Appendix C
Geotechnical Report

PRELIMINARY GEOTECHNICAL INVESTIGAITON REPORT

for

Proposed Cypress College Student Housing
Cypress, California

Prepared For:

North Orange Community College District / Cypress College
Campus Capital Project Office
9200 Valley View Street
Cypress, California 90630

Prepared By:

Langan Engineering and Environmental Services, Inc.
18575 Jamboree Road, Suite 150
Irvine, California 92612

LANGAN

01 March 2023
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Irvine, California 92612

SHAUN H. WILKINS No. 2665 exp. 3/31/24 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

Shaun Wilkins, CEG
Senior Project Geologist
CEG #2665

REGISTERED PROFESSIONAL ENGINEER ENRIQUE A. RIUTORT GE2683 12/31/23 GEOTECHNICAL STATE OF CALIFORNIA

Enrique A. Riutort, PE, GE
Senior Project Manager
GE #2683

REGISTERED PROFESSIONAL ENGINEER DIANE M FIORELLI No. GE 3042 exp 6/30/23 GEOTECHNICAL STATE OF CALIFORNIA

Diane M. Fiorelli, PE, GE
Principal/ Vice President
GE# 3042

LANGAN

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1.0 INTRODUCTION

Langan Engineering and Environmental Services, Inc. (LANGAN) has prepared this report at the authorization of North Orange County Community College District to perform a preliminary geotechnical study for the Cypress College Student Housing Feasibility Study (Project) in Cypress, California (Site). Provided herein is a brief site description, explanation of the proposed project, an overview of available geotechnical information, and a preliminary geotechnical analysis for the proposed development. Recommendations provided herein have been prepared in accordance with the 2022 California Building Code (2022 CBC) and in general accordance with California Geological Survey (CGS) Note 48, *Checklist for the Review of Engineering Geology and Seismology Reports for California Public Schools, Hospitals, and Essential Services Buildings,* dated November 2019 Elevations referenced herein are in feet with respect to North American Vertical Datum of 1988 (NAVD88) unless noted otherwise.

2.0 PROJECT OVERVIEW

2.1 Site Description

The Site consists of land identified by Orange County as Assessor Parcel Numbers (APNs) 134-031-09, 134-031-10, and 134-031-11. The Site encompasses approximately 2.75 acres within Cypress Community College. The site is identified as Lot 6 within the Cypress College property and it is currently developed with a concrete and asphalt paved parking lot. The Site is bound to the north by Peppertree Apartments; to the east by Holder; to the south by the Cypress College Baseball Field; and to the west by the Cypress College Maintenance Facility. The Site is located in the northeastern corner of the Cypress College property (see Figure 1).

Based a previous topographic survey titled, "Cypress College Topographic Survey and Demolition Plan" dated 14 January 2011, the existing site grades range from an approximate elevation of 58.2 feet on the northeast side of the project limits and decreases to an approximate elevation of 56.0 feet at the southwest of the project. The Site entrance has two driveways with some trees and grass. The Site is currently developed as a parking lot for the campus with a gated maintenance facility in the north-northwest limits of the Site. Additionally, in the southeast part of the Site there is an electrical conduit in a 24 inch x 36 inch pull box.

2.2 Proposed Development

It is understood that the proposed development at the Site consists of two student housing buildings. Our understanding of the project is based on the #CC2022-14 Request for Proposal (RFP) submitted by North Orange County Community College District. Based on the submittal RFP, the proposed development will be two three-story structures built in two phases within Lot 6. Phase I has an approximate building footprint of 27,000 square feet to be built on the east side of Lot 6. Phase II will also have an approximate 27,000 square feet footprint and will be built west of the Phase I structure. A proposed temporary parking lot was discussed during the Site walk with the client. The area discussed for the temporary parking lot is directly east of the baseball fields, adjacent to Holders Street.

3.0 AVAILABLE INFORMATION REVIEW

3.1 Document Review

LANGAN reviewed reports, maps and other public available information from the agencies listed below:

- United States Geological Survey (USGS),
- California Geological Survey (CGS),
- City of Cypress,
- Orange County,
- Federal Emergency Management Agency (FEMA), and
- Geologic Energy Management Division (CalGEM) previously known as the Division of Oil, Gas & Geothermal Resources (DOGGR).

A summary of the available information reviewed is provided below.

3.2 Site Development History

Based on review of historical Google Earth satellite images, the Site was developed with office buildings (eastern portion) and a parking lot (western portion) as early as 1985. Based on meeting and discussion with the Client, the office buildings were mobile and had raised steel pier foundations. The office buildings were utilized as a High School Laboratory, Adult Learning High School Laboratory, Computer Laboratory, Maintenance and Operations Building, DSA Building, and Child Day Care. By 2011, the satellite images show the offices buildings removed and the entire Site utilized as a parking lot. One of Langan's borings was completed directly beneath the former Maintenance and Operations buildings.

3.3 Regional and Local Geologic Setting

The subject site is located at the central plain of the Los Angeles Basin, a northwest trending, alluviated lowland situated at the north end of the Peninsular Ranges geomorphic province of coastal southern California. This basin, which is the surface expression of a deep structural trough, has been subdivided into four primary structural blocks distinguished from one another by contrasting basement rock types and stratigraphy. These structural blocks are generally separated by zones of faulting along which movement has been occurring intermittently since middle Miocene time (Yerkes et al., 1965). The site is located near the middle of the Central Block of the Los Angeles Basin, a wedge-shaped area that extends from the Santa Monica Mountains at its northwest end to the San Joaquin Hills at its southeast end.

Locally, the area is underlain by young (Holocene- and late Pleistocene-aged) alluvium deposited on flood plains from the Los Angeles, San Gabriel, and Santa Ana rivers (Sharp, 1976; Yerkes et al., 1965). Young alluvium is generally described as poorly consolidated, poorly sorted, permeable flood-plain deposits consisting of soft clay, silt, and loose to moderately dense sand and silty sand (Saucedo et al., 2016). The site location relative to the regional geologic map is presented on Figure 2.

3.4 Geologic Hazards Review

We evaluated the geologic and seismic hazards at the site in general accordance with California Geological Survey (CGS) Note 48, *Checklist for the Review of Engineering Geology and Seismology Reports for California Public Schools, Hospitals, and Essential Services Buildings,* dated November 2019. The following subsections present the results of our review of the potential geologic hazards as they pertain to the Site.

- Regional Faulting - Recognized and mapped faults that are located within a 100-kilometer (km) radius of the Site based on the CGS "2010 Fault Activity Map (FAM) of California" and "2010 FAM of California Legend" are shown on Figures 3A and 3B. This figure also includes local blind thrust fault faults, which are not included on the FAM. The location of these blind thrust faults were acquired from the United States Geological Survey (USGS) Quaternary fault and fold database.

  Based on our review, the closest known fault to the Site is the Los Alamitos fault located approximately 4.1 miles (6.7 kilometers [km]) southwest of the Site. The next closest faults are the Coyote Hills faults approximately 5.6 miles (9.1 km) northeast of the Site, the Newport-Inglewood fault approximately 7.0 miles (11.2 km) southwest of the Site, and the El Modeno fault located approximately 9.0 miles (14.5 km) east of the Site.

- Regional Seismicity - The Site is located in an active seismic area that has historically been affected by generally moderate to occasionally high levels of ground motion. Therefore, the proposed development will probably experience moderate to occasionally high levels of ground motion from nearby faults as well as ground motions from other active seismic areas of the southern California region.

  A search of the USGS ANSS Comprehensive Earthquake Catalog (ComCat) using a web-based Earthquake Archive Search and URL builder tool, found that as of November 1, 2022, 54 earthquakes with magnitudes of 5.0 or greater have occurred within a 100-km radius of the site since 1800 as shown on Figure 3A. A list of these earthquakes is provided in Appendix A.

  The USGS indicates that the probability of a magnitude 6.7 or greater earthquake to occur in the Los Angeles region in the next 30 years is 60 percent. The probability of a magnitude 7.0 or 7.5 or greater earthquake in the next 30 years for the Los Angeles region is 46 and 31 percent, respectively. A summary of these results is presented in Appendix A.

- Surface Rupture – The Site is not within a mapped Alquist-Priolo (AP) Earthquake Fault Zone as defined by the AP Act, as shown in Figure 4. Geologic review does not indicate the presence of active surface faulting within or adjacent to the Site. Therefore, the potential for ground surface rupture at the Site is considered very low.

- Liquefaction – Liquefaction is a transformation of soil from a solid to a liquefied state during which saturated soil temporarily loses strength resulting from the buildup of excess pore water pressure, especially during earthquake-induced cyclic loading. Soil susceptible to liquefaction includes loose to medium-dense sand and gravel, and low-plasticity silts below the groundwater table. According to the CGS, the Site is within a mapped, currently established liquefaction-potential investigation zone, as shown in Figure 4. Refer to Section 5.4 for a detailed liquefaction analysis at the site.

- Historical High Groundwater – Based on the Los Alamitos 7.5-minute quadrangle (SHZR 019), the historically highest groundwater at the Site is about 10 feet below ground surface, as shown in Figure 5.

- Landslides – According to the CGS and the Los Alamitos 7.5-minute quadrangle (SHZR 019) Landslide Inventory, the Site is not within a mapped Earthquake-Induced Landslide Hazard Zone or a mapped landslide area. The site is relatively flat with no sloped boundary conditions. Therefore, the potential for landsliding at the site is negligible.

- Seismic-Induced Ground Deformations – Seismic-induced ground deformations include ground-surface settlement, differential settlement and lateral spreading resulting from liquefaction and cyclic densification of unsaturated sands and gravels. The Site is mapped within a liquefaction potential investigation zone and therefore, can be located within a zone of differential settlement potential. Therefore, differential seismic-induced ground deformations are expected, mitigations of this hazard are described later in this report.

- Flood Mapping – Based on FEMA's National Flood Hazard Layer FIRMette Number 06059C0109J (December 2009), the Site is inside an area of 0.2 percent annual chance flood; 1 percent annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile as shown in Figure 6.

- Tsunami, Seiche, and Dam Inundation – According to information and maps available from the California Department of Conservation, the Site is not within a mapped tsunami inundation-hazard zone.

  The site is not near an enclosed body of water so the potential for seiche at the site is negligible.

  Based on a review of the California Division of Safety of Dams Dam Breach Inundation Map Web Publisher, the Site is not located in an area subject to inundation from dam failure.

- Subsidence – Land subsidence may be induced from withdrawal of oil, gas, or water from wells. According to a search of the California Geologic Energy Management Division's (CalGEM) Well Finder online tool, no active oil, gas, or geothermal wells are mapped within the Site. One capped well is located 0.74 miles northwest of the Site and one idle oil and gas well is located 0.92 miles southwest of the Site. According to our review of the available information from CalGEM, the Site is not considered to be subject to land subsidence from oil, gas, or water withdrawal from oil wells.

- Expansive Soils – Expansive soils occur when the moisture content in the soil causes swelling or shrinking as a result of cyclic wet/dry weather cycles, installation of irrigation systems, change in landscape plantings, or changes in grading. Swelling and shrinking soils can result in differential movement of structures including floor slabs and foundations, and site work including hardscape, utilities, and sidewalks. The 2022 CBC defines potentially expansive soils as soils with expansion indices (EI) greater than 20. We performed an expansion index test on a sample of near-surface soil from our investigation. The test results indicated that the soil has a very low expansive potential (expansion index = 1).

3.5 Available Document Information

The following table summarizes reports and historic documents that were reviewed by LANGAN and that pertain or are in proximity to the Site:

Document	Summary of Document Findings
Geotechnical Solutions, Inc. "Geotechnical Engineering Comprehensive & Up to Date Report Cypress College – Science Engineering and Mathematics Building (SEM)." sheets 2 through 115.	Geotechnical Solutions, Inc. performed two hollow stem auger borings (HS-1 and HS-2) in April 2016, approximately 400 feet south west of our Site. Geotechnical Solutions also present in their report previous CPTs and borings from 2003 and 2007 that were performed in Cypress College. During their field program no artificial fill encountered below the existing surface at the exploration locations. The subsurface materials encountered were reported to consist of natural soils. Generally, the soils encountered consisted of fine silty sand, sandy silt, with interbedded layers of finer silty and clayey materials. The ground water was reported to be generally at 11 feet below grade. For a 2475 YR Return Period, the liquefaction settlement ranged from 1.0 – 2.25 inches.

4.0 SUBSURFACE INVESTIGATION

LANGAN's geotechnical field investigation was performed 07 November through 09 November 2022. It consisted of nine (9) borings identified as LB-1 through LB-9 and four (4) Cone Penetrometer Tests (CPTs), identified as CPT-1 through CPT-4. One seismic CPT was performed to a depth of 100 feet and the other CPTs were performed to 50 feet. Prior to drilling, the boring locations were marked out by a LANGAN field engineer using site features. Underground Service Alert of Southern California (USA/DigAlert) was contacted to locate and mark known public underground utilities within the public right-of-way. A private utility-locating subcontractor also confirmed that the CPTs and boring locations were clear of conductive underground utilities. Borings were drilled by Martini Drilling using hollow-stem auger techniques with a truck-mounted CME-75 drill rig from 7 through 9 November 2022 to approximate depths of 26.5 to 51.5 feet and one to 5 feet. CPT's were performed by Kehoe Testing and Engineering on 8 November 2022. The borings and CPT's were performed under full-time observation of a LANGAN field engineer. Exploration locations are shown on Figure 7.

Additionally, a field investigation consisting of four (4) hand augers were performed on 5 December 2022 in the southern part of the proposed site limits (Figure 9). The boreholes were drilled with a 4 inch outside diameter hand auger to depths up to 5 feet.

At select boring locations, bulk samples were collected from the upper 5 feet. Standard Penetration Tests (SPT[1]) were performed and samples were collected at typically 5-feet intervals. Ring samples were collected at select depths using a 3.0-inch-outer-diameter split-barrel California sampler lined with 2.42-inch-inner-diameter brass rings in accordance with ASTM D3550. Soil samples were visually examined and classified in the field in accordance with the Unified Soil Classification System (USCS). Upon completion, the borings were backfilled with cement-grout-slurry and patched with concrete, the surface was brought to approximately pre-existing condition. Excess soil cuttings were placed in 55-gallon drums. Boring logs are included in Appendix B.

The CPTs were performed using the guidelines of ASTM D5778 by hydraulically pushing a 1.4-inch-diameter cone-tipped probe into the ground. Electrical strain gauges within the cone continuously measured soil data for the entire depth advanced, including tip resistance at the cone tip and frictional resistance on the friction sleeve behind the cone. Copies of the CPT logs are provided in Appendix C.

4.1 Laboratory Testing

Select soil samples were chosen for laboratory testing to confirm index and measure strength properties of the soils. Laboratory testing was performed by GeoLogic Associates, Inc. and laboratory test results are attached in Appendix D. The laboratory test program included the following tests:

- Direct Shear (ASTM D3080)
- Consolidation (ASTM D2435)
- Finer than No. 200 Sieve Analyses (ASTM D1140)
- Expansion Index (ASTM D4829)
- Atterberg Limits (ASTM D4318)
- Sulfate Content (CTM Test 417)
- Electrical Resistivity (CTM Test 643)
- Chloride Content (CTM Test 422)
- Soil pH (CTM Test 643)
- R - Value (ASTM D2844)

4.2 Subsurface Conditions

LANGAN's interpretation of the subsurface conditions is based on data reported and encountered during our field investigation. In general, the Project is underlain by fill overlying alluvial soil deposits. Subsurface cross-sections are presented graphically in Figures 8A and 8B. Details regarding the subsurface materials encountered are presented in the boring logs included in Appendix B.

[1] The Standard Penetration Test is a measure of the soil density and consistency. The SPT N-value is defined as the number of blows required to drive a 2-inch outer diameter split-barrel sampler 12-inches, after an initial penetration of 6 inches, using a 140-pound hammer free falling of a height of 30-inches (ASTM D1586).

- **Undocumented Fill (Af):** The site is overlain by 2 to 4 inches of asphalt over 0 to 3 inches of aggregate base. Beneath the pavement, undocumented fill was encountered in all borings. In general, the fill encountered at the site consisted of brown, silty fine sand that ranged from 1 to 3 feet.
- **Young Alluvium (Qya):** Alluvial deposits were encountered beneath the fill. The young alluvium soils were observed to consist of loose to medium dense silty fine sand, and loose to very dense sands, sands with silt and silty sands. SPT N-values of granular soils in the top 15 feet typically vary between 2 and 27 blows/foot and for cohesive soils typically vary between 2 and 14 blows/foot. Below 15 feet, the SPT N-values for granular soils vary between 5 and 82 blows/foot and for cohesive soils it vary between 4 and 62 blows/foot.

  Direct shear testing of one silty sand sample in LB-2 at 5 feet below existing grade measured a peak cohesion and internal friction angle of 100 psf and 38.5 degrees, respectively, and an ultimate cohesion and internal friction angle of 0 psf and 35 degrees. In the opposite corner of the site we tested for another direct shear test of one of the silty sand samples in LB-7. The sample at approximately 5 feet measured a peak cohesion of 100 psf and friction angle of 36 degrees, and an ultimate cohesion and friction angle of 100 psf and 31 degrees, respectively.

  Laboratory testing of selected samples in all borings for fine content of measured 28, 11, 15, and 11 percent. Laboratory testing of one sample in LB-1 approximately 20 feet below existing grade measured a liquid limit of 39, plastic limit of 22 and a plasticity index of 17. Corrosion test results are summarized on section 5.2. Results of the consolidation test performed on two samples at 20 and 30 below existing grade are provided in Appendix D.
- **Groundwater:** Groundwater was encountered in all borings ranging from 10 to 12 feet below ground surface. However, there could be changes in ground water levels due to seasonal variations, heavy rain, irrigation, utility breaks and other factors. These results are consistent with historic high groundwater levels reported in Los Alamitos 7.5-minute quadrangle (SHZR 019).

4.3 Subsurface Conditions at the Proposed Temporary Parking

LANGAN's interpretation of the subsurface conditions is based on data reported and encountered during our field investigation. In general, the Project is underlain by fill overlying alluvial soil deposits. Details regarding the subsurface materials encountered within our hand auger locations are presented in the boring logs included in Appendix B.

For the four hand augers performed, the thickness of the grass and roots ranged from 2 to 3 inches. The undocumented fill ranged from 1 to 3 feet and consisted of brown, silty fine sand. Below the undocumented fill we encountered a whitish gray, fine to medium sand.

5.0 PRELIMINARY GEOTECHNICAL EVALUATION AND RECOMMENDATIONS

Based on our subsurface investigation, preliminary engineering analyses, and laboratory testing the proposed development is considered feasible from a geotechnical engineering standpoint. The primary geotechnical issue associated with the proposed development is related to presence for liquefaction-induced settlement to occur during a moderate to major earthquake at the site. After ground improvement to bring the settlement related to liquefaction within tolerable limits, the proposed structures are anticipated to be supported on shallow foundations. As an alternative to shallow foundation with ground improvement, the proposed structures can be supported on deep foundation without ground improvement. Presented below are preliminary geotechnical evaluation and recommendations based on data obtained to date.

For design purposes, we recommend using a design groundwater level consistent with the historic high level of 10 feet below ground surface. Due to the depths of existing groundwater storm water infiltration with dry wells is considered not feasible at the Site.

5.1 Preliminary Liquefaction Analysis

The liquefaction evaluation was performed in accordance with ASCE 7-16, and CGS SP-117A. For this analysis performed to estimate seismic-induced settlements under a Maximum Considered Earthquake geometric mean (MCE_G) level of ground shaking. We utilized a factor of safety (FS) of 1.0, a modal magnitude of 6.7 for a 2 percent probability of exceedance in 50-year earthquake, and a MCE_G Peak Ground Acceleration (PGA_M) of 0.690g. We used a historic high groundwater depth of 10 feet bgs. To evaluate the liquefaction potential at the site, we utilized the Boulanger and Idriss (2014) method SPT-based and CPT-based methods, and the computer program *CLiq and LiquefyPro*. Based on the results of our analysis using the CPT data from our field investigation, there are potentially liquefiable layers at depths ranging from 10 to 25 feet and some small thickness layers below 25 feet. We estimate liquefaction-induced settlements to range from 0.8 inches to 2.2 inches.

We estimated seismic-induced settlements in unsaturated sand and gravels of up to 0.5 inch using Tokimatsu and Seed (1987).

To bring these settlements to tolerable levels of up to 1-inch ground improvement will be necessary for the proposed structures. The results of these analysis are attached in Appendix E.

5.2 Seismic Design Criteria

Seismic design of structures can be designed in accordance with the provisions of ASCE/SEI 7-16 and the California Geological Survey CGS – Note 48. Based on the available subsurface information, site-specific shear wave velocities from the Seismic CPT, and based on our evaluation, the soils underlying the site are potentially liquefiable, indicating Site Class E. However, the soils underlying the site may be characterized as Seismic Site Class D after ground improvement has been performed.

As such, the following preliminary seismic design criteria are recommended for structures bearing on shallow foundations with ground improvement to mitigate the settlement hazard from liquefaction.

Criteria	Mapped Value (Site Class D)
MCE_R Spectral response acceleration at Short Periods, S_S	1.470g
MCE_R Spectral response acceleration at 1 second period, S_1	0.520g
Short Period Site Coefficient, F_a	1.0
Short Period Site Coefficient, F_v	2.5
Site-modified MCE_R Spectral Response Acceleration at Short Periods, S_{MS}	1.470g
Site-modified MCE_R Spectral Response Acceleration at 1 second period, S_{M1}	1.300g
Design Spectral Response Acceleration at short periods, S_{DS}	0.980g
Design Spectral Response Acceleration at 1 second period, S_{D1}	0.867g
MCE_G Peak Ground Acceleration, PGA_M	0.690g

The recommended mapped values of F_v, S_{M1}, and S_{D1} above have been increased by 150 percent in accordance with the exception of Section 11.4.8.1 of Supplement No. 3 to ASCE 7-16. If the structural engineer elects not to use this exception in the seismic design approach, we should be notified so that we may develop site-specific response spectra and seismic design criteria in accordance with Chapter 21 of ASCE 7-16.

5.3 Ground Improvement

Due to the anticipated amount of settlement under seismic loading, ground improvement would be required to mitigate the potential impacts of the liquefaction at the site. Due the depth of the soils subject to liquefaction and shallow groundwater, ground improvement would need to extend up to 25 feet below existing grade to reduce seismic induced settlements to less than 1 inches. Some alternatives that could be considered include drilled displacements columns, deep soil mixing, or rammed aggregate piers (RAPs).

Drilled Displacement Columns

DDCs are constructed by using a displacement auger to create a soil shaft that is filled with Controlled Low Strength Material (CLSM) injected under pressure as the displacement auger is withdrawn from the hole. Typical installation diameter of DDCs vary between 20 to 24 inches. Installation of DDCs produces minimal soil cuttings because the soil is displaced during column installation. The purpose of the drilled displacement columns is to densify the upper soils and transfer building loads to a deeper competent bearing stratum. The structure can then be supported on a shallow foundation bearing on the DDC columns. DDCs can also be constructed to resist uplift loads by drilling them deeper into the bearing layer and installing a central bar.

Because DDCs inject the CLSM under pressure, there is the potential for soil heave near the column. To eliminate the potential to damage nearby improvements, DDCs may need to be set back a horizontal distance from adjacent structures.

Deep Soil Mixing

Deep soil mixing involves advancing a hollow shaft with mixing paddles and/or a section of auger into the soil. As the hollow auger is advanced, cement grout is pumped through the hollow stem auger and discharged laterally at the lower portion of the auger where it is mixed with the native soil. When the desired depth is reached, the hollow stem auger is withdrawn while maintaining or increasing the rotational speed of the auger. The resulting columns of native soil and cement grout cure over time to the required design strength. In addition, steel rebar can also be installed and connected to the foundations to provide uplift capacities.

On a preliminary basis, we recommend that ground improvement be performed to depth of up to 25 feet. Foundations proposed within improved ground generally have an allowable bearing of 4,000 to 5,000 psf. Ground improvement is designed and installed by a specialty contractor, the depth, spacing and bearing should be provided by the specialty contractor. A work plan of the proposed ground improvement should be provided to LANGAN for review.

Care should be taken during any ground improvement for adjacent site walls, so as not to cause damage. The existing site wall should be monitored due to the potential effects of ground improvement procedures. The effects of ground improvement within 30 feet of the site should be evaluated by the specialty contractor to determine if these potential effects are acceptable.

Rammed Aggregate Piers (RAPs)

RAPs are typically constructed by drilling a 30 to 36-inch-diameter hole and backfilling the hole with aggregate. The design depth of the RAP is based on the thickness of the improved layer. The bottom of the RAP is compacted with a hydraulic tamper before the column is filled with aggregate. The aggregate for the RAP is compacted in 12-inch lifts using a hydraulic tamper attached to an excavator. RAP systems are generally installed under design-build contracts by specialized contractors and can have allowable bearing capacities of 6,000 to 8,000 psf. The allowable bearing is determined after a modulus load test program.

A pre-construction RAP modulus load test program is recommended to verify the RAP elements and structural capacities, based on the contractor's construction means and methods. A full-scale static axial load test program should be developed and performed in accordance with appropriate portions of ASTM D1143 and ASTM D1194.

At this time, we recommend a minimum of one load test, the modulus load test program should be performed prior to constructing production RAPs and under full-time observation of a geotechnical engineer to confirm that the installation techniques are suitable to achieve the required stiffness and capacity. The test RAPs should be loaded to a proof load of double the design stress.

Care should be taken during any ground improvement for adjacent site walls, so as not to cause damage. The existing site wall should be monitored due to the potential effects of ground improvement procedures. The effects of ground improvement within 30 feet of the site should be evaluated by the specialty contractor to determine if these potential effects are acceptable.

5.4 Preliminary Shallow Foundation Design – Student Housing Structures

We anticipate the student housing structures would have individual column loads ranging from 300 to 600 kips.

Following completion of ground improvement, a shallow foundation system (spread or continuous footings), bearing on properly prepared and compacted subgrade can be designed with a preliminary bearing pressures of 4,000 to 6,000 pounds per square foot (psf) or higher depending on the type of ground improvement used for liquefaction mitigation. Recommended allowable bearing values including both dead and live loads, and may be increased by one-third for transient loads such as wind or seismic forces.

Spread or continuous footings bearing on improved ground and design in accordance with the above parameters are anticipated to settle less than 1-inch under static loading, with differential settlements of less than ½-inch between adjacent columns. Settlements under dynamic loading are calculated to be up to 1-inch depending on depth of ground improvement.

An ultimate coefficient of friction of 0.35 times the dead load forces may also be used between concrete and the supporting soils for lateral sliding resistance for concrete footings on approved subgrade. If additional lateral resistance is required, a passive earth pressure of 150 pounds per square foot per foot of depth may be used for lateral resistance against the side of the footing. The passive pressure may be increased by 1/3 for transient loading conditions, such as earthquake or wind; however, no increase should be applied to the friction factor.

Footing excavations should be performed using a backhoe bucket fitted with a smooth steel plate welded across the bucket teeth to minimize disturbance during excavation and to provide a smooth bearing surface. Any areas loosened by excavation should be over excavated and recompacted or replaced with structural fill, placed in accordance with the recommendations included in this report, or lean concrete.

The foundation subgrade should be observed and approved by a qualified Geotechnical Engineer prior to steel or concrete placement. The foundations should be constructed as soon as possible following subgrade approval. The contractor shall be responsible for maintaining the subgrade in its approved condition (i.e. free of water, debris, etc.) until the footing is constructed.

5.5 Preliminary Deep Foundation Design – Student Housing Structures

As an alternative to shallow foundations on ground improvement, the proposed student housing structures could be supported on deep foundations such as, augered cast-in-place (ACIP) piles and driven piles. High capacity deep foundation elements can provide efficient support for the student housing structures. The deep foundation elements would receive their primary support through side resistance ("skin friction or side shear") along the pile-soil interface. Over the past 10 years, augered-cast-in-place (ACIP) piles have proven to be a technically and economically effective deep foundation system as well, and are currently being installed on other notable projects in Los Angeles areas.

Augered cast-in-place (ACIP) piles and driven piles foundation systems have also been used but require additional load testing and construction verification. Such piles typically range in diameter from approximately 12 to 24 inches, however, larger diameter elements have been used. The design of deep foundation systems are depending on required loading and ground conditions, length, diameter, concrete/grout strength, and steel reinforcing.

Based upon the current proposed locations of the two student housing structures, and our review of the subsurface conditions encountered in the investigations performed to date, the foundations are anticipated to be underlain by loose sands in the upper 20 feet, underlain by medium dense to very dense sands and gravels with varying amounts of clay or silt and stiff to very stiff clays and silts with varying amounts of sand and gravel. Additional foundation design recommendations are provided in the following sections.

The recommendations provided below are preliminary and will be confirmed or updated as part of our preliminary geotechnical report which will include compression and uplift side shear recommendations, lateral resistance recommendations, settlement considerations, installation recommendations, and load test recommendations. Estimates of lateral capacity will be a function of the foundation type, geometry, foundation stiffness, and soil conditions. We can provide these recommendations if requested by structural engineer. Settlement estimates of deep foundation systems will be a function of the structural loading, foundation diameter and length, pile cap size, and various factors.

Regardless of the deep foundation type chosen, it will be necessary to perform a pre-construction test pile and pile load test program to verify the pile element's geotechnical and structural capacities, as well as the contractor construction means and methods required to provide suitable piles on a production basis.

Auger Cast-In-Place (ACIP) Axial Capacities

ACIP piles are installed by advancing a hollow-stem, continuous flight auger to a pre-determined length into the bearing strata is attained. After attaining the required embedment, grout is then injected through the hollow-stem auger to establish an initial head of grout above the tip of the auger. After establishing the required head of grout above the auger tip, the auger is extracted while continually pumping grout through the hollow-stem and maintaining a positive clockwise rotation of the auger. The supply of grout is accomplished in a controlled manner while coordinating the extraction rate such that a continuous, integral, cast-in-place element is constructed. Computerized automated monitoring equipment (AME) is used to monitor the auger depth, rotation, crowd, torque, and grout volume during pumping. Upon completion of the grouting operation, any accumulated spoils are removed or screened to allow insertion of the internal reinforcing steel through the fluid grout. Reinforcement typically consists of an upper circular, tied reinforcing cage with a lower reduced section or single bar extension such that steel extends to the tip of the pile.

Based on our local experience, ACIP piles have been successfully installed to provide the allowable side shear values and capacities using uncased drilling techniques with natural slurry. However, the need to partially case or use engineered slurry cannot be completely ruled out. The impact of these procedures, if necessary, on the side shear capacity of the deep foundation elements would need to be tested.

Based on our review of the subsurface information obtained to date, for properly constructed ACIP piles, an allowable side shear of 500 pounds per square foot (psf) in compression may be used for design. The recommended design value assume a factor safety of 2.5 for side shear resistance in compression and do not consider end-bearing support. For preliminary design, the 18-inch diameter ACIP pile is considered practical size considering the anticipated building loads.

The load carrying capacities of an 18-inch diameter ACIP pile can be designed with 130 to 170 kips for a 50 to 60 feet long ACIP, respectively.

The ACIP pile capacities for design also need to take into account the downdrag (i.e., negative skin fiction) effect of the liquefiable layers. We recommend the tip of piles should be below the liquefiable soil layers. The 18-inch, 24-inch and 30-inch piles should be designed to account for sufficient downdrag loads of 32 kips, 42 kips, and 53 kips, respectively. Based on our evaluation of the subsurface conditions, we have provided allowable compressive capacities for a range of drilled shaft diameters and embedment lengths in the table below.

Embedment Length (feet)	Allowable Compressive Capacity with Downdrag (kips)		
	18-inch Diameter	24-inch Diameter	30-inch Diameter
50	100	134	167
55	119	159	198
60	137	183	229
65	155	207	258

The allowable axial capacities are based on a factor of safety of 2.5, which assumes load tests are performed prior to installation of production shafts. Movement of the longer drilled shafts under the anticipated service loads are not large enough to mobilize full end bearing resistance; therefore, for shafts larger than 10 times the shaft diameter, end bearing resistance is neglected. The contribution of end bearing resistance may be evaluated on a case by case basis once shaft service loads and lengths have been selected to optimize the shaft lengths and based on our evaluation of the results of the load tests discussed later in this report. Uplift resistance of the drilled shafts can be taken as one-half the allowable compressive capacity.

Center to center shaft/pile spacing of three times the element diameter is recommended for design. For this case, no reduction in individual capacity is needed for the expected small shaft / pile groupings. Since we anticipate final design groupings of only one to three piles, we do not anticipate the need to analyze closer spacing for group effect. If closer spacing is ultimately required, we would need to evaluate the impact of group effect on a layout specific basis.

We have presumed the above pile lengths are referenced from the bottom of the cap. Assuming the existing ground surface will be close to finished grade, we anticipate that an approximately 5-foot excavation would be required for pile caps.

Lateral Resistance

We performed preliminary LPILE computer analyses based on subsurface conditions at the Site for an 18-inch, 24-inch and 30-inch diameter ACIP piles, nominally reinforced with a circular reinforcing cage consisting of 2 percent steel by gross area and 4,500 pounds per square inch (psi) concrete. The tables below provides individual lateral capacities for free head and fixed head shafts embedded 50 feet and spaced at 3 diameters center-to-center for various levels of deflection.

Shaft Diameter (inches)	Axial Capacity Applied at Top of Shaft (kips)	Top of Shaft Deflection (inches)	Lateral Capacity – Free Head (kips)	Lateral Capacity with Liquefaction – Free Head (kips)
18	100	0.25	13	13
		0.5	18	17
		1	24	24
24	130	0.25	24	23
		0.5	32	31
		1	44	42
30	160	0.25	36	35
		0.5	49	45
		1	69	61

Shaft Diameter (inches)	Axial Capacity Applied at Top of Shaft (kips)	Top of Shaft Deflection (inches)	Lateral Capacity – Fixed Head (kips)	Lateral Capacity with Liquefaction – Fixed Head (kips)
18	100	0.25	27	26
		0.5	38	36
		1	49	48
24	130	0.25	48	40
		0.5	67	56
		1	92	80
30	160	0.25	74	57
		0.5	104	78
		1	144	109

These capacities could decrease with lower axial loading. The lateral resistances tabulated in the tables above are for isolated shafts and for shafts in a group with spacing of at least 6 shaft diameters. If shafts are installed in a group of up to 4 shafts with spacing of 3 shaft diameters, we recommend reducing the lateral capacities by 15 percent. However, the design bending moments should not be reduced. If larger shaft groups or different configurations are needed to support the building, we can provide the reduction factors for these groups upon request.

ACIP Pile or Shaft Installation Procedure

ACIP piles are installed by advancing a hollow-stem, continuous flight auger to a pre-determined length into the bearing strata is attained. After attaining the required embedment, grout is then injected through the hollow-stem auger to establish an initial head of grout above the tip of the auger. After establishing the required head of grout above the auger tip, the auger is extracted while continually pumping grout through the hollow-stem and maintaining a positive clockwise rotation of the auger. The supply of grout is accomplished in a controlled manner while coordinating the extraction rate such that a continuous, integral, cast-in-place element is constructed. Computerized automated monitoring equipment (AME) is used to monitor the auger depth, rotation, crowd, torque, and grout volume during pumping. Upon completion of the grouting operation, any accumulated spoils are removed or screened to allow insertion of the internal reinforcing steel through the fluid grout. Reinforcement typically consists of an upper circular, tied reinforcing cage with a lower reduced section or single bar extension such that steel extends to the tip of the pile. Due to the need to attain a relatively high capacity ACIP pile load carrying capacities and the anticipated subsurface conditions, which would include augering through caliche, it is essential that high powered (i.e., sufficient dead weight, crowd, and torque) ACIP equipment be utilized.

ACIP Pile Load Test Recommendations

A pre-construction test pile and pile load test program should be performed to verify the geotechnical and structural capacities, based on the contractor's construction means and methods. A full-scale static axial load test program should be developed and performed, in accordance with ASTM D1143 (compression), and ASTM D3689 (tension) uplift, under full-time observation of a geotechnical engineer to verify the capacities of the piles. If the piles are being relied upon for lateral load, then a lateral load test may also be required.

The test pile program should be performed at locations pre-selected by the project Structural Engineer and Geotechnical Engineer prior to the installation of production piles to confirm that the installation and grouting or concreting techniques are suitable to achieve the required side shear resistance.

Driven Pile Axial Capacities

As an alternative to ACIP, the proposed student housing structures can be supported on driven piles. For preliminary design, the 16-inch square pre-cast, pre-stress concrete driven pile is considered practical size. Our preliminary liquefaction analysis indicated potential liquefiable layers at the depths ranging from 10 to 25 feet and some small thickness layers below 25 feet. Therefore, driven piles will be subjected to downdrag effect of the liquefiable layers when soils in contact with the upper portion of the foundation move downward relative to the movement of the piles under its external loading. The resulting downward force will add to the force applied to the pile by the structure and can lead to excessive settlement of foundation. Therefore, settlement considerations are anticipated to control the minimum pile lengths. The driven pile capacities for design also need to take into account the downdrag effect of the liquefiable layers. Driven pile may anticipate greater downdrag effects.

To provide satisfactory bearing while controlling settlements, we recommend a minimum embedment length of 50 feet below pile cutoff elevation into the dense to very dense layer of sandy soils. An allowable side shear of 500 pounds per square foot (psf) in compression may be used for design. The load capacities for a 16-inch square pre-cast and pre-stress concrete driven piles can be designed with 150 to 175 kips for a 50 to 65 feet long driven pile, respectively. The piles should be designed to account for sufficient dowdrag loads of 36 kips in addition to the building loads.

Piles should be spaced 2 times the widths of the pile, sidewall to sidewall. If closer spacing is required, we would need to evaluate the impact of group effect on a layout specific basis.

<u>Driven Pile Installation Procedure</u>

Piles are typically installed using an impact pile hammer to drive piles into the ground to a design depth and seating blow counts that are determined by an indicator pile test program. Pile driving would cause vibration and noise, which may impact neighboring buildings or structures. A vibration monitoring program should be implemented to monitor vibration levels at neighboring structures during driven pile installation.

<u>Driven Pile Indicator Test Recommendations</u>

Indicator pile installation and full-scale static compression, uplift, and lateral load tests should be performed to confirm pile capacities, pile designs, drive pile lengths and final driving criteria prior to start of production pile driving. Pile load test should be performed in accordance with ASTM D1143 (compression), ASTM D3689 (tension) uplift, and ASTM D3966 (lateral). Indicator piles should be driven at locations selected by the Structural Engineer and Geotechnical Engineer and subjected to dynamic testing. The indicator piles should be the same in every respect to the intended production piles. Dynamic testing of the indicator piles should be performed using Pile Driving Analyzer (PDA) during driving to: measure delivered energy from selected pile driving hammer(s), measure pile stresses during driving, confirm pile capacities at the end of driving and after selected waiting periods, and finalize driving criteria.

5.6 Expansive Soils

Expansive soils swell or shrink when the moisture content of the soil changes. A soil's moisture content can change through cyclic wet/dry weather cycles, variations in the groundwater level, installation of irrigation systems, change in landscape plantings, and changes in site grading. Leaking utilities can also drastically change soil moisture content.

Potentially expansive soils are defined by the 2022 CBC as soils with expansion indices (EI) of greater than 20. Based on laboratory testing of soils within the upper 5-feet from the existing parking lot pavement surface shows a very low expansion potential (i.e. EI=1).

The Site should be designed to promote positive drainage away from the tops of shoring systems and building footprints, and landscaping should consist of mainly drought tolerant native planting that requires limited irrigation.

5.7 Soil Corrosion

Chemical analyses performed on a select sample obtained from the borings for this study is summarized below.

Sample	Soil Type	Depth (feet)	Resistivity (ohm-cm)	pH	Soluble Sulfate (ppm)	Chloride (ppm)
LB-1/B-1	Clayey Sand	0 - 5	7300	7.5	98	37

Based on the corrosion test results, the alluvial soils in the upper 5 feet are considered to be non-corrosive to concrete and low to moderately corrosive ferrous metals. Based on ACI 318 the soil as Exposure Class S0 for sulfate and Exposure Class C0 for chloride. A corrosion expert should be consulted if metal pipe is proposed to be in contact with soil. Based on the laboratory data summarized herein, ACI 318-14 does not have any type of restriction for the current conditions (ASTM C150), no requirements for a maximum water-to-cement ratio, and a minimum specified compressive strength (f'c) of 2,500 pounds per square inch (psi) is required. A copy of the corrosion test results for this study is provided in Appendix D.

5.8 Floor Slabs

Floor Slabs On Improved Ground

Ground floor slabs can be designed as slabs-on-grade bearing on prepared subgrade over improved ground. The slabs can be designed using the following minimum recommendations for bearing on compacted fill.

- After ground improvement, the entire slab on grade area should be proof-rolled with a vibratory drum roller;
- Subgrade modulus, k, equal to 125 pounds per cubic inch (pci);
- Four (4) inches of clean sand with a 15-mil polyethylene capillary break moisture barrier placed at mid-thickness and overlapping at least six (6) inches between joints;
- Steel reinforcing should be designed by the structural engineer.

Structural Slabs On Grade

The proposed floor slabs should be designed as a structural concrete slab design to be supported on the piles. Steel reinforcing and concrete thickness should be designed by the project Structural Engineer. We recommended as a minimum using the following recommendations:

- 5 inch minimum thickness, and
- A moisture barrier between the base course and concrete floor slab consisting of 4 inches of clean sand with 15-mil polyethylene capillary break shall be placed mid-height and with joints lapped not less than 6 inches.

5.9 Pavement Recommendation

The appropriate pavement section depends on the type and strength of subgrade soil, traffic load, and planned pavement life. Recommendations provided herein are in accordance with the 2020

California Department of Transportation Highway Design Manual (HDM) and "American Concrete Institute 330R-01 – Guide for design and construction of Concrete Parking Lots".

Based on the soil conditions present at the Site and estimated traffic volume, preliminary pavement sections are provided in the following table. Based on laboratory results the onsite sandy soils in the upper 5 feet indicate an "R-value" of 72, however an R-value of 50 was used in design based on CalTrans requirements and conservatism. The sections provided herein are for planning purposes only and should be re-evaluated subsequent to site grading. Final pavement sections should be based on actual R-value testing of in-place soils and analysis of anticipated traffic.

In addition, for the proposed temporary parking lot, the laboratory results of the upper 5 feet yield an "R-value" of 62. Therefore, these recommendations are also applicable for the proposed temporary parking lot.

Preliminary Pavement Recommendations			
Pavement Area	**Traffic Index**	**Section Thickness (Inches)**	
		Asphalt Concrete	**Aggregate Base**
Auto Parking Areas	5.0	3	3
Driveway Areas	7.0	4	5

Pavements are presumed to be underlain by subgrade soils consisting of alluvium. Subgrade soils should be overexcavated 24 inches and recompacted to 95 percent relative compaction prior to placement of aggregate base and asphalt concrete. The subgrade should be moisture conditioned to within 2 percent of optimum moisture content, and compacted to a minimum of 95 percent of the laboratory maximum dry density, as determined by ASTM D1557 (Modified Proctor), within the upper 12 inches. Aggregate base should be moisture conditioned to within 2 percent of optimum moisture content compacted to a minimum of 95 percent of the laboratory maximum dry density, as determined by ASTM D1557 (Modified Proctor).

6.0 CONSTRUCTION CONSIDERATIONS

Prior to the commencement of excavation and grading, a meeting should be held at the site with the owner, city inspector, excavation/grading contractor, civil engineer, and Geotechnical Engineer to discuss the work schedule and geotechnical aspects of the grading.

All pavement, vegetation, and deleterious materials should be disposed of off-site prior to initiation of grading operations.

Any foundation and abandoned utility remnants or construction debris associated with former site structures encountered within excavations should be fully removed, where practical, and any void spaces that may be created should be backfilled with approved compacted structural fill. If utility pipes are too deep to be removed economically in proposed pavement areas, they should be filled with cement and sand grout or equivalent material that will prevent future collapse of the pipe.

The overexcavation requirements are minimums for each aspect of the proposed project:

- Proposed pavements need a minimum of 2 feet removal and recompaction.

After completion of excavation, including removal of all below grade remnants, stripping, grubbing, removal of asphalt, base course material, the soil subgrade should be compacted in-place by proofrolling with at least 6 passes of a vibratory roller compactor having a minimum static drum weight of 5 tons. Any areas exhibiting rutting or pumping should be removed and replaced with compacted engineered fill material.

Any soft, loose, or unsuitable soils identified by the geotechnical engineer or his/her representative during subgrade preparation should be removed and replaced with approved compacted fill.

Any environmentally unsuitable soils encountered during the excavation process should be removed and properly disposed of off-site in accordance with all state and local regulations.

Surface site elements, such as site pavers, planters, and walkways can be supported on subgrade soils comprised of compacted fill or native alluvial soils prepared in accordance with the recommendations provided herein.

6.1 Fill Material and Compaction Criteria

The onsite soils are geotechnically suitable for use on site as engineered fill. Fill material (imported or re-used) should be free of organic, frozen, and other deleterious materials and have a maximum particle size no greater than 4 inches. Imported fill should be free of deleterious materials, be non-corrosive, contain no more than 12 percent passing the no. 200 sieve by dry weight and have a plasticity index less than 7. Grain size distributions, Atterberg Limits, maximum dry density, and optimum water content determinations should be made on representative samples of the proposed fill material.

6.2 Site Drainage and Temporary Construction Dewatering

Proper drainage should be maintained at all times. Ponding or trapping of water in localized areas can cause differing moisture levels in the subsurface soil. Drainage should be directed away from the tops of slopes. Erosion protection and drainage control measures should be implemented during periods of inclement weather. During rainfall events, backfill operations may need to be restricted to allow for proper moisture control during fill placement.

6.3 Utility Support

Utilities can be supported on native soils, or bearing on fill. Utilities should be backfilled with excavated on-site alluvium soils or Caltrans Class 2 base, or equivalent, unless otherwise required by the utility owner. Bedding material should be separated from the underlying subgrade material with a geo-synthetic fabric (Mirafi 140N, or equivalent). The bedding material should extend at least 6-inches over the top of the utility, unless otherwise required by the utility owner. Utility trenches above pipe bedding should be backfilled using previously excavated soil (if suitable) or approved imported material.

6.4 Flatwork

Flatwork can be supported on 12 inches of removed and recompacted engineered fill, consisting of the upper 12 inches of onsite soils. The excavation bottom be should be scarified and proofrolled and any areas loose or soft areas should be removed prior to placing new fill. Over excavated material can be used as engineered fill in accordance with recommendations in this report.

Based on our laboratory test results the near-surface soils are generally anticipated to possess a very low-to-low expansion potential.

7.0 FUTURE GEOTECHNICAL SERVICES AND INTERACTION

The conclusions and recommendations included in this report were developed in support of the analysis for the feasibility report. At this time, we recommend the following listed below as the design progresses.

- Review of structural loading, preliminary foundation types, and refinement of settlement estimates;
- Confirmatory design phase investigations and analysis.

8.0 SERVICES DURING DESIGN, CONSTRUCTION DOCUMENTS AND CONSTRUCTION QUALITY ASSURANCE

During final design we should be retained to consult with the design team as geotechnical questions arise. Technical specifications and design drawings should incorporate Langan's recommendations. When authorized, Langan will assist the design team in preparing specification sections related to geotechnical issues such as earthwork, ground improvement, shallow foundations, backfill and excavation support. Langan should also, when authorized, review the project plans, as well as Contractor submittals relating to materials and construction procedures for geotechnical work, to confirm the designs incorporate the intent of our recommendations.

Langan has investigated and interpreted the site subsurface conditions and developed the foundation design recommendations contained herein, and is therefore best suited to perform quality assurance observation and testing of geotechnical-related work during construction. The work requiring quality assurance confirmation and/or special inspections per the Building Code includes, but is not limited to, earthwork, backfill, ground improvement, shallow and deep foundations, and excavation support.

Recognizing that construction observation is the final stage of geotechnical design, quality assurance observation during construction by Langan is necessary to confirm the design assumptions and design elements, to maintain our continuity of responsibility on this project, and allow us to make changes to our recommendations, as necessary. The foundation system and general geotechnical construction methods recommended herein are predicated upon Langan assisting with the final design and providing construction observation services for the Owner. Should Langan not be retained for these services, we cannot assume the role of geotechnical engineer of record, and the entity providing the final design and construction observation services must serve as the engineer of record.

9.0 LIMITATIONS

The conclusions and recommendations provided in this report result from our interpretation of the subsurface conditions encountered in a limited number of boring and CPTs, as well as architectural and structural information provided by Cypress College. Any proposed changes in structures or their locations should be brought to LANGAN's attention as soon as possible so that we can determine whether such changes affect our recommendations.

This report has been prepared to assist the Owner, Owner's representative, architect, and structural engineer in the design process during the entitlement phase of the project and is only applicable to the design of the specific project identified. The information in this report cannot be utilized or depended on by engineers or contractors who are involved in evaluations or designs of facilities (including underpinning, grouting, stabilization, etc.) on adjacent properties which are beyond the limits of that which is the specific subject of this report.

Environmental issues (such as permitting or potentially contaminated soil and groundwater) are outside the scope of this study and should be addressed in a separate evaluation.

We appreciate the opportunity to have provided these services for this project. Should you have any questions regarding this report, please feel free to contact us.

10.0 REFERENCES

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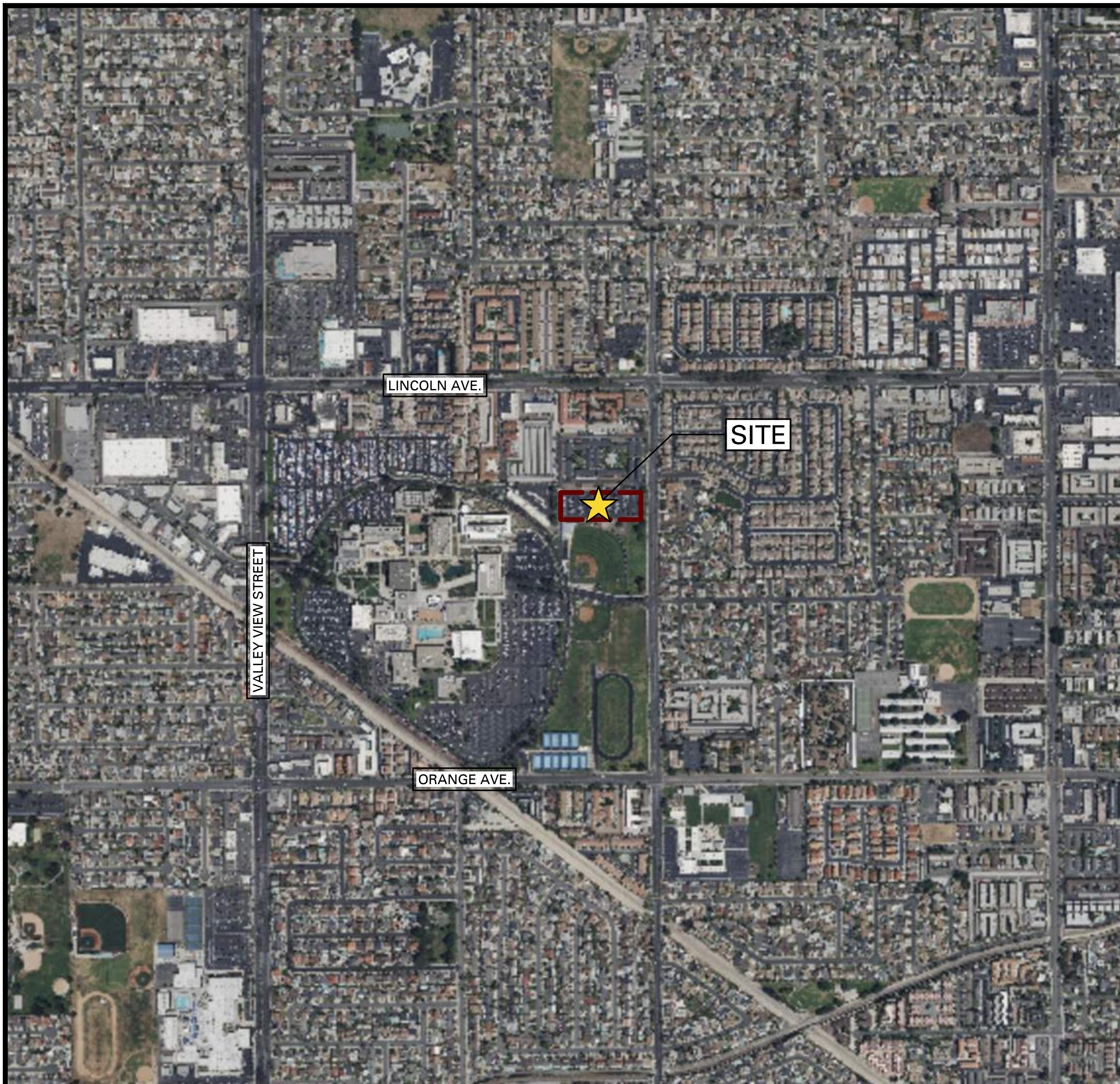
FIGURES



LANGAN

LEGEND:

SITE LIMITS

NOTES:

1. BACKGROUND REFERENCED FROM BING IMAGES ON 03 NOVEMBER 2022.

1000 500 0 1000

SCALE IN FEET

LANGAN

Langan Engineering and Environmental Services, Inc.

18575 Jamboree Road, Suite 150
Irvine, CA 92612

T: 949.561.9200 F: 949.561.9201 www.langan.com

Project	Figure Title	Project No.	Figure No.
CYPRESS COLLEGE STUDENT HOUSING CYPRESS ORANGE COUNTY CALIFORNIA	SITE VICINITY MAP	700123501	1
		Date: NOVEMBER 2022	
		Scale: AS SHOWN	
		Drawn By: JMG	

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Legend

Approximate site boundary

Qya$_2$ - Young Alluvium, Unit 2

Notes:
1. Site located in the Los Alamitos USGS Quadrangle.
2. Imagery courtesy of Geologic Map of the Long Beach 30'x60' Quadrangle, California, Saucedo et al. 2016.
3. All features shown are approximate.

2,000 0 2,000

SCALE IN FEET

LANGAN Langan Engineering and Environmental Services, Inc. 18575 Jamboree Road, Suite 150 Irvine, CA 92612 T: 949.561.9200 F: 949.561.9201 www.langan.com	Project **CYPRESS COLLEGE STUDENT HOUSING STUDY** CYPRESS ORANGE COUNTY CALIFORNIA	Figure Title **REGIONAL GEOLOGIC MAP**	Project No. 700123501 Date NOVEMBER 2022 Scale 1" =2,000 ' Drawn By OG	Figure 2

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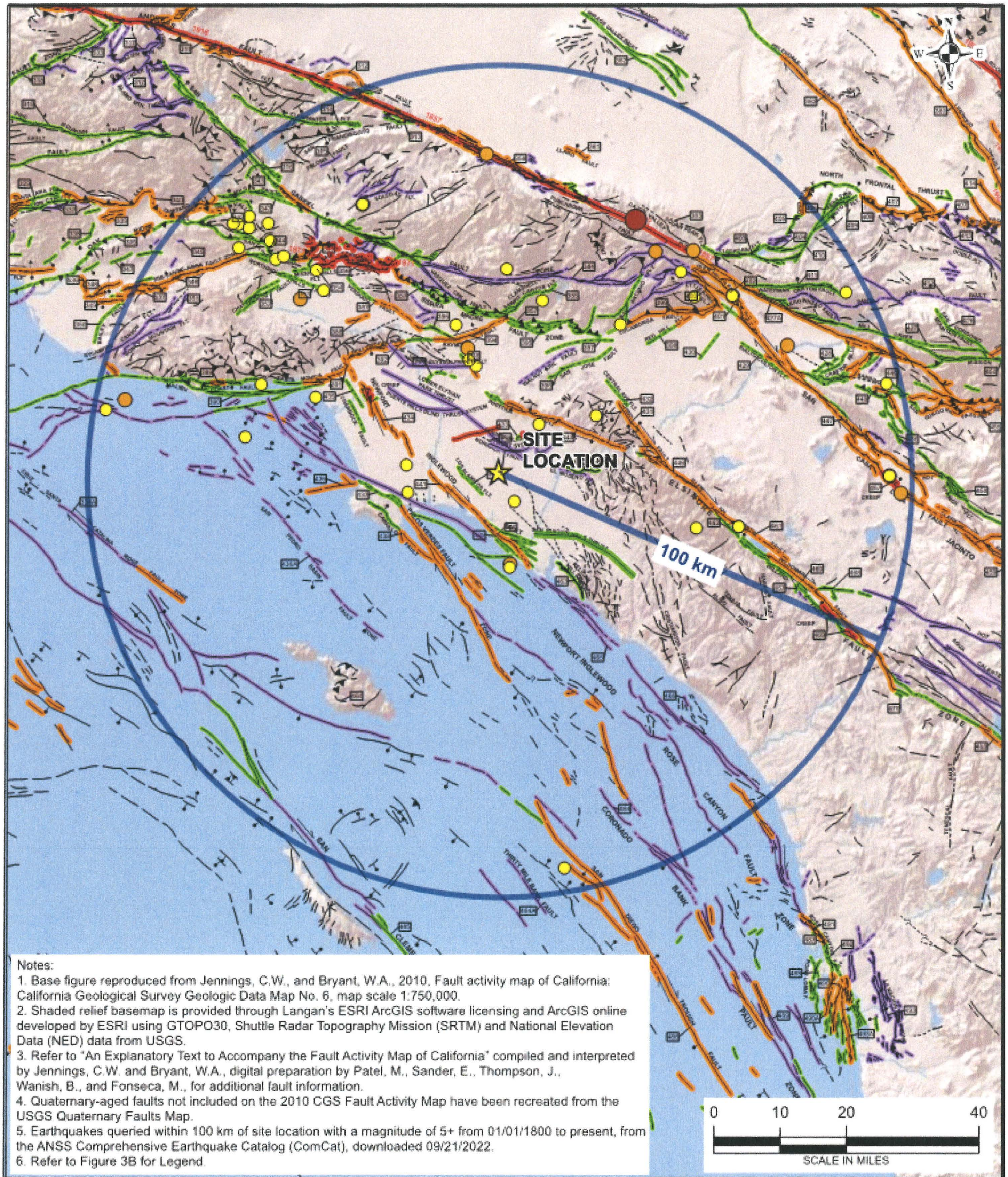

Notes:
1. Base figure reproduced from Jennings, C.W., and Bryant, W.A., 2010, Fault activity map of California: California Geological Survey Geologic Data Map No. 6, map scale 1:750,000.
2. Shaded relief basemap is provided through Langan's ESRI ArcGIS software licensing and ArcGIS online developed by ESRI using GTOPO30, Shuttle Radar Topography Mission (SRTM) and National Elevation Data (NED) data from USGS.
3. Refer to "An Explanatory Text to Accompany the Fault Activity Map of California" compiled and interpreted by Jennings, C.W. and Bryant, W.A., digital preparation by Patel, M., Sander, E., Thompson, J., Wanish, B., and Fonseca, M., for additional fault information.
4. Quaternary-aged faults not included on the 2010 CGS Fault Activity Map have been recreated from the USGS Quaternary Faults Map.
5. Earthquakes queried within 100 km of site location with a magnitude of 5+ from 01/01/1800 to present, from the ANSS Comprehensive Earthquake Catalog (ComCat), downloaded 09/21/2022.
6. Refer to Figure 3B for Legend.

LANGAN Langan Engineering and Environmental Services, Inc. 18575 Jamboree Road, Suite 150 Irvine, CA 92612 T: 949.561.9200 F: 949.561.9201 www.langan.com	Project **CYPRESS COLLEGE STUDENT HOUSING STUDY** CYPRESS ORANGE COUNTY CALIFORNIA	Figure Title **MAP OF MAJOR FAULTS AND EARTHQUAKE EPICENTERS**	Project No. 700123501 Date NOVEMBER 2022 Scale 1 inch = 20 miles Drawn By TO	Figure 3A

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LEGEND:

☆ Site Location

Fault Age

- Historic
- Holocene
- Late Quaternary
- Early Quaternary
- Pre-Quaternary Fault
- 100 km Search Radius

Earthquake Epicenter

- Magnitude 5.0 to 5.9
- Magnitude 6.0 to 6.9
- Magnitude 7.0 to 7.4
- Magnitude 7.5 to 8.0

Fault Symbols

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

Relative or apparent direction of lateral movement.

Direction of dip.

Low angle fault (barbs on upper plate). Fault surface generally dips less than 45° but locally may have been subsequently steepened.

491 Numbers refer to annotations listed in the appendices of the accompanying report.

Structural discontinuity (offshore) separating differing Neogene structural domains.

Brawley Seismic Zone.

Fault Classification

Fault along which historic (last 200 years) displacement has occurred and is associated with one or more of the following:
(a) a recorded earthquake with surface rupture. (Also included are some well-defined surface breaks caused by ground shaking during earthquakes, e.g. extensive ground breakage, not on the White Wolf fault, caused by the Arvin-Tehachapi earthquake of 1952). The date of the associated earthquake is indicated. Where repeated surface ruptures on the same fault have occurred, only the date of the latest movement may be indicated, especially if earlier reports are not well documented as to location of ground breaks.
(b) fault creep slippage - slow ground displacement usually without accompanying earthquakes.
(c) displaced survey lines.

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

▶1906◀ Date bracketed by triangles indicates local fault break.

1906 No triangle by date indicates an intermediate point along fault break.

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

1906 ■ Square on fault indicates where fault creep slippage has occurred that has been triggered by an earthquake on some other fault. Date of causative earthquake indicated. Squares to right and left of date indicate terminal points between which triggered creep slippage has occurred (creep either continuous or intermittent between these end points).

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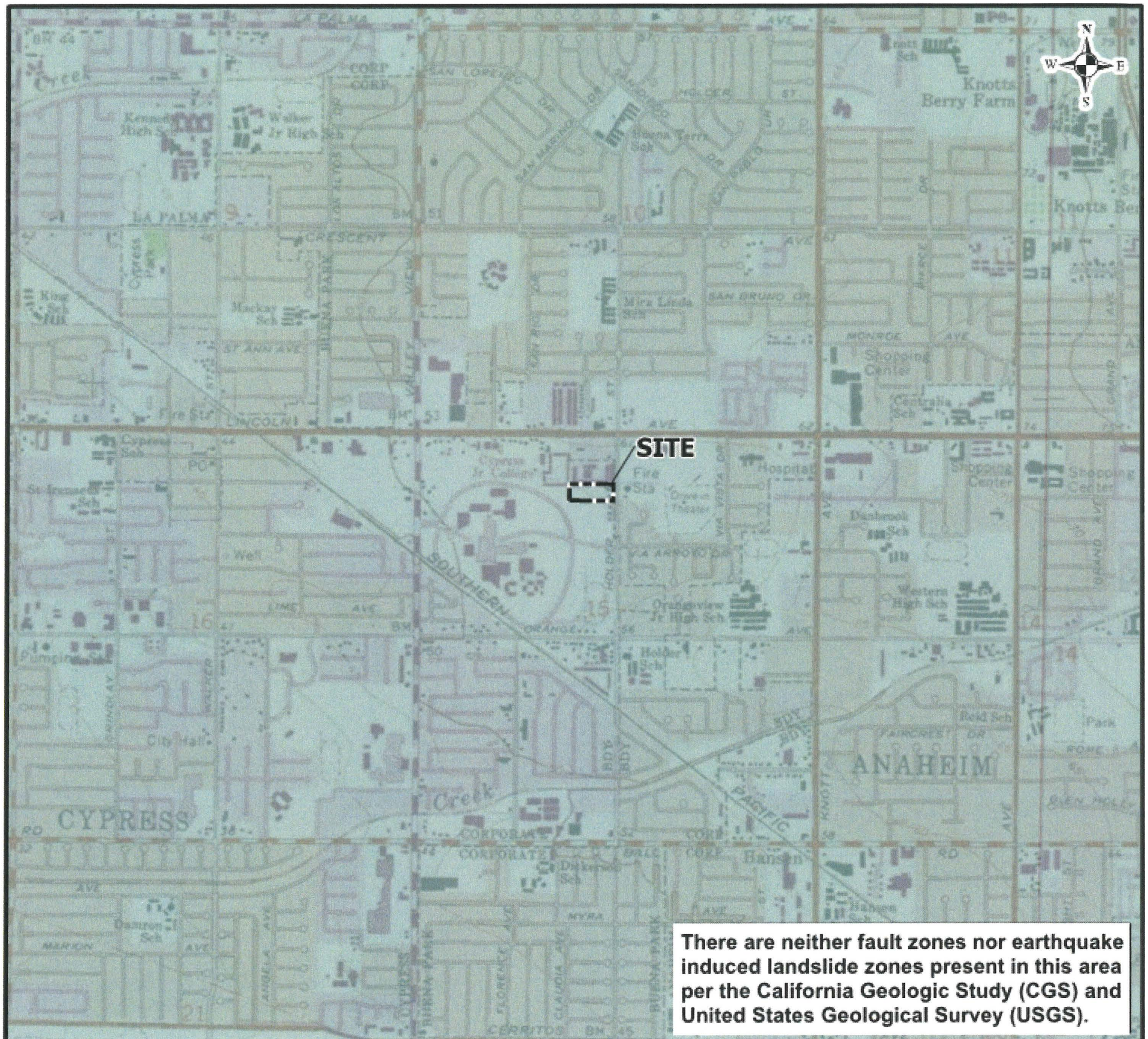
Langan Engineering and Environmental Services, Inc.
18575 Jamboree Road, Suite 150
Irvine, CA 92612
T: 949.561.9200 F: 949.561.9201 www.langan.com

Project	Figure Title	Project No.	Figure
CYPRESS COLLEGE STUDENT HOUSING STUDY CYPRESS ORANGE COUNTY, CALIFORNIA	MAP OF MAJOR FAULTS AND EARTHQUAKE EPICENTERS LEGEND	700123501 Date: NOVEMBER 2022 Scale: NOT TO SCALE Drawn By: TO	3B



Legend

Liquefaction Zones

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

Notes:

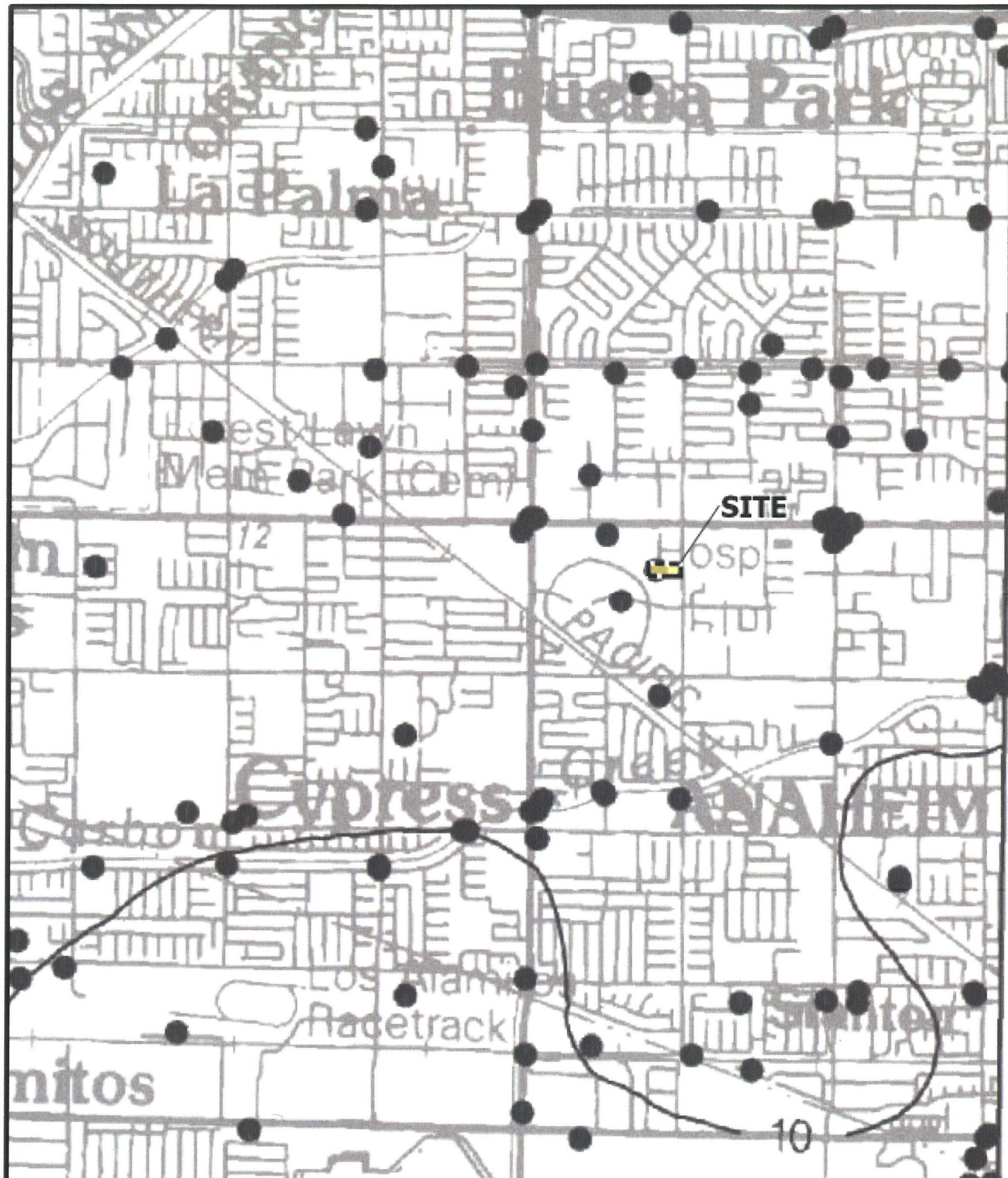
1. Seamless Topographic basemap is provided through Langan's Esri ArcGIS software licensing and ArcGIS online, National Geographic Society, i-cubed.
2. Liquefaction Susceptibility dataset provided in GIS format by the California Department of Conservation. This data is preliminary and has not been reviewed for conformity with United States Geological Survey (USGS) editorial standards or with the North American Stratigraphic Code.

2,000 0 2,000

SCALE IN FEET

LANGAN	Project	Figure Title	Project No.	Figure
Langan Engineering and Environmental Services, Inc. 18575 Jamboree Road, Suite 150 Irvine, CA 92612 T: 949.561.9200 F: 949.561.9201 www.langan.com	CYPRESS COLLEGE STUDENT HOUSING STUDY CYPRESS ORANGE COUNTY CALIFORNIA	EARTHQUAKE AND LIQUEFACTION HAZARDS	700123501 Date: NOVEMBER 2022 Scale: 1" =2,000 ' Drawn By: OG	4

Path: \\langan.com\data\IRV\data5\700123501\Project Data\ArcGIS\APRX\Desktop Study 700123501.aprx Date: 11/28/2022 User: Toulie Time: 4:19 PM



Legend

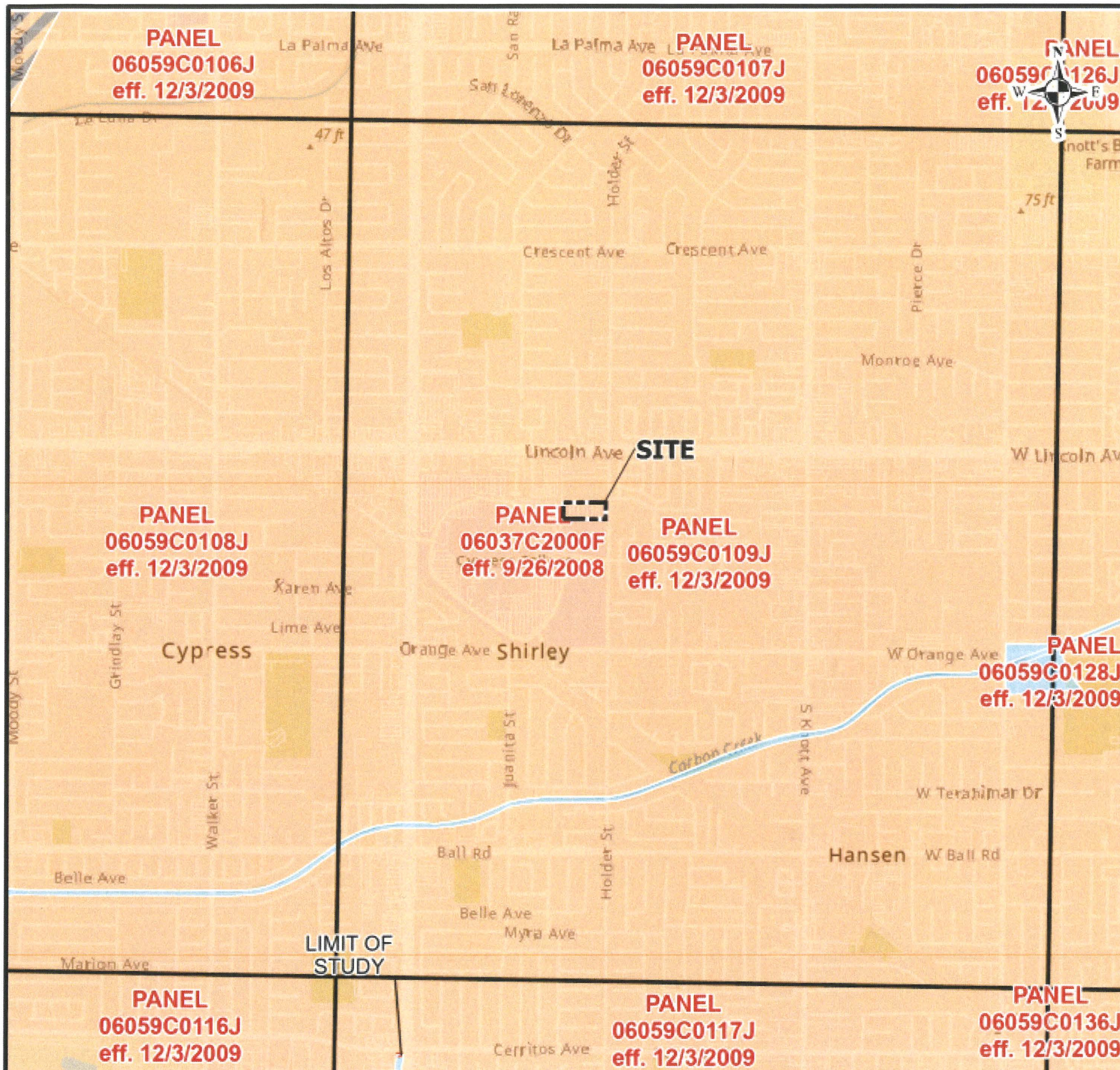
- Borehole Site
- Depth to groundwater (feet)
- Approximate Site Boundary

Notes:
1. "Plate 1.2 Historically Highest Ground Water Contours and Borehole Log Data Locations, Los Alamitos Quadrangle" provided by United States Geographical Survey (USGS), date unknown.
2. All features shown are approximate.

3,000 0 3,000
SCALE IN FEET

LANGAN Langan Engineering and Environmental Services, Inc. 18575 Jamboree Road, Suite 150 Irvine, CA 92612 T: 949.561.9200 F: 949.561.9201 www.langan.com	Project CYPRESS COLLEGE STUDENT HOUSING STUDY CYPRESS ORANGE COUNTY CALIFORNIA	Figure Title HISTORIC GROUND WATER DEPTH	Project No. 700123501 Date NOVEMBER 2022 Scale 1" =3,000 ' Drawn By OG	Figure 5

Path: \\langan.com\data\IRV\data5\700123501\Project Data\ArcGIS\APRX\Desktop Study 700123501.aprx Date: 11/28/2022 User: Toulie Time: 4:21 PM



Legend

Approximate Site Boundary

FIRM Panels

Flood Hazard Zones

- 1% Annual Chance Flood Hazard
- Regulatory Floodway
- Special Floodway
- Area of Undetermined Flood Hazard
- 0.2% Annual Chance Flood Hazard
- Future Conditions 1% Annual Chance Flood Hazard
- Area with Reduced Risk Due to Levee
- Area with Risk Due to Levee

Notes:
1. Seamless Topographic basemap is provided through Langan's Esri ArcGIS software licensing and ArcGIS online. National Geographic Society, i-cubed
2. FEMA Flood Zone dataset provided in GIS format by FEMA National Flood Hazard Layer (NFHL).

2,000 0 2,000
SCALE IN FEET

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18575 Jamboree Road, Suite 150
Irvine, CA 92612

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Project
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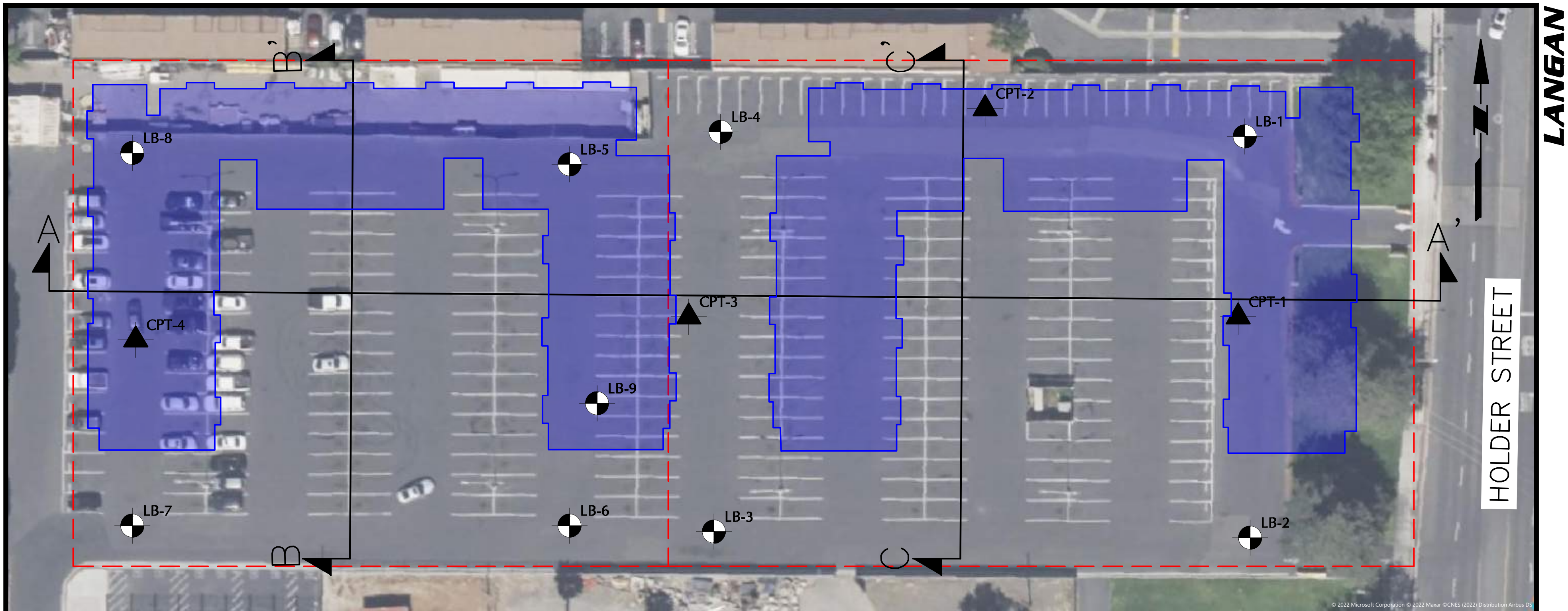
CYPRESS
ORANGE COUNTY CALIFORNIA

Figure Title
FEMA FLOOD HAZARD MAP

Project No. 700123501
Date NOVEMBER 2022
Scale 1" =2,000 '
Drawn By TO
Figure 6

Path: \\langan.com\data\IRV\data5\700123501\Project Data\ArcGIS\APRX\Desktop Study 700123501.aprx



LEGEND:

APPROXIMATE SITE LIMITS.

APPROXIMATE LOCATION OF CROSS–SECTIONS.

LB-1 APPROXIMATE BORING LOCATION.

CPT-1 APPROXIMATE CPT LOCATION.

APPROXIMATE PROPOSED BUILDING LIMITS

NOTES:

1. BACKGROUND IMAGE REFERENCED FROM GOOGLE MAPS ACCESSED ON 10 AUGUST 2022.
2. APPROXIMATE SITE LIMITS ARE REFERENCE FROM REQUEST TITLED, "REQUEST FOR PROPOSAL #CC2022–014" BY CAMPUS CAPITAL PROJECTS OFFICE.
3. PROPOSED BUILDING LIMITS ARE APPROXIMATE AND REFERENCED FROM PROPOSAL TITLED, " REQUEST FOR PROPOSAL #CC2022–014" DATED 01 AUGUST 2022, PREPARED BY CYPRESS COLLEGE.

65 0 32.5 65

SCALE IN FEET

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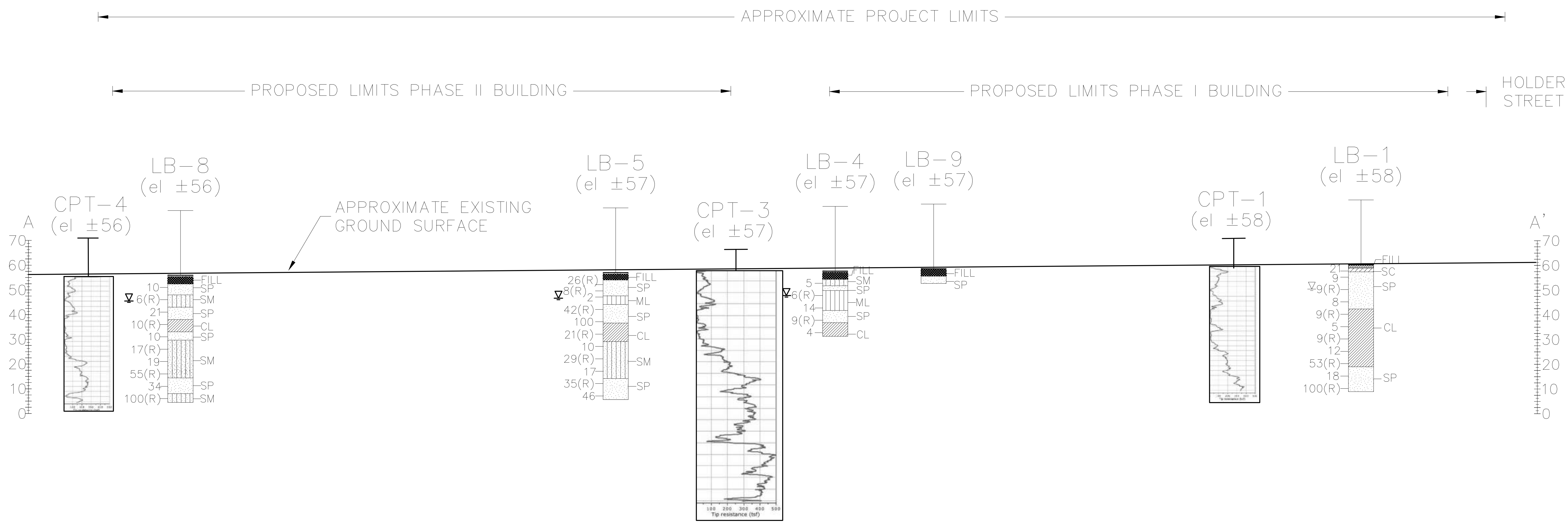
18575 Jamboree Road, Suite 150
Irvine, CA 92612

T: 949.561.9200 F: 949.561.9201 www.langan.com

Project	Figure Title	Project No.	Figure No.
CYPRESS COLLEGE STUDENT HOUSING CYPRESS ORANGE COUNTY CALIFORNIA	EXPLORATION MAP	700123501 Date: NOVEMBER 2022 Scale: AS SHOWN Drawn By: AW	7

Filename: \\langan.com\data\IRV\data5\700123501\Project Data_Discipline\Geotechnical\CAD\Cypress College - PBLM.dwg Date: 02 Nov 2022 Time: 11 am User: jmagana Style Table: Langan.stb Layout: PBLM



LEGEND:

LB-1
(el±940)
N(R)

LB-1	BORING OR CPT IDENTIFICATION
(el±940)	APPROXIMATE GROUND SURFACE ELEVATION (FEET).
N	STANDARD PENETRATION RESISTANCE; NUMBER OF BLOWS OF A 140 LB AUTOMATIC HAMMER FREE FALLING 30 INCHES TO DRIVE A 2-INCH-O.D. SPLIT SPOON SAMPLER 12 INCHES AFTER 6 INCHES OF INITIAL PENETRATION.
N(R)	NUMBER OF BLOWS A 140 LB AUTOMATIC HAMMER FREE FALLING 30 INCHES TO DRIVE A 3-INCH-O.D. CALIFORNIA MODIFIED SAMPLER 12 INCHES AFTER 6 INCHES OF INITIAL PENETRATION.
∇	DEPTH WHEN GROUNDWATER WAS ENCOUNTERED.

KEY TO SYMBOLS:

SC (clayey SAND) — CL (CLAY) — SM (silty SAND) — SP (SAND)

ML (SILT) — GP (GRAVEL) — FILL — ASPHALT

NOTES:

1. APPROXIMATE ELEVATIONS REFERENCED FROM "CYPRESS COLLEGE TOPOGRAPHIC SURVEY AND DEMOLITION PLAN" DATED 14 JANUARY 2011, PREPARED BY C&G ENGINEERING, INC. .
2. THE FIGURE SHOWS GENERALIZED SUBSURFACE CONDITIONS AT THE RESPECTIVE BORINGS. VARIATIONS IN CONDITIONS SHOULD BE EXPECTED BETWEEN BORINGS. FOR A DETAILED DESCRIPTION OF CONDITIONS ENCOUNTERED SEE BORING LOGS.
3. LANGAN BORINGS LB-1 THROUGH LB-8 WERE PERFORMED BETWEEN 7 AND 9 NOVEMBER 2022 UNDER FULL-TIME ENGINEERING OBSERVATION BY A LANGAN FIELD ENGINEER.
4. PROPOSED BUILDING LIMITS REFERENCED FROM PROPOSAL TITLED, "REQUEST FOR PROPOSAL #CC2022-014" DATED 01 AUGUST 2022, PREPARED BY CYPRESS COLLEGE.

40 20 0 40
SCALE IN FEET

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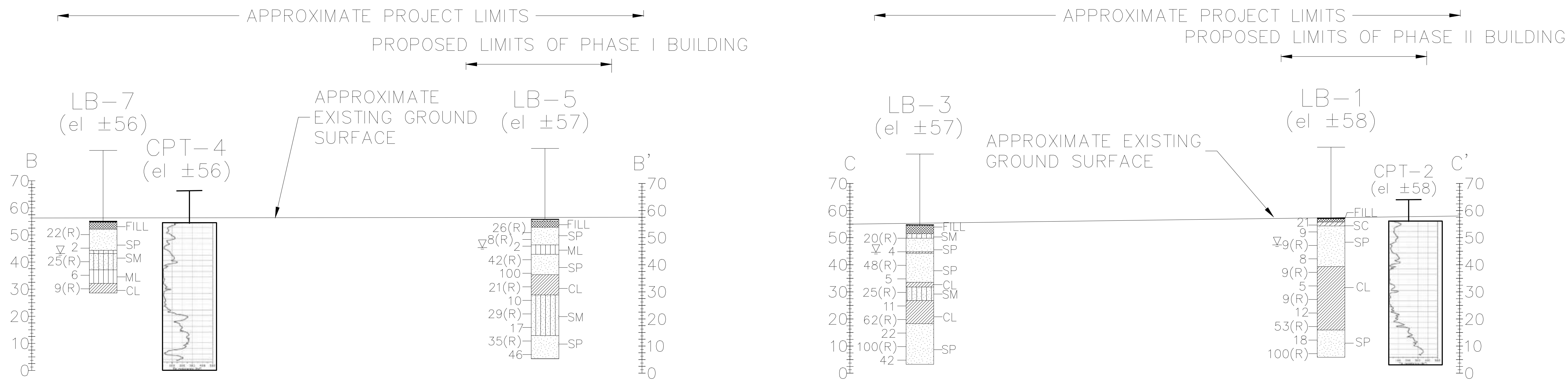
Irvine, CA 92612
T: 949.561.9200 F: 949.561.9201 www.langan.com

Project	Figure Title	Project No.	Figure No.
CYPRESS COLLEGE STUDENT HOUSING CYPRESS ORANGE COUNTY CALIFORNIA	**SUBSURFACE CROSS-SECTION A-A'**	700123501	**8A**
		Date: DECEMBER 2022	
		Scale: AS SHOWN	
		Drawn By: JMG	

Filename: \\langan.com\data\IRV\data5\700123501\Project Data_Discipline\Geotechnical\CAD\Cypress College - PBLM.dwg Date:05 December 2022 User: awei Style Table: Langan.stb Layout: XS A-A'



LEGEND:

LB-1	BORING OR CPT IDENTIFICATION
(el±940)	APPROXIMATE GROUND SURFACE ELEVATION (FEET).
N	STANDARD PENETRATION RESISTANCE; NUMBER OF BLOWS OF A 140 LB AUTOMATIC HAMMER FREE FALLING 30 INCHES TO DRIVE A 2-INCH-O.D. SPLIT SPOON SAMPLER 12 INCHES AFTER 6 INCHES OF INITIAL PENETRATION.
N(R)	NUMBER OF BLOWS A 140 LB AUTOMATIC HAMMER FREE FALLING 30 INCHES TO DRIVE A 3-INCH-O.D. CALIFORNIA MODIFIED SAMPLER 12 INCHES AFTER 6 INCHES OF INITIAL PENETRATION.
∇	DEPTH WHEN GROUNDWATER WAS ENCOUNTERED.

KEY TO SYMBOLS:

SC (clayey SAND) | CL (CLAY) | SM (silty SAND) | SP (SAND)

ML (SILT) | GP (GRAVEL) | FILL | ASPHALT

NOTES:

1. APPROXIMATE ELEVATIONS REFERENCED FROM "CYPRESS COLLEGE TOPOGRAPHIC SURVEY AND DEMOLITION PLAN" DATED 14 JANUARY 2011, PREPARED BY C&G ENGINEERING, INC. .
2. THE FIGURE SHOWS GENERALIZED SUBSURFACE CONDITIONS AT THE RESPECTIVE BORINGS. VARIATIONS IN CONDITIONS SHOULD BE EXPECTED BETWEEN BORINGS. FOR A DETAILED DESCRIPTION OF CONDITIONS ENCOUNTERED SEE BORING LOGS.
3. LANGAN BORINGS LB-1 THROUGH LB-8 WERE PERFORMED BETWEEN 7 AND 9 NOVEMBER 2022 UNDER FULL-TIME ENGINEERING OBSERVATION BY A LANGAN FIELD ENGINEER.
4. PROPOSED BUILDING LIMITS REFERENCED FROM PROPOSAL TITLED, "REQUEST FOR PROPOSAL #CC2022-014" DATED 01 AUGUST 2022, PREPARED BY CYPRESS COLLEGE.

40 20 0 40
SCALE IN FEET

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Langan Engineering and Environmental Services, Inc.
18575 Jamboree Road, Suite 150
Irvine, CA 92612
T: 949.561.9200 F: 949.561.9201 www.langan.com

Project
CYPRESS COLLEGE STUDENT HOUSING
CYPRESS
ORANGE COUNTY CALIFORNIA

Figure Title
SUBSURFACE CROSS SECTIONS B-B' & C-C'

Project No. 700123501
Date DECEMBER 2022
Scale AS SHOWN
Drawn By JMG
Figure No. **8B**

Filename: \\langan.com\data\IRV\data5\700123501\Project Data_Discipline\Geotechnical\CAD\Cypress College - PBLM.dwg Date:05 December 2022 User: awei Style Table: Langan.stb Layout: XS B-B'

LEGEND:

HA-1 — APPROXIMATE HAND AUGER LOCATION.

APPROXIMATE LIMITS OF PROPOSED TEMPORARY PARKING.

NOTES:

1. HAND AUGER LOCATIONS ARE APPROXIMATE
2. BACKGROUND IMAGE REFERENCED FROM BING IMAGES ON 05 DECEMBER 2022.
3. HAND AUGERS WERE PERFORMED BY A LANGAN FIELD ENGINEER ON 5 DECEMBER 2022.
4. LIMITS OF TEMPORARY PARKING LOT DISCUSSED DURING SITE WALK WITH THE CLIENT.

80 40 0 80

SCALE IN FEET

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T: 949.561.9200 F: 949.561.9201 www.langan.com

Project

CYPRESS COLLEGE STUDENT HOUSING

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Figure Title

HAND AUGER EXPLORATION MAP

Project No. 700123501

Date DECEMBER 2022

Scale AS SHOWN

Drawn By JMG

Figure No.

9

Filename: \\langan.com\data\IRV\data5\700123501\Project Data_Discipline\Geotechnical\CAD\Cypress College - Hand Augers.dwg Date:05 December 2022 User: jmagana Style Table: Langan.stb Layout: 11x17 L

APPENDIX A
SEISMIC RESEARCH RESULTS

TABLE A.1 - USGS ANSS COMPREHENSIVE CATALOG SEARCH RESULTS

Date	Latitude	Longitude	Approximate Magnitude	Magnitude Type	Approximate Distance from Site (km)
3/29/2014	33.9325	-117.9158	5.10	mw	15
7/29/2008	33.9485	-117.7663	5.44	mw	27
4/26/1997	34.3690	-118.6700	5.07	ml	85
6/26/1995	34.3940	-118.6690	5.02	ml	87
3/20/1994	34.2310	-118.4750	5.24	ml	61
1/29/1994	34.3060	-118.5790	5.06	ml	74
1/19/1994	34.3780	-118.6190	5.07	ml	82
1/19/1994	34.3790	-118.7120	5.06	ml	88
1/18/1994	34.3770	-118.6980	5.24	ml	87
1/17/1994	34.3260	-118.6980	5.58	ml	83
1/17/1994	34.3400	-118.6140	5.20	ml	79
1/17/1994	34.2750	-118.4930	5.89	ml	66
1/17/1994	34.2130	-118.5370	6.70	mw	64
6/28/1991	34.2700	-117.9930	5.80	mw	49
2/28/1990	34.1440	-117.6970	5.51	ml	46
12/3/1988	34.1510	-118.1300	5.02	ml	37
10/4/1987	34.0740	-118.0980	5.25	ml	28
10/1/1987	34.0610	-118.0790	5.90	mw	26
7/13/1986	32.9710	-117.8740	5.45	ml	96
1/1/1979	33.9165	-118.6872	5.21	ml	62
2/21/1973	33.9790	-119.0502	5.30	mw	96
2/9/1971	34.4160	-118.3700	5.30	mh	73
2/9/1971	34.4160	-118.3700	5.80	mh	73
2/9/1971	34.4160	-118.3700	5.80	mh	73
2/9/1971	34.4160	-118.3700	6.60	mw	73
9/12/1970	34.2548	-117.5343	5.22	ml	65
11/14/1941	33.7907	-118.2637	5.12	ml	23
5/31/1938	33.6993	-117.5112	5.23	ml	49
3/11/1933	33.8500	-118.2660	5.00	ml	23
3/11/1933	33.6238	-118.0012	5.29	mh	23
3/11/1933	33.7667	-117.9850	5.02	mh	8
3/11/1933	33.6308	-117.9995	6.40	mw	22
8/31/1930	34.0300	-118.6430	5.25	ms	62
8/4/1927	34.0000	-118.5000	5.30	uk	48
7/23/1923	34.0890	-117.2590	6.21	mw	76
6/6/1918	33.8000	-117.0000	5.00	ml	94
4/21/1918	33.7620	-116.9720	6.70	mw	97
5/15/1910	33.7000	-117.4000	5.30	mw	59
5/13/1910	33.7000	-117.4000	5.00	ml	59
4/11/1910	33.7000	-117.4000	5.00	ml	59
9/20/1907	34.2000	-117.1000	5.30	mw	94
12/25/1899	33.8000	-117.0000	6.70	mw	94
07/22/1899	34.3000	-117.5000	6.36	mw	71
07/22/1899	34.2000	-117.4000	5.90	ml	70
07/30/1894	34.3000	-117.6000	6.20	mw	65
04/04/1893	34.3000	-118.6000	5.80	ml	75
06/14/1892	34.2000	-117.5000	5.50	ml	63
08/28/1889	34.2000	-117.9000	5.60	ml	43
12/19/1880	34.0000	-117.0000	5.90	ml	96
12/16/1858	34.2000	-117.4000	6.00	ml	70
01/16/1857	34.5200	-118.0400	6.30	mw	77
07/11/1855	34.1000	-118.1000	6.00	ml	31
09/24/1827	34.0000	-119.0000	6.00	mw	92
12/08/1812	34.3700	-117.6500	7.50	mw	69

Notes:

1. The listed Earthquake Catalog Search results obtained from USGS ANSS Comprehensive Catalog on 28 November 2022.
2. Earthquake Catalog search results include earthquake events within 100 km of the Site with magnitudes of 5.0 or greater since 1800.

APPENDIX B
BORING LOGS

LANGAN

Log of Boring **LB-1** Sheet 1 of 2

Project: Cypress College Student Housing		Project No.: 700123501	
Location: 9131 Holder Street, Cypress, CA		Elevation and Datum: Approx. 58	
Drilling Company: Martini Drilling		Date Started: 11/07/2022	Date Finished: 11/07/2022
Drilling Equipment: Truck Mounted CME75 Drill Rig		Completion Depth: 51.5 ft	Rock Depth
Size and Type of Bit: 8-inch O.D. HSA		Number of Samples: Disturbed 11; Undisturbed -; Core -	
Casing Diameter (in): -	Casing Depth (ft): -	Water Level (ft.): First ▽ 10; Completion ▼; 24 HR. ▼	
Casing Hammer: -; Weight (lbs): -; Drop (in): -		Drilling Foreman: Jeff Frazer	
Sampler: 2-inch Split Spoon & 3-inch O.D. California Modified		Field Engineer: Jose Magana Guardado	
Sampler Hammer: Auto; Weight (lbs): 140; Drop (in): 30			

Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
+58.0		0					
+57.8	AC Thickness = 2 inches						Boring was Hand Auger from 0 to 5 feet.
+57.7	AB Thickness = 2 inches						
+56.5	**UNDOCUMENTED FILL** Brown, silty fine SAND, [SM], moist.	2					
+55.0	**YOUNG ALLUVIUM** Medium dense, light reddish brown, clayey fine to medium SAND, [SC], moist.		S-1	SS	18	7 10 11	PID = 0.0 ppm
	Medium dense, light brown, fine SAND, [SP], moist.	4					
	Loose, light brown, fine SAND, [SP], moist.	6	S-2	SS	18	2 4 5	PID = 0.0 ppm
		8					
	▽ Loose, gray, fine SAND, [SP], wet.	10	S-3	CR	18	1 5 4	Groundwater encountered at 10 feet. PID = 0.0 ppm
		12					
		14					
	Loose, light brown to gray, coarse SAND, [SP], wet.	16	S-4	SS	18	1 4 4	PID = 0.0 ppm
+40.0		18					
	Firm, gray, silty CLAY, trace coarse sand, [CL], wet.	20	S-5	CR	18	3 3 6	PID = 0.0 ppm
		22					
		24					
	Firm, gray, silty CLAY, [CL], wet.	26	S-6	SS	4	3 2 3	PID = 0.0 ppm
		28					
		30					

Project	Project No.
Cypress College Student Housing	700123501
Location	**Elevation and Datum**
9131 Holder Street, Cypress, CA	Approx. 58

Material Symbol	Elev. (ft)	Sample Description	Depth Scale (ft)	Number	Type	Recov. (in)	Penetr. resist BL/6in	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
	+28.0	Firm, gray, silty CLAY, some fine sand, [CL], wet.	30	S-7	CR	14	2 / 3 / 6	PID = 0.0 ppm
		Stiff, gray, silty CLAY, some fine sand, [CL], wet.	35	S-8	SS	18	3 / 5 / 7	PID = 0.0 ppm
		Hard, gray, silty CLAY, some fine sand, [CL], wet.	40	S-9	CR	18	8 / 22 / 31	PID = 0.0 ppm
	+16.9	Dense, light brownish gray, medium to coarse SAND, [SP], wet.	41					
		Medium dense, light brownish gray, coarse SAND, [SP], wet.	45	S-10	SS	18	3 / 4 / 14	PID = 0.0 ppm
		Very dense, light brownish gray, medium to coarse SAND, [SP], wet.	50	S-11	CR	18	20 / 50 / 50/6"	PID = 0.0 ppm
	+6.5	End of boring at 51.5 feet. Groundwater encountered at 10 feet. Boring backfilled with cement grout.	51.5					

Depth scale: 30 – 67.5 ft

LANGAN

Log of Boring **LB-2** Sheet 1 of 1

Project: Cypress College Student Housing		Project No.: 700123501	
Location: 9131 Holder Street, Cypress, CA		Elevation and Datum: Approx. 57	
Drilling Company: Martini Drilling		Date Started: 11/07/2022	Date Finished: 11/07/2022
Drilling Equipment: Truck Mounted CME75 Drill Rig		Completion Depth: 26.5 ft	Rock Depth:
Size and Type of Bit: 8-inch O.D. HSA		Number of Samples: Disturbed 5; Undisturbed -; Core -	
Casing Diameter (in): -	Casing Depth (ft): -	Water Level (ft.): First ▽ 10.5; Completion ▼; 24 HR. ▼	
Casing Hammer: -	Weight (lbs): -; Drop (in): -	Drilling Foreman: Jeff Frazer	
Sampler: 2-inch Split Spoon & 3-inch O.D. California Modified		Field Engineer: Jose Magana Guardado	
Sampler Hammer: Auto	Weight (lbs): 140; Drop (in): 30		

Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
+57.0		0					Boring was Hand Auger from 0 to 5 feet.
+56.8	AC Thickness = 3 inches						
+56.2	AB Thickness = 7 inches						
	UNDOCUMENTED FILL Reddish brown, silty fine SAND, [SM], moist.	2					
+54.0	**YOUNG ALLUVIUM**	4					
	Medium dense, light brown, medium to coarse SAND, [SP], moist.	6	S-1	CR	18	6 / 8 / 10	PID = 0.0 ppm
+49.0		8					
	Loose, grayish brown, silty fine SAND, [SM], wet. ▽	10	S-2	SS	18	1 / 3 / 3	PID = 0.0 ppm
+46.5	Loose, dark grayish brown, medium SAND, [SP], moist.						Groundwater encountered at 10.5 feet.
+44.0		12, 14					
	Medium dense, dark gray, silty fine SAND, [SM], wet.	16	S-3	CR	18	7 / 9 / 18	PID = 0.0 ppm
		18					
	Loose, grayish brown, silty fine SAND, [SM], wet.	20	S-4	SS	18	1 / 2 / 3	PID = 0.0 ppm
		22, 24					
	Medium dense, dark gray, silty fine SAND, [SM], wet.	26	S-5	CR	18	5 / 12 / 17	PID = 0.0 ppm
+30.5	End of boring at 26.5 feet. Groundwater encountered at 10.5 feet. Boring backfilled with cement grout.	28, 30					

LANGAN

Project: Cypress College Student Housing	Project No.: 700123501
Location: 9131 Holder Street, Cypress, CA	Elevation and Datum: Approx. 56.6
Drilling Company: Martini Drilling	Date Started: 11/07/2022 — Date Finished: 11/07/2022
Drilling Equipment: Truck Mounted CME75 Drill Rig	Completion Depth: 50.5 ft — Rock Depth:
Size and Type of Bit: 8-inch O.D. HSA	Number of Samples: Disturbed 10 — Undisturbed - — Core -
Casing Diameter (in): - — Casing Depth (ft): -	Water Level (ft.): First ▽ 10.2 — Completion ▼ — 24 HR. ▼
Casing Hammer: - — Weight (lbs): - — Drop (in): -	Drilling Foreman: Jeff Frazer
Sampler: 2-inch Split Spoon & 3-inch O.D. California Modified	Field Engineer: Jose Magana Guardado
Sampler Hammer: Auto — Weight (lbs): 140 — Drop (in): 30	

Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
+56.6		0					
+56.4	AC Thickness = 2.5 inches						Boring was Hand Auger from 0 to 5 feet.
	UNDOCUMENTED FILL Reddish-brown, silty fine SAND, [SM], moist.	2					
+53.6	Reddish-brown, silty fine SAND, [SM], moist.	4					
+51.6	**YOUNG ALLUVIUM** Medium dense, light brown, fine to medium, SAND, [SP], moist.	6	S-1	CR	18	5 / 8 / 12	PID = 0.0 ppm
		8					
+46.6	Soft, light brown, silty CLAY, [CL], moist.	10 ▽					
+46.1	Very loose, dark borwn, fine, SAND, [SP], dry.		S-2	SPT	18	1 / 2 / 2	PID = 0.0 ppm
		12					
		14					
	No recovery	16	S-3	CR	0	8 / 24 / 24	PID = 0.0 ppm
		18					
	Loose, light brown, coarse SAND, [SP], wet.	20	S-4	SPT	18	1 / 2 / 3	PID = 0.0 ppm
+35.4	Medium stiff, gray, silty CLAY, [CL], wet.	22					
+33.6		24					
	Medium dense, gray, silty fine SAND, [SM], wet.	26	S-5	CR	18	3 / 10 / 15	PID = 0.0 ppm
+28.6		28					
		30					

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Log of Boring **LB-3**

Project	Project No.
Cypress College Student Housing	700123501
Location	**Elevation and Datum**
9131 Holder Street, Cypress, CA	Approx. 56.6

Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
+26.6	Stiff, gray, silty CLAY, trace sand, [CL], wet.	30	S-6	SPT	18	2 / 4 / 7	PID = 0.0 ppm
	Hard, gray, silty CLAY, [CL], wet.	35	S-7	CR	18	19 / 31 / 31	PID = 0.0 ppm
+20.6 / +20.1	Very dense, light brown, fine to medium SAND, [SP], wet.	36					
	Medium dense, light brown, fine to medium SAND, [SP], wet.	40	S-8	SPT	18	3 / 8 / 14	PID = 0.0 ppm
	Very dense, light brown, fine to medium SAND, [SP], wet.	45	S-9	CR	18	16 / 37 / 50/5"	PID = 0.0 ppm
	Dense, light brown, medium to coarse SAND, [SP], wet.	50	S-10	SPT	18	10 / 22 / 20	PID = 0.0 ppm
+5.1	End of Boring at 51.5 feet. Ground water was encountered at 10.2 feet. Boring was backfilled with cement grout.	51.5					

Depth scale: 30 – 67.5

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Log of Boring **LB-4** Sheet 1 of 1

Project: Cypress College Student Housing		Project No.: 700123501	
Location: 9131 Holder Street, Cypress, CA		Elevation and Datum: Approx. 57	
Drilling Company: Martini Drilling		Date Started: 11/08/2022	Date Finished: 11/08/2022
Drilling Equipment: Truck Mounted CME75 Drill Rig		Completion Depth: 26.5 ft	Rock Depth
Size and Type of Bit: 8-inch O.D. HSA		Number of Samples: Disturbed 10; Undisturbed -; Core -	
Casing Diameter (in): -	Casing Depth (ft): -	Water Level (ft.): First ▽ 10; Completion ▼; 24 HR. ▼	
Casing Hammer: -	Weight (lbs): -; Drop (in): -	Drilling Foreman: Jeff Frazer	
Sampler: 2-inch Split Spoon & 3-inch O.D. California Modified		Field Engineer: Jose Magana Guardado	
Sampler Hammer: Auto	Weight (lbs): 140; Drop (in): 30		

Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
+57.0		0					Boring was Hand Auger from 0 to 5 feet.
+56.8	AC Thickness = 2.5 inches						
+56.4	AB Thickness = 4 inches						
	UNDOCUMENTED FILL Brown, silty fine SAND, [SM], moist.						
+54.0	Brown, silty fine SAND, [SM], moist.						
	Loose, dark brown, silty fine SAND, [SM], moist.		S-1	SS	18	2 / 2 / 3	PID = 0.0 ppm
+51.0	**YOUNG ALLUVIUM** Loose, light brown, fine to medium SAND, [SP], moist.	6					
+49.0	Medium stiff, gray brown, clayey SILT, [ML], moist.	10 ▽	S-2	CR	18	2 / 3 / 3	PID = 0.0 ppm
	Stiff, gray brown, clayey SILT, [ML], moist.		S-3	SS	18	2 / 6 / 8	PID = 0.0 ppm
+41.0	Medium dense, dark brown, fine to medium SAND, [SP], wet.	16					
	Loose, dark brown, fine to medium SAND, [SP], wet.	20	S-4	CR	18	6 / 4 / 5	PID = 0.0 ppm
+36.0	No Recovery.						
	Soft, gray, silty CLAY, [CL], wet.		S-5	SS	18	2 / 2 / 2	Observed sample fall out of sampler onto floor, sample consisted of Soft, gray, silty CLAY, [CL], wet. PID = 0.0 ppm
+30.5	End of Boring at 26.5 feet. Groundwater was encountered at 10 feet. Boring was backfilled with cement grout.	26					

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Log of Boring **LB-5** Sheet 1 of 2

Project: Cypress College Student Housing	Project No.: 700123501		
Location: 9131 Holder Street, Cypress, CA	Elevation and Datum: Approx. 57		
Drilling Company: Martini Drilling	Date Started: 11/08/2022	Date Finished: 11/08/2022	
Drilling Equipment: Truck Mounted CME75 Drill Rig	Completion Depth: 51.5 ft	Rock Depth:	
Size and Type of Bit: 8-inch O.D. HSA	Number of Samples — Disturbed: 11	Undisturbed: -	Core: -
Casing Diameter (in): - ; Casing Depth (ft): -	Water Level (ft.) — First: ▽ 10.5	Completion: ▼	24 HR.: ▼
Casing Hammer: - ; Weight (lbs): - ; Drop (in): -	Drilling Foreman: Jeff Frazer		
Sampler: 2-inch Split Spoon & 3-inch O.D. California Modified	Field Engineer: Jose Magana Guardado		
Sampler Hammer: Auto ; Weight (lbs): 140 ; Drop (in): 30			

Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
+57.0		0					Boring was Hand Auger from 0 to 5 feet.
+56.8	AC Thickness = 2.5 inches						
+56.3	AB Thickness = 6 inches						
	UNDOCUMENTED FILL Brown, silty fine SAND, [SM], moist.	2					
+54.0	**YOUNG ALLUVIUM**	4					
	Medium dense, light brown, fine SAND, [SP], moist.	6	S-1	CR	18	4 10 16	PID = 0.0 ppm
	Loose, light brown, loose, fine to medium SAND, [SP], moist.	8	S-2	CR	18	4 4 4	PID = 0.0 ppm
+47.5	Soft, gray brown, clayey SILT, some fine sand, [ML], wet. ▽	10	S-3	SS	18	1 1 1	PID = 0.0 ppm Groundwater encountered at 10.5 feet.
		12					
+44.0	Dense, light brown, medium to coarse SAND, [SP], wet.	14, 16	S-4	CR	18	10 20 22	PID = 0.0 ppm
		18					
+36.5	Very dense, light brown, medium to coarse SAND, [SP], wet. Stiff, gray, silty CLAY, [CL], moist.	20	S-5	SS	18	1 50/4"	PID = 0.0 ppm
		22, 24					
	Stiff, gray, silty CLAY, some fine sand, [CL], wet.	26	S-6	CR	16	3 5 16	PID = 0.0 ppm
+29.0		28, 30					

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Log of Boring **LB-5** Sheet 2 of 2

Project	Project No.
Cypress College Student Housing	700123501
Location	**Elevation and Datum**
9131 Holder Street, Cypress, CA	Approx. 57

Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
+27.0	Medium dense, grayish brown, silty fine to medium SAND, some clay, [SM], moist.	30	S-7	SS	13	3 / 4 / 6	PID = 0.0 ppm
	Medium dense, grayish brown, silty fine SAND, some clay, [SM], moist.	35	S-8	CR	18	6 / 13 / 16	PID = 0.0 ppm
	Medium dense, grayish brown, silty fine SAND, some clay, [SM], moist.	40	S-9	SS	13	3 / 7 / 10	PID = 0.0 ppm
+14.0		43					
	Medium dense, light brown, medium to coarse SAND, [SP], wet.	45	S-10	CR	0	3 / 12 / 23	PID = 0.0 ppm
	Dense, light brown, medium to coarse SAND, [SP], wet.	50	S-11	SS	0	8 / 25 / 21	PID = 0.0 ppm
+5.5	End of boring at 51.5 feet. Groundwater encountered at 10.5 feet. Boring backfilled with cement grout.	51.5					

Depth scale: 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58, 60, 62, 64, 66, 67.5

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Log of Boring **LB-6** Sheet 1 of 1

Project: Cypress College Student Housing		Project No.: 700123501	
Location: 9131 Holder Street, Cypress, CA		Elevation and Datum: Approx. 56.6	
Drilling Company: Martini Drilling		Date Started: 11/09/2022	Date Finished: 11/09/2022
Drilling Equipment: Truck Mounted CME75 Drill Rig		Completion Depth: 26.5 ft	Rock Depth
Size and Type of Bit: 8-inch O.D. HSA		Number of Samples: Disturbed 5; Undisturbed -; Core -	
Casing Diameter (in): -	Casing Depth (ft): -	Water Level (ft.): First ▽ 9.5; Completion ▼; 24 HR. ▼	
Casing Hammer: -; Weight (lbs): -; Drop (in): -		Drilling Foreman: Jeff Frazer	
Sampler: 2-inch Split Spoon & 3-inch O.D. California Modified		Field Engineer: Jose Magana Guardado	
Sampler Hammer: Auto; Weight (lbs): 140; Drop (in): 30			

Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
+56.6		0					Boring was Hand Auger from 0 to 5 feet.
+56.4	AC Thickness = 2 inches						
+56.1	AB Thickness = 4 inches						
	UNDOCUMENTED FILL Brown, silty fine SAND, [SM], moist.	2					
+53.1	**YOUNG ALLUVIUM**	4					
	Loose, light brown, fine to medium SAND, [SP], moist.	6	S-1	SS	18	3 / 3 / 5	PID = 0.6 ppm
+48.6		8					
	Firm, grayish brown, silty CLAY, [CL], moist.	10					Groundwater encountered at 9.5 feet.
+46.1	Medium dense, grayish brown, fine to medium SAND, [SP], wet.		S-2	CR	16	6 / 8 / 8	PID = 1.7 ppm
		12					
		14					
	Medium dense, light brown, medium to coarse SAND, [SP], wet.		S-3	SS	12	2 / 6 / 6	PID = 3.8 ppm
+40.6	Medium dense, grayish brown, silty fine SAND, [SM], wet.	16					
+38.6		18					
	Loose, light brown, medium to coarse SAND, [SP], wet.	20	S-4	CR	18	3 / 5 / 6	PID = 5.5 ppm
		22					
+33.6		24					
	Medium dense, grayish brown, silty fine SAND, some clay, [SM], wet.	26	S-5	SS	18	3 / 5 / 5	PID = 1.0 ppm
+30.1	End of boring at 26.5 feet. Groundwater encountered at 9.5 feet. Boring backfilled with cement grout.	28					
		30					

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Log of Boring **LB-7** Sheet 1 of 1

Project: Cypress College Student Housing		Project No.: 700123501	
Location: 9131 Holder Street, Cypress, CA		Elevation and Datum: Approx. 56	
Drilling Company: Martini Drilling		Date Started: 11/09/2022	Date Finished: 11/09/2022
Drilling Equipment: Truck Mounted CME75 Drill Rig		Completion Depth: 26.5 ft	Rock Depth
Size and Type of Bit: 8-inch O.D. HSA		Number of Samples: Disturbed 5; Undisturbed -; Core -	
Casing Diameter (in): -	Casing Depth (ft): -	Water Level (ft.): First ▽ 12; Completion ▼; 24 HR. ▽	
Casing Hammer: - ; Weight (lbs): -	Drop (in): -	Drilling Foreman: Jeff Frazer	
Sampler: 2-inch Split Spoon & 3-inch O.D. California Modified		Field Engineer: Jose Magana Guardado	
Sampler Hammer: Auto; Weight (lbs): 140	Drop (in): 30		

Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
+56.0		0					
+55.6	Asphalt thickness = 4 inches						Boring was Hand Auger from 0 to 5 feet.
	UNDOCUMENTED FILL Grayish brown, silty fine SAND, [SM], moist.	2	B-1	BAG			
+53.0	**YOUNG ALLUVIUM**	4					
	Medium dense, light brown, fine SAND, [SP], moist.	6	S-1	CR	14	6 / 10 / 12	PID = 8.0 ppm
		8					
	Very loose, light brown, fine SAND, [SP], wet.	10	S-2A	SS	18	1 / 1 / 1	PID = 1.1 ppm
+45.3	Very loose, grayish brown, silty fine SAND, [SM], some clay, wet.	12 ▽					Groundwater encountered at 12 feet.
		14					
	Medium dense, grayish brown, silty fine SAND, [SM], moist.	16	S-3	CR	18	5 / 7 / 18	PID = 1.3 ppm
+38.0		18					
	Firm, grayish brown, clayey SILT, [ML], some coarse sand, moist.	20	S-4	SS	18	1 / 3 / 3	PID = 1.6 ppm
+33.0		22					
	Firm, grayish brown, silty CLAY, [CL], wet.	24–26	S-5	CR	18	4 / 5 / 6	PID = 0.2 ppm
+29.5	End of boring at 26.5 feet. Groundwater encountered at 12 feet. Boring backfilled with cement grout.	28					
		30					

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Project: Cypress College Student Housing		Project No.: 700123501	
Location: 9131 Holder Street, Cypress, CA		Elevation and Datum: Approx. 56	
Drilling Company: Martini Drilling		Date Started: 11/08/2022	Date Finished: 11/08/2022
Drilling Equipment: Truck Mounted CME75 Drill Rig		Completion Depth: 51.5 ft	Rock Depth:
Size and Type of Bit: 8-inch O.D. HSA		Number of Samples: Disturbed 10; Undisturbed -; Core -	
Casing Diameter (in): -	Casing Depth (ft): -	Water Level (ft.): First ▽ 10.5; Completion ▼; 24 HR. ▼	
Casing Hammer: -; Weight (lbs): -; Drop (in): -		Drilling Foreman: Jeff Frazer	
Sampler: 2-inch Split Spoon & 3-inch O.D. California Modified			
Sampler Hammer: Auto; Weight (lbs): 140; Drop (in): 30		Field Engineer: Jose Magana Guardado	

Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
+56.0		0					Boring was Hand Auger from 0 to 5 feet.
+55.8	AC Thickness = 2.5 inches						
+55.3	AB Thickness = 6 inches						
	UNDOCUMENTED FILL Brown, silty fine SAND, [SM], moist.	2					
+52.5	**YOUNG ALLUVIUM**	4					
	Medium dense, light brown, fine to medium SAND, [SP], moist.	6	S-1	SS	18	1 4 6	PID = 0.0 ppm
+48.0		8					
	Loose, brownish gray, silty fine SAND, [SM], wet. ▽	10	S-2	CR	18	1 2 4	PID = 0.0 ppm Groundwater encountered at 10.5 feet
		12					
+43.0		14					
	Medium dense, light brown, medium to coarse SAND, [SP], moist. Medium dense, dark grayish brown, fine to medium SAND, [SP], moist.	16	S-3	SS	18	5 11 10	PID = 0.0 ppm
+38.0		18					
	Firm, grayish brown, silty CLAY, some fine sand, [CL], moist.	20	S-4	CR	18	3 5 5	PID = 0.0 ppm
		22					
+33.0		24					
	Medium dense, light brown, medium to coarse SAND, [SP], wet.		S-5	SS	14	3 5 5	PID = 0.0 ppm
+30.3	Medium dense, grayish brown, silty fine SAND, some clay, [SM], moist.	26					
		28					
		30					

Project	Project No.
Cypress College Student Housing	700123501
Location	**Elevation and Datum**
9131 Holder Street, Cypress, CA	Approx. 56

Elev. (ft)	Sample Description	Depth Scale	Sample Number	Type	Recov. (in)	Penetr. resist BL/6in	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
+26.0	Medium dense, grayish brown, silty fine SAND, some clay, [SM], moist.	30	S-6	CR	18	7 / 8 / 9	PID = 0.0 ppm
	Dense, grayish brown, silty fine SAND, [SM], moist.	35	S-7	SS	13	4 / 8 / 11	PID = 0.0 ppm
	Dense, grayish brown, silty fine SAND, some clay, [SM], moist.	40	S-8	CR	18	9 / 17 / 38	PID = 0.0 ppm
+13.0	Dense, light brown, medium to coarse SAND, [SP], wet.	45	S-9	SS	16	4 / 13 / 21	PID = 0.0 ppm
+8.0	Very dense, grayish brown, silty fine SAND, [SM], wet.	50	S-10	CR	18	13 / 32 / 50/6"	PID = 0.0 ppm
+4.5	End of boring at 51.5 feet. Groundwater encountered at 10.5 feet. Boring backfilled with cement grout.	51.5					

Depth scale: 30 – 67.5

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Log of Boring **LB-9** Sheet 1 of 1

Project: Cypress College Student Housing	Project No.: 700123501
Location: 9131 Holder Street, Cypress, CA	Elevation and Datum: Approx. 57
Drilling Company: Martini Drilling	Date Started: 11/09/2022 / Date Finished: 11/09/2022
Drilling Equipment: Hand Auger	Completion Depth: 6 ft / Rock Depth:
Size and Type of Bit: 4-inch O.D. Hand Auger	Number of Samples: Disturbed 0 / Undisturbed - / Core -
Casing Diameter (in): - / Casing Depth (ft): -	Water Level (ft.): First ▽ / Completion ▼ / 24 HR. ▼
Casing Hammer: - / Weight (lbs): - / Drop (in): -	Drilling Foreman: Jeff Frazer
Sampler:	Field Engineer: Jose Magana Guardado
Sampler Hammer: / Weight (lbs): / Drop (in):	

Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
+57.0		0					
+56.8	AC Thickness = 3 inches						Boring was Hand Auger from 0 to 5 feet.
	UNDOCUMENTED FILL Light brown, silty fine SAND, [SM], moist.	2					
+54.0	**YOUNG ALLUVIUM**	4					
	Light brown, fine SAND, [SP], moist.		S-1	HA	12		Bag sample collected from 5 to 6 feet. PID = 0.0 ppm
+51.0	End of boring at 6 feet. No groundwater encountered. Boring backfilled with soil cuttings.	6					
		8 – 30					

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Log of Boring **HA-1** Sheet 1 of 1

Project: Cypress College Student Housing	Project No.: 700123501		
Location: 9131 Holder Street, Cypress, CA	Elevation and Datum: Approx. 58		
Drilling Company: -	Date Started: 12/05/2022	Date Finished: 12/05/2022	
Drilling Equipment: Hand Auger	Completion Depth: 5 ft	Rock Depth:	
Size and Type of Bit: 4-inch O.D.	Number of Samples	Disturbed: -	Undisturbed: - / Core: -
Casing Diameter (in): - / Casing Depth (ft): -	Water Level (ft.)	First: ▽	Completion: ▼ / 24 HR.: ▼
Casing Hammer: - / Weight (lbs): - / Drop (in): -	Drilling Foreman: Jose Magana Guardado		
Sampler: -	Field Engineer: Jose Magana Guardado		
Sampler Hammer: - / Weight (lbs): - / Drop (in): -			

Material Symbol	Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
	+58.0 / +57.8	Grass and roots thickness = 2 inches	0					
	+55.0	**UNDOCUMENTED FILL** Brown, silty fine to medium SAND, [SM], moist.	2	B-1	BAG			Bulk Sample Collected from 0-5 feet.
	+53.0	**YOUNG ALLUVIUM** Whitish gray, fine to medium SAND, [SP], moist.	4					
		End of boring at approximately 5 feet. No groundwater was encountered. Boring backfilled with gravel.	6					

Depth scale: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30

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Log of Boring **HA-2** Sheet 1 of 1

Project: Cypress College Student Housing		Project No.: 700123501	
Location: 9131 Holder Street, Cypress, CA		Elevation and Datum: Approx. 58	
Drilling Company: -		Date Started: 12/05/2022	Date Finished: 12/05/2022
Drilling Equipment: Hand Auger		Completion Depth: 5 ft	Rock Depth
Size and Type of Bit: 4-inch O.D.		Number of Samples: Disturbed - / Undisturbed - / Core -	
Casing Diameter (in): -	Casing Depth (ft): -	Water Level (ft.): First ∇ / Completion ▼ / 24 HR. ▼	
Casing Hammer: -	Weight (lbs): - / Drop (in): -	Drilling Foreman: Jose Magana Guardado	
Sampler: -			
Sampler Hammer: -	Weight (lbs): - / Drop (in): -	Field Engineer: Jose Magana Guardado	

Material Symbol	Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
	+58.0	**UNDOCUMENTED FILL** Brown, silty fine to medium SAND, some coarse gravel, [SM], moist.	0					
	+57.0	**YOUNG ALLUVIUM** Whitish gray, fine to medium SAND, [SP], moist.	2	B-1	BAG			Bulk Sample Collected from 0-5 feet.
	+53.0	End of boring at approximately 5 feet. No groundwater was encountered. Boring backfilled with gravel.	4–30					

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Log of Boring **HA-3** Sheet 1 of 1

Project: Cypress College Student Housing	Project No.: 700123501		
Location: 9131 Holder Street, Cypress, CA	Elevation and Datum: Approx. 58		
Drilling Company: -	Date Started: 12/05/2022	Date Finished: 12/05/2022	
Drilling Equipment: Hand Auger	Completion Depth: 5 ft	Rock Depth	
Size and Type of Bit: 4-inch O.D.	Number of Samples	Disturbed: -	Undisturbed: - / Core: -
Casing Diameter (in): - / Casing Depth (ft): -	Water Level (ft.)	First: ▽	Completion: ▼ / 24 HR.: ▼
Casing Hammer: - / Weight (lbs): - / Drop (in): -	Drilling Foreman: Jose Magana Guardado		
Sampler: -			
Sampler Hammer: - / Weight (lbs): - / Drop (in): -	Field Engineer: Jose Magana Guardado		

MATERIAL SYMBOL	Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
	+58.0		0					
	+57.8	Grass, roots thickness= 3 inches						
	+56.5	**UNDOCUMENTED FILL** Brown, silty fine to medium SAND, [SM], moist.						
		YOUNG ALLUVIUM Whitish gray, fine to medium SAND, [SP], moist.	2					
	+53.0		4					
		End of boring at approximately 5 feet. No groundwater was encountered. Boring backfilled with gravel.	6					
			8					
			10					
			12					
			14					
			16					
			18					
			20					
			22					
			24					
			26					
			28					
			30					

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Log of Boring **HA-4** Sheet 1 of 1

Project: Cypress College Student Housing		Project No.: 700123501		
Location: 9131 Holder Street, Cypress, CA		Elevation and Datum: Approx. 58		
Drilling Company: -		Date Started: 12/05/2022	Date Finished: 12/05/2022	
Drilling Equipment: Hand Auger		Completion Depth: 5 ft	Rock Depth	
Size and Type of Bit: 4-inch O.D.		Number of Samples	Disturbed: -	Undisturbed: - / Core: -
Casing Diameter (in): -	Casing Depth (ft): -	Water Level (ft.)	First	Completion / 24 HR.
Casing Hammer: - / Weight (lbs): - / Drop (in): -		Drilling Foreman: Jose Magana Guardado		
Sampler: -				
Sampler Hammer: - / Weight (lbs): - / Drop (in): -		Field Engineer: Jose Magana Guardado		

Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
+58.0		0					
+57.8	Grass, roots thickness= 3 inches						
+57.0	**UNDOCUMENTED FILL** Brown, silty fine to medium SAND, [SM], moist.						
	YOUNG ALLUVIUM Whitish gray, fine to medium SAND, [SP], moist.	2					
		4					
+53.0	End of boring at approximately 5 feet. No groundwater was encountered. Boring backfilled with gravel.						
		6					
		8					
		10					
		12					
		14					
		16					
		18					
		20					
		22					
		24					
		26					
		28					
		30					

APPENDIX C
CPT REPORT

SUMMARY

OF

CONE PENETRATION TEST DATA

Project:

Cypress College Housing Feasibility
9131 Holder Street
Cypress, CA
November 8, 2022

Prepared for:

Mr. Daniel Judge Serrano
Langan Eng. & Environmental Services
18575 Jamboree Road, Ste 150
Irvine, CA 92612
Office (949) 561-9200 / Fax (949) 561-9201

Prepared by:

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

TABLE OF CONTENTS

SUMMARY
OF
CONE PENETRATION TEST DATA

1. INTRODUCTION

This report presents the results of a Cone Penetration Test (CPT) program carried out for the Cypress College Housing Feasibility project located at 9131 Holder Street in Cypress, California. The work was performed by Kehoe Testing & Engineering (KTE) on November 8, 2022. The scope of work was performed as directed by Langan Eng. & Environmental Services personnel.

2. SUMMARY OF FIELD WORK

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

LOCATION	DEPTH OF CPT (ft)	COMMENTS/NOTES:
CPT-1	50	
CPT-2	50	
CPT-3	100	
CPT-4	50	

TABLE 2.1 - Summary of CPT Soundings

3. FIELD EQUIPMENT & PROCEDURES

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

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

At location CPT-3, shear wave measurements were obtained at approximately 5-foot intervals. The shear wave is generated using an air-actuated hammer, which is located inside the front jack of the CPT rig. The cone has a triaxial geophone, which recorded the shear wave signal generated by the air hammer.

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

4. CONE PENETRATION TEST DATA & INTERPRETATION

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

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

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

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

Sincerely,

KEHOE TESTING & ENGINEERING

Steven P. Kehoe
President

11/14/22-el-4616

APPENDIX

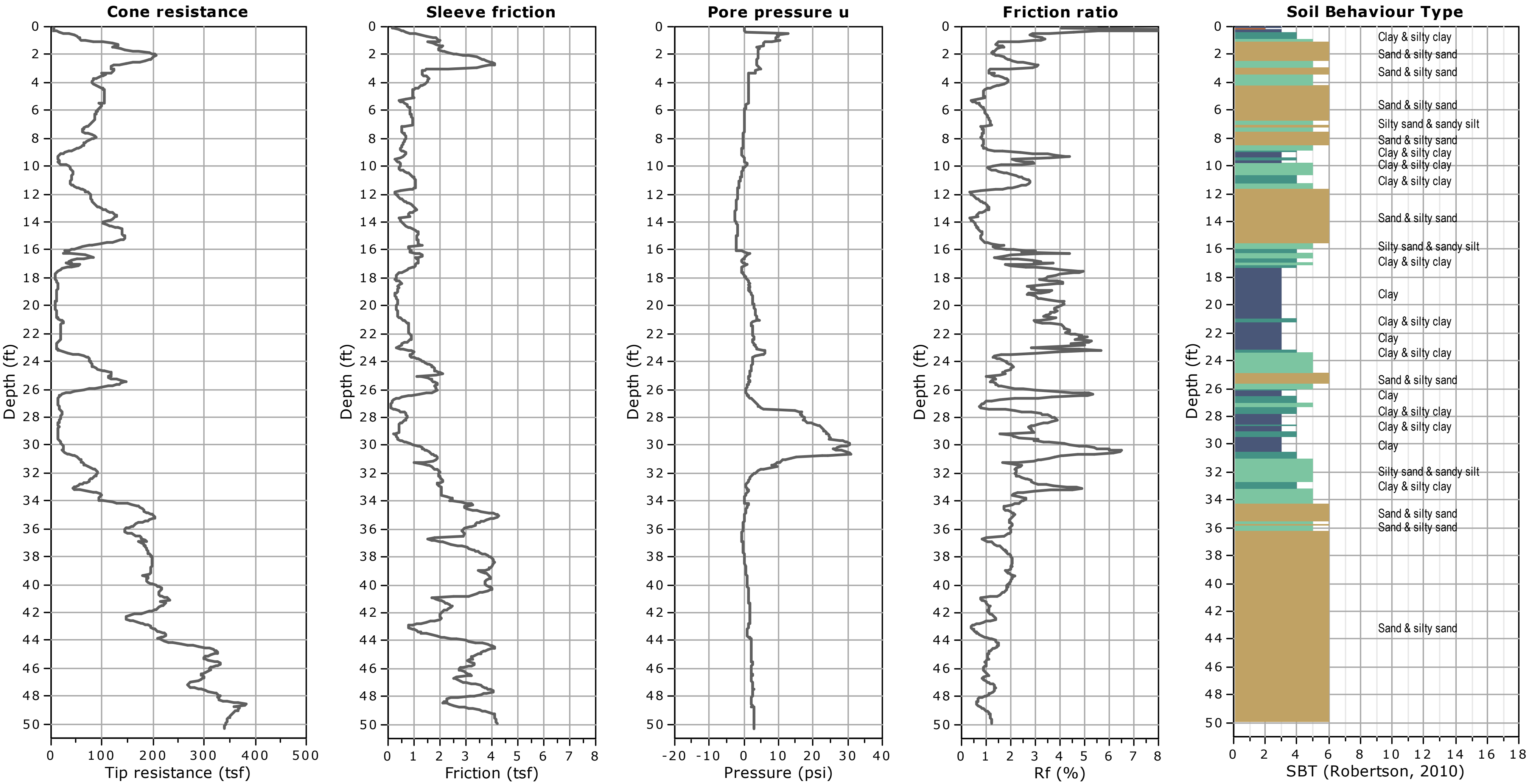
Kehoe Testing and Engineering
714-901-7270
steve@kehoetesting.com
www.kehoetesting.com

Project: Langan Eng & Env Services / Cypress College Housing Feasibility

Location: 9131 Holder St, Cypress, CA

CPT-1

Total depth: 50.33 ft, Date: 11/8/2022



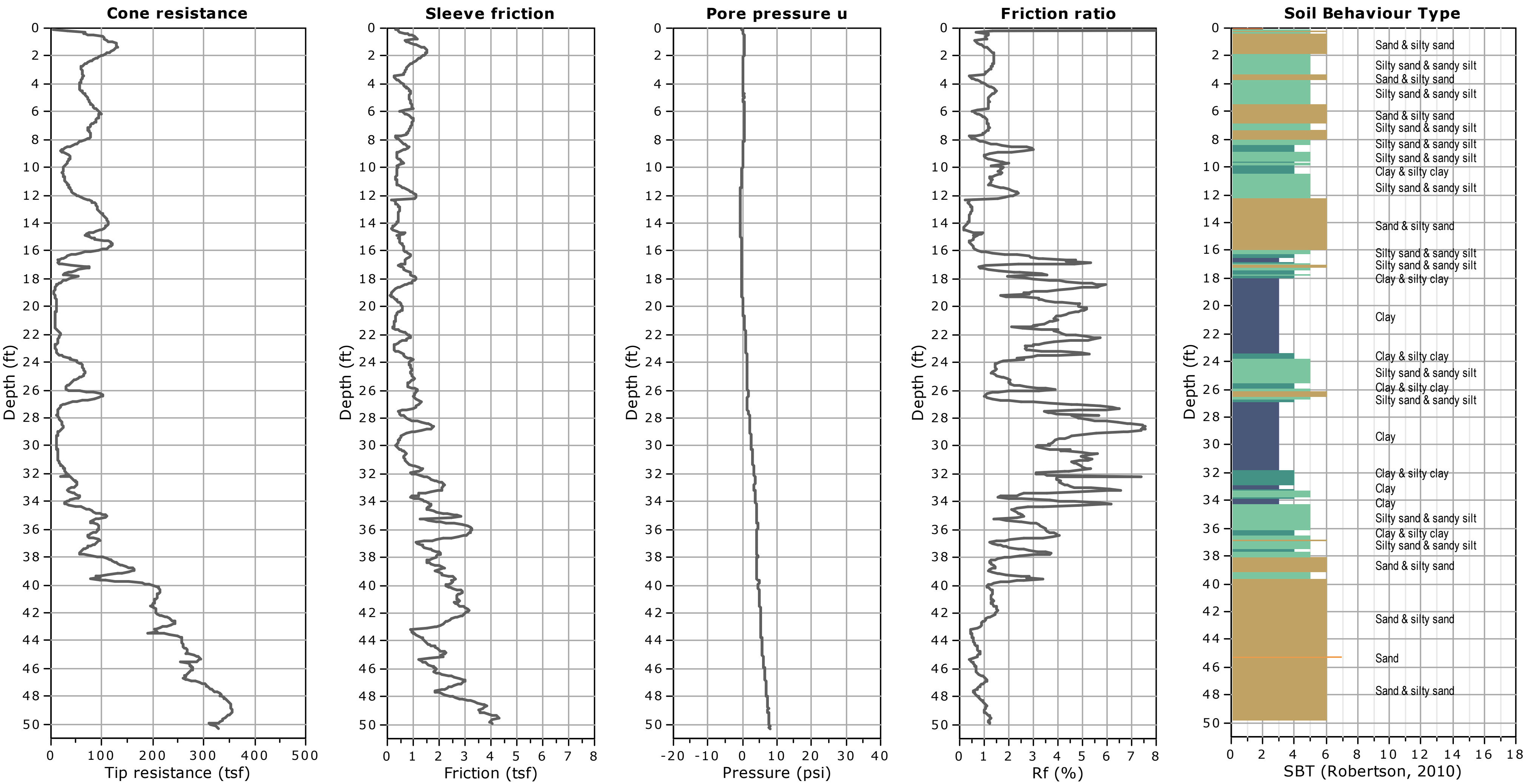
Kehoe Testing and Engineering
714-901-7270
steve@kehoetesting.com
www.kehoetesting.com

Project: **Langan Eng & Env Services / Cypress College Housing Feasibility**

Location: **9131 Holder St, Cypress, CA**

CPT-2

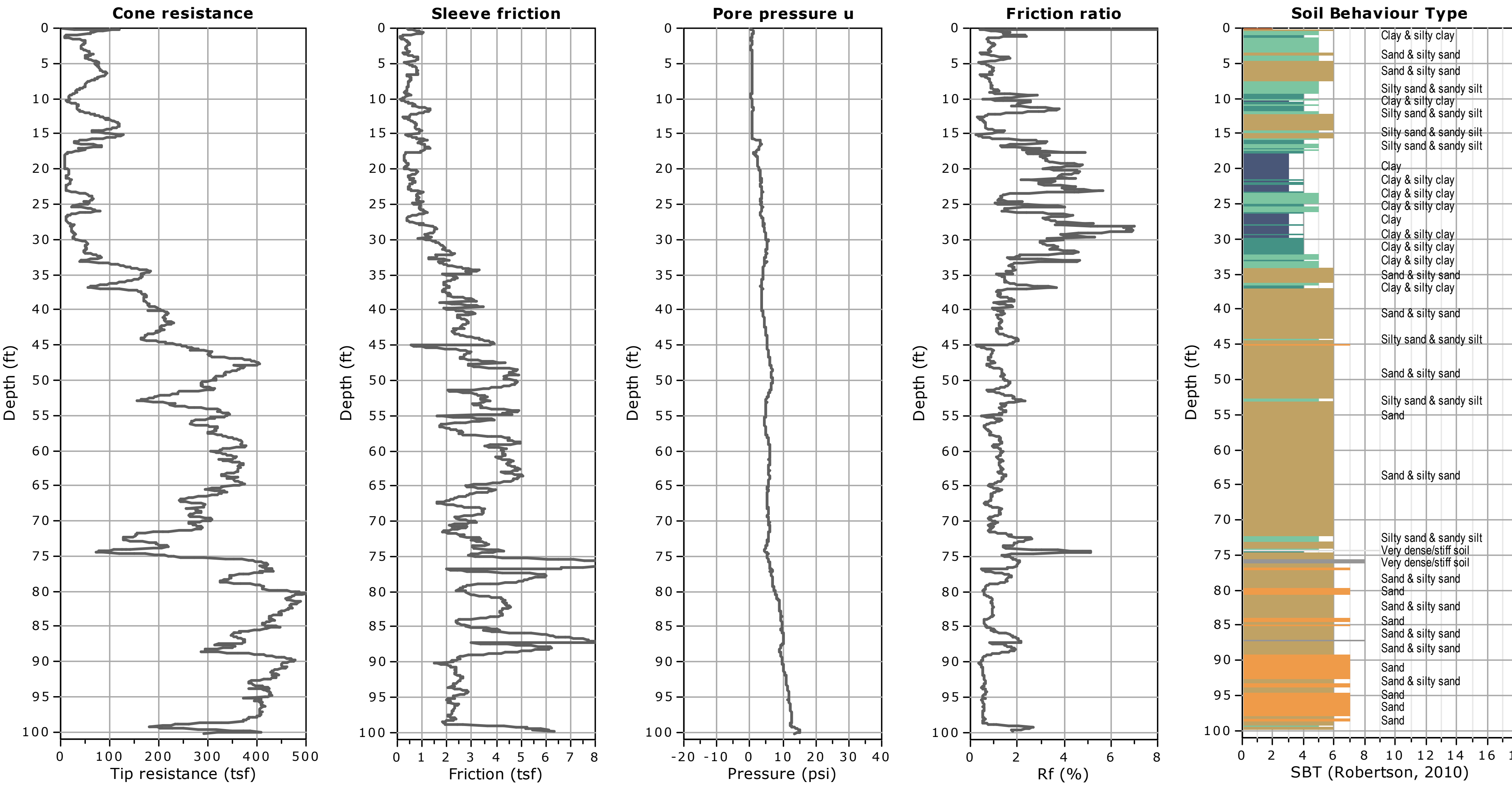
Total depth: 50.28 ft, Date: 11/8/2022



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

Project: **Langan Eng & Env Services / Cypress College Housing Feasibility** — **CPT-3**

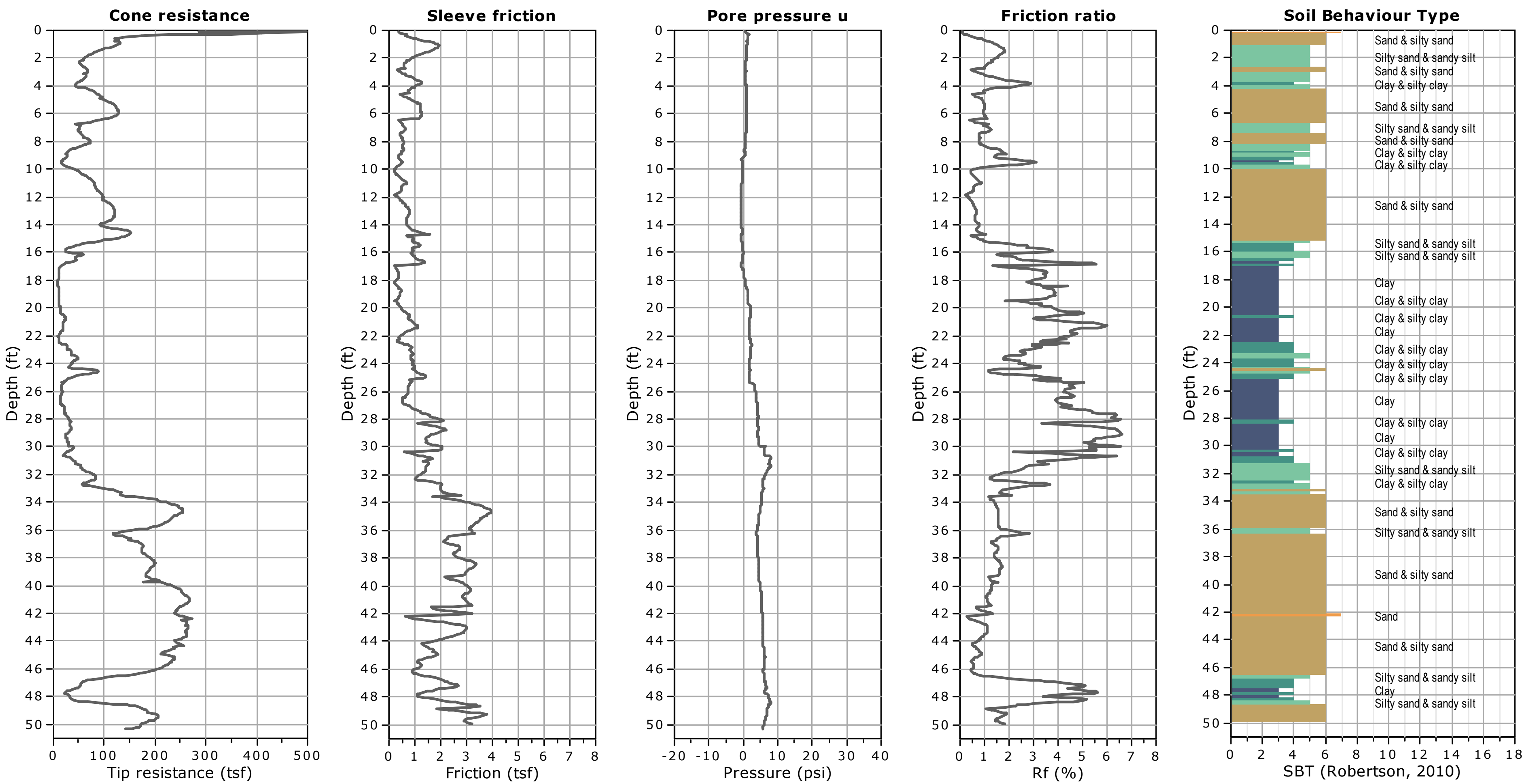
Location: **9131 Holder St, Cypress, CA** — Total depth: 100.14 ft, Date: 11/8/2022



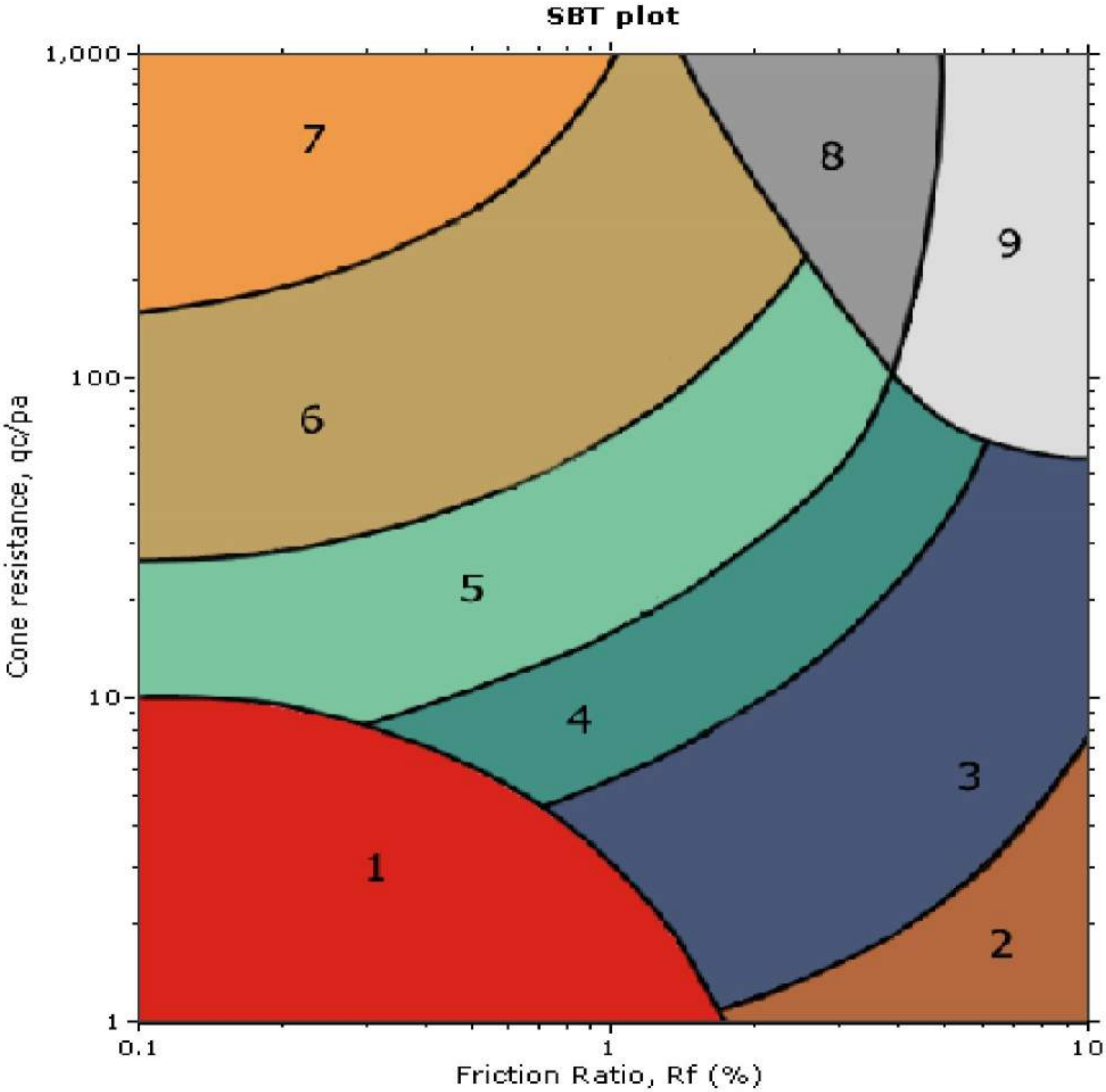
Kehoe Testing and Engineering
714-901-7270
steve@kehoetesting.com
www.kehoetesting.com

Project: **Langan Eng & Env Services / Cypress College Housing Feasibility** **CPT-4**

Location: **9131 Holder St, Cypress, CA** Total depth: 50.36 ft, Date: 11/8/2022



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



SBT legend

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

Langan Eng & Env Services
Cypress College Housing Feasibility
Cypress, CA

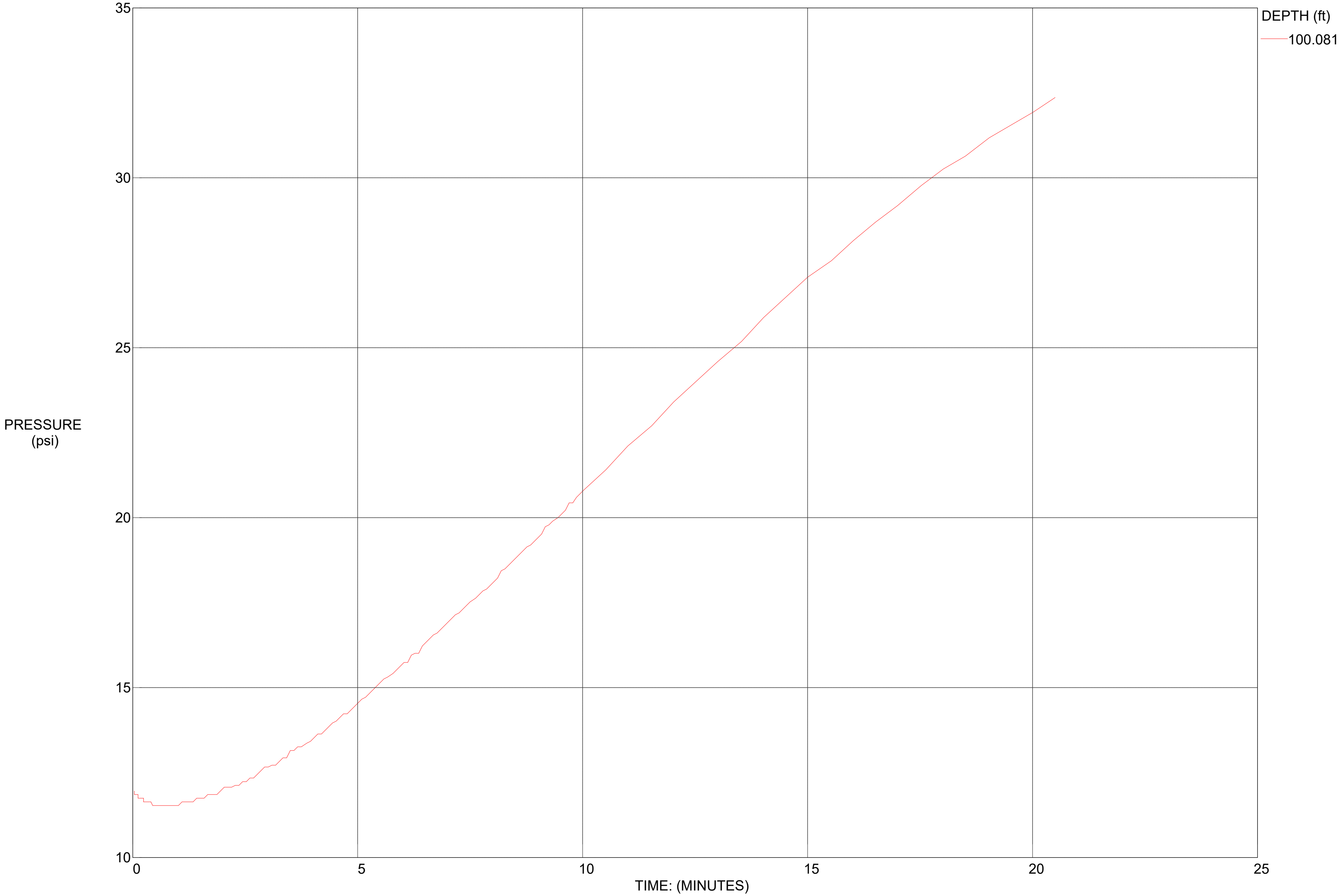
CPT Shear Wave Measurements

Location	Tip Depth (ft)	Geophone Depth (ft)	Travel Distance (ft)	S-Wave Arrival (msec)	S-Wave Velocity from Surface (ft/sec)	Interval S-Wave Velocity (ft/sec)
CPT-3	5.05	4.05	4.52	6.84	660	
	10.07	9.07	9.29	13.68	679	698
	15.06	14.06	14.20	23.00	617	527
	20.11	19.11	19.21	32.52	591	527
	25.03	24.03	24.11	41.76	577	530
	30.09	29.09	29.16	50.08	582	606
	35.17	34.17	34.23	56.40	607	802
	40.06	39.06	39.11	62.28	628	830
	45.11	44.11	44.16	67.96	650	888
	50.03	49.03	49.07	73.78	665	845
	55.22	54.22	54.26	79.84	680	856
	60.04	59.04	59.07	84.80	697	971
	65.03	64.03	64.06	90.46	708	881
	70.05	69.05	69.08	96.12	719	887
	75.03	74.03	74.06	101.48	730	929
	80.05	79.05	79.08	106.64	742	973
	85.14	84.14	84.16	111.76	753	994
	90.29	89.29	89.31	117.76	758	858
	95.01	94.01	94.03	122.28	769	1044
	100.07	99.07	99.09	127.60	777	951

Shear Wave Source Offset - 2 ft

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

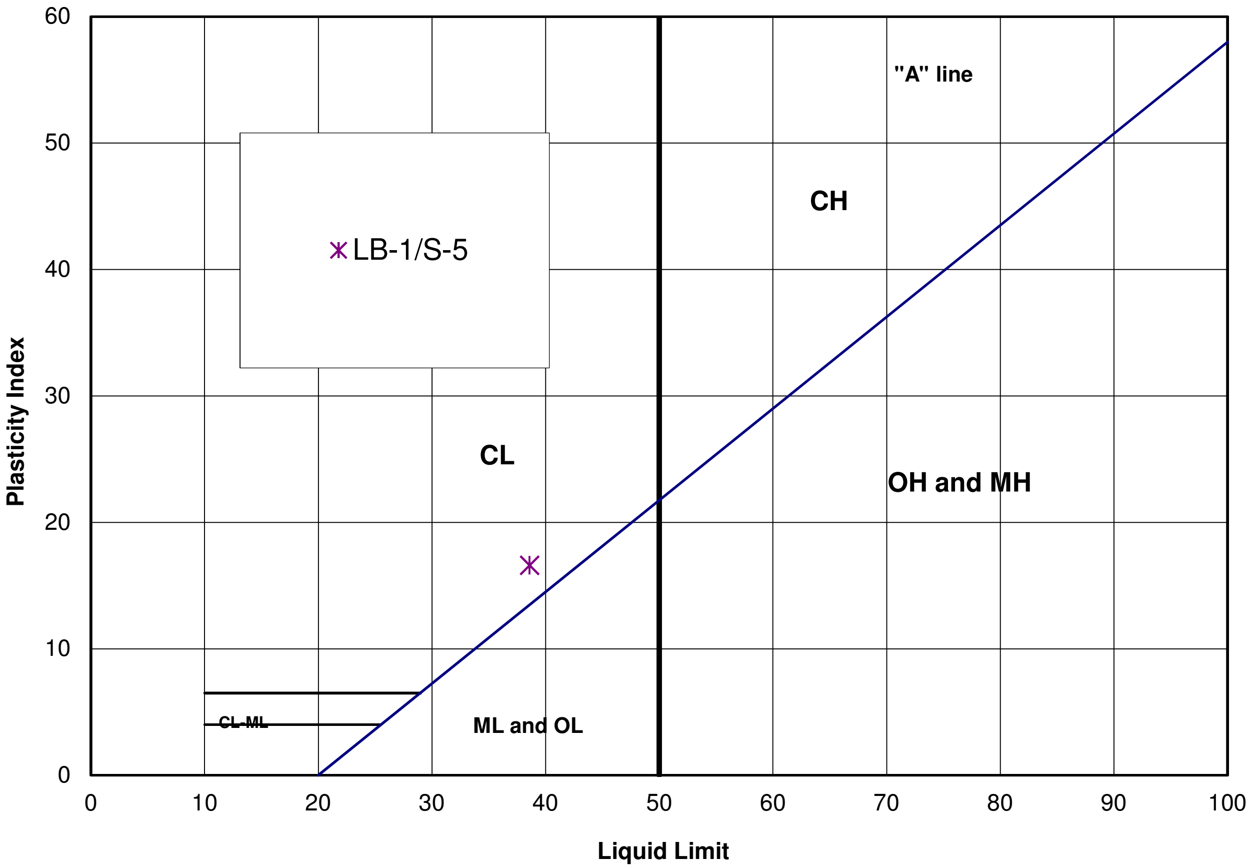
TEST ID: CPT-3



PRESSURE
(psi)
35
30
25
20
15
10
0
5
10
15
20
25
TIME: (MINUTES)
DEPTH (ft)
100.081

APPENDIX D
LABORATORY TEST RESULT

PLASTICITY INDEX _ ASTM D4318



Sample	Depth	LL	PL	PI	USCS	Material Description
LB-1/S-5	20'	39	22	17	CL	
LB-8/S-7	35'	-	NP	-	SM	

Job Name: Langan # 700123501 Date: 11-22-22

Job No.: 2012-0057

Geo-Logic ASSOCIATES

WASH #200 SIEVE - ASTM D 1140-92

Job Name Langan # 700123501 Date 11-22-22

Job No. 2012-0057 By LD

Sample	LB-1/S-3	**Sample**	LB-1/S-10	**Sample**	LB-3/S-8
Soil Type		Soil Type		Soil Type	
% water		% water		% water	
Wet weight		Wet weight		Wet weight	
Dry weight	216.6	Dry weight	245.5	Dry weight	276.2
+ 200 sieve	155.2	+ 200 sieve	217.6	+ 200 sieve	234.7
% Retained	71.7	% Retained	88.6	% Retained	85.0
%Pass. #200	**28**	**%Pass. #200**	**11**	**%Pass. #200**	**15**

Sample	LB-8/S-3	**Sample**		**Sample**	
Soil Type		Soil Type		Soil Type	
% water		% water		% water	
Wet weight		Wet weight		Wet weight	
Dry weight	283.5	Dry weight		Dry weight	
+ 200 sieve	253.4	+ 200 sieve		+ 200 sieve	
% Retained	89.4	% Retained		% Retained	
%Pass. #200	**11**	**%Pass. #200**		**%Pass. #200**	

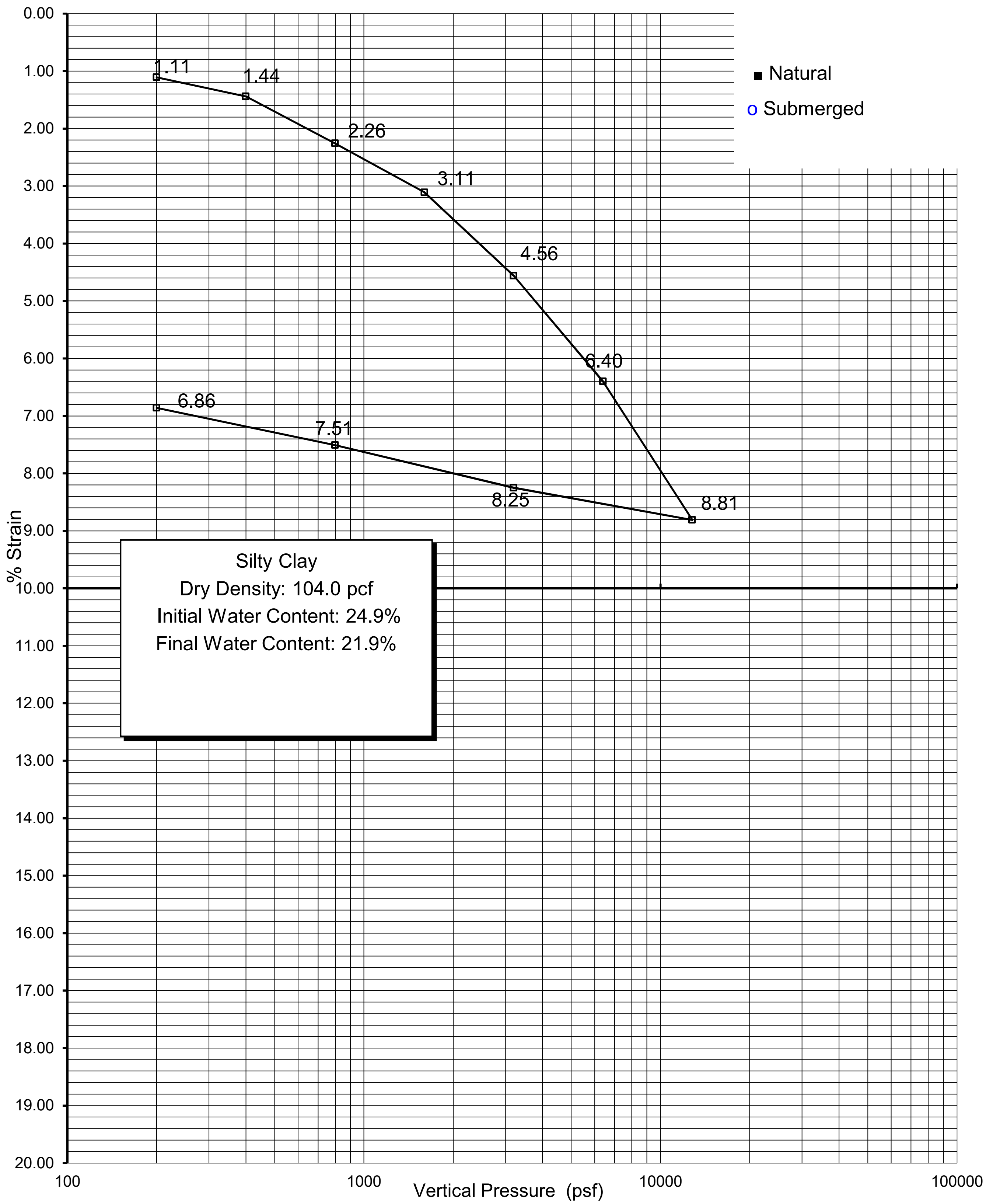
Sample		**Sample**		**Sample**	
Soil Type		Soil Type		Soil Type	
% water		% water		% water	
Wet weight		Wet weight		Wet weight	
Dry weight		Dry weight		Dry weight	
+ 200 sieve		+ 200 sieve		+ 200 sieve	
% Retained		% Retained		% Retained	
%Pass. #200		**%Pass. #200**		**%Pass. #200**	

Sample		**Sample**		**Sample**	
Soil Type		Soil Type		Soil Type	
% water		% water		% water	
Wet weight		Wet weight		Wet weight	
Dry weight		Dry weight		Dry weight	
+ 200 sieve		+ 200 sieve		+ 200 sieve	
% Retained		% Retained		% Retained	
%Pass. #200		**%Pass. #200**		**%Pass. #200**	

Geo-Logic ASSOCIATES

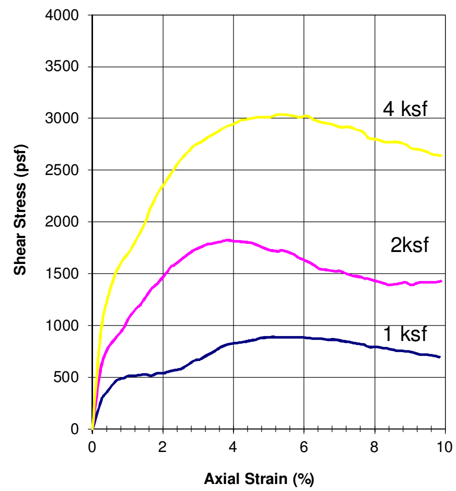
CONSOLIDATION TEST - ASTM D2435

Boring / Sample No. LB-1 / S-7	Depth: 30'	Date 11-15-22

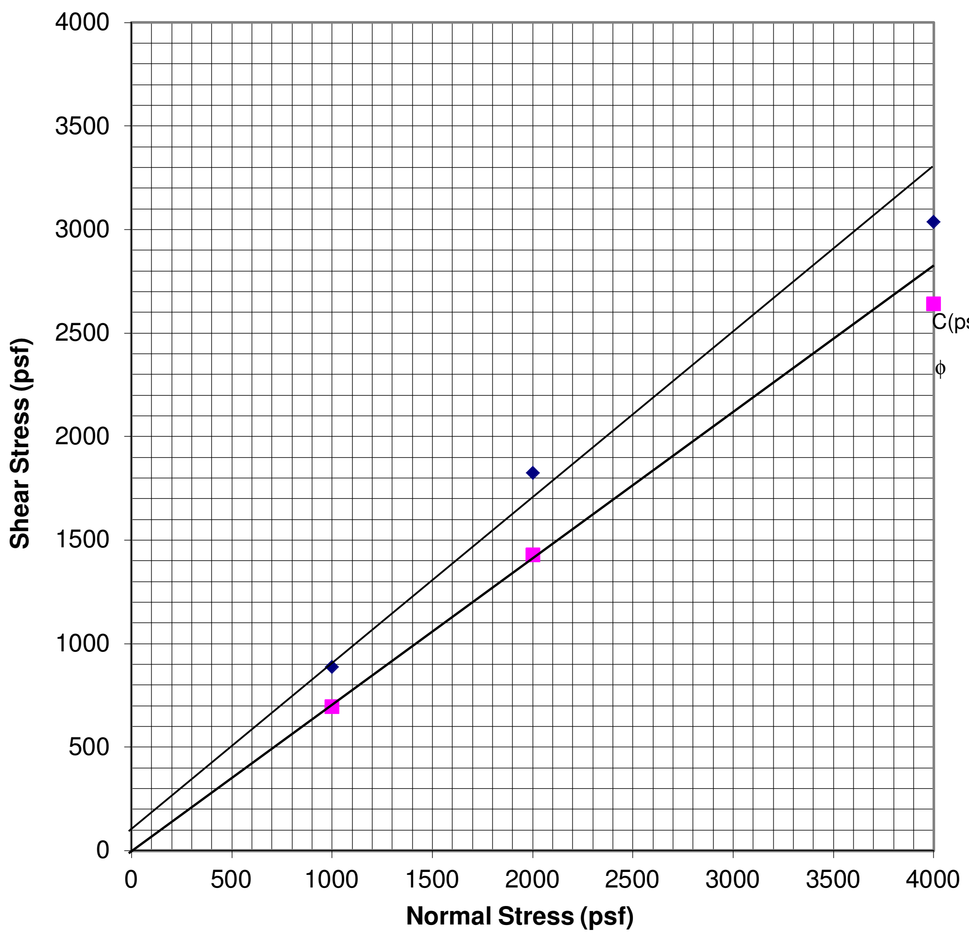


DIRECT SHEAR
ASTM D3080

PROJECT:	Langan # 700123501	Date:	11/22/2022
GLA JOB NO.:	2012-0057		
SAMPLE :	LB-2 / S-1		
SAMPLE TYPE:	Undisturbed		
DESCRIPTION:	Silty Sand		



Specimen No.	1	2	3
Normal Stress, psf	1000	2000	4000
Peak Stress, psf	888	1824	3036
Displacement, % strain	5.04	3.84	5.24
Ultimate Stress, psf	696	1428	2640
Displacement, % strain	9.84	9.88	9.88
Initial Dry Density, pcf	103.9	103.9	103.9
Initial Water Content,%	2.3	2.3	2.3
Final Water Content,%	22.9	22.9	22.9
Strain Rate, in/min.	0.025	0.025	0.025

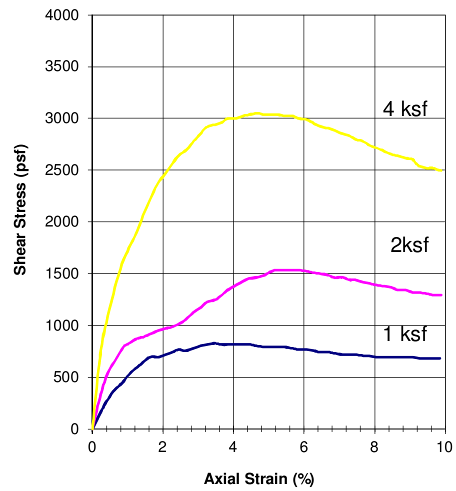


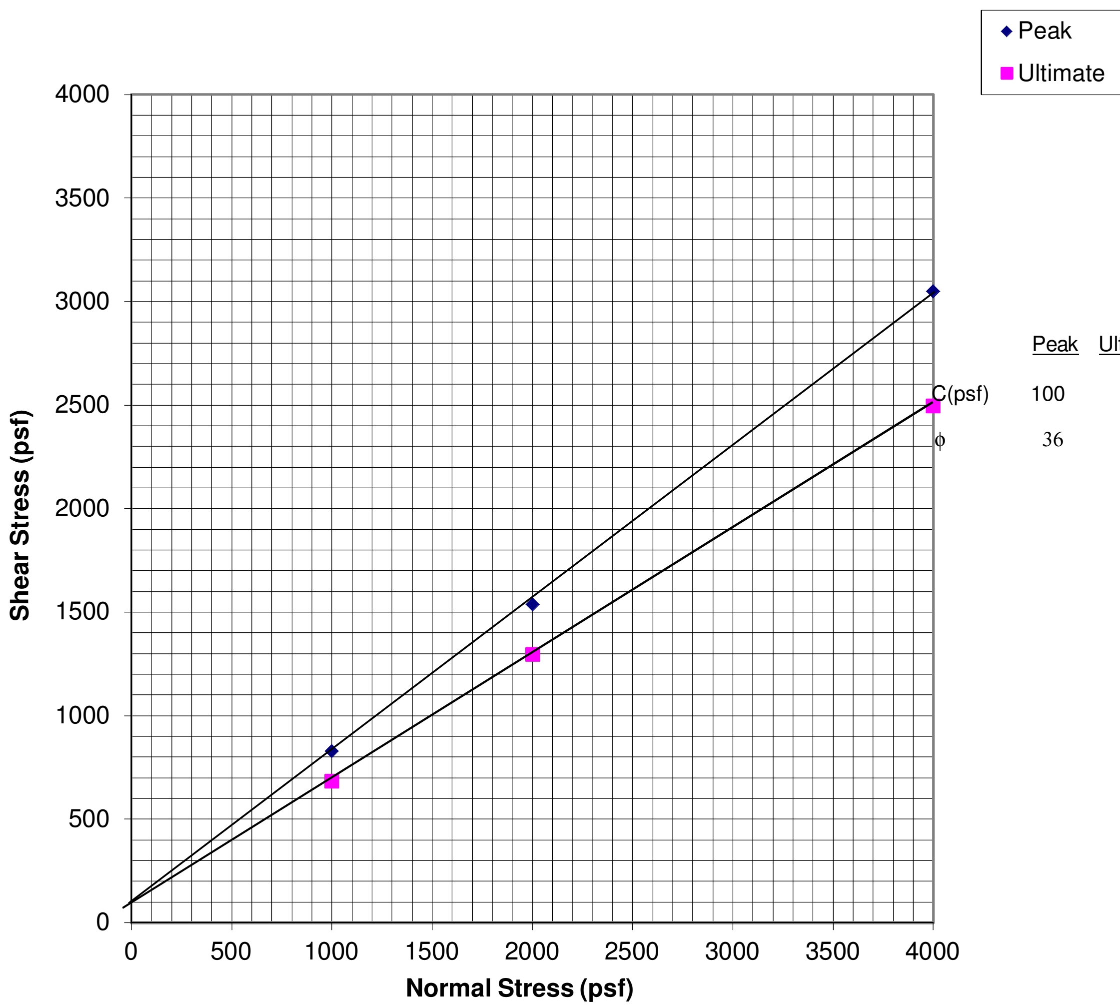
	Peak	Ultimate
C(psf)	100	0
ϕ	38.5	35

DIRECT SHEAR
ASTM D3080

PROJECT:	Langan # 700123501	Date:	11/22/2022
GLA JOB NO.:	2012-0057		
SAMPLE :	LB-7 / S-1		
SAMPLE TYPE:	Undisturbed		
DESCRIPTION:	Silty Sand		

Specimen No.	1	2	3
Normal Stress, psf	1000	2000	4000
Peak Stress, psf	828	1536	3048
Displacement, % strain	3.48	5.24	4.68
Ultimate Stress, psf	684	1296	2496
Displacement, % strain	9.84	9.88	9.88
Initial Dry Density, pcf	100.2	100.2	100.2
Initial Water Content,%	3.1	3.1	3.1
Final Water Content,%	21.5	21.5	21.5
Strain Rate, in/min.	0.025	0.025	0.025





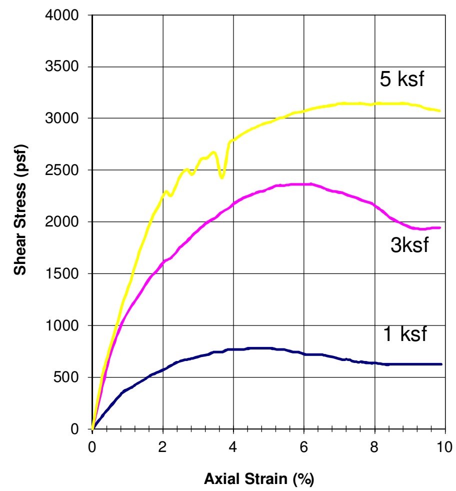
	Peak	Ultimate
C(psf)	100	100
ϕ	36	31

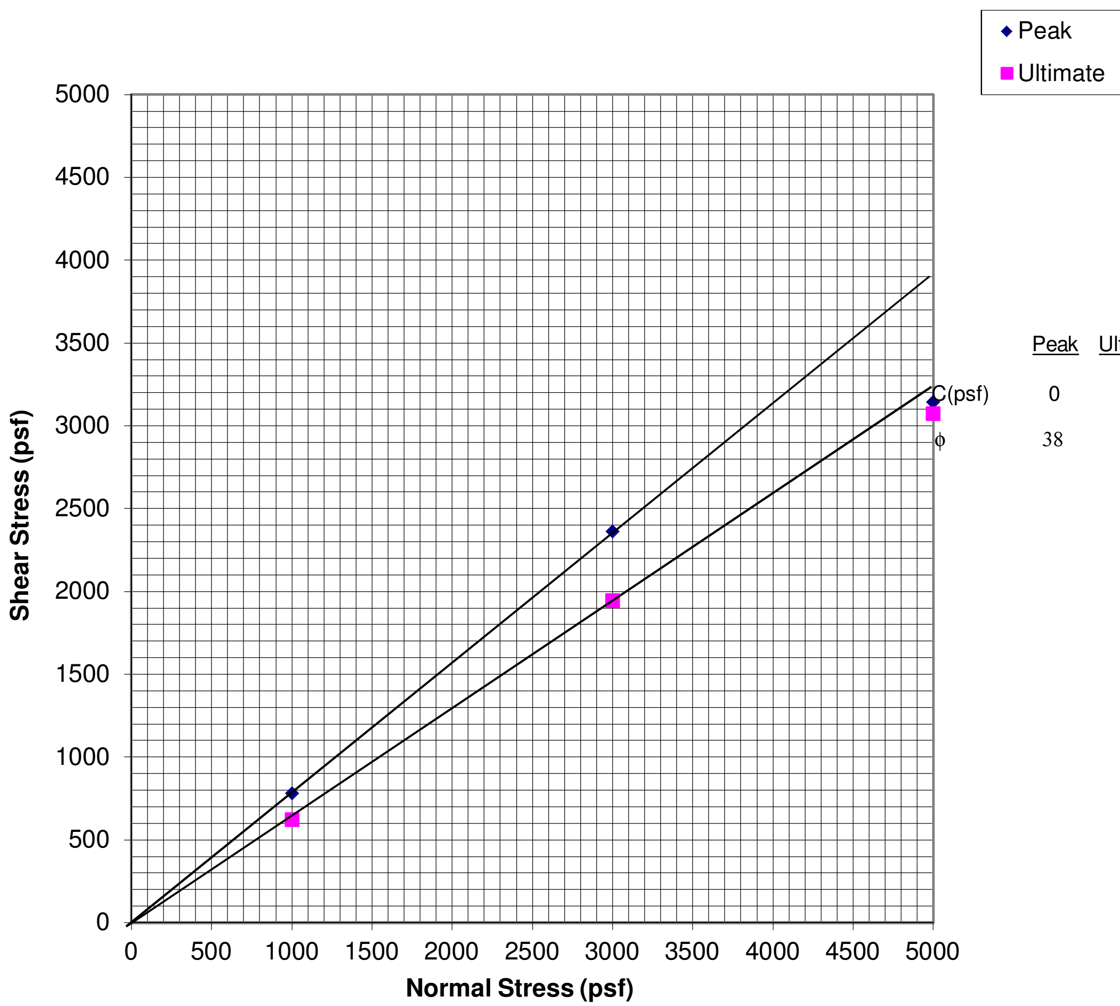
GeoLogic Associates

DIRECT SHEAR
ASTM D3080

PROJECT:	Langan # 700123501	Date:	11/22/2022
GLA JOB NO.:	2012-0057		
SAMPLE :	LB-2 / S-5		
SAMPLE TYPE:	Undisturbed		
DESCRIPTION:	Silty Sand		

Specimen No.	1	2	3
Normal Stress, psf	1000	3000	5000
Peak Stress, psf	780	2364	3144
Displacement, % strain	4.48	5.68	7.04
Ultimate Stress, psf	624	1944	3072
Displacement, % strain	9.88	9.84	9.84
Initial Dry Density, pcf	99.4	99.4	99.4
Initial Water Content,%	22.6	22.6	22.6
Final Water Content,%	42.6	42.6	42.6
Strain Rate, in/min.	0.025	0.025	0.025





	Peak	Ultimate
C(psf)	0	0
ϕ	38	33

Langan # 700123501

SOIL TEST RESULTS

Job No. 2012-0057

SAMPLE NO.:	LB-1 / B-1				
DESCRIPTION	Silty Sand				
DIRECT SHEAR TEST (type)					
Initial Moisture Content %					
Dry Density (pcf)					
Normal Stress (psf)					
Peak Shear Stress (psf)					
Ultimate Shear Stress (psf)					
Cohesion (psf)					
Internal Friction Angle (degrees)					
EXPANSION TEST UBC STD 18-2					
Initial Dry Density (pcf)					
Initial Moisture Content %					
Final Moisture Content %					
Pressure (psf)					
Expansion Index / Swell %					
CORROSIVITY TEST					
Resistivity (CTM643) (ohm-cm)	7300				
pH (CTM643)	7.5				
CHEMICAL TESTS					
Soluble Sulfate (CTM 417) (ppm)	98				
Chloride Content (CTM 422) (ppm)	37				
Wash #200 Sieve (ASTM-1140) %					
Sand Equivalent (ASTM D2419)					

Geo**L**ogic **A**ssociates

'R' VALUE CA 301

Client: Langan | Date: 11/22/22 | By: LD

Client's Job No.: **700123501** | Sample No.: LB-1 / B-1

GLA Reference: 2012-0057 | Soil Type: Brown, Silty Sand

TEST SPECIMEN		A	B	C	D
Compactor Air Pressure	psi	**350**	**350**	**350**	
Initial Moisture Content	%	**6.2**	**6.2**	**6.2**	
Water Added	ml	**60**	**54**	**57**	
Moisture at Compaction	%	11.5	11.0	11.2	
Sample & Mold Weight	gms	**3202**	**3198**	**3200**	
Mold Weight	gms	**2103**	**2110**	**2103**	
Net Sample Weight	gms	1099	1088	1097	
Sample Height	in.	**2.525**	**2.521**	**2.511**	
Dry Density	pcf	118.3	117.8	119.0	
Pressure	lbs	**3680**	**9440**	**5020**	
Exudation Pressure	psi	293	752	400	
Expansion Dial	x 0.0001	**0**	**3**	**0**	
Expansion Pressure	psf	0	13	0	
Ph at 1000lbs	psi	**15**	**13**	**13**	
Ph at 2000lbs	psi	**28**	**23**	**25**	
Displacement	turns	**4.54**	**4.34**	**4.44**	
R' Value		72	77	75	
Corrected 'R' Value		**72**	**77**	**75**	

FINAL 'R' VALUE	
By Exudation Pressure (@ 300 psi):	**72**
By Epansion Pressure :	**N/A**
TI = 5	

Geo-Logic ASSOCIATES

'R' VALUE CA 301

Client: Langan Engineering | Date: 12/7/22 | By: LD

Client's Job No.: **700123501** | Sample No.: LB-11 / B-1

GLA Reference: 2012-0057 | Soil Type: Brown, Silty Sand

TEST SPECIMEN		A	B	C	D
Compactor Air Pressure	psi	**250**	**350**	**150**	
Initial Moisture Content	%	**9.7**	**9.7**	**9.7**	
Water Added	ml	**30**	**25**	**35**	
Moisture at Compaction	%	12.4	12.0	12.9	
Sample & Mold Weight	gms	**3196**	**3188**	**3203**	
Mold Weight	gms	**2084**	**2103**	**2096**	
Net Sample Weight	gms	1112	1085	1107	
Sample Height	in.	**2.55**	**2.479**	**2.544**	
Dry Density	pcf	117.5	118.4	116.8	
Pressure	lbs	**3800**	**5990**	**2320**	
Exudation Pressure	psi	303	477	185	
Expansion Dial	x 0.0001	**8**	**15**	**0**	
Expansion Pressure	psf	35	65	0	
Ph at 1000lbs	psi	**25**	**22**	**30**	
Ph at 2000lbs	psi	**43**	**39**	**57**	
Displacement	turns	**4.21**	**3.85**	**4.62**	
R' Value		62	67	49	
Corrected 'R' Value		**62**	**67**	**49**	

FINAL 'R' VALUE	
By Exudation Pressure (@ 300 psi):	**62**
By Epansion Pressure :	**N/A**
TI = 5	

Geo-Logic ASSOCIATES

EXPANSION INDEX - UBC 18-2 & ASTM D 4829-88

PROJECT Langan # 700123501 JOB NO. 2012-0057

Sample LB1 - B-1 By LD
Sta. No.
Soil Type Brown, Silty Sand

Date	Time	Dial Reading	Wet+Tare	603.7
11/17/2022	16:20	0.4034	Tare	207.7
		H2O	Net Weight	396
11/18/2022	10:00	0.4022	% Water	10
			Dry Dens.	109.1
			% Max	
			Wet+Tare	629.4
			Tare	207.7
			Net Weight	421.7
INDEX	1	0.1%	% Water	17.1

Sample By
Sta. No.
Soil Type

Date		Dial Reading	Wet+Tare	
			Tare	
			Net Weight	
			% Water	
			Dry Dens.	
			% Max	
			Wet+Tare	
			Tare	
			Net Weight	
INDEX			% Water	

Sample By
Sta. No.
Soil Type

Date		Dial Reading	Wet+Tare	
			Tare	
			Net Weight	
			% Water	
			Dry Dens.	
			% Max	
			Wet+Tare	
			Tare	
			Net Weight	
INDEX			% Water	

Sample By
Sta. No.
Soil Type

Date		Dial Reading	Wet+Tare	
			Tare	
			Net Weight	
			% Water	
			Dry Dens.	
			% Max	
			Wet+Tare	
			Tare	
			Net Weight	
INDEX			% Water	

Geo-Logic ASSOCIATES

APPENDIX E
LIQUEFACTION RESULTS

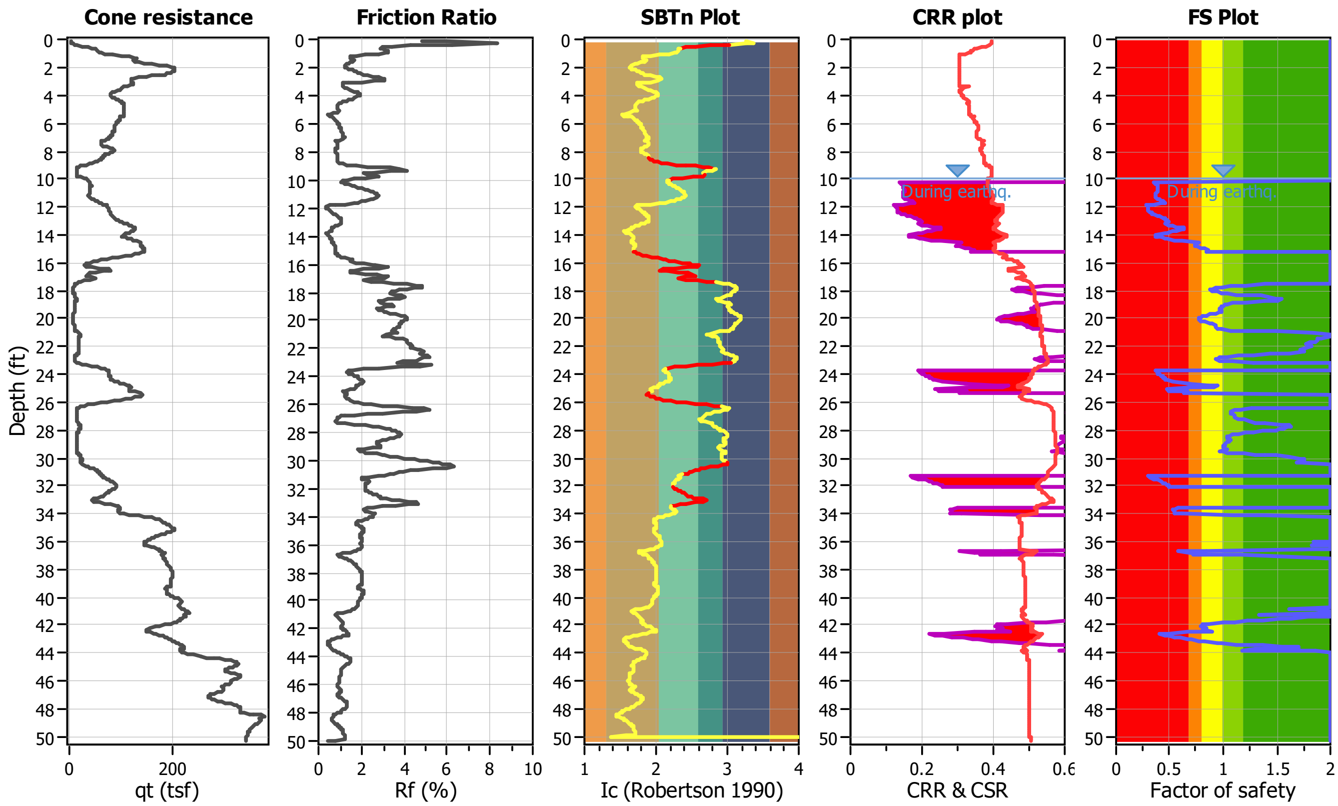
LIQUEFACTION ANALYSIS REPORT

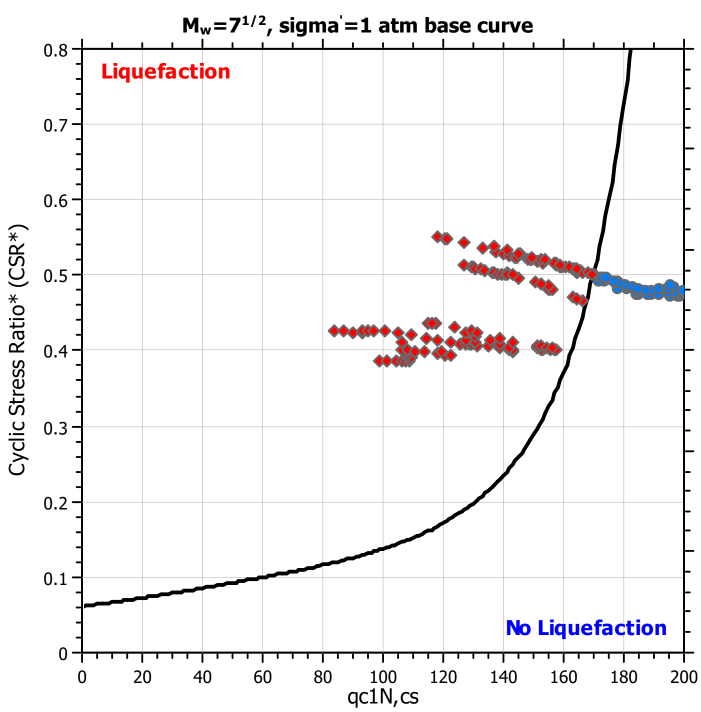
Project title : Cypress College Housing Development **Location : Cypress College**

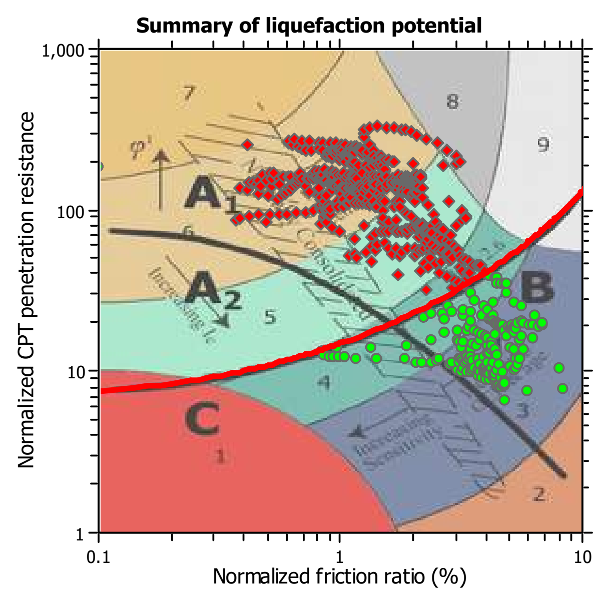
CPT file : CPT1

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	10.00 ft	Use fill:	No	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	10.00 ft	Fill height:	N/A		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	Yes
Earthquake magnitude M_w:	6.74	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	50.00 ft
Peak ground acceleration:	0.69	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method

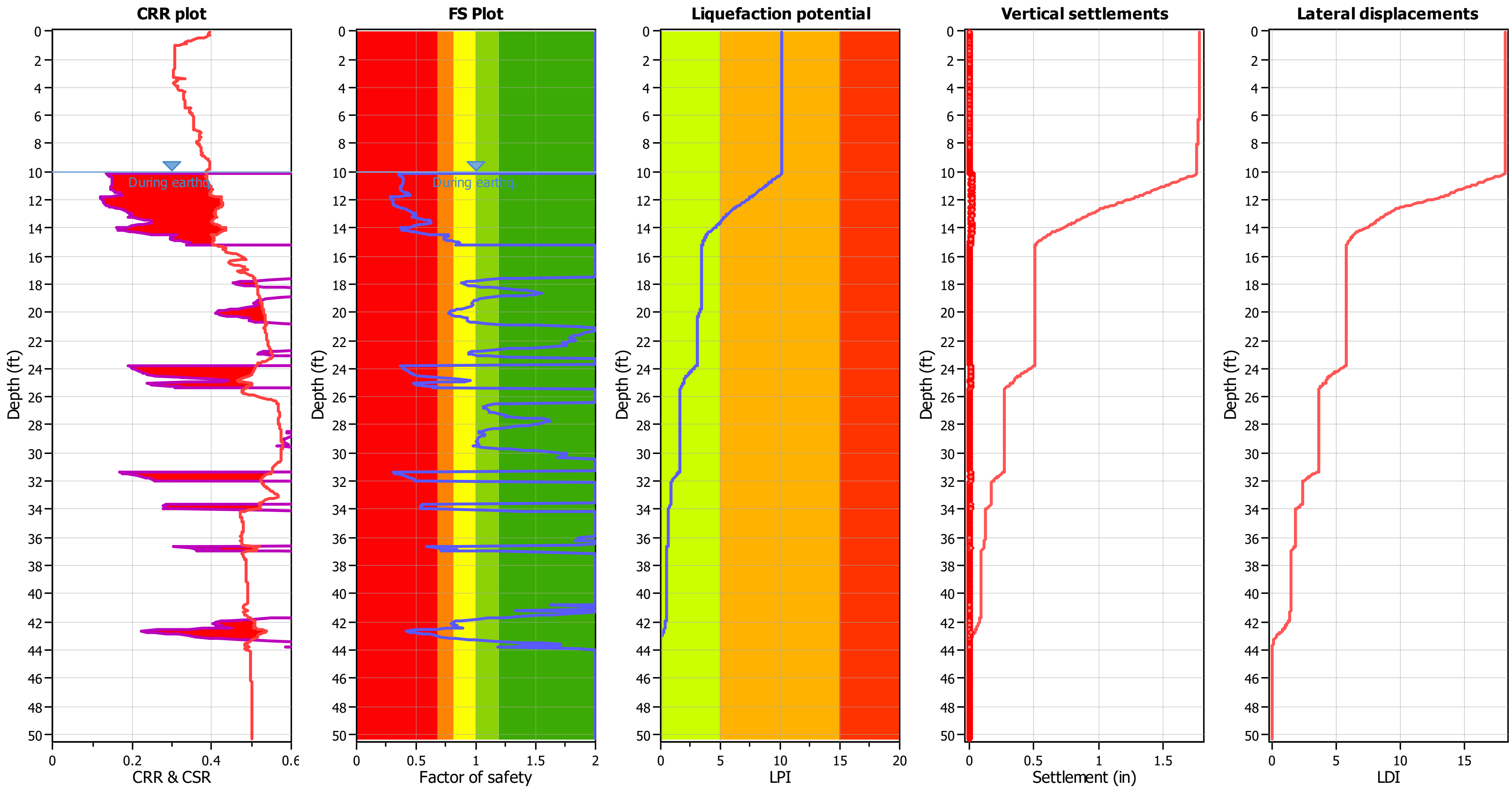






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	10.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.74	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.69	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	10.00 ft	Fill height:	N/A	Limit depth:	50.00 ft

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

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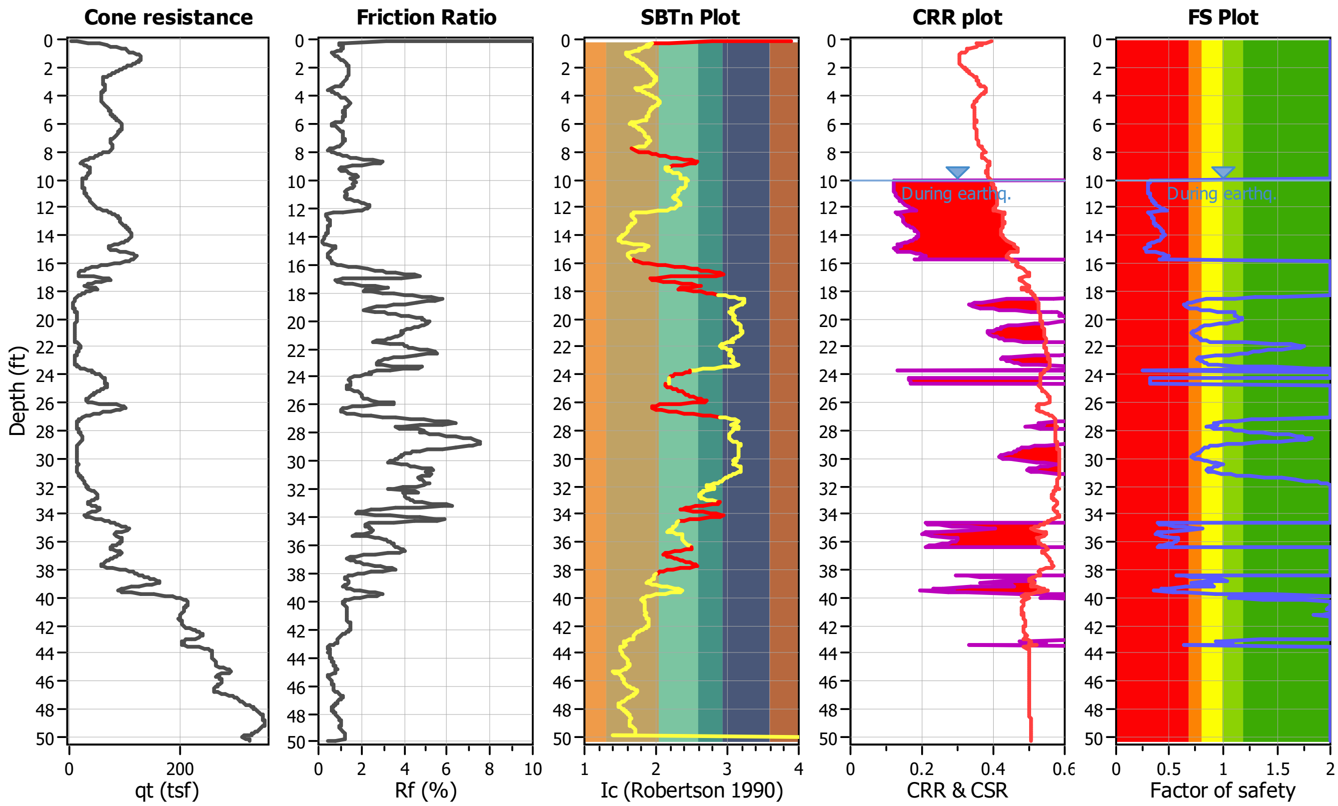
LIQUEFACTION ANALYSIS REPORT

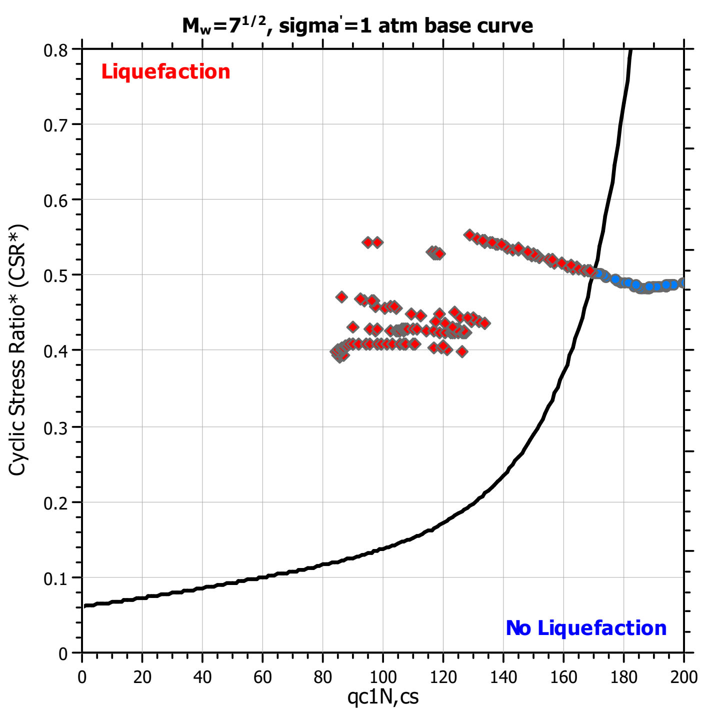
Project title : Cypress College Housing Development **Location : Cypress College**

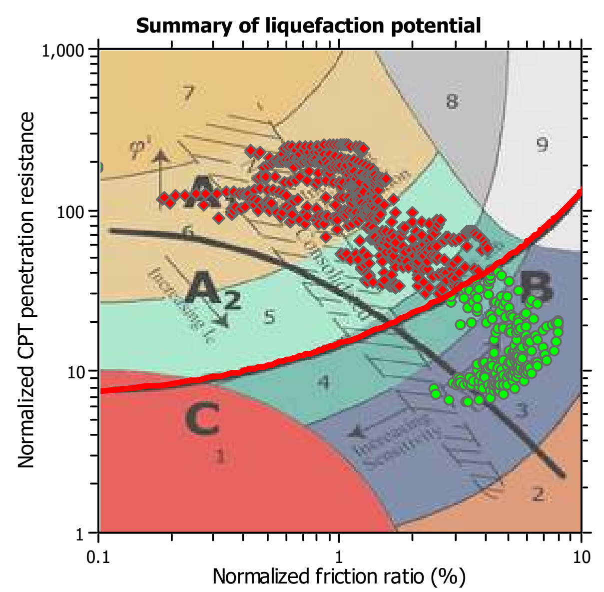
CPT file : CPT2

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	10.00 ft	Use fill:	No	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	10.00 ft	Fill height:	N/A		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	Yes
Earthquake magnitude M_w:	6.74	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	50.00 ft
Peak ground acceleration:	0.69	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method

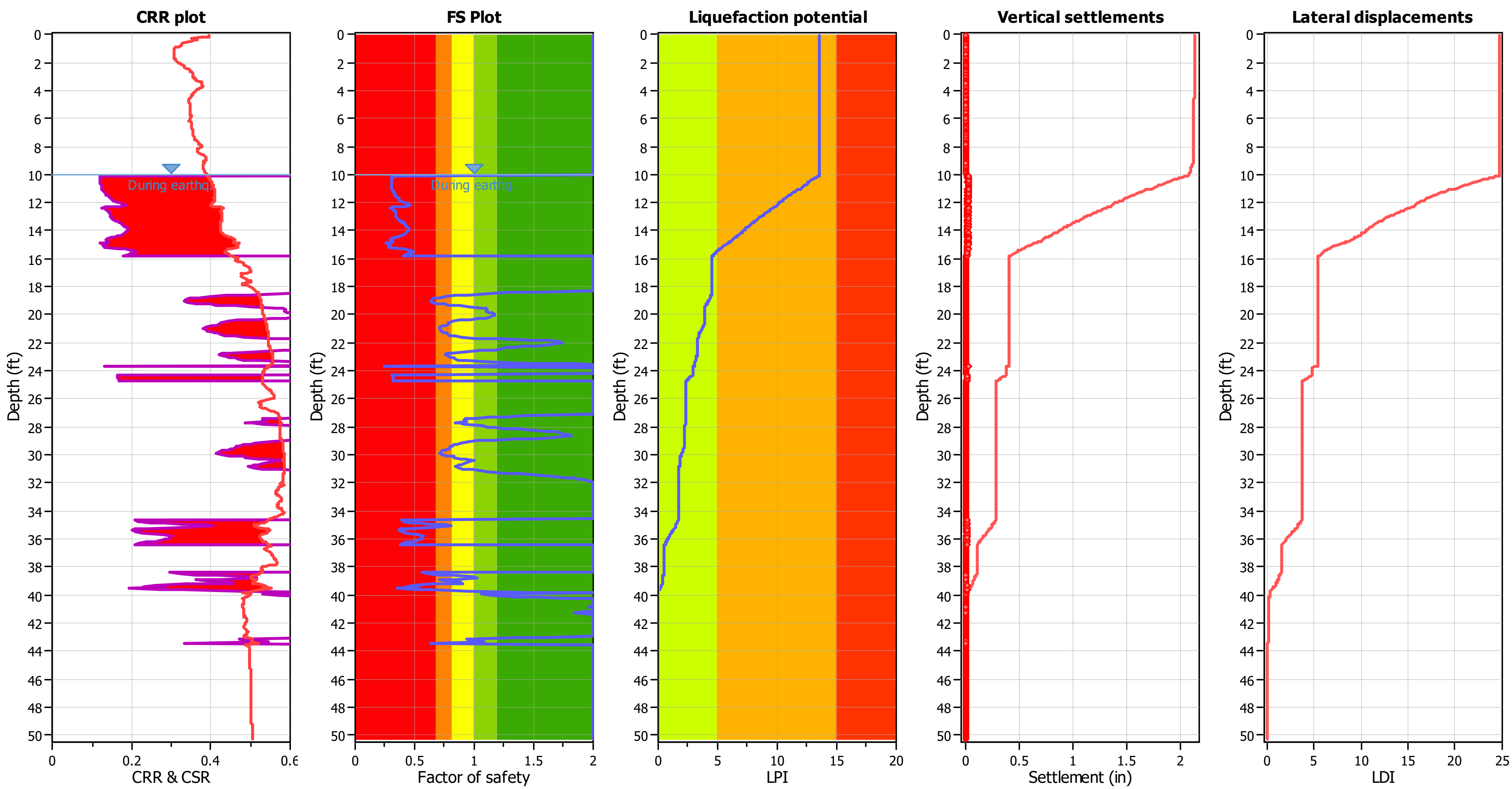






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	10.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.74	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.69	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	10.00 ft	Fill height:	N/A	Limit depth:	50.00 ft

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

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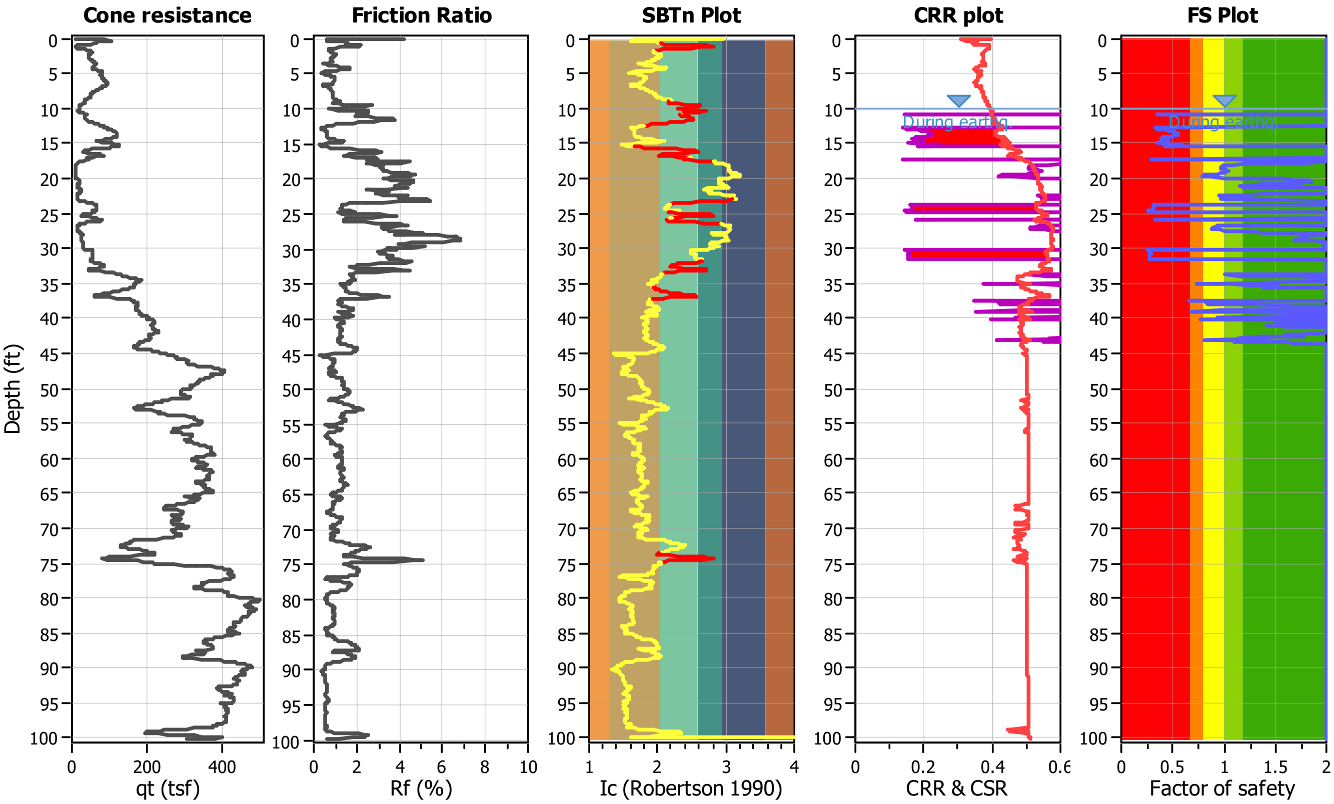
LIQUEFACTION ANALYSIS REPORT

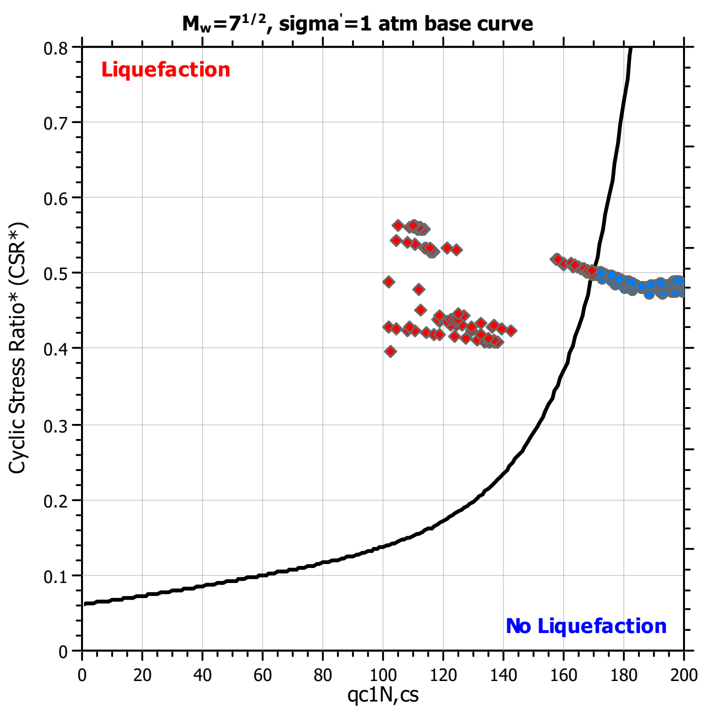
Project title : Cypress College Housing Development **Location : Cypress College**

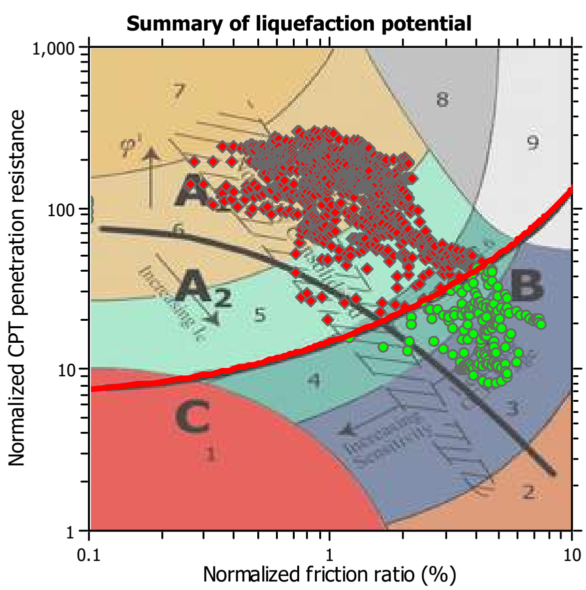
CPT file : CPT3

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	10.00 ft	Use fill:	No	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	10.00 ft	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	50.00 ft
Earthquake magnitude M_w:	6.74	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method
Peak ground acceleration:	0.69	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

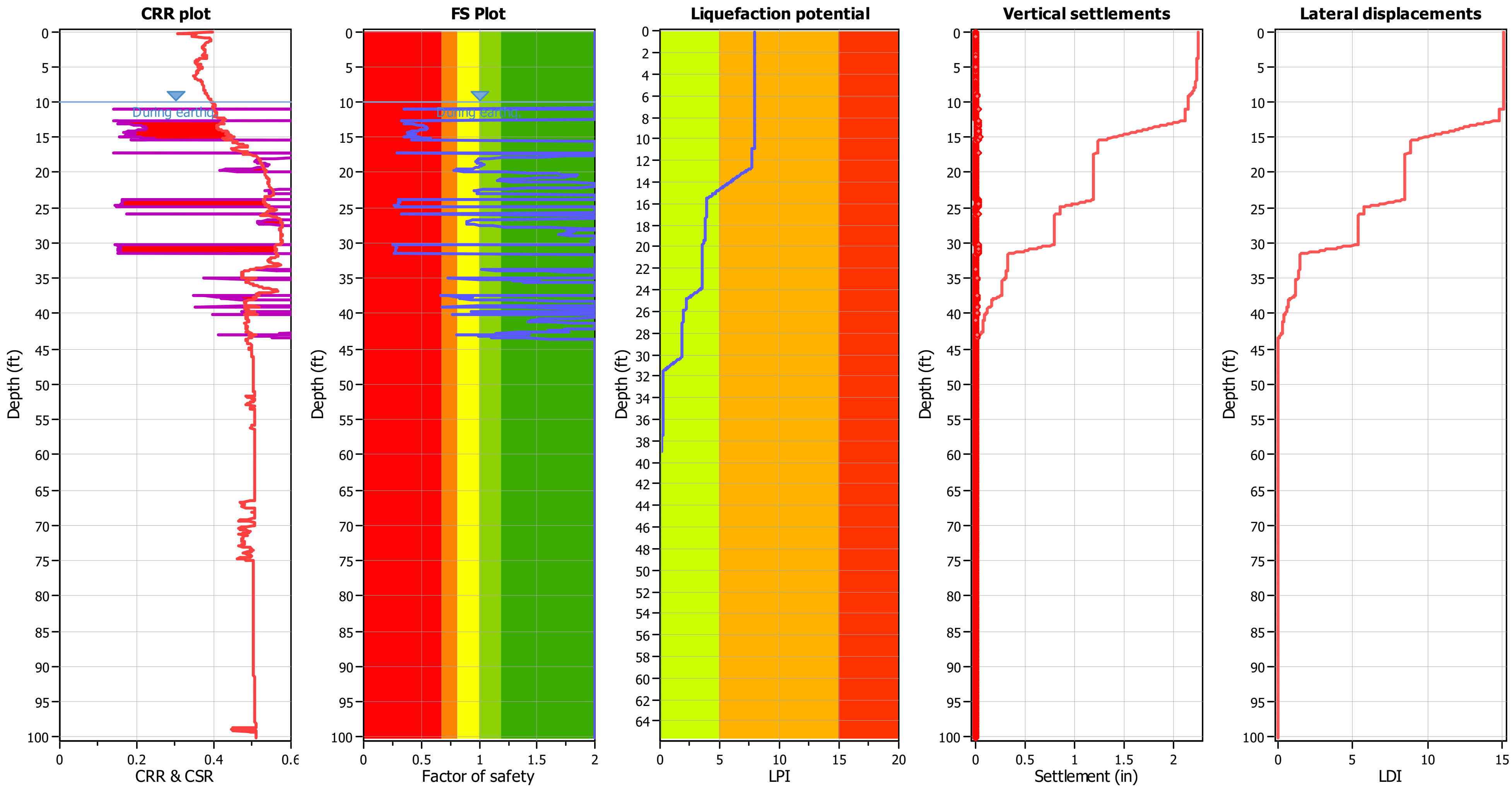






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	10.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.74	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.69	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	10.00 ft	Fill height:	N/A	Limit depth:	50.00 ft

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

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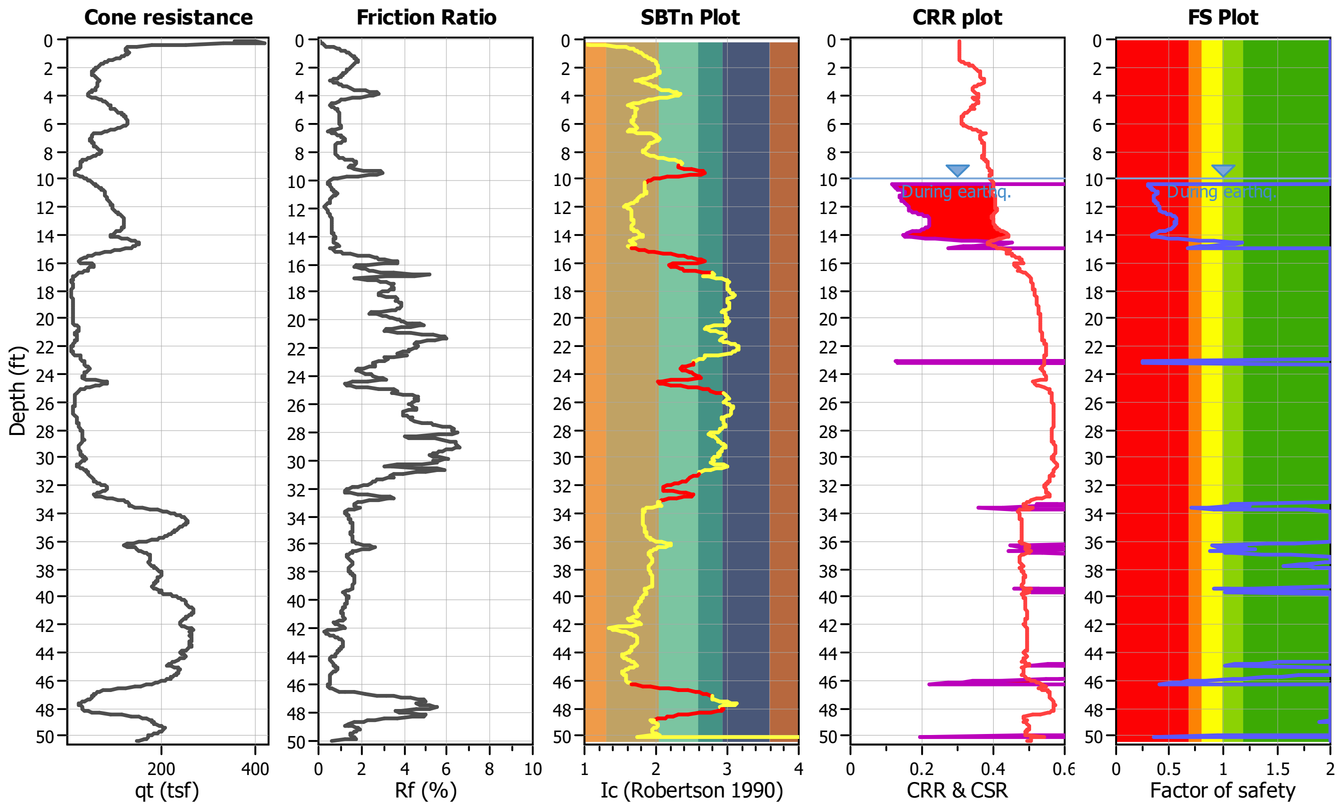
LIQUEFACTION ANALYSIS REPORT

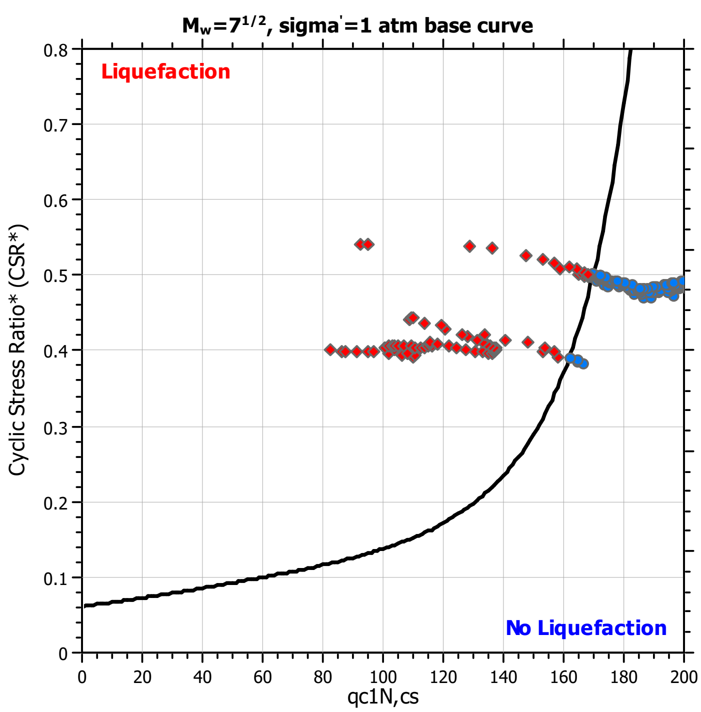
Project title : Cypress College Housing Development **Location : Cypress College**

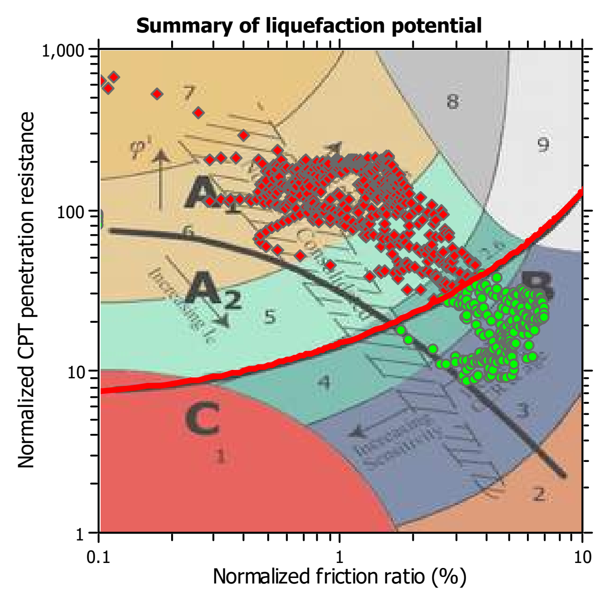
CPT file : CPT4

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	10.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	10.00 ft	Fill height:	N/A		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w:	6.74	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.69	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method

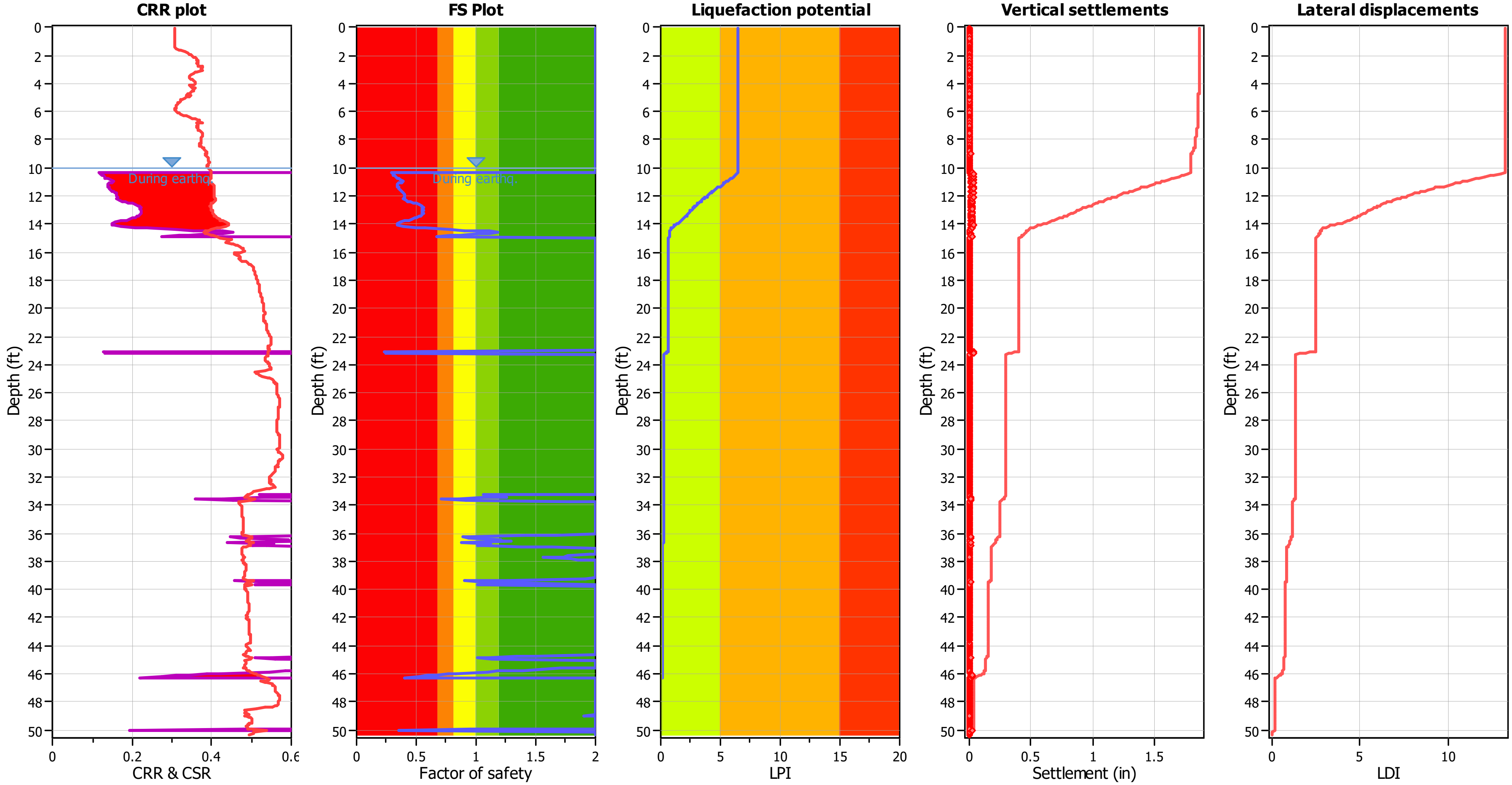






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	10.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.74	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.69	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	10.00 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

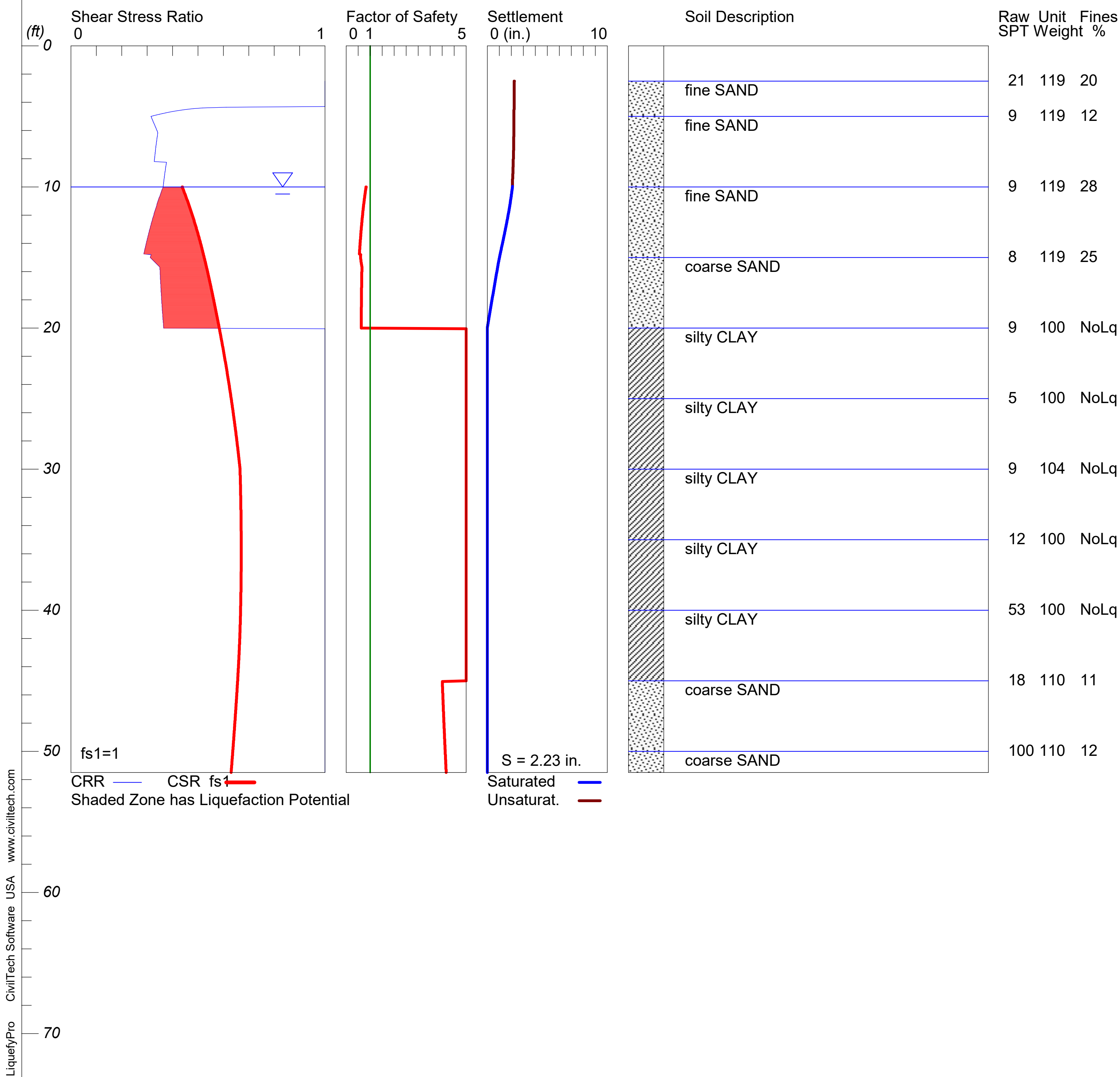
- Very high risk
- High risk
- Low risk

LIQUEFACTION ANALYSIS

Cypress College Student Housing

Hole No.=LB-1 Water Depth=10 ft Surface Elev.=+58

Magnitude=6.74
Acceleration=0.69g

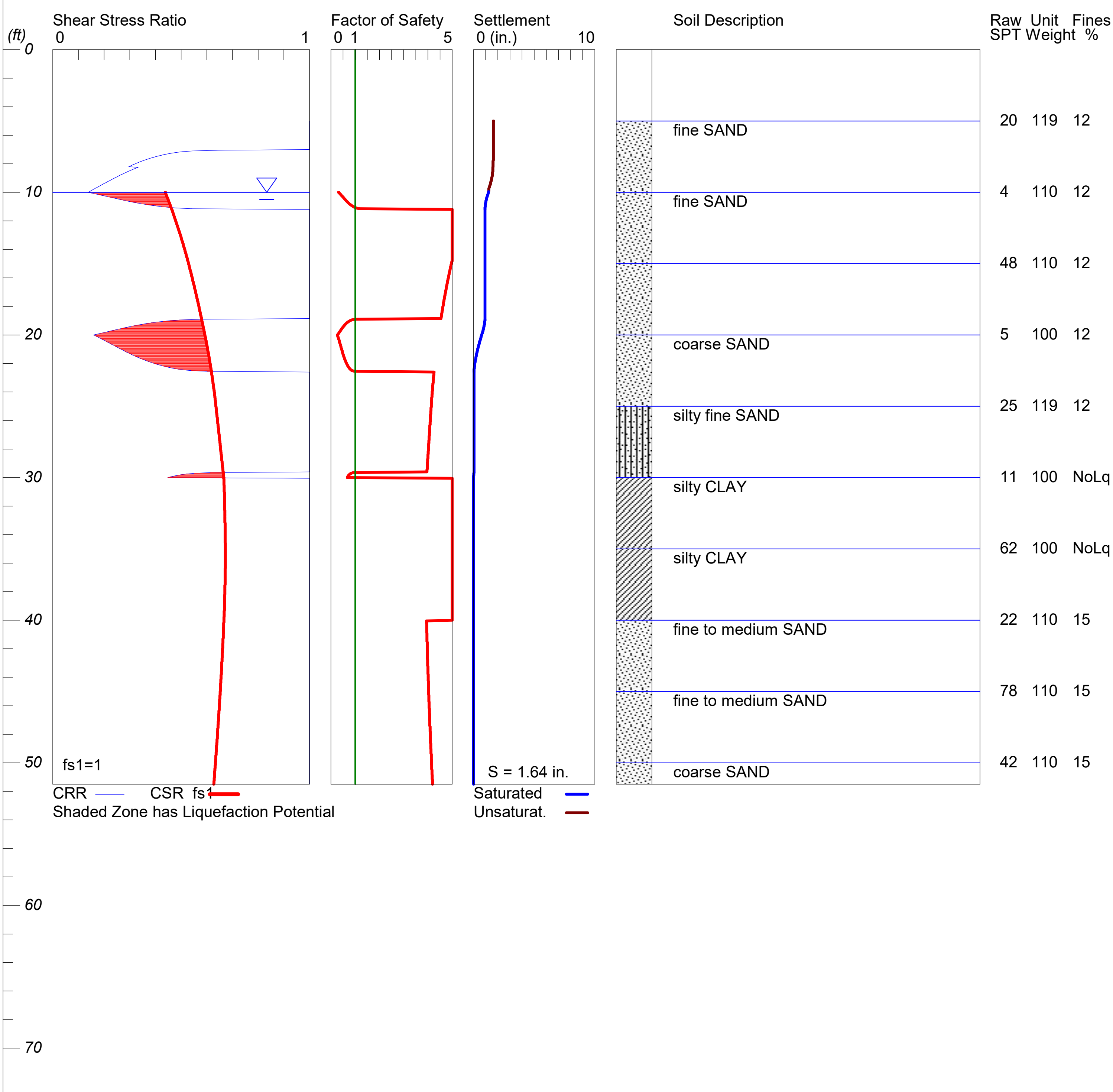


LIQUEFACTION ANALYSIS

Cypress College Student Housing

Hole No.=LB-3 Water Depth=10 ft Surface Elev.=+56.6

Magnitude=6.74
Acceleration=0.69g

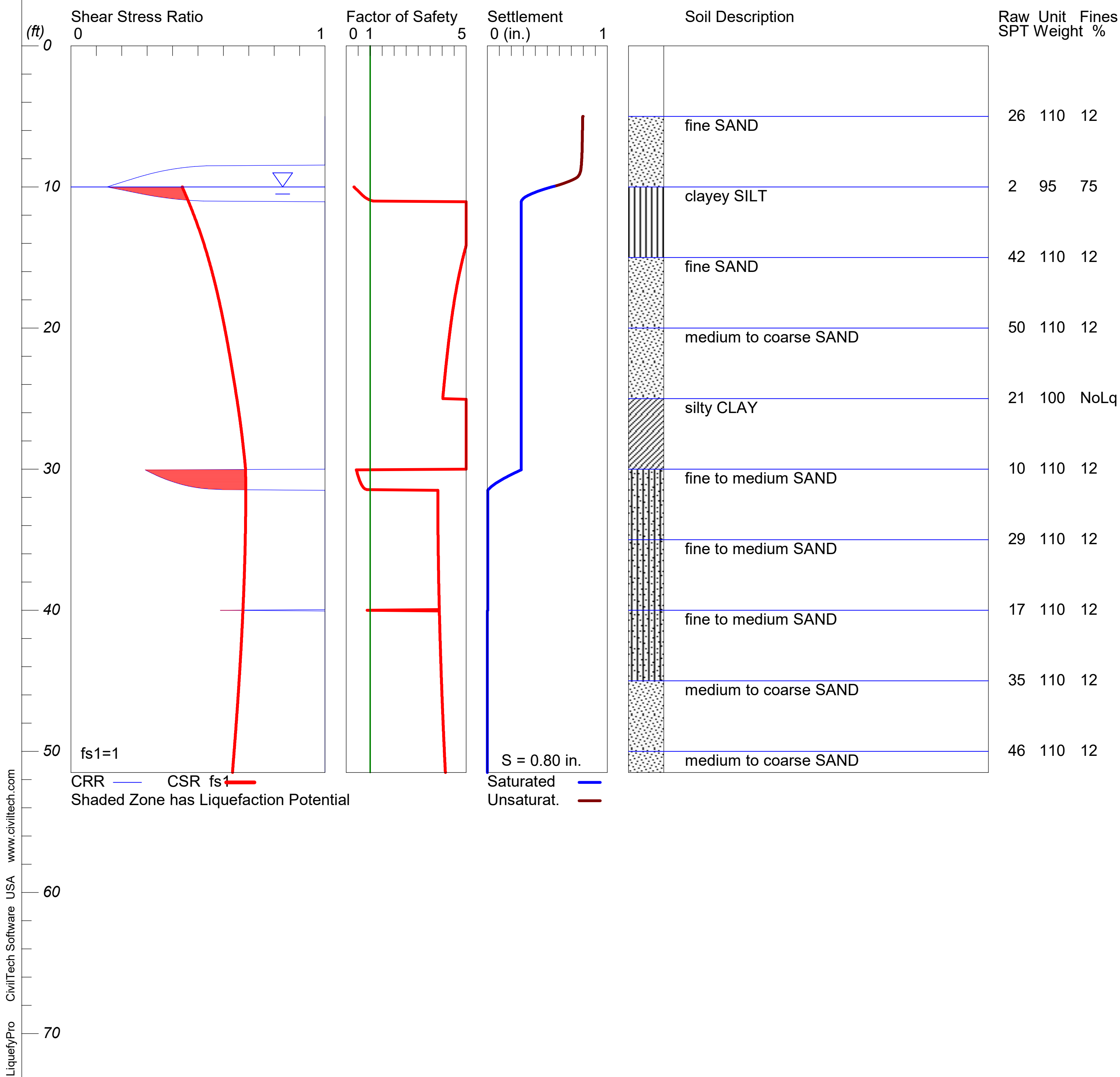


LIQUEFACTION ANALYSIS

Cypress College Student Housing

Hole No.=LB-5 Water Depth=10 ft Surface Elev.=+57

Magnitude=6.74
Acceleration=0.69g

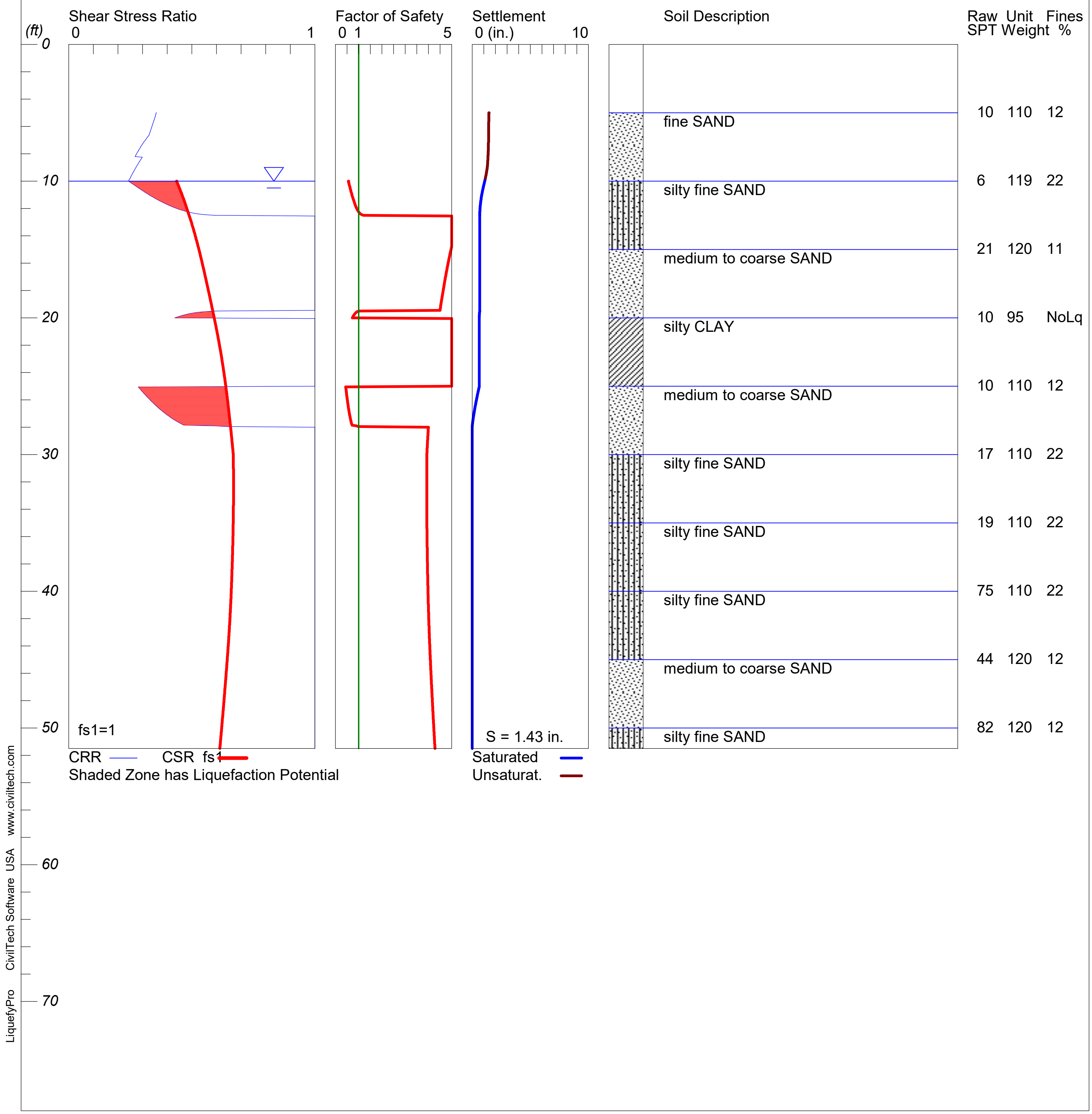


LIQUEFACTION ANALYSIS

Cypress College Student Housing

Hole No.=LB-8 Water Depth=10 ft Surface Elev.=+56

Magnitude=6.74
Acceleration=0.69g

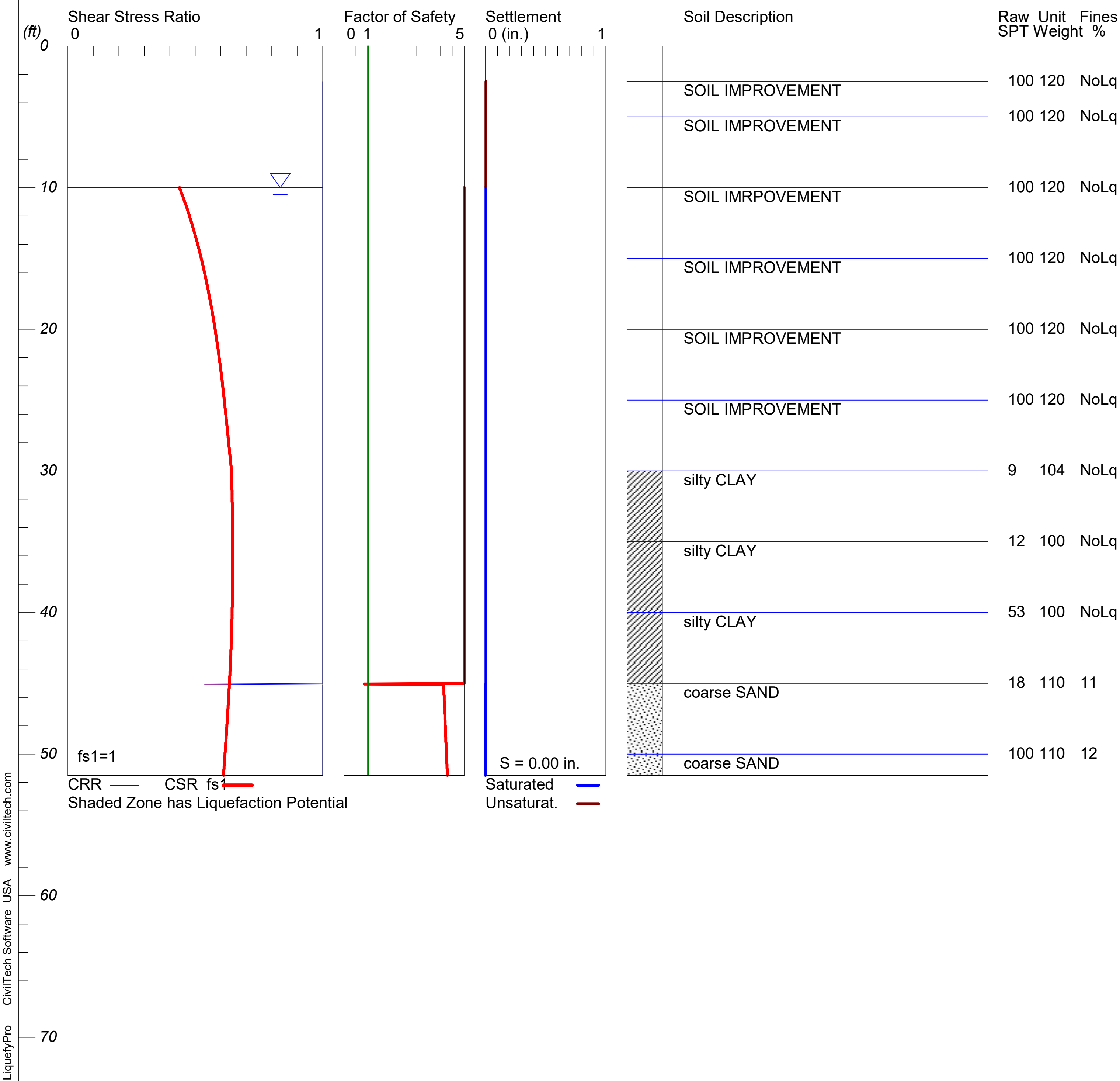


LIQUEFACTION ANALYSIS

Cypress College Student Housing

Hole No.=LB-1   Water Depth=10 ft   Surface Elev.=+58

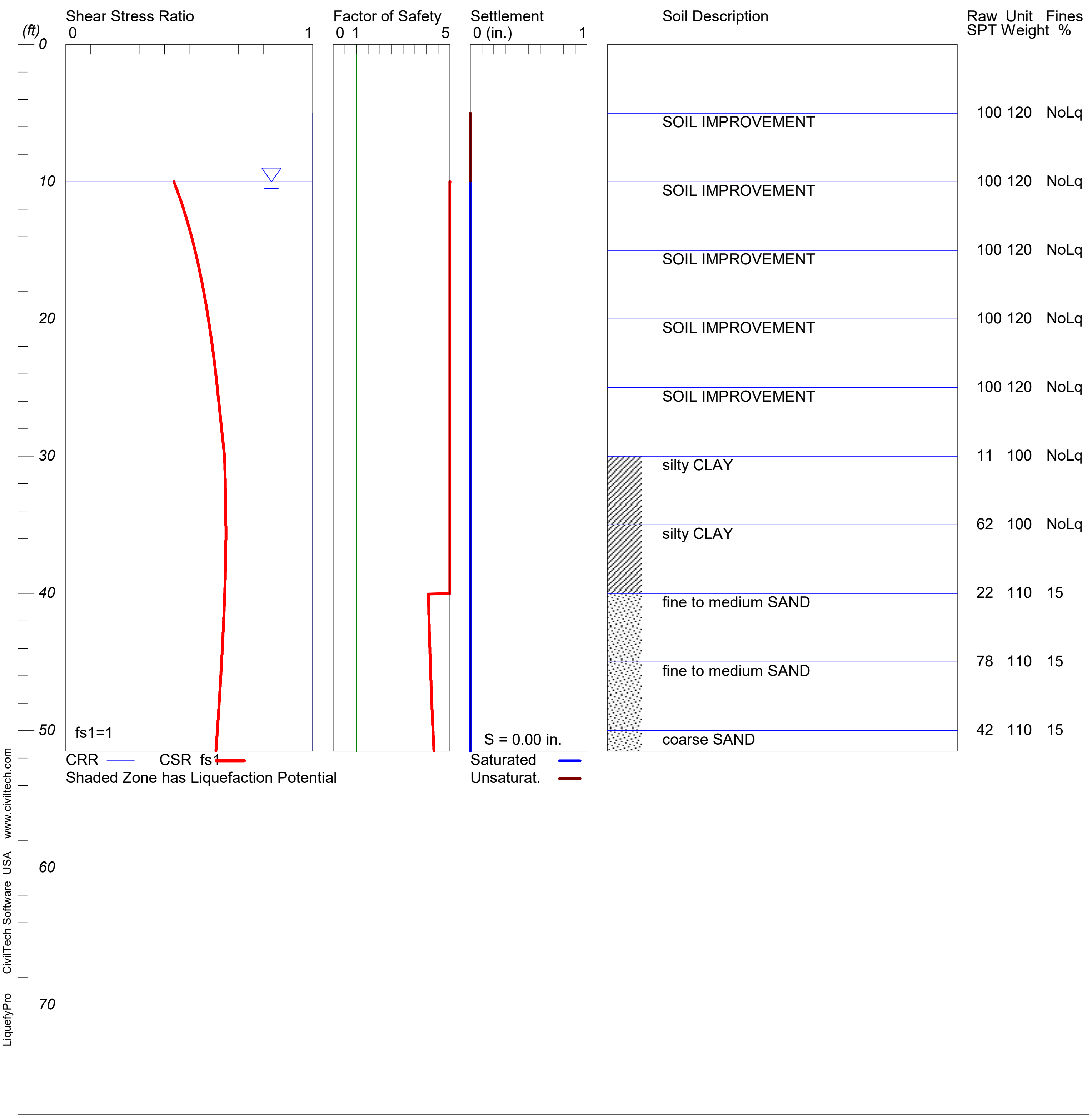
Magnitude=6.74
Acceleration=0.69g



LIQUEFACTION ANALYSIS

Cypress College Student Housing

Hole No.=LB-3 Water Depth=10 ft Surface Elev.=+56.6 Magnitude=6.74 Acceleration=0.69g

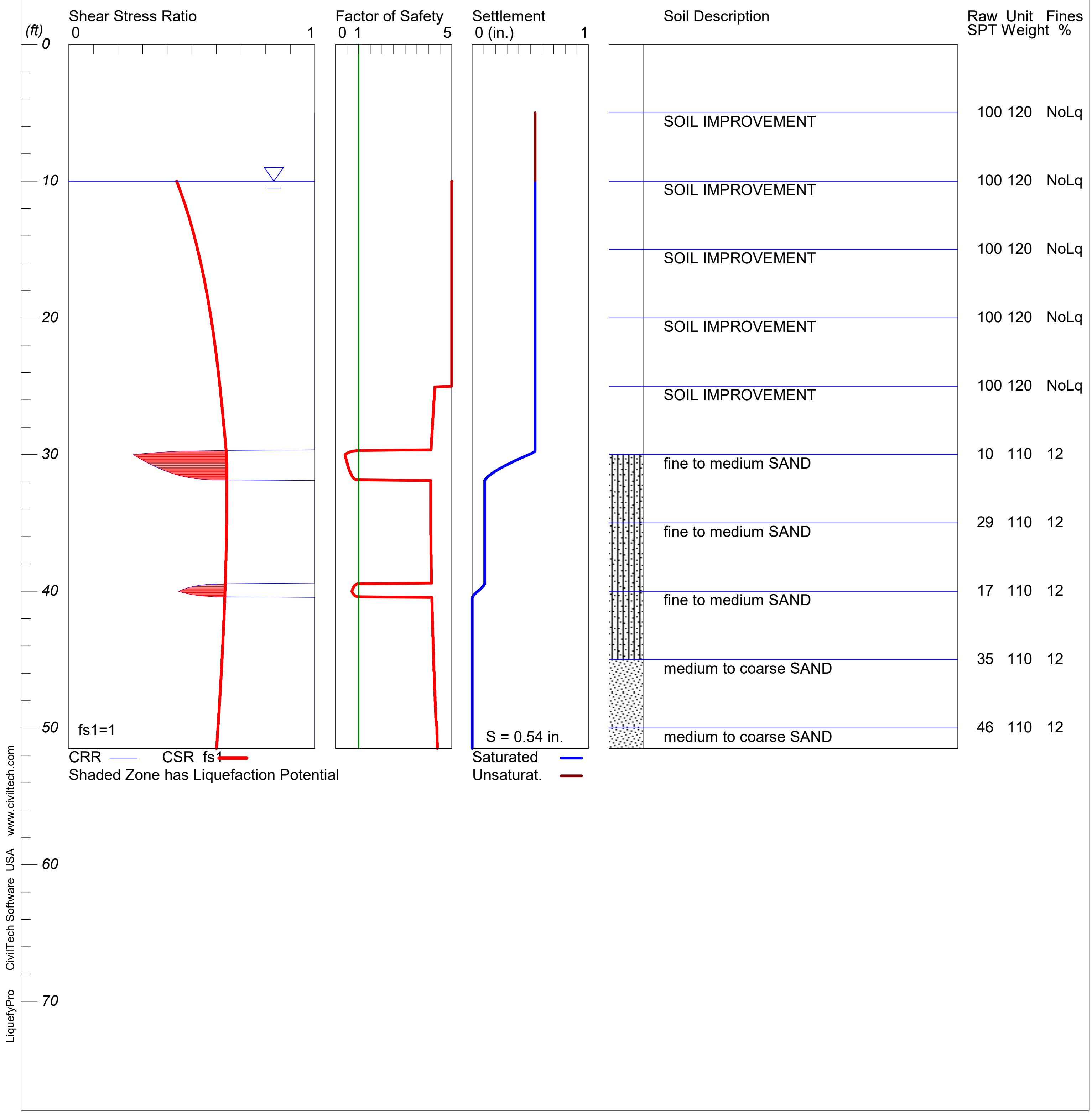


LIQUEFACTION ANALYSIS

Cypress College Student Housing

Hole No.=LB-5   Water Depth=10 ft   Surface Elev.=+57

Magnitude=6.74
Acceleration=0.69g



LIQUEFACTION ANALYSIS

Cypress College Student Housing

Hole No.=LB-8 Water Depth=10 ft Surface Elev.=+56

Magnitude=6.74
Acceleration=0.69g