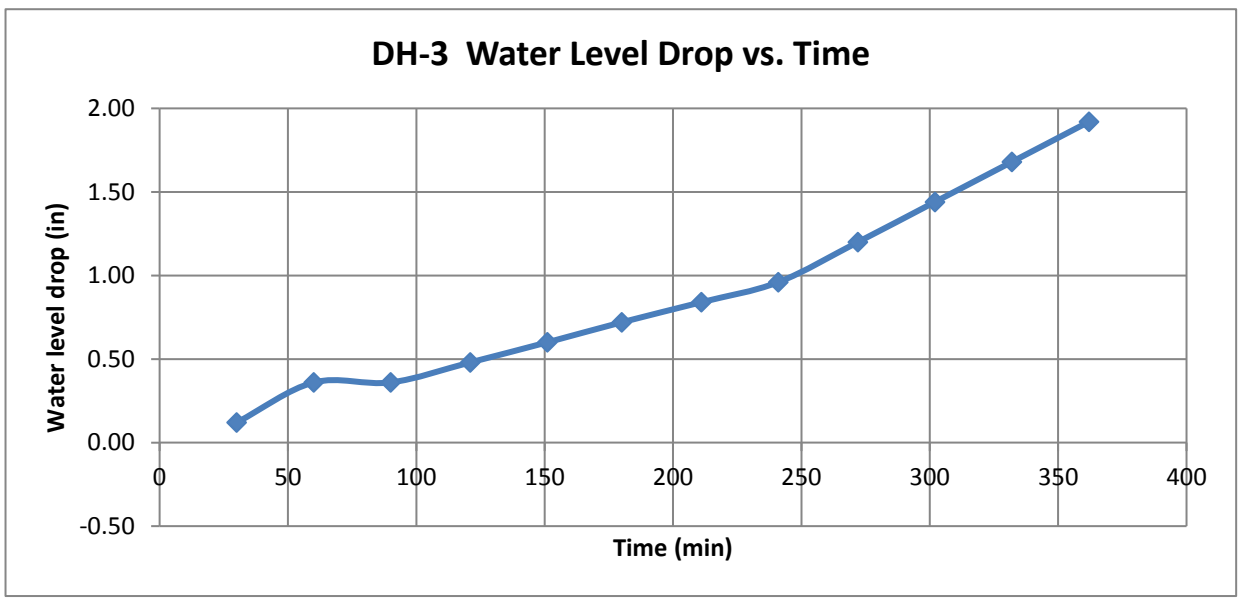
Project Name: EF International Language Campus
Project Number: 18-252-00

Test Hole Number: DH-3
Total Depth : 4.92 feet
Test Hole Diameter: 8.00 inches radius= 4 inches

Trial	Start Time	End Time	ΔT	Total Time	Initial Depth of Water	Final Depth of Water	ΔD	ΣΔD	ΔHavg	Infiltration Rate
			(min)	*(min)*	*(ft)*	*(ft)*	*(in)*	*(in)*	*(in)*	*(in/hour)*
1	7:55	8:25	30.0	30.0	3.22	3.23	0.12	0.12	20.34	0.02
2	8:25	8:55	30.0	60.0	3.23	3.25	0.24	0.36	20.16	0.04
3	8:55	9:25	30.0	90.0	3.21	3.21	0.00	0.36	20.52	0.00
4	9:25	9:56	31.0	121.0	3.21	3.22	0.12	0.48	20.46	0.02
5	9:56	10:26	30.0	151.0	3.21	3.22	0.12	0.60	20.46	0.02
6	10:26	10:55	29.0	180.0	3.21	3.22	0.12	0.72	20.46	0.02
7	10:55	11:26	31.0	211.0	3.21	3.22	0.12	0.84	20.46	0.02
8	11:26	11:56	30.0	241.0	3.21	3.22	0.12	0.96	20.46	0.02
9	11:56	12:27	31.0	272.0	3.21	3.23	0.24	1.20	20.40	0.04
10	12:27	12:57	30.0	302.0	3.21	3.23	0.24	1.44	20.4	0.04
11	12:57	13:27	30.0	332.0	3.21	3.23	0.24	1.68	20.4	0.04
12	13:27	13:57	30.0	362.0	3.21	3.23	0.24	1.92	20.4	0.04

Average Infiltration Rate (in/hour) 0.04





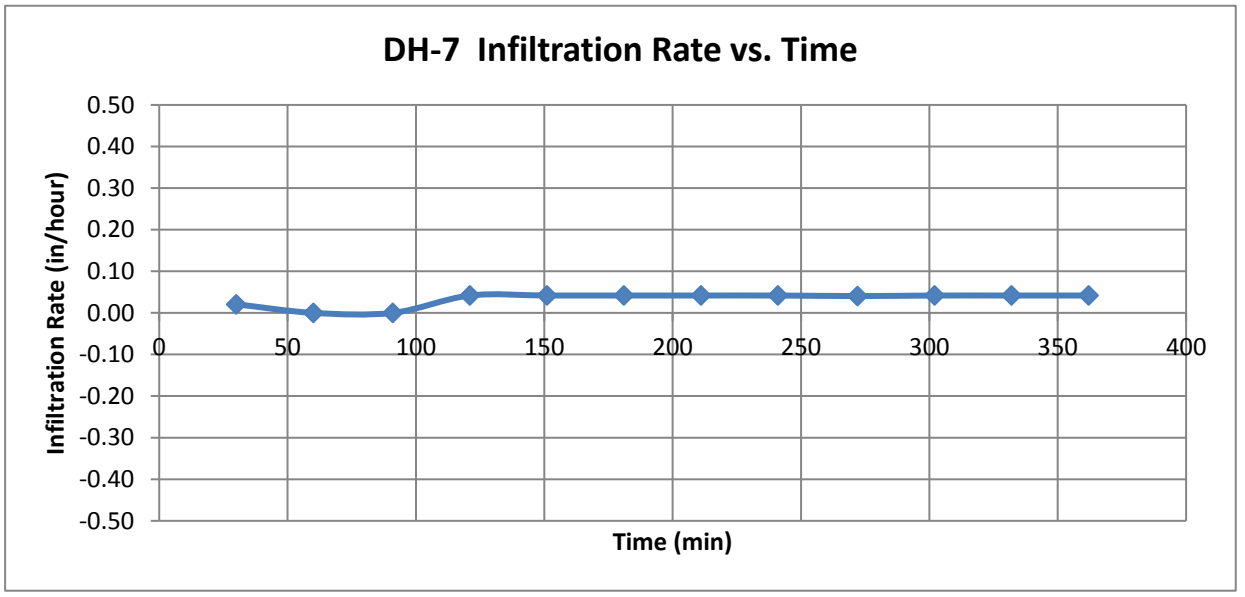
Riverside/Orange County - Infiltration Test in a Boring

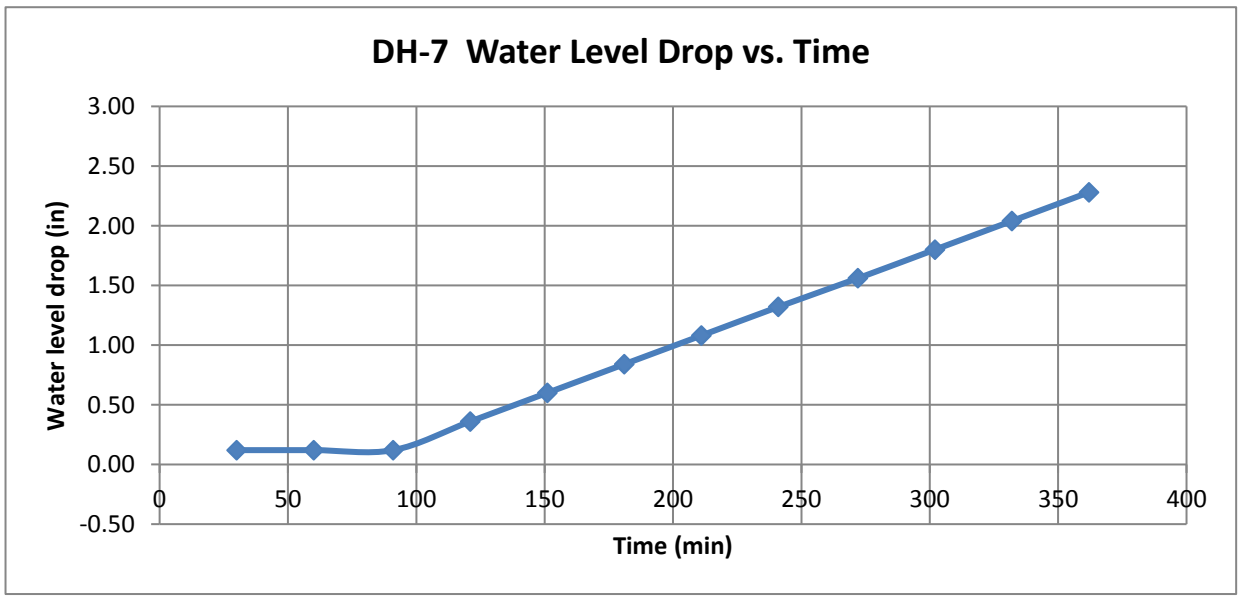
Project Name: EF International Language Campus
Project Number: 18-252-00

Test Hole Number: DH-7
Total Depth : 5.00 feet
Test Hole Diameter: 8.00 inches radius= 4 inches

Trial	Start Time	End Time	ΔT	Total Time	Initial Depth of Water	Final Depth of Water	ΔD	∑ΔD	ΔHavg	Infiltration Rate
			(min)	*(min)*	*(ft)*	*(ft)*	*(in)*	*(in)*	*(in)*	*(in/hour)*
1	8:02	8:32	30.0	30.0	3.23	3.24	0.12	0.12	21.18	0.02
2	8:32	9:02	30.0	60.0	3.24	3.24	0.00	0.12	21.12	0.00
3	9:02	9:33	31.0	91.0	3.24	3.24	0.00	0.12	21.12	0.00
4	9:33	10:03	30.0	121.0	3.24	3.26	0.24	0.36	21.00	0.04
5	10:03	10:33	30.0	151.0	3.24	3.26	0.24	0.60	21.00	0.04
6	10:33	11:03	30.0	181.0	3.24	3.26	0.24	0.84	21.00	0.04
7	11:03	11:33	30.0	211.0	3.24	3.26	0.24	1.08	21.00	0.04
8	11:33	12:03	30.0	241.0	3.24	3.26	0.24	1.32	21.00	0.04
9	12:03	12:34	31.0	272.0	3.24	3.26	0.24	1.56	21.00	0.04
10	12:34	13:04	30.0	302.0	3.24	3.26	0.24	1.80	21	0.04
11	13:04	13:34	30.0	332.0	3.24	3.26	0.24	2.04	21	0.04
12	13:34	14:04	30.0	362.0	3.24	3.26	0.24	2.28	21	0.04

Average Infiltration Rate (in/hour) 0.04

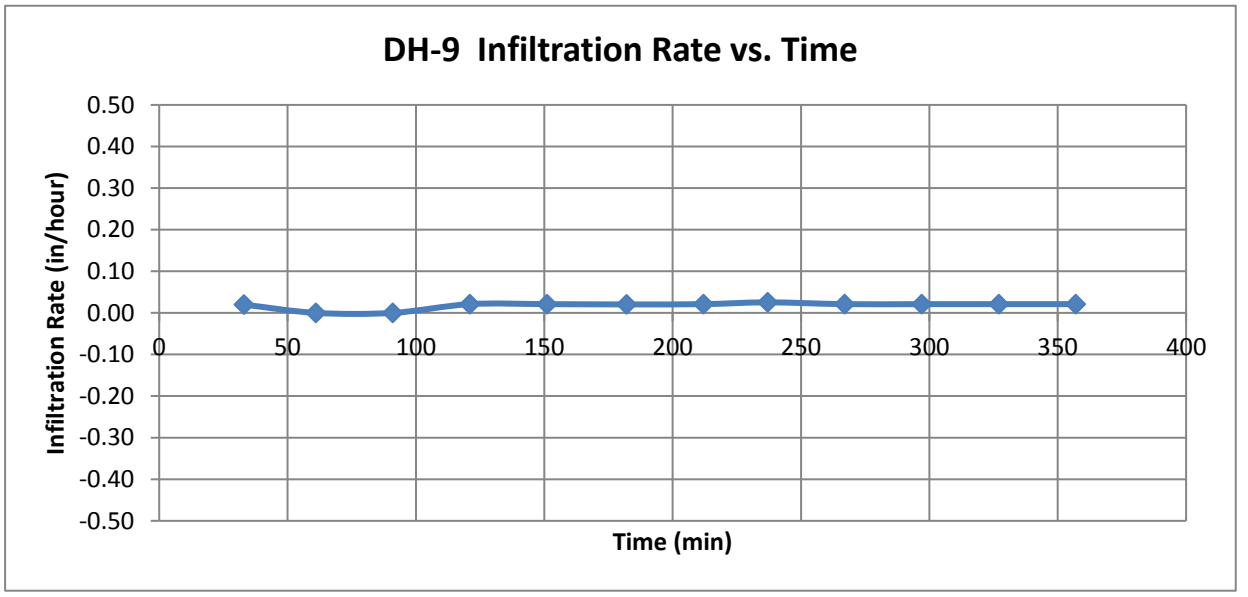
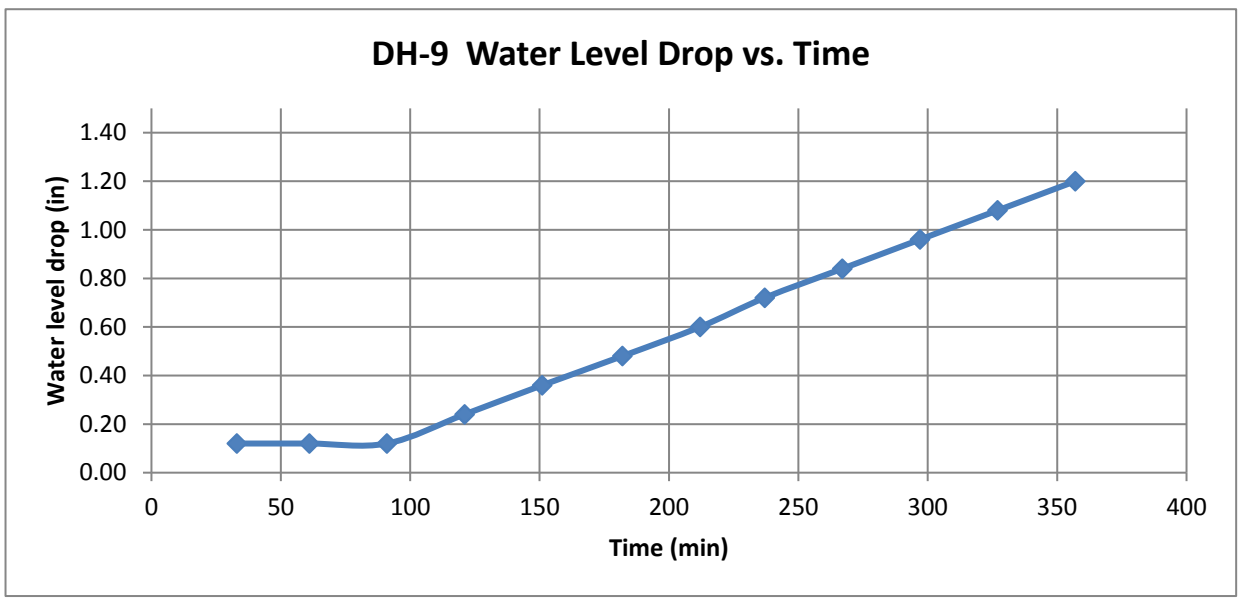




Riverside/Orange County - Infiltration Test in a Boring

Project Name: EF International Language Campus
Project Number: 18-252-00

Test Hole Number: DH-9
Total Depth : 5.00 feet
Test Hole Diameter: 8.00 inches radius= 4 inches

Trial	Start Time	End Time	ΔT	Total Time	Initial Depth of Water	Final Depth of Water	ΔD	∑ΔD	ΔHavg	Infiltration Rate
			(min)	*(min)*	*(ft)*	*(ft)*	*(in)*	*(in)*	*(in)*	*(in/hour)*
1	8:10	8:43	33.0	33.0	3.33	3.34	0.12	0.12	19.98	0.02
2	8:43	9:11	28.0	61.0	3.28	3.28	0.00	0.12	20.64	0.00
3	9:11	9:41	30.0	91.0	3.28	3.28	0.00	0.12	20.64	0.00
4	9:41	10:11	30.0	121.0	3.26	3.27	0.12	0.24	20.82	0.02
5	10:11	10:41	30.0	151.0	3.26	3.27	0.12	0.36	20.82	0.02
6	10:41	11:12	31.0	182.0	3.26	3.27	0.12	0.48	20.82	0.02
7	11:12	11:42	30.0	212.0	3.26	3.27	0.12	0.60	20.82	0.02
8	11:42	12:07	25.0	237.0	3.26	3.27	0.12	0.72	20.82	0.03
9	12:07	12:37	30.0	267.0	3.26	3.27	0.12	0.84	20.82	0.02
10	12:37	13:07	30.0	297.0	3.26	3.27	0.12	0.96	20.82	0.02
11	13:07	13:37	30.0	327.0	3.26	3.27	0.12	1.08	20.82	0.02
12	13:37	14:07	30.0	357.0	3.26	3.27	0.12	1.20	20.82	0.02

Average Infiltration Rate (in/hour) 0.02